Effects of Medicare Medical Reviews on Ambiguous Short-Stay Hospital Admissions

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Objective. To examine the effects of Medicare's Medical Review (MR) program on short-stay inpatient hospitalization.

Data Sources/Study Setting. One Hundred percent of Medicare Part A and Part B claims and the Master Beneficiary Summary File (2007–2010).

Study Design. Retrospective observational study using a difference-in-differences approach. We examined six primary intake diagnoses, we believed likely to be targeted by MR. We stratified by hospital profit structure, bed size, system membership, and inpatient admission rate to test for differential effects. The comparison group was hospital visits occurring in those MACs that had yet to implement, as well as those that did not implement during the period of interest.

Data Collection. None.

Principal Findings. Medical Review significantly reduced the likelihood of inpatient admission for patients with an intake diagnosis of “Non-Specific Chest Pain” by 1.29 percentage points ($p < .001$). This effect was stronger in larger hospitals (-2.03 , $p < .001$), nonsystem hospitals (-2.54 , $p < .001$), and those with a lower inpatient rate (-1.86 , $p < .001$).

Conclusions. Short inpatient hospitalizations were emphasized by MR, and our results show that MR modestly reduced their prevalence among certain patients and certain hospitals. Future work should examine whether this resulted in adverse patient outcomes.

Key Words. Medical review, observation, hospital, Medicare, inpatient

Background

Short inpatient hospital stays (i.e., two days or fewer) have long been an area of emphasis for the Centers for Medicare & Medicaid Services in their efforts to reduce costs of care (Medicare Payment Advisory Commission [MedPAC] 2015a,b). These patients are typically far less costly to treat, yet hospitals receive

the full diagnosis-related group (DRG) reimbursement when they are admitted as inpatients (Medicare Payment Advisory Commission [MedPAC] 2015a,b). The Medicare Benefit Policy Manual contains guidance stating that hospital stays expected to last fewer than 24 hours should be billed under the outpatient (Part B) fee-for-service benefit as “Observation” (Medicare Payment Advisory Commission [MedPAC] 2015b; Centers for Medicare & Medicaid Services 2016a). While, for most patients, assessing the need for an inpatient stay is likely straightforward, how a hospital interprets this guidance can have profound implications for patients whose needs are less clear. In 2014, CMS clarified their policy with the “two midnights” rule stating that any hospital stays expected to last fewer than “two midnights” should be billed as observation unless there is a clearly documented need for the higher level of care. Although the policy remained largely unchanged, this determination resulted in considerable push-back from the medical community, who argued that the “two midnights” rule fails to consider a patient’s individual and clinical needs, and that observation disqualifies patients from coverage for potentially important postacute care in a Skilled Nursing Facility (SNF) (Barr 2012; Mason 2014; American Medical Association 2016). The Medicare Payment Advisory Commission (MedPAC) reported that 13 percent of all Medicare-covered inpatient discharges in 2012 (about 1.2 million) did not meet the two-midnight rule (Medicare Payment Advisory Commission [MedPAC] 2015a,b). These statistics raise several questions, including whether this policy is clinically appropriate and whether the systems put in place by CMS have been effective in the face of the substantially higher revenue hospitals receive from an inpatient admission.

When a hospital is determining whether to admit a particular patient or to treat under “observation,” they are necessarily balancing clinical and billing considerations. A change in policy can therefore have a substantial impact on this calculus (Soderstrom 1993; Bowblis et al. 2012; Unruh et al. 2013). It is also reasonable to expect that adherence to a policy designed to influence provider behavior will be mediated by the mechanisms enforcing the policy. For example, stricter regulation of nursing home quality standards can lead to higher achievement of some of those standards (Bowblis et al. 2012; Mukamel

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et al. 2012). To that end, CMS employs a number of utilization review (UR) contractors, each with distinct responsibilities, but all of which are charged with auditing billed claims for medical and/or fiscal appropriateness (Centers for Medicare & Medicaid Services 2016b).

We examined the effects of introducing a new type of review contractor, Medicare Administrative Contractors (MAC), on the use of short-stay inpatient care. MACs were first introduced in 2006 as part of a larger contracting reform effort within CMS (Centers for Medicare & Medicaid Services). They took over claims processing responsibilities from fiscal intermediaries, as well as claims review for compliance with billing regulations, a process known as “Medical Review” (MR), from the quality improvement organizations (Centers for Medicare & Medicaid Services 2006, 2015a,b). To strengthen their enforcement efforts, MACs wielded a wide array of punitive authorities including full denial of payment for frequent offenders in order to disincentivize future errors (Centers for Medicare & Medicaid Services 2015). The severity of the penalties depends, in part, on the magnitude of the error and the frequency with which the error is identified at a particular provider (Centers for Medicare & Medicaid Services 2015). In the case of full reimbursement denial, providers may not seek payment from the patient and therefore lose 100 percent of the revenue from the hospital visit. While providers may appeal a denial, in recent years a substantial backlog of appeals has developed and CMS has offered several phases of settlements to providers with claims under appeal (Centers for Medicare & Medicaid Services 2014).

