

Readmissions and Mortality After “Before Medically Advised” Hospital Discharges
Among Medicare Beneficiaries with Opioid Use Disorder

Running title: Outcomes After “Before Medically Advised” Discharge

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Abstract

Background: ‘Before medically advised’ (BMA) discharges are rising among hospitalized people with opioid use disorder (OUD) and associated with worse outcomes. However, little is known about BMA discharge among the growing share of U.S. Medicare beneficiaries with OUD.

Objective: To examine patterns of hospital readmissions and mortality by discharge type among Medicare beneficiaries with OUD.

Design: Retrospective cohort study using 100% national inpatient Medicare data from 2016-2019.

Participants: Fee-for-service Medicare beneficiaries age 18+ with an OUD diagnosis during an inpatient hospitalization, excluding those with in-hospital deaths, hospice discharges, or planned readmissions. Discharge types were classified as BMA, home, skilled nursing facilities (SNFs), or non-SNF institutional settings.

Main Measures: Using linear probability models adjusted for demographic, clinical and hospital covariates, we examined 30-day unplanned all-cause readmission and mortality probabilities across discharge types. Secondly, we assessed time until readmission and mortality, count of subsequent readmissions or BMA discharges, and readmissions occurring at different hospitals.

Key Results: Among 339,712 hospitalized Medicare beneficiaries with OUD, 13,997 (4.1%) were discharged BMA. Within 30 days, 25.5% of patients discharged BMA were readmitted and 2.5% died. Readmissions after BMA discharge occurred sooner, more frequently, often at different hospitals, and were more likely to end in another BMA discharge compared to readmissions after other discharges. Adjusted readmission probabilities for BMA discharges were 7.1 percentage points (pp) higher than home discharges and 6.0-8.9pp higher than SNF and

non-SNF discharges (all $p < 0.001$). Adjusted mortality probabilities for BMA discharges were 0.7pp higher than home discharges, but 0.8-1.9pp lower than SNF and non-SNF discharges (all $p < 0.001$).

Conclusions: BMA discharge among Medicare beneficiaries with OUD is associated with fragmented patterns of post-discharge care, and increased readmissions and deaths relative to home discharges. Efforts are needed to address the drivers and consequences of BMA discharge among individuals with OUD in Medicare.

Hospitalizations among individuals with opioid use disorder (OUD) frequently and increasingly end in ‘before medically advised’ (BMA) discharges, in which patients leave care earlier than recommended by their physician.^{1–6} In qualitative studies, individuals with OUD and other substance use disorders (SUDs) commonly report inadequately treated withdrawal symptoms, poorly managed pain, stigmatization from providers, and feelings of confinement or isolation during lengthy hospital stays as factors leading to BMA discharge.^{7–10} BMA discharges can be associated with serious consequences, including readmission, mortality, financial costs, and insufficient post-discharge follow-up.^{1,6,11–14}

This study extends previous analyses of BMA discharges among patients with OUD by focusing on the Medicare population. In recent years, hospitalizations involving OUD have increased among Medicare beneficiaries including older adults (aged ≥ 65) and younger adults with disabilities.^{2,15–17} Hospitalized Medicare beneficiaries with OUD have longer lengths of stay than those without OUD,^{18,19} potentially due to multiple barriers to discharge for this population, including difficulties gaining access to post-acute care facilities.^{3,20–23} Medicare beneficiaries with OUD have high rates of chronic and painful comorbidities^{24,25} and may encounter challenges accessing post-discharge OUD care as a result of coverage limitations and lack of disability- or age-friendly services,^{26–29} potentially placing them at risk of poor post-hospitalization outcomes.^{18,26} However, to date, research has not explored the patterns of readmission and mortality following BMA discharges in this population.

Our objective was to study the incidence of 30-day unplanned all-cause hospital readmissions, 30-day all-cause mortality, and characteristics of readmissions among Medicare beneficiaries with OUD, comparing BMA discharges and other discharge types, including discharges to home, skilled nursing facilities (SNF), or non-SNF institutional settings. Our

hypotheses were centered on comparisons between BMA discharges and non-BMA discharges to home because patients discharged BMA typically do not go to institutional settings. We hypothesized that after adjusting for baseline characteristics, BMA discharges would be associated with higher probabilities of 30-day readmissions and mortality than home discharges. Additionally, we hypothesized that, compared to home discharges, BMA discharges would differ on a variety of readmission characteristics, such as having earlier readmissions or deaths, repeated readmissions, BMA discharge upon readmission, or readmissions taking place at different hospitals. The study findings can inform efforts to improve care outcomes and continuity among Medicare beneficiaries with OUD.

