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Hospital Prescribing of Opioids to Medicare Beneficiaries

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Abstract

IMPORTANCE—Use of opioids during and shortly after an acute hospitalization is warranted in some clinical settings. However, given the potential of opioids for short-term adverse events and long-term physiologic tolerance, it is important to understand the frequency of opioid prescribing at hospital discharge, hospital variation, and patient and hospital factors associated with opioid prescribing, which is currently unknown in the United States.

OBJECTIVE—To estimate the frequency of opioid prescribing at hospital discharge among Medicare beneficiaries without an opioid prescription claim 60 days prior to hospitalization; to document hospital variation in prescribing; and to analyze patient and hospital factors associated with prescribing, including hospital average performance on pain-related Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) measures.

DESIGN, SETTING, AND PARTICIPANTS—Analysis of pharmacy claims of a 20% random sample of Medicare beneficiaries hospitalized in 2011 without an opioid prescription claim in the 60 days before hospitalization.

MAIN OUTCOMES AND MEASURES—Our main outcome was a new opioid claim within 7 days of hospital discharge. We estimated a multivariable linear probability model of patient factors associated with new opioid use and described hospital variation in adjusted rates of new

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opioid use. In multivariable linear regression analysis, we also analyzed hospital factors associated with average adjusted new opioid use at the hospital level, including the percentage of each hospital's patients who reported that their pain during hospitalization was always well controlled in the 2011 HCAHPS surveys.

RESULTS—Among 623 957 hospitalizations, 92 882 (14.9%) were associated with a new opioid claim. Among those hospitalizations with an associated opioid claim within 7 days of hospital discharge, 32 731 (42.5%) of 77 092 were associated with an opioid claim after 90 days postdischarge. Across 2512 hospitals, the average adjusted rate of new opioid use within 7 days of hospitalization was 15.1% (interquartile range, 12.3%–17.4%; interdecile range, 10.5%–20.0%). A hospital's adjusted rate of new opioid use was modestly positively associated with the percentage of its inpatients reporting that their pain was always well managed (increase from 25th to the 75th percentile in the HCAHPS measure was associated with an absolute increase in new opioid use of 0.89 percentage points or a relative increase of 6.0%; $P < .001$).

CONCLUSIONS AND RELEVANCE—New opioid use after hospitalization is common among Medicare beneficiaries, with substantial variation across hospitals and a large proportion of patients using a prescription opioid 90 days after hospitalization. The degree to which observed hospital variation in short- and longer-term opioid use reflects variation in inappropriate prescribing at hospital discharge is unknown.

Prescribing of opioids at the time of discharge from an acute hospitalization represents an important but underdescribed potential avenue through which previously opioid-naïve patients may develop long-term use.^{1–3} Use of opioids during and shortly after hospitalization is warranted in many clinical settings, for example, in patients with orthopedic injuries, those undergoing surgery, and those receiving palliative care. Failure to appropriately manage pain in these settings may adversely affect patient quality of life, delay discharge from the hospital, and in cases of surgery lead to interferences in postoperative rehabilitation and chronic postsurgical pain.^{4–7} However, prescribing of opioids is also associated with both short- and long-term risks including physical dependence. Adverse effects of opioid use are of particular concern given that deaths attributable to prescription opioids more than tripled in the United States during the 1999–2014 period.⁸

Limited evidence exists on prescribing of opioids at hospital discharge. Among opioid-naïve patients undergoing low-risk surgery in Ontario, Canada, 7% received opioids within 1 week of hospital discharge, and these patients were 44% more likely to use opioids long-term than patients who were not prescribed opioids in the first week postdischarge.¹ In another Ontario-based study of patients undergoing major elective surgery, 49% of patients filled a prescription for an opioid after discharge and 3% continued to receive opioids after 90 days.² In an analysis of opioid-naïve patients discharged at a US safety net hospital in 2011, 25% of patients were prescribed an opioid at discharge; the risk of opioid use 1 year later was 4-fold higher among patients with opioid receipt than among those without opioid receipt.³