Conceptual Framework

Our conceptual framework is based on past work examining the effects of utilization review policies and targeted regulatory efforts on treatment patterns (Wickizer 1992; Dranove and Spier 2003; Bowblis et al. 2012). The earliest comprehensive study of UR policies by Wickizer examined the effects of utilization review policies on hospitals and found that they were associated with significant reductions in admissions and expenditures. This study also showed that the greatest reductions occurred during the earliest months of implementation (Wickizer 1992). Later, Dranove and Spier presented a more formal theoretical framework for how UR can influence physician treatment decisions through various financial incentives. They described medical decision making as a process “in which the physician and the UR agency possess independent private information on the value of a treatment.” They also emphasized that clear communication of, and commitment to, a particular threshold for

treatment approval improves the performance of a particular UR policy (Dranove and Spier 2003). Finally, more recent work by Bowblis and colleagues explored the effects of increased regulation of nursing home quality standards, and found that emphasizing certain quality measures leads to increased performance on those standards and related standards, at times at the expense of other unrelated standards (Bowblis et al. 2012).

For this study, our treatment decision of interest is whether a patient who presents in the emergency department (ED) without being immediately discharged is admitted for an inpatient stay or treated as an outpatient either in the ED or in a formal observation unit. The hypothetical pathways followed by such a patient are presented broadly in Figure 1. A patient of interest in this study enters the hospital by way of the emergency department for some acute event. The patient is evaluated in the emergency department and a decision is made to discharge the patient, admit to inpatient care, or treat as an outpatient under observation. A patient may also continue to be evaluated under observation and be subsequently admitted for an inpatient stay if there is a change in condition or new medical information comes to light. Upon discharge, a patient may return home and/or may seek rehabilitation. Those patients admitted to an inpatient stay who remain for three or more days may qualify for Part A covered postacute care, but those treated under observation do not, and may only seek outpatient rehabilitation if needed. We expect that most patients presenting in the ED who are not immediately discharged can be easily assigned to inpatient or outpatient care under current CMS guidance. Those for whom the decision is more ambiguous are our population of interest.

There is a modest but growing body of literature examining use of hospital observation stays as a substitute for full inpatient admission. Feng and colleagues found in one study that from 2007 to 2009, the ratio of observation stays to inpatient stays increased by 34 percent, and was accompanied by an increase in observation length of stay (Feng, Wright, and Mor 2012). A second study by Wright and colleagues showed that after controlling for patient characteristics, hospital characteristics such as bed size and the presence of a free-standing outpatient clinic were significant drivers of the likelihood of inpatient admission (Wright et al. 2014). It is likely that this increase has been at least partially driven by financial incentives from various payers including CMS; however, a more recent study by Wright and colleagues found similar increases in the Veterans Administration network which is internally funded and not subject to such incentives (Wright et al. 2016).

We hypothesized that the introduction of MACs was associated with a decrease in the likelihood of short-stay inpatient admission within certain

Figure 1: Hypothetical Hospital Visit Patient Trajectories

patient groups whose need for an inpatient stay may appear unclear when reviewed. We also hypothesized that certain types of hospitals may be more susceptible to the economic shock of MR and would therefore exhibit a greater decrease. Prior to the introduction of the MACs, hospitals likely operated with a general understanding of how the billing regulations pertaining to short-stay inpatient care and medical necessity were enforced. That is, they generally knew who the short-stay patients were and whose needs would still be considered significant enough to be an allowable inpatient stay despite the regulation. As an inpatient stay would yield greater revenue for the hospital than keeping the patient in the ED or under observation, a rational hospital seeking to maximize per-patient revenue would choose to admit any such patients to an inpatient stay. Additionally, as hospitals' use of observation treatment protocols and dedicated observation units can vary, we expect that hospitals would vary in their ability and willingness to treat more serious cases under observation (Ross et al. 2013). The introduction of the MACs presented a potential change in this enforcement calculus, one further complicated by the fact that the MACs each developed their own internal strategies for identifying potentially improper admissions, which were often not clearly communicated with providers (Centers for Medicare & Medicaid Services, 2006). In addition to the short-run uncertainty of how strictly a particular MAC may enforce the regulations, hospitals also faced the risk of nonpayment from CMS should they choose to admit a patient

whose need for inpatient care is unclear. In this study, we examined the effects of MAC implementation on the likelihood of being admitted to an inpatient stay. We also stratified along four hospital characteristics: bed size, profit structure, membership in a hospital system, and within-diagnosis inpatient admission rates (Year=2007).

METHODS

Population and Study Design

This was a retrospective cohort study examining the effect of introduction of the MACs on use of inpatient care for short-stay hospital visits. Our population of interest was all Medicare FFS covered hospital visits from 2007 through 2010 that remained in the hospital overnight and for up to four days. Our outcome of interest was whether at some point during the visit, the patient was admitted to an inpatient stay or simply treated in the ED or under observation. Our primary independent variable was whether the hospital visit occurred after the MAC operating in the jurisdiction in which the hospital operates had fully implemented and begun conducting MR. Each MAC began operating during a different month in an apparently random and steady sequence during the initial rollout period (2007–2010). Five contractors (MACs 2, 6, 7, 8, and 15) did not begin operating during this period and were treated as control groups in our analyses.