Methods

Data sources. We used 2016-2019 Medicare Master Beneficiary Summary Files (MBSF) and Medicare Provider Analysis and Review (MedPAR) files for 100% of hospitalized Medicare beneficiaries.

Study cohort. We included short-term and critical access hospital stays among fee-for-service Medicare beneficiaries at least 18 years of age who resided in the 50 U.S. states or the District of Columbia. We identified the first hospitalization from 2016 to 2019 where an individual had evidence of OUD and included all subsequent hospital claims within a 30-day follow-up window (eFigure 1 in Supplement). We identified OUD using ICD-10-CM codes for opioid “abuse” or dependence (F codes), toxic effects of opioids (T codes), or ICD-10-PCS codes for OUD-related pharmacotherapy or medication management (HZ codes; eTable 1 in Supplement).³⁰ We searched for these ICD-10 codes in any of the 25 positions on the MedPAR claims to increase sensitivity.³¹ In the case of duplicate claims for individual hospital stays

(defined by a distinct grouping of patient identifier, admission date, and hospital), only the claim with the longer length of stay was retained.

We excluded index discharges occurring after December 1, 2019 because we could not ascertain the full 30-day follow-up period for those discharges. To ensure that we had complete inpatient claims data and to mitigate against differential access to outpatient Medicare benefits after discharge, we excluded beneficiaries who were not continuously enrolled in fee-for-service Medicare during the 30-day follow-up window or until death. Additionally, we were interested in examining unplanned readmissions after discharges to home, SNFs, and non-SNF institutional settings, as well as BMA discharges. Therefore, index admissions were excluded if the discharge status on the MedPAR claim indicated that the patient was discharged or transferred to another location (see eTable 2 in Supplement for full list), died in the hospital, or had a planned readmission (eFigure 1; eTable 2 in Supplement).

Outcomes. The primary outcomes were 30-day all-cause unplanned readmission and 30-day all-cause mortality. We defined a 30-day all-cause unplanned readmission as a hospitalization that occurred within 30 days of the index discharge date. All-cause mortality was determined by the date of death in the MBSF. Secondary outcomes included having multiple readmissions or multiple BMA discharges within 30 days, whether readmissions occurred at the same hospital as the index admission, time to readmission, and time to mortality.

Exposure. We defined BMA discharge based on discharge status coded as “left against medical advice or discontinued care.” Though the code reads “against medical advice”, we use the term “before medically advised” because it is less stigmatizing.³² We classified discharges home with and without home health services as discharges to home, discharges to SNFs and intermediate care facilities as discharges to SNF, and discharges to inpatient rehabilitation

facilities, long-term care hospitals, and psychiatric hospitals as non-SNF institutional discharges (eTable 2 in Supplement).

Covariates. We selected covariates based on their potential associations with both BMA discharge and readmissions. Patient-level demographic characteristics included age category (18-34, 35-49, 50-64, 65-79, ≥ 80), sex and race/ethnicity as recorded, dual-eligibility for Medicaid during any month of the study (January 2016-December 2019), and having end-stage renal disease as the original reason for Medicare eligibility. Medical comorbidities included diagnoses for serious injection-related infections, Hepatitis C, HIV/AIDS, five categories of comorbid SUDs (alcohol, sedatives/hypnotics/anxiolytics, stimulants, tobacco, and other substances), serious mental illness, Alzheimer's disease and related dementias, chronic pain, mobility impairment, whether OUD or opioid overdose was the primary diagnosis during the index admission, and Elixhauser comorbidity score. Tobacco use disorders, HIV/AIDS, and mobility impairment) were ascertained using Chronic Conditions Warehouse algorithms from the beneficiary summary file, which use a two-year reference period, while the remainder were ascertained by searching ICD-10 codes in any of the 25 positions on the index hospitalization's MedPAR claim (eTable 3 in Supplement). Admission characteristics included indicators for nonelective admissions, intensive care unit use, and weekend admissions. Length of stay was not included as a covariate because it is influenced by BMA discharge.

Statistical Analysis. We first performed a descriptive analysis comparing the demographic, clinical, hospital stay characteristics, and outcomes of index admissions across discharge types. We constructed Kaplan-Meier curves and used log-rank tests to describe differences in the time to readmission and time to mortality by discharge type. In a supplemental analysis, we also stratified descriptive characteristics by age group (an indicator for age ≥ 65

given differences in Medicare eligibility) because these groups have different clinical and enrollment characteristics,³³ discharge patterns,³³ readmission patterns,³⁴ and mortality rates.^{18,35,36}

We used a linear probability regression model to examine the associations between discharge type and 30-day readmissions and mortality, adjusting for all covariates listed above. We fit an additional model including interactions between the age ≥ 65 indicator and discharge type indicators to examine whether the association between discharge type and readmissions/mortality differed between younger and older adults. We included hospital fixed effects in the regression models to control for the time-invariant characteristics of hospitals that may be associated with BMA discharge and readmissions or mortality. Standard errors were clustered at the state level.

