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Interdependence of Performance Measures Within the Health Care Delivery System

3M Clinical and Economic Research

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Executive Summary

The health care delivery system is a complex, interdependent network of providers and sites of service in which one performance issue can influence multiple other aspects of performance and contribute to overall delivery system ineffectiveness.

Using eleven measures of delivery system performance, differences in actual performance compared to risk-adjusted expected performance were identified within each of the top 100 Core Based Statistical Areas (CBSAs) by volume of Medicare beneficiaries. The performance measures included population measures such as per capita admissions, hospital performance measures such as readmissions, and delivery system performance attributes such as the rate of transition to outpatient surgery. Calendar year 2017 and 2018 Medicare fee-for-service claims data was used in the analysis.

Patterns of performance differences among the eleven measures of delivery system performance across the 100 CBSAs were identified using correlation analysis. Hospital admission performance was positively correlated with readmission performance and non-surgical, short-stay, low-severity emergency department (ED) admission performance. ED visits were positively correlated with post-discharge return ED visit performance and negatively correlated with population physician and care management encounters. Inpatient complication performance was positively correlated with admission to a skilled nursing facility performance and readmission performance. The rate of transition to outpatient surgery performance was positively correlated with readmission performance and surgical mortality performance.

A well-functioning delivery system should seek to provide care in the most cost-effective setting. Excess use of high-cost care settings such as inpatient hospital care and ED visits is a major driver of overall health care costs. The observed patterns of performance relationships can potentially provide insights into management approaches for focusing performance improvement efforts.

Introduction and Objective

In any geographic area, the health care delivery system is a complex, interdependent network of providers and sites of service. From a cost of care perspective, a well-functioning delivery system should seek to provide care in the most cost-effective setting. Excess use of high-cost care settings such as inpatient hospital care and emergency department (ED) visits is indicative of a health care delivery system that is not functioning as intended. There are often multiple performance issues within the delivery system in a geographic area. The overall performance of a delivery system in terms of hospital admissions and ED visits can be influenced by other performance issues that impact delivery system functioning and effectiveness. In a highly interdependent health care delivery system, the evaluation of performance across a broad scope of measures will potentially identify patterns of performance that can be used to focus performance improvement efforts.

The objective of the study is to identify patterns of performance differences that tend to consistently occur together within health care delivery systems across geographic areas. Using a cross-section of measures of delivery system performance, differences in actual performance (A) compared to risk-adjusted expected performance (E) were identified within each geographic area. Patterns of (A-E) performance differences across performance measures within geographic areas were identified using correlation analysis.

Geographic Areas

Since beneficiaries can have care provided by multiple providers across multiple sites of services within a geographic area, the definition of a geographic area had to be broad enough to encompass the majority of providers and sites of service providing care to beneficiaries residing in a geographic area. The metropolitan areas identified in the Core Based Statistical Areas (CBSAs) from the Office of Management and Budget were used to identify geographic areas.[1] The top 100 CBSAs by volume of Medicare beneficiaries were used in the analysis. 59.6%of all Medicare beneficiaries reside in the top 100 CBSAs.

A well-functioning delivery system should seek to provide care in the most cost-effective setting. Excess use of high-cost care settings such as inpatient hospital care and emergency department visits is a major driver of overall health care costs. The observed patterns of performance relationships will potentially provide insights into management approaches for focusing performance improvement efforts.

Performance Measures

To the extent possible, the study used performance measures and risk-adjustment methods that are actively being used today for regulatory purposes such as hospital payment. The methodologies collectively referred to as "Potentially Preventable Events" (PPEs)[2] were included as performance measures:

- Potentially Preventable Admissions (PPAs)[3,4]
- Potentially Preventable Emergency Department Visits (PPVs)[5,6]
- Potentially Preventable Complications (PPCs)[7,8]
- Potentially Preventable Readmissions (PPRs)[9,10]
- Potentially Preventable Return Emergency Department Visits (PPREDs)

The PPAs and PPVs were risk adjusted using Clinical Risk Groups (CRGs)[11,12] and the PPCs, PPRs, and PPREDs were risk adjusted using All Patient Refined Diagnosis Related Groups (APR DRGs).[13,14] The APR DRGs are assigned at hospital admission and at discharge and have severity-of-illness subclasses and risk-of-mortality subclasses. The PPE measures, the CRGs and the APR DRGs have been used in a substantial number of regulatory applications and have undergone the scrutiny associated with any regulatory implementation. Appendix A contain the number of Medicaid and major commercial payers using the PPE measures, CRGs and APR DRGs. The PPE measures, CRGs and APR DRGs have been widely evaluated and utilized in the healthcare literature. Appendix B contains a bibliography of articles and reports citing the PPEs, CRGs and APR DRGs.