The extent to which opioids are prescribed at hospital discharge, variation in prescribing across hospitals, and patient and hospital factors associated with opioid prescribing are unknown in the United States. Moreover, US hospitals are both measured and financially incentivized on the basis of patient satisfaction with hospital care through the Hospital

Consumer Assessment of Healthcare Providers and Systems (HCAHPS) initiative, an important domain of which includes patient perceptions of the quality of pain care while hospitalized.⁹ The possibility that this measure could incentivize both greater inpatient use of opioids and the prescribing of opioids at hospital discharge has been suggested in recently proposed legislation, the Promoting Responsible Opioid Prescribing Act of 2016,¹⁰ but the association between opioid prescribing rates at hospital discharge and hospital performance on pain-related HCAHPS measures has not been investigated.

Using data on prescription drug claims of a national random sample of Medicare beneficiaries who were hospitalized in 2011 and did not have a prescription claim for an opioid in the 60 days prior to hospitalization, we estimated the frequency with which individuals filled a prescription for an opioid within 1 week of hospital discharge, described variation across hospitals in rates of postdischarge prescription opioid use, and analyzed patient and hospital factors associated with postdischarge opioid use.

Key Points

Question

How much do hospitals vary in opioid prescribing at hospital discharge, and what patient and hospital factors are associated with prescribing?

Findings

In this observational study of Medicare beneficiaries hospitalized in 2011 without an opioid claim in the 60 days before hospitalization, 14.9% of discharges involved a new opioid claim within 7 days of discharge. A hospital's adjusted rate of new opioid use was modestly positively associated with the hospital's average performance on pain-related Hospital Consumer Assessment of Healthcare Providers and Systems measures.

Meaning

New opioid use after hospitalization is common among Medicare beneficiaries, with substantial variation across hospitals.

Methods

This study was exempted from ethical review of studies with human participants by the University of Southern California.

Study Population

We identified acute short-stay hospitalizations of Medicare beneficiaries using the Centers for Medicare and Medicaid Services (CMS) MEDPAR (Medicare Provider Analysis and Review) hospital discharge data files for a 20% random sample of beneficiaries in 2011. MEDPAR files contain information on each acute hospital stay, including admission and discharge dates, *International Classification of Diseases, Ninth Revision* procedure and diagnosis codes, diagnosis-related group (DRG) codes, and hospital identity.

Because we were interested in measuring prescription opioid use of patients before and after hospitalization, we limited our analyses to discharges of beneficiaries who had 12 months of continuous Medicare Part D enrollment (N = 1 511 335 discharges). Because not all Medicare beneficiaries obtain drug coverage through the Part D program, our sample was representative of the Part D population, not Medicare overall. We excluded Medicare Advantage enrollees because not all hospitals submit claims to CMS for these patients.¹¹ Our study population, therefore, included discharges of Medicare fee-for-service beneficiaries (n = 1 055 759). We required beneficiaries with a January or February 2011 discharge date to have Part D enrollment in 2010 because we needed to identify opioid use in a 60-day period before hospitalization (n = 1 042 120).

We merged discharges to American Hospital Association Annual Survey data that includes comprehensive information on US hospitals. We excluded 4866 discharges from hospitals with missing hospital identity, 1271 discharges from hospitals outside the United States, 11 478 discharges from hospitals that were not general medical or surgical hospitals, and 491 discharges from federal government hospitals. The resulting sample included 1 023 994 discharges. Finally, to identify new opioid use, we focused on hospitalized beneficiaries who did not fill a prescription for an opioid in the 60 days prior to the index hospitalization admission date (final sample, n = 623 957). A flow diagram of sample construction is provided in eFigure 1 in the Supplement.

We linked each discharge with beneficiary data from the Beneficiary Annual Summary Files, including age, sex, race (non-Hispanic white, non-Hispanic black, Hispanic, Asian, other including North American native), metropolitan residence, and 5-digit zip code of residence. Additional beneficiary data included whether a beneficiary received a low income subsidy or received dual insurance coverage by Medicaid and Medicare at least 1 month of the year. Beneficiary files also included indicators of major comorbid conditions (Table 1).