Our sample was limited to individuals who have Medicare Fee-For-Service (FFS) as primary payer for the entire year during which the hospital visit occurred, as billing claims are not available for Medicare Advantage patients. We also excluded hospital visits occurring in critical access hospitals as they operate under a different payment mechanism and government hospitals as they likely experience changing financial incentives differently. We also excluded same day discharges and hospital visits lasting more than 3 days, which we considered unlikely to be ambiguous. Finally, we excluded discharges occurring in the final three months of 2010, to maintain a consistent cohort with future work examining patient outcomes occurring within 90 days of discharge.

Data

Our data on hospital visits were drawn from the 2007 through 2010 100 percent Medicare Inpatient and Outpatient National Claims History files.

Inpatient hospitalizations are listed in the Hospital Inpatient Standard Analytic File (SAF). ED visits and observation stays are recorded in the Hospital Outpatient SAF. We also incorporated beneficiary demographic characteristics from the Medicare Master Beneficiary Summary File (MBSF). Hospital characteristics were drawn from the Medicare Provider of Services (POS) file, and a survey collected by the American Hospital Association (AHA).

Hospital Visits

To be included in our sample, an individual must begin the hospital visit in the emergency department (HCPCS codes 92281–92285, 92291, or G0380–0384, or revenue center codes 0450–0459 on the outpatient claim). The patient may then either remain entirely in the ED, convert to observation (revenue center codes 0760 or 0762, or Healthcare Common Procedure Coding System (HCPCS) codes G0378 or G0379 Centers for Medicare & Medicaid Services, 2016a), or be admitted for an inpatient stay. As no separate ED claim is submitted for patients who are admitted to inpatient, we checked the inpatient claims for the presence of the previously mentioned HCPCS or revenue center codes for ED use to exclude nonemergent admissions.

Diagnosis Cohorts

We categorized all visits using the International Classification of Diseases 9th Edition (ICD-9) Clinical Classification Software (CCS) developed by the Agency for Healthcare Research & Quality (AHRQ). We based our classification on the primary diagnosis code (ICD-9) listed upon either entry to the ED or admission to the inpatient stay, as these codes can change between admission and discharge as the patient's needs are better understood. We separately examined the following six diagnosis groups we believed to be likely at risk for switching from inpatient to outpatient following the example of past work, and based upon preliminary analyses and consultation with clinical colleagues: 102 (Non-Specific Chest Pain), 245 (Syncope), 251 (Abdominal Pain), 133 (Other Lower Respiratory Disease), 159 (Urinary Tract Infections), and 55 (Fluid and Electrolyte Disorders) (Wright et al. 2016).

MAC Implementation

The MACs were established across 15 regional jurisdictions across the United States over the course of several years. The implementation schedule for each

jurisdiction is described on the CMS website in detail, and summarized in Table 1 (Centers for Medicare & Medicaid Services) Using this information, each hospital was assigned to its respective MAC, and each hospital visit was coded as occurring before or after that MACs implementation date. The staggered rollout presents a unique opportunity to study the effects of this program in a quasi-experimental design.

Control Variables

We examined the following time-varying patient-level variables drawn from the MBSF: including patient age (grouped as 65–69, 70–74, 75–79, 80–84, and 85+), gender, dual eligibility for Medicare and Medicaid, and number of comorbidities identified by the Chronic Condition Warehouse (CCW) in the calendar year of the hospital visit. At the hospital level, we examined hospital profit status as defined in the POS file (recoded as for-profit or not-for-profit, excluding government hospitals who may experience financial incentives differently), and bed size and system membership using the AHA survey data. We split hospitals into quartiles of bed size using all Medicare-certified short-stay hospitals in the United States (excluding critical access hospitals).

Table 1: Medicare Administrative Contractors Jurisdictions and Implementation Schedule

<i>Jurisdiction</i>	<i>States</i>	<i>Implementation Month</i>
1	CA, HI, NV	Oct-08
2	WA, OR, ID, AK	Post 2010
3	MT, WY, UT, AZ, ND, SD	Aug-06
4	CO, NM, OK, TX	May-08
5	IA, KS, MO, NE	Sep-08
6	MN, WI, IL	Post 2010
7	AR, LA, MS	Post 2010
8	MI, IN	Post 2010
9	FL	Mar-09
10	AL, GA, TN	Apr-09
11	NC, SC, VA, WV	Aug-10
12	DE, DC, MD, NJ, PA	Jan-09
13	CT, NY	Nov-08
14	ME, MA, NH, VT, RI	Sep-09
15	KY, OH	Oct-10

Source: Centers for Medicare & Medicaid Services.