Analyses were performed with Stata version 18. Two-sided p-values < 0.05 indicated statistical significance. This study was reviewed by the Brown University institutional review board and deemed exempt human subjects research.

Results

There were 339,712 eligible index admissions involving OUD. The overall prevalence of BMA discharge was 4.1% ($n=13,997$) and differed by age eligibility status: 6.3% among younger adults (<65) and 1.9% among older adults (≥ 65 ; Table 1; eTable 4 in Supplement). The remaining admissions in the sample were discharged to home (70.9%), SNFs (17.3%), and non-SNF institutional settings (7.7%; Table 1).

Characteristics of index admissions by discharge status.

Table 1 compares characteristics of index admissions by discharge type. Compared to those with all other discharge types, individuals with BMA discharges tended to be younger (mean 52.0 years vs. 60.1-70.5 years) and were more likely to be dually enrolled in Medicaid (73.8% vs. 50.9-54.5%). Individuals discharged BMA were also more likely to be male, Hispanic, or Black/African American, while they were less likely to be Asian/Pacific Islander or non-Hispanic White. On average, individuals with BMA discharges had the fewest Elixhauser comorbidities (mean 4.0 vs. 4.8-5.2) and the shortest hospital lengths of stay (mean 2.9 days vs. 4.7-7.9 days). Additionally, individuals with BMA discharges were more likely to be diagnosed with any of the five categories of SUDs, HIV/AIDs, or Hepatitis C, while they were less likely to have diagnoses consistent with Alzheimer's disease or related dementias, chronic pain, or mobility impairment. Compared to all other discharge types, individuals with BMA discharges were substantially more likely to have a primary diagnosis of OUD (12.9% vs. 1.3-5.9%), while those with non-SNF institutional discharges were more likely to have a primary diagnosis of opioid overdose (16.6% vs. 9.9-11.9%). These patterns were similar among younger and older adults (eTable 4 in Supplement).

Outcomes by discharge status. The unadjusted incidence of 30-day readmissions was higher for BMA discharges (25.5%) compared to discharges to home (18.6%), SNFs (21.7%), and non-SNF institutional settings (18.2%; Table 2). Among readmitted individuals, those with BMA discharges had the shortest average time to readmission compared to all other discharge types (9.9 days vs. 12.8-13.3 days; Table 2). These trends were consistent among younger and older adults (eTable 5 in Supplement). Figure 1 shows the cumulative incidence of 30-day readmission by discharge status. Log-rank tests demonstrated statistically significant differences

in the survival curves for readmission between BMA discharges and each other discharge type (all $p < 0.001$), both overall and within age groups (Figure 1; eFigure 2 in Supplement).

Among readmitted individuals ($n=65,744$), those with BMA discharges were more likely than all other discharge types to have multiple readmissions (23.4% vs. 13.1-18.3%) and to have readmissions ending in another BMA discharge (20.9% vs. 0.8-3.5%) (Table 2). Readmitted individuals with BMA discharges returned to the same hospital 49.2% of the time compared to 62.4-70.2% of the time among those with other discharge types (Table 2). Differences in these outcomes by discharge type were similar across age groups (eTable 5 in Supplement).

The unadjusted incidence of 30-day all-cause mortality was highest for SNF discharges (5.6%), followed by non-SNF (3.6%), BMA (1.8%), and home discharges (1.7%; Table 2; eTable 5 in Supplement). Among those who died within 30 days of discharge ($n=8,567$), the average time to death was slightly shorter for BMA discharges than other discharge types (14.6 days vs. 15.3-16.1 days; Table 2), and this pattern held in both age groups (eTable 5 in Supplement). As shown in Figure 2, the overall cumulative incidence of mortality for BMA discharges did not differ significantly from home discharges ($p=0.56$). However, the cumulative incidence differed between BMA and home discharges among younger adults ($p < 0.001$; eFigure 3 in Supplement). SNF and non-SNF discharges were associated with higher cumulative mortality incidence than BMA discharges (both $p < 0.001$).