Integral to each PPE measure is a specification of the subset of patients considered "at risk." Patients are considered at risk for a PPE when their clinical circumstances are such that there is reasonable likelihood that the PPE could have been prevented. For example, following a discharge for coronary bypass surgery, a readmission for a complication of surgery such as a surgical site infection would

be considered a PPR, but a readmission for appendicitis would not be considered a PPR. 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 that if there were a systematic pattern of higher-than-expected occurrence of the PPE, there would be concerns regarding 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 to the PPE methodologies, a measure of 30-day post-inpatient procedure mortality was included in the analysis.[15] Like PPEs, the 30-day post-inpatient procedure mortality measure is only applied to 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. Higher-than-expected rates of these measures are indicative of a delivery system that is not functioning as intended.

Five measures of service volume were also evaluated:

- 4-day post-discharge admissions to a skilled nursing or rehabilitation facility[16] (PAC Admit)
- Site-neutral transitions: Procedures being performed in an inpatient site of service that could be performed in an outpatient site of service[17]
- Non-surgical, low-severity, short-stay admissions from the emergency department (ED Admit)
- Per capita ambulatory physician and care management encounters (PCME)
- Inpatient length of stay (LOS)

Unlike the PPEs and the 30-day post-inpatient procedure mortality measure, the 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). Simultaneously evaluating PPEs, surgical mortality and service volume measures can provide more targeted insights into potential quality and delivery system problems within a delivery system. For example, a lower-than-expected rate of per capita ambulatory visits in the context of higher-than-expected rates of per capita emergency department visits would raise questions concerning access to primary care.

Table 1 contains a summary overview of the PPEs, surgical mortality and 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.

Integral to each PPE measure is a specification of the subset of patients considered "at risk." Patients are considered at risk for a PPE when their clinical circumstances are such that there is reasonable likelihood that the PPE could have been prevented.

Table 1: Description of Performance Measures

Performance Measure	Name	Type	Methodology	Risk Adjustment
Potentially Preventable Admissions	PPA	Population	Hospital admissions that are potentially preventable	Clinical Risk Groups (CRGs)
Potentially Preventable Emergency Department Visits	PPV	Population	Emergency department visits that are potentially preventable	Clinical Risk Groups (CRGs)
Potentially Preventable Complications	PPC	Inpatient	One or more potentially preventable complications during a hospital admission	Admission APR DRG with Severity of Illness Subclasses
Potentially Preventable Readmissions	PPR	Post-Acute	Potentially preventable readmissions within 30 days of hospital discharge	Discharge APR DRG with Severity of Illness Subclasses
Potentially Preventable Return ED Visits	PPRED	Post-Acute	Potentially preventable ED visits within 30 days of hospital discharge	Discharge APR DRG with Severity of Illness Subclasses
30-Day Post-Inpatient Procedure Mortality	Surgical Mortality	Inpatient Post-Acute	Death within 30 days of an inpatient surgical procedure	Admission APR DRG with Risk of Mortality Subclasses
Post-Discharge PAC Facility Admission	PAC Admit	Post-Acute	Admission to a skilled nursing or rehabilitation facility within four days of hospital discharge	Discharge APR DRG with Severity of Illness Subclasses
Site Neutral Procedures	Site Neutral	Inpatient Outpatient	Low-complexity hospital admissions for procedures that could be performed in an outpatient site of service	Site neutral procedure categories
Hospital Admissions from the Emergency Department	ED Admit	Emergency Department	Short-stay, non-surgical, low-severity hospital admissions from the ED	Admission APR DRG with Severity-of-Illness Subclasses
Physician and Care Management Encounters	PCME	Population	Any non-ED ambulatory visit with an Evaluation and Management code	Clinical Risk Groups (CRGs)
Inpatient Length of Stay	LOS	Inpatient	Extreme LOS capped at high outlier value	Discharge APR DRG with Severity of Illness Subclasses