Analytic Approach

We modeled the within-hospital effect of MAC implementation on the probability of an ED patient being admitted to an inpatient stay using a difference-in-differences regression approach with “two-way” fixed effects for hospital and month, and standard errors robust to heteroskedasticity. The “two-way” fixed effects enable us to control for trends in the outcome of interest over time, with an interaction between the two effects estimating our outcome of interest. As each MAC began operating at a different point over the four-year period, hospital visits postimplementation were effectively compared with both those hospitals that never implemented and those operating in a MAC jurisdiction that simply has yet to implement. Further, we expect that this “two-way” fixed effects model is robust to any unobserved hospital characteristics so long as they remain largely time-invariant. The model can be expressed as:

$$ADM_{myh} = \alpha + \gamma_m + \vartheta_y + \delta_h + \lambda IMP_{myh} + \beta x'_{myh} + \varepsilon_{myh}$$

where ADM_{myh} represents the linear probability of a patient in hospital h at month m and year y being admitted to an inpatient stay. Therefore, γ_m represents the month fixed effect, ϑ_y represents the year fixed effect, δ_h represents the hospital fixed effect, λIMP_{myh} represents the effect of the hospital visit occurring after the corresponding MAC began operating, which is an interaction between hospital (and therefore MAC) and the month/year combination. The $\beta x'_{myh}$ in our model represents the effect of our vector of time-varying control variables, α represents a constant, and ε_{myh} is the error term.

We modeled this relationship across all acute care hospitals, and then stratified by hospital profit structure (for-profit, nonprofit), quartiles of bed size, system membership, and whether the hospital’s inpatient rate was above or below the median, to test whether certain types of hospitals were more susceptible to the effects of this program.

RESULTS

We identified 3,658,445 hospital visits across our six diagnosis groups occurring in 2,797 distinct Medicare-certified hospitals. The remaining acute care hospitals we identified did not have any Medicare FFS covered visits meeting our inclusion criteria. As shown in Table 2, a majority of hospital visits were

Table 2: Hospital and Hospital Visit Sample Characteristics by Diagnosis Group—2007–2010

<i>Hospital Visits/ Diagnoses</i>	<i>Non-Specific Chest Pain</i>	<i>Syncope</i>	<i>Abdominal Pain</i>	<i>Other Lower Respiratory Disease</i>	<i>Urinary Tract Infection</i>	<i>Fluid and Electrolyte Disorders</i>	<i>Total</i>
N Hospital visits	1,392,461	602,029	432,606	633,765	300,377	297,207	3,658,445
Type of visit							
ER/Observation only	43.5%	28.4%	33.4%	14.2%	40.4%	34.8%	33.8%
Inpatient	56.5%	71.6%	66.6%	85.8%	59.6%	65.2%	66.2%
MAC implementation							
Before	66.7%	65.2%	64.9%	66.1%	66.0%	67.1%	66.1%
After	33.3%	34.8%	35.1%	33.9%	34.0%	32.9%	33.9%
Age group							
Age 65–69	23.2%	12.7%	22.5%	17.3%	12.3%	14.6%	18.8%
Age 70–74	21.1%	15.4%	20.7%	17.9%	14.3%	15.8%	18.6%
Age 75–79	19.8%	19.4%	19.4%	19.3%	17.7%	18.2%	19.3%
Age 80–84	18.0%	22.7%	18.0%	19.9%	21.8%	20.8%	19.6%
Age 85+	17.8%	29.8%	19.5%	25.6%	33.9%	30.6%	23.7%
Sex							
Male	39.4%	41.9%	37.1%	43.6%	28.9%	34.0%	39.0%
Female	60.6%	58.1%	62.9%	56.4%	71.1%	66.0%	61.0%
Dually eligible							
No	76.7%	81.4%	75.1%	72.5%	65.9%	70.8%	75.2%
Yes	23.3%	18.6%	24.9%	27.5%	34.1%	29.2%	24.8%
Comorbidity index							
0	60.4%	59.6%	64.2%	34.8%	58.1%	48.3%	55.1%
1	19.3%	16.6%	16.6%	20.5%	15.0%	19.0%	18.4%
2	12.0%	15.5%	10.6%	21.4%	17.4%	17.7%	15.0%
3	5.7%	5.3%	4.1%	14.5%	5.7%	7.9%	7.2%
4+	2.6%	3.0%	4.5%	8.8%	3.8%	7.0%	4.4%

