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MEMORANDUM

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

SUBJECT: Readmission Literature Survey Findings

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

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

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

Methods

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

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

Table 1. Search strategy summary

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

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

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

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

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

Findings

Population-based readmission measures

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

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

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

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

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

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

ED use and observation stays

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

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

Different follow-up periods

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

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

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

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

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

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

Alternative measures of post-discharge health care use

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

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

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

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

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

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

Target readmission rate

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

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

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

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

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

Implications of declining admission rates

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

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

The impact of HRRP

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

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

Readmission rates

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

Mortality

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

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

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

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

ED and observation stays

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

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

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

Admission rates

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

Other HRRP affects

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

Conclusions

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

Target rates

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

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

Alternative measures

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

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

HRRP

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

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APPENDIX: ALTERNATIVE POST-ACUTE CARE MEASURES

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

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

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

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

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

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

[d]NQF

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