Risk Adjustment and Expected Values

The eleven performance measures were risk adjusted using either APR DRGs (event measures) or CRGs (population measures). Appendix C contains a detailed description of APR DRGs and CRGs. Both risk adjustment methods are examples of a categorical clinical model, which 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 Medicare beneficiaries who are at risk (referred to as the national norm value for the performance measure) and 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 a CBSA) is the number of at-risk beneficiaries in each risk category times the national norm value for the risk category and summed over all risk categories (indirect rate standardization). If the difference between the actual value (A) and the expected value (E) is negative (A<E), performance (A-E) is below expected. If the difference between the actual value and the expected value is positive (A>E), performance is above expected. %(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). For the PPEs and surgical mortality, a positive %(A-E)/E is indicative of poor performance; for the service volume measures, however, a positive or negative value of %(A-E)/E must be interpreted in the context of the other performance measures (a negative %(A-E)/E for PCME is not necessarily good performance if %(A-E)/E for PPVs is positive). Comparison to a reference norm is critical because even the best performing delivery systems that provide optimal care will have an underlying rate of performance issues.

A risk-adjusted expected value computed in this way assures that the comparison to actual performance is based on a performance level that is achievable and not based on a theoretical standard performance level that may not be achievable. For PPEs and surgical mortality measures, limiting the determination of performance differences to beneficiaries at risk for the performance measure being potentially preventable, and to the difference between actual performance and expected performance based on comparison to a national risk-adjusted norm, identifies performance differences 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 5% 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 includes only hospitals paid under the inpatient prospective payment system (IPPS). Beneficiaries were assigned to a CBSA based on their county of residence.

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 5% 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).

Results

Appendix D contains the %(A–E)/E for each performance measure for the 100 CBSAs with the greatest number of Medicare beneficiaries. For the 100 CBSAs, Table 2 contains the Pearson correlation for each combination of performance measures that is statistically significant at the .01 level. The correlations do not indicate a causal or predictive relationship between two measures of performance; rather, they indicate that two measures of performance tend to have a consistent pattern of performance differences across CBSAs (either similar or opposite). The correlations are of performance (%(A-E)/E) and not of frequency of occurrence. Essentially, for any two performance measures, the correlation measures the relationship of the A-E performance differences across CBSAs.

Table 2: Statistically significant correlations at the .01 level for %(A-E)/E of performance measures across CBSAs

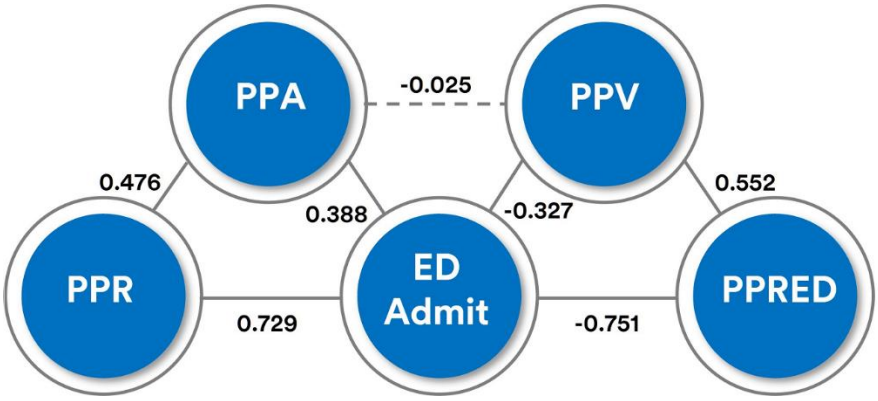
	Potentially Preventable Event Measures					Surgical Mortality	Service Volume Measures				
Measure	**PPA**	**PPV**	**PPC**	**PPR**	**PPRED**		**PAC Admit**	**Site Neutral**	**ED Admit**	**PCME**	**LOS**
Hospital Admissions (PPA)				0.476	-0.334				0.388		
ED Visits (PPV)					0.552	-0.330		-0.468	-0.327	-0.393	
Complications (PPC)				0.258			0.294				0.514
Readmissions (PPR)	0.476		0.258		-0.358			0.272	0.729	0.310	0.454
Return to ED (PPRED)	-0.334	0.552		-0.358		-0.272		-0.472	-0.751	-0.334	-0.262
Surgical Mortality		-0.330			-0.272			0.326	0.270		
PAC Facility Admissions			0.294								
Site Neutral Procedures		-0.468		0.272	-0.472	0.326			0.508	0.533	
ED Admissions	0.388	-0.327		0.729	-0.751	0.270		0.508		0.444	0.368
Physician & Care Mgmt Encounters (PCME)		-0.393		0.310	-0.334			0.533	0.444		0.338
Length of Stay (LOS)			0.514	0.454	-0.262				0.368	0.338	

A positive correlation means that the pattern of performance across CBSAs tends to be similar (i.e., performance of two measures across CBSAs tends to increase or decrease in a similar pattern). A negative correlation means that the pattern of performance across CBSAs tends to be opposite (i.e., performance of two measures across CBSAs tends to increase or decrease in a consistent but opposite pattern). For example, the positive correlation of 0.729 between PPRs and ED Admit means CBSAs with higher-than-expected ED Admit performance (A>E) tend to have higher-than-expected PPR performance, and CBSAs with lower-than-expected ED Admit performance (A<E) tend to have lower-than-expected PPR performance.