Outcomes

Our primary outcome was whether a beneficiary filled a prescription for an opioid within 7 days of hospital discharge (“new opioid use postdischarge”). We also considered several secondary outcomes. First, to assess longer-term use, we identified discharges with at least a 90-day follow-up and identified those in which the patient filled an opioid after 90 days of discharge. Second, to analyze dosing differences across hospitals, we analyzed the proportion of discharges in which new opioid use within 7 days of hospital discharge was 20 morphine equivalents per day or higher. Third, to analyze how duration of opioid prescribing varied across hospitals, we analyzed the proportion of discharges in which new opioid use within 7 days of hospital discharge exceeded a 7-day supply. Finally, because our data did not specifically allow us to determine whether an opioid was prescribed at hospital discharge or shortly thereafter in the outpatient setting, we analyzed the proportion of discharges in which a new opioid prescription was filled within 3 days of discharge, assuming that such opioid use reflected filling of a prescription written at hospital discharge. We identified prescription opioids according to National Drug Code (complete, partial, and combination opioid agonists were included).

Statistical Analysis

We first computed the proportion of hospitalizations in which a new prescription opioid was filled within 7 days of hospital discharge and the proportion of hospitalizations in which a new prescription opioid continued to be used after 90 days postdischarge. We next estimated a multivariable, discharge-level linear probability model to study patient level factors associated with new opioid use. The dependent variable was a binary outcome for whether a discharge involved a new prescription opioid claim within 7 days of discharge. Independent variables included patient characteristics, indicators for each of 585 DRGs, and hospital indicators. Patient characteristics included age, sex, race, Medicare-Medicaid dual eligibility and low-income subsidy for at least 1 month during the year, metropolitan residence indicator, indicators for each of 23 comorbid conditions, and patient 5-digit zip code median income. We reported changes in the adjusted probability of new prescription opioid use associated with each independent variable, with the exception of DRG given the large number of DRG variables. For categorical and binary variables, our estimates represented the difference in the probability of new opioid use for the corresponding category relative to the reference category (set at 0 for binary variables). To facilitate comparisons of how new opioid use was related to specific reasons for hospitalization, we reestimated the model replacing DRG indicators with medical and surgical major diagnostic categories (MDCs). These categories are formed by dividing all possible principal diagnoses into 25 mutually exclusive diagnosis areas. We further subdivided each MDC into surgical vs medical reason for hospitalization.

After analyzing patient-level predictors of new opioid use, we described hospital variation in adjusted rates of new opioid use. Using estimates from the multivariable model described above that included DRG, we predicted adjusted rates of new opioid use for each hospital, holding patient characteristics at their sample mean. We reported the distribution in adjusted rates of new opioid use by hospital for both primary and secondary measures of opioid use.

Finally, we analyzed hospital-level factors associated with new postdischarge opioid use by estimating a hospital level multivariable linear regression of patient risk-adjusted rates of postdischarge opioid use as a function of hospital characteristics, including number of beds, staffing (number of attending physicians, residents, registered nurses, each per bed), for-profit status, system affiliation, teaching hospital status, rural status, and presence of an electronic health record. In addition, we included an independent variable from the 2011 HCAHPS survey on the percentage of patients reporting that their pain during hospitalization was always well controlled.¹² We restricted our analysis to hospitals with at least 50 discharges in 2011 and weighted regressions by the number of observations per hospital. Analyses were performed for both primary and secondary measures of opioid use.

Analyses were conducted using Stata software, version 14 (StataCorp LP). The 95% confidence intervals (CIs) around reported means reflects 0.025 in each tail or $P < .05$.

Results

Our sample included 623 957 hospitalizations with no opioid claim in the 60 days prior to hospital admission. Overall, 92 882 (14.9%) were associated with a new opioid claim within

7 days of discharge (Table 1). Among 77 092 of these 92 882 hospitalizations with 90-day follow-up, 32 731 (42.5%) were associated with an opioid claim after 90 days postdischarge.