continued

Table 2. Continued

Hospitals-Visits Diagnoses	Non-Specific Chest Pain	Syncope	Abdominal Pain	Other Lower Respiratory Disease	Urinary Tract Infection	Fluid and Electrolyte Disorders	Total
N Hospitals	2,768	2,756	2,765	2,751	2,755	2,759	2,797
Bed size quartiles							
1 (6–84 Beds)	21.7%	21.7%	21.7%	21.5%	21.8%	21.7%	21.8%
2 (85–163 Beds)	25.6%	25.7%	25.6%	25.7%	25.6%	25.7%	25.6%
3 (164–291 Beds)	26.8%	26.8%	26.8%	26.9%	26.8%	26.8%	26.7%
4 (292–2,207 Beds)	25.9%	25.8%	25.9%	25.9%	25.8%	25.8%	25.9%
Profit structure							
Nonprofit	77.5%	77.4%	77.5%	77.6%	77.3%	77.5%	77.2%
For-profit	22.5%	22.6%	22.5%	22.4%	22.7%	22.5%	22.8%
System membership							
No	37.5%	37.3%	37.4%	37.1%	37.2%	37.3%	38.0%
Yes	62.5%	62.7%	62.6%	62.9%	62.8%	62.7%	62.0%
Hospital inpatient rate							
Below median	46.0%	46.2%	46.0%	46.4%	47.9%	47.2%	41.5%
Above median	54.0%	53.8%	54.0%	53.6%	52.1%	52.8%	58.5%

1. Bed size quartiles established using all US Medicare-certified short-stay hospitals.
Source: American Hospital Association, Centers for Medicare & Medicaid Services.

for women (61.0 percent), and individuals 75 years or older (62.6 percent). Most hospitalizations were not dually eligible for Medicare and Medicaid (75.2 percent), and a majority had a score of zero on the comorbidity index (55.1 percent). The largest diagnosis group was “Non-Specific Chest Pain” ($N = 1,392,461$). This group’s characteristics largely mirrored the overall sample, with the exception of being on average younger than the full sample (55.6 percent 75 years or older). Hospital visit characteristics for each of the diagnosis groups can be found in Table 2. Most of the hospitals included in this study were nonprofit entities (77.2 percent). Distribution of hospitals across bed size quartiles was roughly even, with slightly more hospitals appearing in the two largest quartiles (26.7 percent and 25.9 percent for quartiles 3 and 4 respectively). A majority was also part of a hospital system (62.0 percent) and had an inpatient admission rate above the median (58.5 percent) for the six included diagnosis groups. Hospital statistics for each of the six diagnosis groups can be found in Table 2, and largely mirror the full sample.

Full regression results for each of the six diagnosis groups with the complete hospital sample are presented in Table 3. MAC implementation was significantly associated with a reduction in the likelihood of inpatient admission in two of the six diagnosis groups, “Non-Specific Chest Pain” (−1.29 percentage points, $p < .001$), and “Syncope” (−0.55 percentage points, $p < .001$). The other four diagnosis groups did not exhibit a significant relationship. A significant overall reduction in the likelihood of inpatient admission over time was observed across all six groups ($p < .001$ for all groups), although magnitude of the effect varied (−0.46 percentage points for “Urinary Tract Infection,” −8.93 percentage points for “Non-Specific Chest Pain”). Age, sex, dual eligibility, and the comorbidity index were also highly significant in all models ($p < .001$, see Table 3 for detailed results).

Results of our stratified analyses are presented in Table 4, and revealed substantial variation in effect sizes across hospitals. Among “Non-Specific Chest Pain” patients, the smallest hospitals exhibited a significant increase (2.79 percentage points, $p < .001$) in the likelihood of inpatient admission. Larger hospitals, in contrast, exhibited a much larger decrease in the likelihood of inpatient admission as compared with the overall group (−2.29 percentage points, $p < .001$ and −2.03 percentage points, $p < .001$ for Q3 and Q4, respectively). Nonprofit hospitals exhibited a slightly larger decrease in the likelihood of inpatient admission (−1.33 percentage points, $p < .001$ vs. −1.04 percentage points, $p < .001$). Hospitals that were part of a system exhibited a considerably smaller decrease in the likelihood of inpatient admission (−0.72 percentage points, $p < .001$ vs. −2.54 percentage points, $p < .001$).

Table 3: Regression of Effects of MAC Implementation on Likelihood of Inpatient Admission for Full Hospital Sample, Six Diagnosis Groups