Adjusted Analyses. After adjusting for covariates, individuals with a BMA discharge had a 7.1 percentage point higher probability of 30-day readmission compared to home discharges (95% CI: [6.4, 7.7]; Table 3). The adjusted probability of 30-day mortality was 0.7 percentage points higher for BMA than home discharges (95% CI: [0.4, 0.9]). Differences in readmissions and mortality between BMA and home discharges were not statistically significant

between age groups (readmission: p interaction = 0.08; mortality: p interaction = 0.64; eTable 6 in Supplement).

Individuals with BMA discharges exhibited higher adjusted probabilities of 30-day readmission than individuals with SNF and non-SNF discharges by 6.0 (95% CI: [5.1, 6.9]) and 8.9 (95% CI: [7.0, 10.8]) percentage points, respectively (Table 3). However, individuals with BMA discharges had lower adjusted probabilities of 30-day mortality compared to SNF and non-SNF discharges by 1.9 (95% CI [-2.3, -1.6]) and 0.8 (95% CI [-1.2, -0.4]) percentage points, respectively (Table 3).

Discussion

BMA discharges constituted a nontrivial fraction of discharges in this national sample of more than 300,000 hospitalized Medicare beneficiaries with OUD. Overall, about 1 in 24 live discharges were designated as BMA, with a higher prevalence among those under age 65, at about 1 in 16. Similar to other studies, we observed that Medicare beneficiaries with OUD have high readmission rates, regardless of discharge type.^{18,19,37} This study adds that individuals with OUD who were discharged BMA had even higher probabilities of 30-day readmission and mortality than individuals discharged to home. Individuals discharged BMA also had a higher rate of 30-day readmission compared to individuals discharged to SNF and non-SNF institutional settings, although the latter groups had higher mortality rates. This could be due to the continued medical attention received in institutional settings, which may be protective against readmissions, whereas BMA discharges appear to disrupt care continuity, resulting in revolving door readmissions.

Our findings suggest that BMA discharge was linked to a cascade of negative consequences and potential care fragmentation. Readmissions among individuals with BMA discharges were more likely to happen multiple times within 30 days, end in another BMA discharge, and take place at a different hospital. Similar findings were reported among patients with OUD-related infective endocarditis.⁶ The fact that a substantial proportion of patients with BMA discharges ultimately seek care again and that readmission to different hospitals was common may reflect dissatisfaction with initial care episodes. Different-hospital readmission has previously been linked to worse outcomes, as disruptions in care continuity and coordination can lead to errors and redundancies. Gaps in care continuity may be particularly harmful to Medicare beneficiaries with OUD who are especially likely to have multiple comorbidities that may require coordinated care.^{24,25}

Consistent with other studies, patients with OUD discharged BMA were more likely to have additional SUDs (most had a nicotine use disorder) and primary diagnoses of OUD or opioid overdose.^{5,6,38–40} Patients with SUDs often report leaving BMA due to withdrawal symptoms, stigmatization by staff, cravings for a “smoke break,” and punitive responses to in-hospital substance use.^{8,9,41} Research suggests that the use of in-hospital withdrawal management strategies,^{4,5,39,42,43} addiction medicine consultations,⁴⁴ and community transitional care models⁷ are associated with reduced risk of BMA discharge. However, the availability and use of hospital-based SUD treatments and services is often suboptimal and varies widely across healthcare facilities.^{5,45–48} Improving the quality of inpatient care for patients with OUD and addressing withdrawal symptoms early in a hospitalization are imperatives and could reduce both BMA discharge and subsequent readmissions and mortality.

This study is among the first to focus on BMA discharge among patients with OUD in the Medicare population, which includes older adults and younger adults with disabilities, and may require specific interventions. In qualitative studies, both individuals with disabilities and older adults with OUD have reported experiencing intersectional forms of stigma in health care settings, with stigma on the basis of their substance use compounded by disability, age, and other aspects of their social identities.^{28,49} Reducing BMA discharge and its associated consequences will require multi-level interventions, including reducing provider stigma, eliminating biases in pain management, integrating SUD treatment within inpatient hospital care and traditional geriatric and chronic condition care, and enforcing Americans with Disabilities Act requirements for health care accessibility.^{26,27,29,49–51} It is critical for clinicians who care for older adults and individuals with disabilities across hospital, post-acute, and outpatient settings to be trained in identifying SUDs, providing specialist referrals as needed, and prescribing medications for OUD to ensure care access and continuity.^{26,29} Similarly, clinicians specializing in SUD treatment need to be aware of the unique access needs and multiple comorbidities of older adults and adults with disabilities.^{26,27,29,49}