While most new opioid use after hospital discharge was among beneficiaries 65 years or older, 8.2% of discharges with new opioid use involved beneficiaries younger than 45 years (Table 1). Most beneficiaries with new opioid use were female (57.9%). Non-Hispanic white and non-Hispanic black or African American beneficiaries accounted for 80.5% and 12.8% of the discharges, respectively. Overall, 41.7% of discharges with new opioid use involved beneficiaries who were dually eligible for Medicare and Medicaid. The most common comorbid conditions of beneficiaries with new opioid use postdischarge included hypertension (82.7%), hyperlipidemia (65%), anemia (55.7%), rheumatoid arthritis (49.4%), ischemic heart disease (49.3%), diabetes (40.2%), depression (31.5%), and congestive heart failure (30.4%).

Patient Factors Associated With New Postdischarge Opioid Use

After multivariable adjustment, new postdischarge opioid use was more common among younger beneficiaries (Table 2). For example, the unadjusted percentage of new opioid use for beneficiaries 85 years or older was 6.0%. Relative to these beneficiaries, the adjusted percentage of new opioid use was higher by 1.9 percentage points (95% CI, 1.7–2.2) for those aged 74 to 84 years, and by 6.8 percentage points (95% CI, 6.6–7.1) for those aged 65 to 74 years. Differences in new opioid use were not present according to patient race. New opioid use was more likely among beneficiaries who resided in rural areas, received low-income subsidies, or were dually eligible for Medicare and Medicaid. Surgical hospitalizations were more likely to be associated with new postdischarge opioid use, and among these, diseases of the hepatobiliary system and pancreas, digestive system, female reproductive system, and surgery related to burns had the largest associations (eTable 1 in the Supplement). Among medical hospitalizations, diseases of the musculoskeletal system and connective tissue (eg, nonoperative management of fractures) had among the largest associations with new opioid use after hospitalization. Similar relationships were observed in opioid use 90 days after hospital discharge (eTable 2 in the Supplement).

Hospital Variation in Opioid Use Postdischarge

New postdischarge opioid use varied across hospitals (Figure). Across 2507 hospitals, the average adjusted rate of new postdischarge opioid use was 15.1% (interquartile range, 12.3%–17.4%; interdecile range, 10.5%–20.0%). Similar variation was observed when we restricted analysis to new opioid prescriptions filled within 3 days of hospitalization (eFigure 2 in the Supplement). Among patients with new opioid use within 7 days of hospital discharge, large variation was also observed in opioid use 90 days postdischarge (eFigure 3 in the Supplement). Finally, large variation was observed across hospitals in the proportion of discharges in which new opioid use within 7 days of hospital discharge was 20 morphine equivalents per day or higher (eFigure 4 in the Supplement) and in which new opioid use exceeded a 7-day supply (eFigure 5 in the Supplement).

Hospital Factors Associated With New Opioid Use After Discharge

Hospital characteristics are described in eTable 3 in the Supplement. A hospital's adjusted rate of new postdischarge opioid use was positively associated with its HCAHPS measure of the percentage of inpatients reporting that their pain was always well managed during hospitalization (Table 3). An increase from the 25th to the 75th percentile of the HCAHPS measure (from 66% to 71% of patients reporting their pain was always well managed, a 5 percentage-point increase) was associated with an absolute increase in new postdischarge opioid use of 0.89 percentage points ($P < .001$). This represents a relative increase of 6.0% over the average hospital's percentage of new opioid use after discharge (from 15.1% to 16.0% of hospitalizations). Similar relationships were observed for our secondary opioid use measures (eTables 4 and 5 in the Supplement). For example, an increase from the 25th to the 75th percentile of the HCAHPS measure was associated with a 0.86 percentage point absolute increase (7.1% relative increase compared with baseline of 12.2%) in the proportion of patients with an opioid claim within 7 days of discharge that was 20 morphine equivalents per day or higher (eTable 5 in the Supplement). New postdischarge opioid use was positively associated with the number of full-time registered nurses per bed and negatively associated with the number full-time resident physicians per bed. Government, rural, and system affiliated hospitals had higher adjusted rates of new postdischarge opioid use.