Among the three population performance measures (PPAs, PPVs and PCMEs), the only statistically significant correlation was for PPVs and PCMEs (-0.393). The negative correlation means that in CBSAs with higher-than-expected PPV performance (more potentially preventable ED visits than expected) there tended to be lower-than-expected PCME performance (fewer non-ED ambulatory visit contacts than expected). This relationship between PPV and PCME performance suggests that CBSAs with lower-than-expected (A<E) non-ED ambulatory visits (primary care) tend to have higher-than-expected (A>E) PPVs.

It was somewhat surprising that there was no correlation between PPA and PPV performance since it would be reasonable to expect that CBSAs with higher-than-expected PPV performance (more preventable ED visits than expected) might also have higher-than-expected PPA performance (more preventable admissions than expected). However, performance of the ED Admit measure (non-surgical, low-severity, short-stay medical admissions through the ED) appears to act as an intermediary between PPA and PPV performance. Figure 1 contains the correlations for PPA, PPV, PPR, PPRED and ED Admit performance across CBSAs. There is a positive correlation between PPR performance and PPA performance and a positive correlation between post-discharge ED visit (PPRED) performance and PPV performance across CBSAs. Thus, CBSAs with higher-than-expected PPRs tend to also have higher-than-expected PPAs, and CBSAs with higher-than-expected PPREDs tend to also have higher-than-expected PPVs.

Figure 1: Correlation of %(A-E)/E for PPAs, PPVs, PPRs, PPREDs and ED Admit. Dashed line indicates the correlation is not significant at the 0.01 level

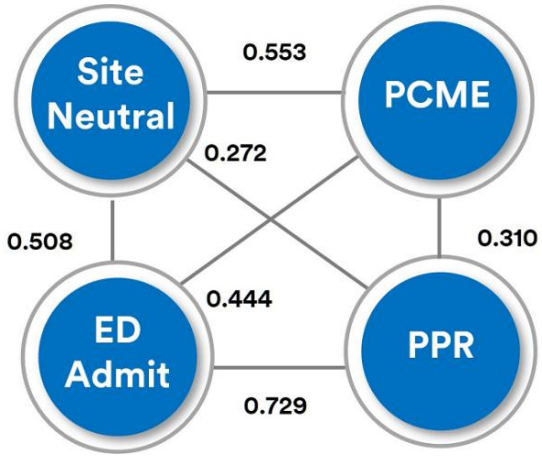


Since ED Admit performance has a positive correlation with both PPA and PPR performance, CBSAs with higher-than-expected ED Admit performance tend to also have higher-than-expected PPA and PPR performance. However, ED Admit performance has a negative correlation with both PPV and PPRED performance. Thus, CBSAs with higher-than-expected ED Admit performance tend to have lower-than-expected PPV and PPRED performance. This is not surprising, since any patient

admitted through the ED is considered a hospital admission and not an ED visit. The result is that higher-than-expected ED Admit performance tends to be associated with higher-than-expected PPA performance and lower-than-expected PPV performance. Since 74% of hospital admissions are through the ED, it is not surprising that ED Admit performance tends to be associated with both PPA and PPV performance. Operationally, a geographic region or a health plan with higher-than-expected PPA performance should evaluate the admission criteria in hospital EDs as one possible performance issue that may be associated with higher-than-expected PPA performance.

As shown in Figure 2, there is a positive correlation across CBSAs for PPR, ED Admit, PCME and Site Neutral procedure performance. This cluster of performance measures tend to have similar performance across CBSAs. It is somewhat surprising that a higher-than-expected use of inpatient surgery (a slow rate of transition to outpatient surgery) tends to be associated with higher-than-expected PPRs, PCMEs and admissions through the ED. This suggests that if hospitals in a CBSA have a slow transition to developing the infrastructure for outpatient surgery, it may be indicative of more extensive issues in the functioning of the delivery system. The procedures included in the Site Neutral measure are primarily performed in hospital outpatient departments and are not typically performed in free-standing same-day surgery centers.[17] Site Neutral performance is also positively correlated with surgical mortality (0.326) suggesting that less invasive surgical techniques that make outpatient surgery possible may be underutilized in CBSAs that have been slow to transition to outpatient surgery.