Hospital/ Diagnoses	Non-Specific Chest Pain	Syncope	Abdominal Pain	Other Lower Respiratory Disease	Urinary Tract Infection	Fluid and Electrolyte Disorders
Implementation	-1.29*** (-1.6 to -1)	-0.55** (-0.9 to -0.2)	0.36 (-0.1 to 0.8)	-0.10 (-0.4 to 0.2)	0.56 (0 to 1.1)	0.03 (-0.6 to 0.6)
t-statistic	9.95	3.35	1.46	0.40	1.66	0.09
Age 70-74	0.81*** (0.6 to 1)	1.30*** (0.9 to 1.7)	0.56** (0.2 to 1)	0.97*** (0.7 to 1.3)	2.34*** (1.7 to 3)	0.53 (-0.1 to 1.1)
Age 75-79	2.09*** (1.9 to 2.3)	3.07*** (2.7 to 3.5)	1.37*** (1 to 1.8)	1.74*** (1.5 to 2)	6.13*** (5.5 to 6.8)	1.83*** (1.3 to 2.4)
Age 80-84	2.97*** (2.7 to 3.2)	4.46*** (4.1 to 4.8)	2.37*** (2 to 2.8)	2.36*** (2.1 to 2.6)	8.76*** (8.2 to 9.3)	2.53*** (2 to 3.1)
Age 85+	4.36*** (4.1 to 4.6)	5.63*** (5.3 to 6.1)	3.64*** (3.2 to 4)	3.75*** (3.5 to 4)	12.03*** (11.5 to 12.6)	4.65*** (4.1 to 5.2)
Female sex (Ref. Male)	-6.25*** (-6.4 to -6.1)	-2.07*** (-2.3 to -1.9)	-1.39*** (-1.7 to -1.1)	-2.42*** (-2.6 to -2.3)	-4.54*** (-4.9 to -4.2)	0.33 (0 to 0.7)
Dual eligibility	-1.82*** (-2 to -1.6)	0.48*** (0.2 to 0.8)	-8.25*** (-8.6 to -7.9)	-1.24*** (-1.4 to -1)	-1.10*** (-1.5 to -0.7)	0.30* (0 to 0.8)
Quan comorbidity index (Ref. 0)						
1	9.67*** (9.5 to 9.9)	8.83*** (8.5 to 9.1)	16.75*** (16.4 to 17.1)	9.42*** (9.2 to 9.7)	20.31*** (19.9 to 20.8)	13.01*** (12.6 to 13.4)
2	14.89*** (14.7 to 15.1)	10.02*** (9.7 to 10.3)	16.45*** (16 to 16.9)	13.60*** (13.4 to 13.8)	19.90*** (19.5 to 20.3)	14.46*** (14 to 14.9)
3	20.95*** (20.6 to 21.3)	15.63*** (15.2 to 16)	23.11*** (22.5 to 23.7)	16.00*** (15.8 to 16.2)	25.90*** (25.3 to 26.5)	20.92*** (20.4 to 21.5)
4+	24.83*** (24.4 to 25.3)	17.68*** (17.2 to 18.2)	27.93*** (27.4 to 28.4)	18.34*** (18.1 to 18.6)	29.35*** (28.6 to 30.1)	24.25*** (23.7 to 24.8)
Year (Ref. 2007)						
2008	-2.83*** (-3 to -2.6)	-1.50*** (-1.8 to -1.2)	-0.07 (-0.4 to 0.3)	-0.03 (-0.3 to 0.2)	-0.34 (-0.8 to 0.1)	-0.93*** (-1.4 to -0.5)
2009	-5.86*** (-6.1 to -5.6)	-3.43*** (-3.8 to -3.1)	-1.23*** (-1.7 to -0.8)	-0.47*** (-0.8 to -0.2)	-0.59* (-1.1 to 0)	-3.32*** (-3.9 to -2.8)
2010	-8.93*** (-9.2 to -8.6)	-5.09*** (-5.5 to -4.7)	-1.90*** (-2.4 to -1.4)	-0.98*** (-1.3 to -0.7)	-0.46 (-1.1 to 0.2)	-4.45*** (-5.1 to -3.8)

Note: Estimates reflect change in likelihood of admission to inpatient in whole percentage points. Model includes fixed effects for hospital and month not shown.

*p < .05, **p < .01, ***p < .001.

Source: American Hospital Association, Centers for Medicare & Medicaid Services.

Table 4: Overall and Hospital Sub-Group Analyses of MAC Implementation's Effect on Likelihood of Inpatient Admission: Six Primary Intake Diagnosis Groups – 2007–2010

Hospital Diagnoses	Non-Specific Chest Pain	Syncope	Abdominal Pain	Other Lower Respiratory Disease	Urinary Tract Infection	Fluid and Electrolyte Disorders
All Hospitals	-1.29*** (-1.6 to -1)	-0.55** (-0.9 to -0.2)	0.36 (-0.1 to 0.8)	-0.10 (-0.4 to 0.2)	0.56 (0 to 1.1)	0.03 (-0.6 to 0.6)
Bed size Q1	2.79*** (1.8 to 3.8)	2.08** (0.5 to 3.6)	1.09 (-0.6 to 2.8)	0.79 (-0.2 to 1.8)	2.17* (0.3 to 4.1)	2.81** (0.9 to 4.7)
Bed size Q2	0.53 (-0.1 to 1.2)	0.12 (-0.8 to 1.1)	0.82 (-0.3 to 2)	-0.68* (-1.4 to 0)	-1.17 (-2.5 to 0.2)	-0.52 (-1.9 to 0.9)
Bed size Q3	-2.29*** (-2.8 to -1.8)	-0.70 (-1.4 to 0)	-0.25 (-1.1 to 0.6)	0.09 (-0.5 to 0.6)	-0.03 (-1.1 to 1.1)	-1.57** (-2.7 to -0.5)
Bed size Q4	-2.03*** (-2.4 to -1.6)	-1.23*** (-1.8 to -0.7)	0.39 (-0.3 to 1.1)	-0.16 (-0.6 to 0.3)	1.21** (0.3 to 2.1)	0.53 (-0.4 to 1.4)
Nonprofit	-1.33*** (-1.6 to -1)	-0.80*** (-1.2 to -0.4)	0.29 (-0.2 to 0.8)	-0.08 (-0.4 to 0.3)	0.35 (-0.3 to 1)	-0.02 (-0.7 to 0.6)
For-profit	-1.04** (-1.7 to -0.4)	0.41 (-0.6 to 1.4)	0.46 (-0.7 to 1.6)	0.09 (-0.6 to 0.8)	1.31 (-0.2 to 2.8)	-0.64 (-2.1 to 0.8)
System membership Yes	-0.72*** (-1.1 to -0.4)	0.16 (-0.3 to 0.6)	0.51 (-0.1 to 1.1)	-0.02 (-0.4 to 0.3)	0.80* (0.1 to 1.5)	0.71 (0 to 1.4)
System membership No	-2.54*** (-3 to -2.1)	-2.03*** (-2.7 to -1.4)	-0.10 (-1 to 0.8)	-0.29 (-0.8 to 0.2)	-0.06 (-1.1 to 1)	-1.45** (-2.5 to -0.4)
Above median Inp. Rate	-1.00*** (-1.3 to -0.7)	-0.89*** (-1.3 to -0.4)	0.20 (-0.4 to 0.8)	-0.04 (-0.3 to 0.3)	0.85* (0.1 to 1.6)	0.11 (-0.6 to 0.8)
Below median Inp. Rate	-1.86*** (-2.3 to -1.4)	-0.14 (-0.9 to 0.6)	0.38 (-0.5 to 1.3)	-0.29 (-1.1 to 0.5)	0.04 (-0.9 to 1)	-0.04 (-1 to 1)