Discussion

Analyzing prescription drug claims of a national random sample of Medicare beneficiaries who were hospitalized in 2011 and who were not prescribed an opioid within the 60 days prior to hospitalization, we found that approximately 15% of beneficiaries filled a new prescription for an opioid within 7 days of discharge and that the likelihood of postdischarge use varied across hospitals. For example, in the bottom decile of hospitals in terms of adjusted postdischarge opioid use, 10.5% of beneficiaries filled a new opioid prescription within 7 days of discharge, compared with 20.0% in the top decile of hospitals. Moreover, among beneficiaries with new opioid use within 7 days of discharge, 42.5% filled an opioid claim after 90 days postdischarge. We also found that hospitals that ranked more highly in terms of HCAHPS assessment of the quality of inpatient pain control had modestly higher rates of new postdischarge opioid use.

The prescribing of opioids during and after hospitalization is warranted in many clinical settings. Although we identified substantial variation across hospitals in new postdischarge opioid use, it is unknown whether this variation reflects differences in appropriate or inappropriate prescribing across hospitals. Distinguishing between these 2 possibilities is important, however, given that opioid prescribing at hospital discharge has in some settings been associated with increased risk of long-term use.¹⁻³ Appropriate differences across hospitals in new postdischarge opioid use may stem from differences in average pain severity across hospitals or differences in the case mix of hospitalizations, which we attempted to account for through adjustment with DRG codes. In contrast, inappropriate differences across hospitals in new postdischarge opioid use may stem from systematic differences in practice patterns, which may be related to prescribing culture, other hospital

characteristics, or possibly pay-for-performance measures related to the quality of inpatient pain management.^{13–16}

Our finding that patients in the top decile of hospitals were twice as likely to fill a prescription for an opioid within 7 days of hospital discharge as patients in the bottom decile suggests that appropriate reasons for these observed differences, while important, may not fully explain the gap.

Our finding of a positive hospital-level relationship between HCAHP Spain management scores and the likelihood of postdischarge opioid use should be interpreted with caution. First, many patient, hospital, and regional factors may confound this relationship despite our attempts to account for patient characteristics and other hospital-level factors. For example, hospital performance on cultural competency measures is positively associated with performance on pain-related HCAHPS measures,¹⁷ implying that differences in cultural competency across hospitals may explain variation in opioid prescribing rather than hospital responses to pay-for-performance incentives. Second, our estimated associations were modest in size, suggesting that proposals to reduce hospital pay-for-performance incentives regarding inpatient pain management are unlikely to have large effects on opioid use.

Our findings could suggest that current outcome measurements of the adequacy of pain control should be coupled with process measurements on the appropriateness of opioid use or, put differently, that a central limitation of current pain satisfaction measures is their inability to account for appropriateness. To the extent that prescribing of opioids at discharge is aberrantly high in some hospitals, further detailed inquiry may be warranted into the appropriateness of this prescribing and whether opioid-prescribing rates could be safely reduced in those hospitals.

Our study had several limitations. First, we could not determine whether observed variation in opioid use after hospital discharge was related to appropriate or inappropriate prescribing variation. Second, given only 1 year of data, we could not study whether hospitals with higher adjusted rates of postdischarge opioid use had greater adverse events related to opioids, though many studies demonstrate links between opioid use and adverse opioid-related outcomes.^{18–22} Third, we focused on the Medicare population, specifically beneficiaries under fee-for-service. Medicare is an important population to consider, however, given that opioid use among the elderly and disabled is associated with higher mortality and other adverse outcomes.^{18,23,24} Fourth, although we found that postdischarge prescription opioid use was positively associated with hospital performance on HCAHPS pain measures, this association was not only modest in size but may have been confounded by unobserved hospital or population characteristics. Fifth, our primary outcome was opioid use within 7 days of a hospitalization. It is possible that this may reflect outpatient prescribing of opioids rather than opioids prescribed at the time of hospital discharge. Our findings, however, were unaffected by a narrower window of 3 days postdischarge.