Figure 2: Correlation of %(A-E)/E for Site Neutral, PCMEs, PPRs and ED Admit



PPC (inpatient complications) performance is positively correlated across CBSAs with PPR (0.258), LOS (0.514) and PAC Facility admission (0.294) performance. Higher-than-expected PPC performance across CBSAs is not only associated with higher-than-expected LOS but also the need for more post-acute care follow-up as evidenced by higher-than-expected PPR and PAC Facility Admission performance.

Discussion

The correlations identify clusters of performance differences that tend to occur within the health care delivery systems of CBSAs. The correlations do not indicate a causal or predictive relationship between measures of performance. Instead, the correlation results can be used to identify

contributing delivery system performance issues that may be more amenable to quality improvement efforts. For example, a health plan that has higher-than-expected hospital admissions should evaluate its readmission performance and its criteria and practices for admitting patients from the ED. These performance areas could have an impact on overall hospital admissions and may be a more focused and manageable issue to address than the overall hospital admissions performance issue.

ED Admit performance is correlated with the performance of multiple measures, especially PPA and PPR performance. Geographic regions where patients tend to use the ED for primary care (presumably low socioeconomic status (SES) areas) could have artificially better-than-expected performance because the denominator of the ED Admit measure may include a substantial volume of non-urgent patients who will virtually never be hospitalized. In a previous research study, low SES geographic areas were found to have lower-than-expected ED Admit performance but higher-than-expected PPA and PPR performance[18] suggesting a potential bias that could impact the observed correlations between these measures. To evaluate the impact of this potential bias on the correlation results, the socioeconomic status component of the Social Vulnerability Index from the Centers for Disease Control and Prevention (CDC) was used to identify high and low SES counties.[19] Using only the subset of beneficiaries residing in the 25% of counties with the lowest SES, the correlations were recomputed. For the subset of beneficiaries residing in the 25% of counties with the lowest SES, the correlation between ED Admit and PPRs across the 100 largest CBSAs was 0.522 and between ED Admit and PPAs was 0.299. These correlations were consistent with the correlations for all beneficiaries in the 100 largest CBSAs with a correlation between ED Admit and PPRs of 0.729 and between ED Admit and PPAs of 0.388.

Summary

Using eleven measures of delivery system performance, differences in actual performance compared to risk-adjusted expected performance were identified within each of the top 100 CBSAs by volume of Medicare beneficiaries. Patterns of performance differences among the eleven measures of delivery system performance across the 100 CBSAs were identified using correlation analysis. Excess use of high-cost care settings such as inpatient hospital care and emergency department visits is a major driver of overall health care costs. Hospital admission performance was positively correlated with readmission performance and non-surgical low-severity ED admission performance. ED visits were positively correlated with post-discharge return ED visit performance and negatively correlated with population physician and care management encounters. Inpatient complication performance was positively correlated with admission to a skilled nursing facility performance and readmission performance. The rate of transition to outpatient surgery performance was positively correlated with readmission performance and surgical mortality performance. The substantial number of correlations observed reflect that the healthcare delivery system is a complex, interdependent network of providers and sites of service in which one performance issue can influence multiple other aspects of performance, impact the functioning of the delivery system, and contribute to overall delivery system ineffectiveness. The observed patterns of performance relationships can potentially provide a focused and manageable approach to addressing overall delivery system performance.

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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 Citing PPAs, PPVs, PPCs, PPRs, PPREDs, CRGs and 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.