This study has limitations. First, we used diagnosis codes in inpatient claims to define OUD status. Thus, individuals who only had OUD documented in outpatient claims were excluded. Second, the reliability of the “left against medical advice” code is unknown, as individual physicians may vary in their use of the code (e.g., some physicians may apply the code if a patient decides to go home instead of taking up recommended post-acute care, while others may not classify this as a BMA discharge⁵²). However, the inpatient claims are the best available source of BMA discharge status at a national level. Third, the study excluded Medicare Advantage enrollees, a quickly growing segment of the Medicare population, who may face

different costs and restrictions for behavioral health treatment services. Fourth, while we controlled for multiple observed clinical and other characteristics, we could not capture all potential confounders and we acknowledge the possibility of residual confounding of patient characteristics and discharge type, even after adjusting for some characteristics. For example, patients discharged to SNF and non-SNF institutional settings probably have greater clinical needs than those discharged home, even conditional on observed diagnoses, which could explain the much higher adjusted probabilities of mortality among those with institutional discharges.

Additionally, this study uses data from 2016-2019 and predates fee-for-service Medicare coverage of outpatient OUD treatment in opioid treatment programs (OTPs). Before 2020, Medicare beneficiaries with OUD often had limited access to outpatient care due to lack of coverage for these services, and because many community-based substance use treatment settings did not accept Medicare as a payment type.^{53,54} Recent studies show that the coverage expansion improved access to OTPs for many Medicare beneficiaries.⁵⁵⁻⁵⁷ Future research could examine whether changes in coverage for OUD treatment reduced readmission and mortality rates of Medicare beneficiaries with OUD after being discharged to home or BMA.

Conclusion

BMA discharge among Medicare beneficiaries with OUD was associated with increased probability of 30-day readmission and mortality compared to home discharges after accounting for confounding characteristics. BMA discharge was also associated with concerning short-term sequelae and patterns of care fragmentation, including being readmitted sooner, recurrent readmissions or BMA discharges, and readmissions to different hospitals. Given these findings, due attention should be directed to the availability and effectiveness of hospital-based interventions for reducing BMA discharge. Furthermore, it is essential to enhance access to post-

discharge SUD services encompassing treatment, harm reduction, and recovery supports among Medicare beneficiaries with OUD of all ages.

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Conflicts of interest: Simeon Kimmel is a medical consultant for the Massachusetts Department of Public Health's Bureau of Addiction Services and has provided expert legal testimony related to infectious diseases and substance use disorders. Patience Dow received funding from the National Institutes of Health, served as an expert panelist for an Abt Associates study focused on opioid use and misuse in older adults, and was a member of a National Academies of Sciences, Engineering, and Medicine ad hoc committee on evaluating the effects of opioids and benzodiazepines on all-cause mortality in Veterans. The other authors had nothing to disclose.

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Table 1. Demographic, clinical, and hospital stay characteristics of index admissions by discharge location among Medicare beneficiaries with OUD-related admissions, 2016-2019 (N=339,712)