Conclusions

Among Medicare patients without opioid use in the 60 days prior to hospitalization, prescribing of opioids at the time of hospital discharge is common, with substantial variation across hospitals and a large proportion of patients using a prescription opioid 90 days after hospitalization. The degree to which observed variation in postdischarge opioid use reflects inappropriate prescribing is unknown.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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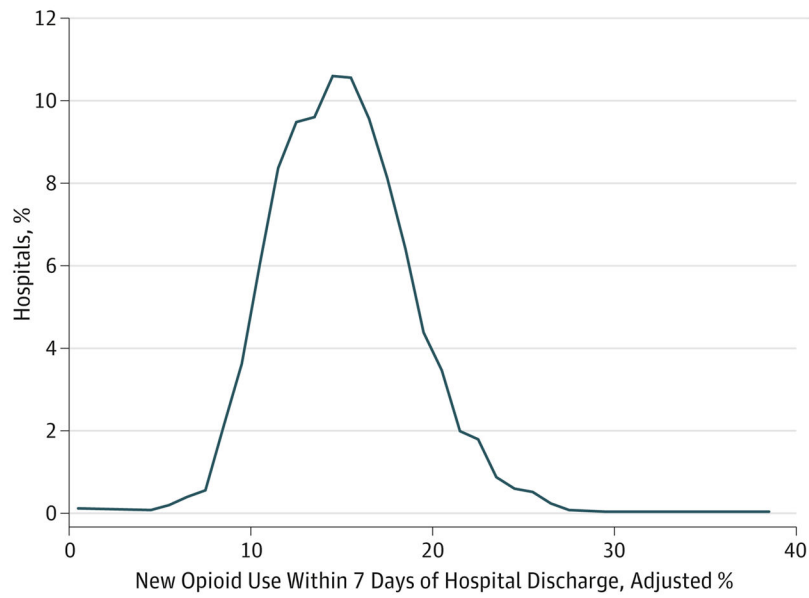


Figure. Hospital Variation in Adjusted Rate of New Opioid Use Within 7 Days of Hospital Discharge

Adjusted rates of new opioid use were estimated among 2507 hospitals with at least 50 discharges in 2011. The average adjusted rate of new opioid use within 7 days of hospital discharge was 15.1%, with an interquartile range of 12.3% (25th percentile) to 17.4% (75th percentile) and an interdecile range of 10.5% (10th percentile) to 20.0% (90th percentile).

Table 1

Characteristics of Medicare Beneficiaries With New Opioid Use Within 7 Days of Hospital Discharge

Characteristic	Beneficiaries, No. (%)
Total	92 882 of 623 957 (14.9)
Age, y	
<45	7590 (8.2)
45–54	8026 (8.6)
55–64	9853 (10.6)
65–74	38 520 (41.5)
74–84	22 229 (23.9)
85	6664 (7.2)
Female sex	53 740 (57.9)
Race	
Non-Hispanic white	74 815 (80.5)
Non-Hispanic black/African American	11 911 (12.8)
Non-Hispanic other race	1092 (1.2)
Asian	1590 (1.7)
Hispanic	2678 (2.9)
Native American	586 (0.6)
Low-income subsidy/dual eligibility	
No low-income subsidy	49 622 (53.4)
Low-income subsidy, not dual eligible	4528 (4.9)
Medicare-Medicaid dual eligible	38 732 (41.7)
Urban residence	68 882 (74.2)
Beneficiary chronic conditions	
Anemia	51 742 (55.7)
Asthma	12 721 (13.7)
Atrial fibrillation	13 108 (14.1)
Benign prostatic hyperplasia	10 411 (11.2)
Chronic kidney disease	31 239 (33.6)
Chronic obstructive pulmonary disease	25 423 (27.4)
Congestive heart failure	28 248 (30.4)
Dementia	11 119 (12.0)
Depression	29 218 (31.5)
Diabetes	37 338 (40.2)
Hip fracture, prior	3202 (3.4)
Hyperlipidemia	60 331 (65.0)
Hypertension	76 835 (82.7)
Hypothyroidism	18 000 (19.4)
Ischemic heart disease	45 787 (49.3)