Notes: Estimates reflect change in likelihood of admission to inpatient in whole percentage points (95% Confidence Interval). Bed size quartiles established using all US Medicare-certified short-stay hospitals. Complete model results not shown but available upon request.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Source: American Hospital Association, Centers for Medicare & Medicaid Services.

Hospitals with a rate of inpatient admission below the median exhibited a greater decrease in likelihood after implementation (-1.86 percentage points, $p < .001$ vs. -1.00 percentage points, $p < .001$).

Hospital visits for “Syncope” patients exhibited similar results to those for “Non-Specific Chest Pain” but were overall of smaller magnitude. Noteworthy exceptions were hospitals in the 2nd and 3rd quartile of bed size, for-profit hospitals, hospitals that were part of a system, and hospitals with a rate of inpatient admission below the median, all of which did not exhibit a significant effect. As with the full hospital sample, nearly all of the models across the remaining four diagnosis groups and hospital subsamples showed no significant effect of MAC implementation. For hospital visits for “Other Lower Respiratory Disease,” hospitals in the 2nd quartile of bed size exhibited a significant decrease of 0.68 percentage points ($p < .05$). For patients with a primary diagnosis of “Urinary Tract Infection,” significant effects were observed in Q1 and Q4 hospitals (2.17 percentage points, $p < .05$ and 1.21 , $p < .01$). Hospitals that were part of a system and those with a inpatient rate above the median exhibited significant increases in the likelihood of admission after MAC implementation (0.80 and 0.85 percentage points, $p < .05$). Finally, among hospitals with a primary diagnosis of “Fluid and Electrolyte Disorders,” significant effects were observed in Q1 hospitals (2.81 percentage points, $p < .01$), Q3 hospitals (-1.57 percentage points, $p < .05$), and hospitals that were not part of a system (-1.45 percentage points, $p < .01$). Complete model results for the six diagnosis groups and all hospital subgroups can be found in the Table S1.

DISCUSSION

The results of this study indicate that implementation of the MAC program was significantly associated with a small but significant reduction of 1.29 percentage points in the likelihood of a short-stay patient with a primary intake diagnosis of “Non-specific Chest Pain” being admitted to inpatient care. This effect was more pronounced in nonprofit hospitals, larger hospitals, and hospitals that were not part of a system. We also detected a significant effect on the likelihood of a patient with a primary intake diagnosis of “Syncope” being admitted, but this effect was smaller and less pronounced across our different hospital subgroups. In contrast, other diagnosis groups expected to be targeted by Medical Reviews largely did not exhibit significant changes in use of

observation. To our knowledge, ours is the first study to examine the effects of MACs and MR on short-stay inpatient hospital use in this manner.

Our overall results are consistent with past work by Wright and colleagues showing that hospital administrative characteristics have a significant effect on the likelihood of being admitted to an observation stay (Wright et al. 2014). However that study employed a more limited definition of outpatient hospital care by only examining those claims explicitly coded as “Observation” according to CMS guidance (Feng, Wright, and Mor 2012; Feng et al. 2014; Wright et al. 2014). In this study, we used a more expansive definition including all ED visits that were not-same day discharges. As has been shown in past work, the provision and infrastructure of an outpatient hospital visit can vary considerably from one hospital to the next, and this may be reflected in variation in coding patterns not captured in past work (Feng, Wright, and Mor 2012; Ross et al. 2013).