Characteristic, n (%) ^a	Home	BMA	SNF	Non-SNF institution ^b
Index admissions with alive discharges	240,858 (70.9)	13,997 (4.1)	58,814 (17.3)	26,043 (7.7)
Unique hospitals, N	4,222	2,544	3,250	2,813
Year of index hospitalization ^c				
2016	80,052 (33.2)	4,994 (35.7)	18,087 (30.8)	8,348 (32.1)
2017	62,878 (26.1)	3,642 (26.0)	15,403 (26.2)	6,864 (26.4)
2018	54,251 (22.5)	2,942 (21.0)	13,750 (23.4)	5,978 (23.0)
2019	43,677 (18.1)	2,419 (17.3)	11,574 (19.7)	4,853 (18.6)
Demographics				
Age, mean (SD), years	60.1 (13.8)	52.0 (13.0)	70.5 (12.2)	62.7 (14.3)
Age 18-34 years	11,994 (5.0)	1,554 (11.1)	375 (0.6)	1,111 (4.3)
Age 35-49 years	39,670 (16.5)	4,202 (30.0)	2,497 (4.2)	3,515 (13.5)
Age 50-64 years	87,424 (36.3)	5,505 (39.3)	13,069 (22.2)	8,133 (31.2)
Age 65-79 years	85,337 (35.4)	2,582 (18.4)	29,015 (49.3)	10,381 (39.9)
Age ≥80 years	16,433 (6.8)	154 (1.1)	13,858 (23.6)	2,903 (11.1)
Female	133,013 (55.2)	5,671 (40.5)	36,833 (62.6)	14,710 (56.5)
Race/ethnicity				
American Indian or Alaska Native	2,976 (1.2)	153 (1.1)	505 (0.9)	268 (1.0)
Asian or Pacific Islander	1,626 (0.7)	71 (0.5)	408 (0.7)	185 (0.7)
Black or African American	30,883 (12.8)	2,109 (15.1)	5,376 (9.1)	2,575 (9.9)
Hispanic	14,429 (6.0)	1,115 (8.0)	2,673 (4.5)	1,317 (5.1)
Non-Hispanic White	187,737 (77.9)	10,348 (73.9)	49,266 (83.8)	21,349 (82.0)
Other	1,121 (0.5)	71 (0.5)	280 (0.5)	124 (0.5)
Unknown	2,086 (0.9)	130 (0.9)	306 (0.5)	225 (0.9)
Dual Medicaid enrollment	131,189 (54.5)	10,324 (73.8)	29,928 (50.9)	13,715 (52.7)
Original Medicare eligibility due to end-stage renal disease	10,764 (4.5)	638 (4.6)	3,126 (5.3)	1,073 (4.1)
Comorbidities				
Elixhauser index, mean (SD)	4.8 (2.1)	4.0 (2.1)	5.8 (2.1)	5.2 (2.2)
0-2	32,870 (13.6)	3,452 (24.7)	3,112 (5.3)	2,516 (9.7)
3-5	113,822 (47.3)	6,478 (46.3)	21,550 (36.6)	11,388 (43.7)
6-8	72,762 (30.2)	3,101 (22.2)	24,014 (40.8)	9,111 (35.0)
≥9	21,404 (8.9)	966 (6.9)	10,138 (17.2)	3,028 (11.6)
Serious injection drug use-related infections	5,850 (2.4)	622 (4.4)	3,616 (6.1)	1,571 (6.0)
Hepatitis C	19,843 (8.2)	2,152 (15.4)	3,467 (5.9)	1,835 (7.0)
Alcohol use disorder	24,024 (10.0)	2,495 (17.8)	3,957 (6.7)	3,217 (12.4)
Sedative, hypnotic, or anxiolytic use disorders	21,633 (9.0)	1,815 (13.0)	3,539 (6.0)	3,895 (15.0)

Stimulant use disorder	21, 903 (9.1)	3,190 (22.8)	1,960 (3.3)	2,609 (10.0)
Tobacco use disorder	129,759 (53.9)	11,352 (81.1)	21,490 (36.5)	13,297 (51.1)
Other SUDs ^d	24,199 (10.0)	2,753 (19.7)	2,317 (3.9)	2,643 (10.1)
Serious mental illness	95,141 (39.5)	5,488 (39.2)	21,279 (36.2)	13,364 (51.3)
HIV/AIDS	4,551 (1.9)	524 (3.7)	710 (1.2)	382 (1.5)
Alzheimer's disease/related dementias	9,809 (4.1)	249 (1.8)	9,357 (15.9)	2,532 (9.7)
Chronic pain	111,096 (46.1)	4,515 (32.3)	29,443 (50.1)	11,090 (42.6)
Mobility impairment	18,395 (7.6)	824 (5.9)	8,991 (15.3)	4,395 (16.9)
Admission characteristics				
Primary diagnosis: opioid use disorder	14,269 (5.9)	1,799 (12.9)	789 (1.3)	689 (2.6)
Primary diagnosis: opioid overdose	23,914 (9.9)	1,660 (11.9)	6,122 (10.4)	4,331 (16.6)
Non-elective admission	210,734 (87.5)	12,755 (91.1)	52,860 (89.9)	23,442 (90.0)
Intensive care unit use	71,228 (29.6)	4,299 (30.7)	22,727 (38.6)	13,327 (51.2)
Weekend	55,981 (23.2)	3,611 (25.8)	14,180 (24.1)	6,470 (24.8)
Hospital length of stay, mean (SD), days	4.7 (5.2)	2.9 (4.3)	7.9 (8.1)	7.8 (9.3)

Abbreviations: BMA, before medically advised, SNF, skilled nursing facility, SD, standard deviation, SUD, substance use disorder.

^a Unless otherwise specified.

^b Refers to non-SNF institutional settings, including inpatient rehabilitation facilities, long-term care hospitals, and psychiatric hospitals.

^c For each individual, we designated the first hospitalization with a diagnosis consistent with OUD between 2016-19 as the index visit. Thus, each individual only contributed one index visit to the sample and there are more index visits in earlier years.

^d Includes ICD-10 codes for “abuse”/dependence (F codes) or toxic effects (T codes) of cannabis, hallucinogens, inhalants, and “other psychoactive substances.”