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Potentially Preventable Return Visits to the Emergency Department (PPREDs)

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Appendix C: Description of Performance Measures and Risk Adjustment Methods

Performance Measures:

Potentially Preventable Admissions (PPAs)

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 go to: https://www.3m.com/3M/en_US/health-information-systems-us/drive-value-based-care/patient-classification-methodologies/ppa/

Potentially Preventable Emergency Department Visits (PPVs)

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 go to: https://www.3m.com/3M/en_US/health-information-systems-us/drive-value-based-care/patient-classification-methodologies/ppv/

Potentially Preventable Complications (PPCs)

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 go to: https://www.3m.com/3M/en_US/health-information-systems-us/drive-value-based-care/patient-classification-methodologies/ppcs/

Potentially Preventable Readmissions (PPRs)

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 go to:
https://www.3m.com/3M/en_US/health-information-systems-us/drive-value-based-care/patient-classification-methodologies/pprs/

Potentially Preventable Return Emergency Department Visits Following Hospital Discharge (PPRED)

Potentially Preventable Return Emergency Department (ED) 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 (ED 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 PPRED during the 30 days following a hospital discharge. For more detail go to: https://www.3m.com/3M/en_US/health-information-systems-us/drive-value-based-care/patient-classification-methodologies/pprs/

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. For more detail go to: https://multimedia.3m.com/mws/media/2044672O/surgical-mortality-hospital-quality.pdf

Post-Discharge Facility Admission

The Post-discharge Facility Admission measure identifies patients who were admitted to a skilled nursing facility or rehabilitation facility within four 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. For more detail go to: https://multimedia.3m.com/mws/media/2051382O/report-geographic-variation-in-post-acute-care-facility-admissions.pdf.

Site Neutral Procedures

Site neutral procedures are inpatient surgical cases that could reasonably be performed in an outpatient setting. The procedures considered eligible to be shifted from inpatient to outpatient were required to meet four criteria:

- The procedure is currently performed in both an inpatient and outpatient site of service
- The combined inpatient and outpatient volume of the procedure is substantial
- For inpatients the procedure will cause payment to be increased
- It is possible to identify equivalent procedures using the inpatient and outpatient procedure code sets.

The patients considered eligible to be shifted from inpatient to outpatient were required to meet three criteria:

- For inpatients the procedure must be clinically consistent with the reason for hospital admission
- High severity of illness patients at the time of admission are excluded
- Complex patients with multiple distinct procedure are excluded

Patients who meet these criteria and have a procedure that meets the site neutral criteria are considered eligible to be shifted from inpatient to outpatient. The Site Neutral Measure is the fraction of site neutral procedures performed in an inpatient setting. For more detail go to: https://multimedia.3m.com/mws/media/2092871O/the-shift-to-outpatient-surgery-geographic-variation-and-site-neutral-payments.pdf

Hospital Admissions from the Emergency Department

The ED Admit measure identifies hospital admissions that are a low-severity medical admission from the Emergency Department. 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.

Physician and Care Management Encounters (PCMEs)

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.

Inpatient Length of Stay (LOS)

Patients who died during the hospital stay, were transferred to another acute-care hospital or left a hospital against medical advice were excluded from the LOS measure because they do not represent the full course of treatment. The APR DRGs have low and high LOS outlier values for each APR DRG and severity-of-illness subclass. Patients with LOS below the low LOS outlier value are atypical and usually represent data errors and are excluded. Patients with LOS that exceeds the high LOS outlier are less likely to be data errors and more likely to reflect individual hospital variation. Patients with LOS that exceeds the high LOS outlier value have their LOS truncated and set at the high LOS outlier value. This allows a consistent pattern of long length of stays to contribute to the evaluation of LOS performance without having a small number of patients with an extreme LOS disproportionately impact the evaluation of LOS performance. The LOS measure is the arithmetic mean LOS

Risk Adjustment Methods:

All Patient Refined DRGs (APR 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 go to: https://www.3m.com/3M/en_US/health-information-systems-us/drive-value-based-care/patient-classification-methodologies/apr-drgs/

Clinical Risk Groups (CRGs)

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 health care 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 more detail go to: https://www.3m.com/3M/en_US/health-information-systems-us/drive-value-based-care/patient-classification-methodologies/crgs/