This variation must also be considered when evaluating the effects of the policy. Some hospitals are better equipped than others to treat patients with more extensive needs under observation. For example, some hospitals have dedicated observation units, whereas others consider observation an extension of the ED (Feng, Wright, and Mor 2012; Ross et al. 2013). The current rules governing the use of inpatient and observation stays do not account for this variation, and may therefore be incentivizing appropriate care in some hospitals but not others. Additionally, these differences may explain some of the variation we observe in our results. For example, a hospital with a dedicated observation unit or standardized treatment protocols may be more responsive to payer incentives as they are better equipped to safely treat patients under observation (Ross et al. 2013). Future work examining whether the “two-midnight” rule is properly calibrated to existing hospital infrastructure may be beneficial, but hospital systems across the country would also likely benefit in the long-run from a more standardized, tailored definition of observation care.

The results of this work have important policy implications for the Medicare program to consider. It is unclear exactly why the observed effects are specific to “Non-Specific Chest Pain” and “Syncope” patients, and not the other diagnoses we examined. It is possible that these patients were the “low hanging fruit” for hospitals. That is, hospitals perceived these patients as the easiest to treat in an outpatient setting without compromising care or substantially disrupting their revenue streams. For example, “Non-Specific Chest Pain” can indicate that a cardiac event has occurred, and treatment involves assessing the risk of a subsequent event. Standardized protocols have been

developed in recent years allowing this to be more easily done under observation (Mahler et al. 2015). It is also possible that MAC review efforts emphasized chest pain patients, driving a more substantial change for those patients while blunting potential effects for other patients. This would be consistent with past efforts examining the effects of punitive regulatory policies (Bowblis et al. 2012). It will be important to understand whether such targeted auditing is occurring when developing future review based initiatives. It also remains unclear whether any savings are truly achieved without also examining the costs of the MACs themselves. MR is only one aspect of the MACs' overall scope of work and it would be difficult to disentangle the marginal cost over the pre-MAC infrastructure for this specific responsibility.

Regardless, it is essential to understand the clinical nature of the patients most likely to be affected and whether their needs are being met under an outpatient level of care. The decision to audit and/or ultimately decline a claim for a short-stay inpatient admission is effectively made by an external third party, who may underestimate the clinical needs of the patient. Should such a disconnect occur with frequency, rigorous enforcement may incentivize providers to "over-correct," shifting patients with a genuine need away from inpatient stays (Feng, Wright, and Mor 2012). This may place patients at greater risk of worsening health, readmission, or mortality. Further, these outcomes would likely result in increased costs to the Medicare program, potentially invalidating any savings achieved in the index hospital visit. Future work should examine patient outcomes such as readmission and postdischarge expenditures in evaluating and refining the algorithms used to identify short-stay hospitalizations best suited for outpatient care.

Our work is subject to several limitations. First, we only examined patients within six primary admission diagnosis groups whose visits last from 1–3 days. These patients overall represent a small subset of total Medicare-covered hospital visits. While we find a significant relationship for "Non-Specific Chest Pain" and for "Syncope" in certain hospitals, these results do not necessarily generalize to other Medicare-covered hospitalizations, or hospitalizations covered by other payers. A second related limitation is that we only examine the primary diagnosis recorded during the initial evaluation at the ED, and do not incorporate secondary diagnoses nor discharge diagnoses which may contain useful clinical information. We selected this approach because CMS billing guidance states that the decision to admit be made based on initial projections of the patient's length of stay. Third, although our model controls for time-invariant hospital characteristics and several time-varying patient characteristics, it is possible that our estimates reflect factors

unobserved in our data. For example, a reduction in the within-hospital rate of inpatient stays could be driven by hospitals more selectively admitting patients unaffected by the change in enforcement. Fourth, Medicare payment policies are often in flux as new rules are being implemented, and the changes in observation use we report may have been caused by an unrelated policy. However, we believe this to be unlikely given the random and variable start dates across the different jurisdictions. A related limitation is that the hospital visits examined here occurred several years ago, and in the interim several additional payment policies have been implemented which may limit the utility of these results. Finally, we do not have information on the specific approach each MAC employed in flagging and auditing claims, so we cannot say with certainty whether the diagnosis-specific effect we observed was driven by hospital or MAC behaviors.

Our study results indicate that implementation of MACs influenced hospitals to make modest reductions in their use of short-stay inpatient hospitalization for patients with “Non-Specific Chest Pain” and “Syncope,” and an ambiguous need for an inpatient level of care. This effect also varied across different types of hospitals. Future work should examine whether this change resulted in any adverse outcomes or costs for those patients affected to target those hospital visits best suited for outpatient care.

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- HCR Manor Care, Inc. – Chair, Independent Quality Committee
- NaviHealth, Inc. – Chair of SAB, consultant
- PointRight, Inc. – former Director. Holds less than 1% equity.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix SA1: Author Matrix.

Table S1. Regression of Effects of MAC Implementation on Likelihood of Inpatient Admission for Full Hospital Sample and All Hospital Cohorts, Six Diagnosis Groups.