Table 2. Post-discharge outcomes and readmission characteristics by discharge location among Medicare beneficiaries with OUD-related admissions, 2016-2019 (N=339,712)

Characteristic, n (%) ^a	Home (n=240,858)	BMA (n=13,997)	SNF (n=58,814)	Non-SNF institution ^b (n=26,043)
All-cause unplanned 30-day readmissions	44,689 (18.6)	3,562 (25.5)	12,766 (21.7)	4,727 (18.2)
All-cause 30-day mortality	4,129 (1.7)	249 (1.8)	3,265 (5.6)	924 (3.6)
Characteristics of 30-day readmissions by index discharge type among those readmitted within 30 days				
	Home (n=240,858)	BMA (n=13,997)	SNF (n=58,814)	Non-SNF (n=26,043)
More than one readmission within 30 days	8,165 (18.3)	832 (23.4)	1,863 (14.6)	621 (13.1)
Readmission ends in BMA discharge	1,546 (3.5)	744 (20.9)	96 (0.8)	92 (2.0)
First readmission is to same hospital	30,104 (67.4)	1,751 (49.2)	8,955 (70.2)	2,950 (62.4)
Average days to readmission, mean (SD)	13.0 (8.6)	9.9 (8.7)	13.3 (8.5)	12.8 (9.2)
Characteristics of 30-day deaths by index discharge type among those who died within 30 days				
	Home (n=240,858)	BMA (n=13,997)	SNF (n=58,814)	Non-SNF (n=26,043)
Average days to death, mean (SD)	16.1 (8.4)	14.6 (8.9)	15.4 (8.4)	15.3 (8.4)

Abbreviations: BMA, before medically advised, SNF, skilled nursing facility, SD, standard deviation.

^a Unless otherwise specified.

^b Refers to non-SNF institutional settings, including inpatient rehabilitation facilities, long-term care hospitals, and psychiatric hospitals.

Table 3. Fixed effects linear probability model results for the association of discharge location with 30-day readmissions and mortality

	Estimate [95% CI], percentage points ^a	
	30-day readmission	30-day mortality
Home discharge (vs. BMA)	-7.1 [-7.7, -6.4] ***	-0.7 [-0.9, -0.4] ***
SNF discharge (vs. BMA)	-6.0 [-6.9, -5.1] ***	1.9 [1.6, 2.3] ***
Non-SNF discharge ^b (vs. BMA)	-8.9 [-10.8, -7.0] ***	0.8 [0.4, 1.2] ***
Age 35-49 years (vs. 18-34 years)	-4.3 [-5.3, -3.3] ***	-0.2 [-0.3, 0.0]
Age 50-64 years (vs. 18-34 years)	-6.7 [-8.0, -5.5] ***	-0.2 [-0.4, -0.1] **
Age 65-79 years (vs. 18-34 years)	-6.4 [-7.7, -5.1] ***	0.4 [0.2, 0.5] ***
Age ≥80 years (vs. 18-34 years)	-7.4 [-8.5, -6.3] ***	2.2 [1.9, 2.4] ***
Female	-0.7 [-1.1, -0.3] ***	-0.7 [-0.8, -0.5] ***
American Indian or Alaska Native (vs. Non-Hispanic White)	0.1 [-1.4, 1.6]	0.1 [-0.3, 0.5]
Asian or Pacific Islander (vs. Non-Hispanic White)	0.7 [-0.5, 2.0]	0.3 [-0.4, 1.0]
Black or African American (vs. Non-Hispanic White)	1.8 [0.9, 2.7] ***	-0.3 [-0.5, -0.1] ***
Hispanic (vs. Non-Hispanic White)	0.2 [-0.4, 0.9]	0.1 [-0.2, 0.4]
Other (vs. Non-Hispanic White)	-0.5 [-2.7, 1.8]	0.6 [-0.6, 1.7]
Unknown (vs. Non-Hispanic White)	0.4 [-1.4, 2.2]	-0.4 [-0.8, 0.0] *
Dual-eligible	1.8 [1.6, 2.1] ***	-0.4 [-0.5, -0.3] ***
Elixhauser index	2.4 [2.3, 2.4] ***	0.6 [0.6, 0.7] ***
Serious injection-related infection	3.6 [2.7, 4.4] ***	0.2 [-0.2, 0.6]
Hepatitis C	-1.6 [-2.3, -1.0] ***	0.0 [-0.2, 0.3]
HIV/AIDS	1.1 [-0.2, 2.4]	-0.4 [-0.7, 0.0] *
Alcohol use disorder	-2.2 [-2.9, -1.5] ***	-1.0 [-1.1, -0.8] ***
Sedative/hypnotic/anxiolytic use disorder	-1.3 [-1.8, -0.9] ***	-0.2 [-0.3, 0.0]
Stimulant use disorder	-1.6 [-2.1, -1.0] ***	-0.2 [-0.3, 0.0] *
Tobacco use disorder	2.6 [2.3, 3.0] ***	0.2 [0.1, 0.3] ***
Other substance use disorder	-2.1 [-2.5, -1.7] ***	-0.2 [-0.3, -0.1] **
Serious mental illness	-2.4 [-2.8, -2.1] ***	-1.2 [-1.3, -1.0] ***
Chronic pain	-2.5 [-2.8, -2.1] ***	-1.2 [-1.4, -1.1] ***
Mobility impairment	5.6 [5.1, 6.2] ***	-0.3 [-0.5, -0.1] ***
Alzheimer's Disease or related dementias	-0.4 [-1.0, 0.3]	1.0 [0.8, 1.3] ***
Non-elective admission	4.0 [3.4, 4.6] ***	0.8 [0.6, 1.0] ***
Primary diagnosis: opioid use disorder	-2.5 [-2.9, -2.0] ***	0.4 [0.2, 0.6] ***
Primary diagnosis: opioid overdose	-3.6 [-4.3, -3.0] ***	-0.2 [-0.4, -0.1] **
Weekend admission	0.3 [0.1, 0.6] *	-0.2 [-0.3, 0.0] *
Intensive care unit use	0.5 [0.2, 0.9] **	0.5 [0.3, 0.6] ***
2017 (vs. 2016)	-1.7 [-2.1, -1.4] ***	0.0 [-0.1, 0.1]
2018 (vs. 2016)	-2.1 [-2.4, -1.8] ***	-0.1 [-0.2, 0.1]
2019 (vs. 2016)	-3.5 [-4.1, -3.0] ***	0.0 [-0.1, 0.2]
Number of observations	339,354 ^c	339,354 ^c