Appendix D: Correlations A-E by CBSA

CBSA	Description	Enrollees	PPA	PPV	PPC	PPR	PPRED	SURG MORT	PAC ADMIT	SITE NEUT	ED ADMIT	PCME	LOS
35620	New York-Newark-Jersey City, NY-NJ-PA	3,477,374	3.71	-19.96	12.43	5.02	-18.37	-4.84	21.63	24.09	32.66	26.25	17.94
31080	Los Angeles-Long Beach-Anaheim, CA	2,018,533	8.86	-16.62	0.12	7.23	-17.16	-18.99	2.28	13.70	17.71	20.34	-1.48
16980	Chicago-Naperville-Elgin, IL-IN-WI	1,553,019	13.10	-0.23	8.73	2.96	-12.98	-13.85	6.17	-4.82	22.85	1.94	-1.74
37980	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	1,151,611	1.75	-0.72	3.24	4.82	-6.08	-4.25	11.19	7.36	25.43	7.42	3.64
33100	Miami-Fort Lauderdale-West Palm Beach, FL	1,120,536	2.95	-1.97	4.47	14.15	-12.96	14.51	3.10	27.80	40.37	33.68	4.37
19100	Dallas-Fort Worth-Arlington, TX	969,720	-2.64	-0.75	-2.95	2.53	-1.75	-11.53	3.71	20.08	0.79	4.54	0.29
14460	Boston-Cambridge-Newton, MA-NH	882,316	4.06	20.13	17.20	10.88	-1.24	-18.52	20.81	-10.21	24.08	3.92	4.44
47900	Washington-Arlington-Alexandria, DC-VA-MD-WV	862,581	-1.04	18.66	4.28	-1.96	-1.79	-10.47	0.24	13.52	-7.58	11.61	4.83
26420	Houston-The Woodlands-Sugar Land, TX	860,680	8.48	-3.19	3.94	2.59	-8.85	-11.14	-21.82	7.55	1.83	3.04	-1.10
19820	Detroit-Warren-Dearborn, MI	856,883	17.30	7.86	9.78	10.79	-1.51	-10.60	-7.92	-8.51	21.62	2.13	-0.08
12060	Atlanta-Sandy Springs-Roswell, GA	842,609	-7.40	1.13	4.62	-0.58	0.86	0.38	-22.61	-5.04	-6.55	3.88	4.18
41860	San Francisco-Oakland-Hayward, CA	784,683	-9.05	21.60	-3.28	-4.74	14.49	-25.16	-5.94	-13.43	-16.06	0.40	-1.42
38060	Phoenix-Mesa-Scottsdale, AZ	764,469	-13.45	10.74	-4.95	-10.13	6.66	-2.49	-12.05	25.24	-19.52	19.61	-9.31
40140	Riverside-San Bernardino-Ontario, CA	675,059	-4.97	13.21	-5.08	4.43	8.32	4.96	-3.34	7.35	-8.45	9.96	-3.11
45300	Tampa-St. Petersburg-Clearwater, FL	671,260	2.37	-9.20	-5.66	8.33	-9.08	6.14	12.95	39.44	43.41	18.02	0.54
42660	Seattle-Tacoma-Bellevue, WA	601,808	-19.63	-1.57	4.97	-9.40	9.08	-4.22	-14.19	-14.71	-16.01	-3.79	-1.30
33460	Minneapolis-St. Paul-Bloomington, MN-WI	582,966	-10.55	20.23	-0.57	-5.02	-4.80	-23.79	2.00	12.91	4.80	-15.15	-9.87
38300	Pittsburgh, PA	554,147	-2.23	17.76	-9.80	3.22	-14.88	7.67	-4.27	2.13	26.80	-15.09	0.42
41180	St. Louis, MO-IL	552,931	14.64	11.11	-3.89	5.72	-6.84	-8.85	0.14	-5.72	5.07	-10.68	-3.95
41740	San Diego-Carlsbad, CA	534,371	-5.14	-2.96	-10.90	-4.49	5.44	-14.56	7.13	21.62	-6.71	3.26	-5.48
12580	Baltimore-Columbia-Towson, MD	500,742	13.64	19.82	-23.43	-0.12	0.32	-20.06	3.69	-4.95	2.21	7.15	2.98
17460	Cleveland-Elyria, OH	440,420	15.22	11.25	12.07	4.79	-7.76	-3.10	17.61	-21.95	10.07	-2.21	-3.68
36740	Orlando-Kissimmee-Sanford, FL	429,897	18.46	-7.93	-8.72	7.64	-7.79	4.14	-5.32	41.14	43.58	18.34	4.83
38900	Portland-Vancouver-Hillsboro, OR-WA	424,316	-14.28	15.34	-11.58	-12.73	23.64	-15.80	-18.40	-9.47	-23.66	-13.39	-6.94
19740	Denver-Aurora-Lakewood, CO	421,531	-21.69	8.39	-6.80	-13.46	6.17	-17.93	-5.89	3.49	-22.65	-0.58	-13.24
40900	Sacramento--Roseville--Arden-Arcade, CA	420,311	-16.60	16.76	-7.13	-7.64	30.44	-24.02	-17.72	-13.72	-27.63	-4.84	-8.41
16740	Charlotte-Concord-Gastonia, NC-SC	409,143	-1.52	20.34	-2.69	-2.26	8.41	8.17	-1.66	-6.09	-11.11	5.34	0.32
17140	Cincinnati, OH-KY-IN	399,516	7.34	8.41	-10.24	-0.56	-2.99	2.78	5.80	-8.22	4.84	-0.61	-5.79
41700	San Antonio-New Braunfels, TX	396,741	-17.31	-18.81	-6.93	0.55	-13.55	4.93	-11.09	35.40	15.65	2.81	-0.29
28140	Kansas City, MO-KS	371,993	20.41	14.89	-10.17	5.23	-10.15	4.18	-8.29	6.85	30.50	-10.69	-5.75
29820	Las Vegas-Henderson-Paradise, NV	355,854	2.94	0.03	-2.63	15.27	0.98	4.72	-18.76	51.78	22.56	7.38	-4.96
39300	Providence-Warwick, RI-MA	346,076	10.87	19.11	16.70	14.33	5.82	-0.10	20.62	-8.41	23.22	3.45	2.80