Characteristic	Beneficiaries, No. (%)
Osteoporosis	11 317 (12.2)
Rheumatoid arthritis	45 846 (49.4)
Stroke or transient ischemic attack, prior	7531 (8.1)
Cancer	
Breast	4679 (5.0)
Colorectal	3899 (4.2)
Prostate	4605 (5.0)
Lung	2945 (3.2)
Endometrial	1135 (1.2)
Opioid use after 90 days postdischarge among new opioid users with 90-day follow-up	32 731 of 77 092 (42.5)

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Table 2Patient Characteristics Associated With New Opioid Use Within 7 Days of Hospital Discharge^a

Characteristic	New Opioid Use, Unadjusted % (SD)	Point Change in New Opioid Use, Adjusted Absolute % (95% CI)	P Value for Adjusted Change
Age, y			
<45	18.5 (38.8)	11.8 (11.3 to 12.3)	<.001
45–54	18.0 (38.5)	11.2 (10.7 to 11.6)	<.001
55–64	16.7 (37.3)	8.3 (8.0 to 8.7)	<.001
65–74	20.9 (40.7)	6.8 (6.6 to 7.1)	<.001
74–84	12.1 (32.6)	1.9 (1.7 to 2.2)	<.001
85	6.0 (23.7)	[Reference]	
Sex			
Female	14.8 (35.5)	0.7 (0.5 to 0.9)	<.001
Male	15.0 (35.7)	[Reference]	
Race/ethnicity category			
Non-Hispanic white	15.4 (36.1)	[Reference]	
Non-Hispanic black/African American	13.2 (33.8)	–0.1 (–0.3 to 0.2)	.58
Other race	14.1 (34.8)	–0.3 (–1.0 to 0.5)	.47
Asian	12.3 (32.9)	0.6 (0.0 to 1.2)	.06
Hispanic	12.3 (32.8)	0.4 (–0.1 to 0.8)	.13
Native American	18.0 (38.4)	–0.1 (–1.3 to 1.1)	.87
Low-income subsidy/dual eligibility			
No low-income subsidy	16.7 (37.3)	[Reference]	
Low-income subsidy, not dual eligible	15.7 (36.4)	0.6 (0.2 to 1.0)	.003
Medicare-Medicaid dual eligible	13.0 (33.6)	0.8 (0.6 to 1.0)	<.001
Residence			
Urban	14.1 (0.34)	–1 (–1.3 to –0.7)	<.001
Rural	17.7 (0.38)	[Reference]	
Beneficiary chronic conditions			
Anemia	13.6 (34.3)	–0.7 (–0.8 to –0.5)	<.001
Asthma	14.1 (34.8)	0.6 (0.4 to 0.8)	<.001
Atrial fibrillation	9.8 (29.8)	–1.1 (–1.3 to –0.9)	<.001
Benign prostatic hyperplasia	13.8 (34.5)	–0.1 (–0.3 to 0.2)	.65
Chronic kidney disease	11.6 (32)	–0.6 (–0.8 to –0.5)	<.001
Chronic obstructive pulmonary disease	11.9 (32.3)	0.6 (0.4 to 0.8)	<.001
Congestive heart failure	10.2 (30.3)	–0.9 (–1.1 to –0.7)	<.001
Dementia	6.6 (24.8)	–2.7 (–2.9 to –2.4)	<.001
Depression	12.8 (33.4)	0.3 (0.1 to 0.5)	.001
Diabetes	13.1 (33.7)	–0.6 (–0.8 to –0.4)	<.001
Hip fracture, prior	11.7 (32.2)	–5.5 (–5.9 to 5.0)	<.001