CBSA	Description	Enrollees	PPA	PPV	PPC	PPR	PPRED	SURG MORT	PAC ADMIT	SITE NEUT	ED ADMIT	PCME	LOS
26900	Indianapolis-Carmel-Anderson, IN	339,988	-2.33	25.66	-3.28	-1.31	13.36	-5.95	14.38	-8.19	-10.41	-3.31	-4.81
18140	Columbus, OH	329,113	-0.80	17.13	3.85	0.27	7.61	-1.67	2.27	-3.40	-9.58	-3.95	-7.73
34980	Nashville-Davidson--Murfreesboro--Franklin, TN	305,801	9.10	-10.12	-7.54	5.22	-6.80	7.30	0.10	15.29	10.71	2.70	-5.59
47260	Virginia Beach-Norfolk-Newport News, VA-NC	302,180	5.96	3.63	-0.80	-3.31	16.84	0.58	-2.51	-7.84	-18.08	6.12	2.42
33340	Milwaukee-Waukesha-West Allis, WI	293,082	-9.15	29.97	7.76	0.04	9.21	-13.53	-4.34	-11.23	-5.37	-9.45	0.93
27260	Jacksonville, FL	286,584	8.05	1.75	-11.87	7.56	-6.68	11.27	6.00	14.73	21.97	21.05	-2.75
41940	San Jose-Sunnyvale-Santa Clara, CA	281,603	-20.10	0.24	-14.17	-1.42	-1.59	-24.27	5.72	-5.83	9.11	10.11	-0.05
12420	Austin-Round Rock, TX	259,708	9.20	-1.56	-13.94	-3.79	-6.55	-7.39	-12.65	14.27	0.93	9.04	-3.70
31140	Louisville/Jefferson County, KY-IN	253,680	4.75	-5.72	-9.95	1.49	-5.01	6.61	10.02	5.78	-0.16	1.09	-4.45
15380	Buffalo-Cheektowaga-Niagara Falls, NY	252,892	-14.05	16.30	9.64	2.30	-0.44	9.83	9.28	7.30	-7.14	-10.52	15.92
35840	North Port-Sarasota-Bradenton, FL	240,903	-26.00	-13.74	-7.61	-5.46	-14.53	34.72	25.76	22.72	28.29	23.81	-4.80
25540	Hartford-West Hartford-East Hartford, CT	239,697	-10.05	24.04	6.65	3.56	11.34	-1.41	29.40	0.87	-4.73	3.45	0.51
40060	Richmond, VA	237,351	12.41	19.52	-2.38	-1.79	2.23	-11.83	-9.57	13.20	4.92	3.77	6.32
35380	New Orleans-Metairie, LA	236,740	15.43	20.32	-26.45	10.26	19.60	-12.14	-34.32	-23.50	-14.62	-3.80	-5.20
13820	Birmingham-Hoover, AL	236,461	-3.58	-6.22	11.38	1.46	-11.76	36.33	-16.48	7.61	-1.41	-5.09	5.05
40380	Rochester, NY	235,969	-19.91	18.06	12.92	20.51	9.29	-14.04	-20.31	-21.34	24.47	-4.85	20.37
32820	Memphis, TN-MS-AR	231,239	-9.47	5.61	7.04	9.47	10.19	15.83	-11.60	5.56	5.19	2.13	5.56
36420	Oklahoma City, OK	229,959	-8.90	11.46	-9.04	-3.88	22.58	19.54	-12.45	-13.42	-20.71	0.72	-2.74

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