Characteristic	New Opioid Use, Unadjusted % (SD)	Point Change in New Opioid Use, Adjusted Absolute % (95% CI)	P Value for Adjusted Change
Hyperlipidemia	14.6 (35.3)	0 (−0.1 to 0.2)	.62
Hypertension	14.1 (34.8)	−0.1 (−0.3 to 0.2)	.66
Hypothyroidism	12.7 (33.2)	−0.7 (−0.9 to −0.5)	<.001
Ischemic heart disease	12.5 (33)	0 (−0.2 to 0.2)	.67
Osteoporosis	12.6 (33.1)	−0.9 (−1.2 to −0.7)	<.001
Rheumatoid arthritis	17.0 (37.6)	3.2 (3.0 to 3.3)	<.001
Stroke or transient ischemic attack, prior	8.0 (27.1)	−2.2 (−2.4 to −1.9)	<.001
Cancer			
Breast	15.7 (36.4)	−0.4 (−0.8 to 0.0)	.04
Colorectal	17.4 (37.9)	−0.2 (−0.7 to 0.2)	.31
Prostate	17.0 (37.5)	0.4 (−0.1 to 0.8)	.09
Lung	20.0 (40)	2.4 (1.9 to 3.0)	<.001
Endometrial	20.2 (40.1)	−0.6 (−1.4 to 0.3)	.22

^aTable reports estimates of a multivariable, discharge-level linear probability model of patient-level factors associated with a new opioid claim after discharge. The dependent variable was a binary outcome variable for whether a discharge involved a new prescription opioid claim within 7 days of discharge. Independent variables included patient characteristics, indicators for diagnosis-related group, and indicators for hospitals. Patient characteristics included age, sex, race, binary indicators for Medicare-Medicaid dual eligibility and low-income subsidy for at least 1 month during the year, binary indicator for metropolitan residence, indicator variables for comorbid conditions (reference category, not having the comorbid condition), and 5-digit patient zip code median income. Table reports changes in the adjusted absolute percentage point change in new prescription opioid use postdischarge associated with each independent variable.

Table 3

Association Between Hospital Characteristics and Adjusted Rate of New Opioid Use Within 7 Days of Hospital Discharge, Hospital-Level Analysis^a

Independent Variable	Point Change in New Opioid Use, Adjusted Absolute % (95% CI)	P Value
HCAHPS measure of percentage of patients with pain always well managed (per 5-percentage-point absolute increase in score) ^b	0.89 (0.74 to 1.04)	<.001
Hospital beds (per 100 bed)	0.02 (−0.04 to 0.07)	.53
Full time (per 1-unit increase)		
Physicians per bed	−0.34 (−0.91 to 0.24)	.25
Residents per bed	−0.83 (−1.49 to −0.18)	.01
Registered nurses per bed	0.91 (0.62 to 1.19)	<.001
Hospital ownership		
For profit [Reference, nonprofit]	−0.06 (−0.46 to 0.33)	.76
Government [Reference, nonprofit]	1.41 (0.98 to 1.84)	<.001
System affiliated		
Yes [Reference, no]	0.85 (0.57 to 1.14)	<.001
Teaching		
Yes [Reference, no]	−0.07 (−0.52 to 0.38)	.77
Rural		
Yes [Reference, no]	0.47 (0.01 to 0.93)	.05
Electronic health record		
Yes [Reference, no]	−0.26 (−1.07 to 0.55)	.53

Abbreviation: HCAHPS, Hospital Consumer Assessment of Healthcare Providers and Systems.

^aTable presents estimates from a hospital-level multivariable linear regression of patient risk-adjusted rates of hospital opioid use (adjusted for patient characteristics in Table 2) as a function of hospital characteristics, including number of beds, staffing (number of attending physicians, residents, registered nurses, each per bed), for-profit status, system affiliation (yes/no), teaching hospital status (yes/no), rural status, presence of an electronic health record, and an independent variable from the 2011 HCAHPS survey on the percentage of patients reporting that their pain during hospitalization was always well controlled. Analyses were restricted to 2507 hospitals with at least 50 discharges in 2011 and weighted by the number of observations per hospital.

^bA 5-percentage-point increase in the HCAHPS measure corresponds to an increase from the 25th to 75th percentile of hospital scores (from 66% to 71% of patients reporting that their pain was always well managed).