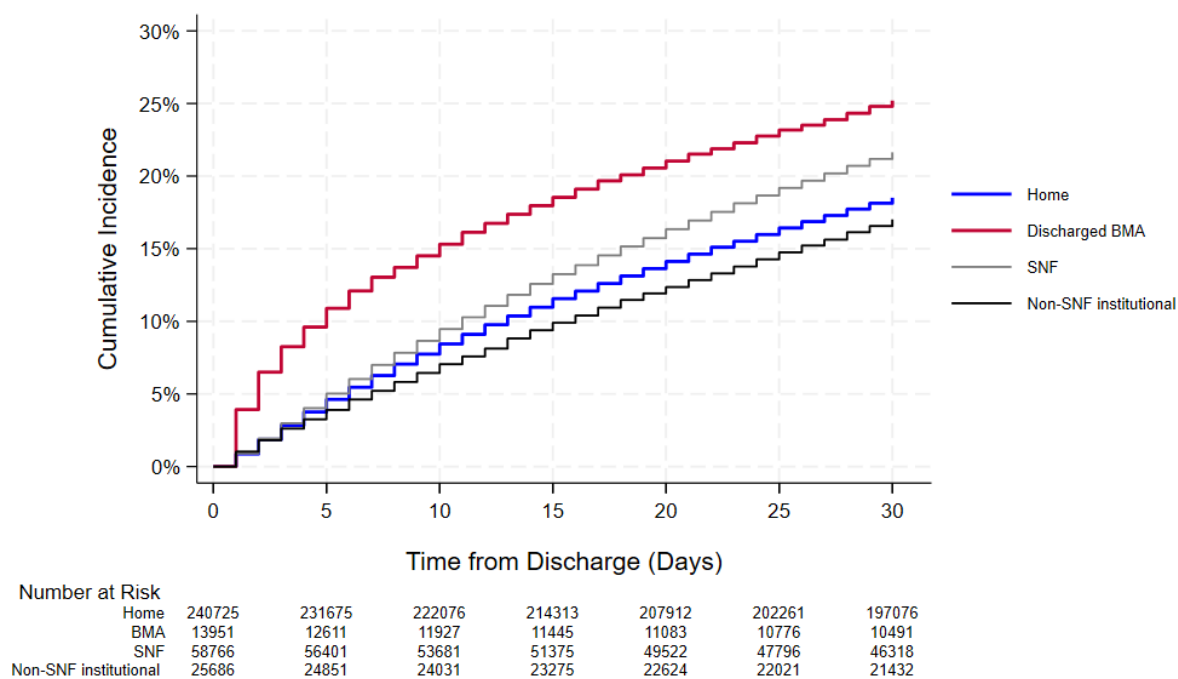
Abbreviations: BMA, before medically advised; SNF, skilled nursing facility.

^a Coefficients are expressed in percentage point format. Standard errors are clustered at the state level.

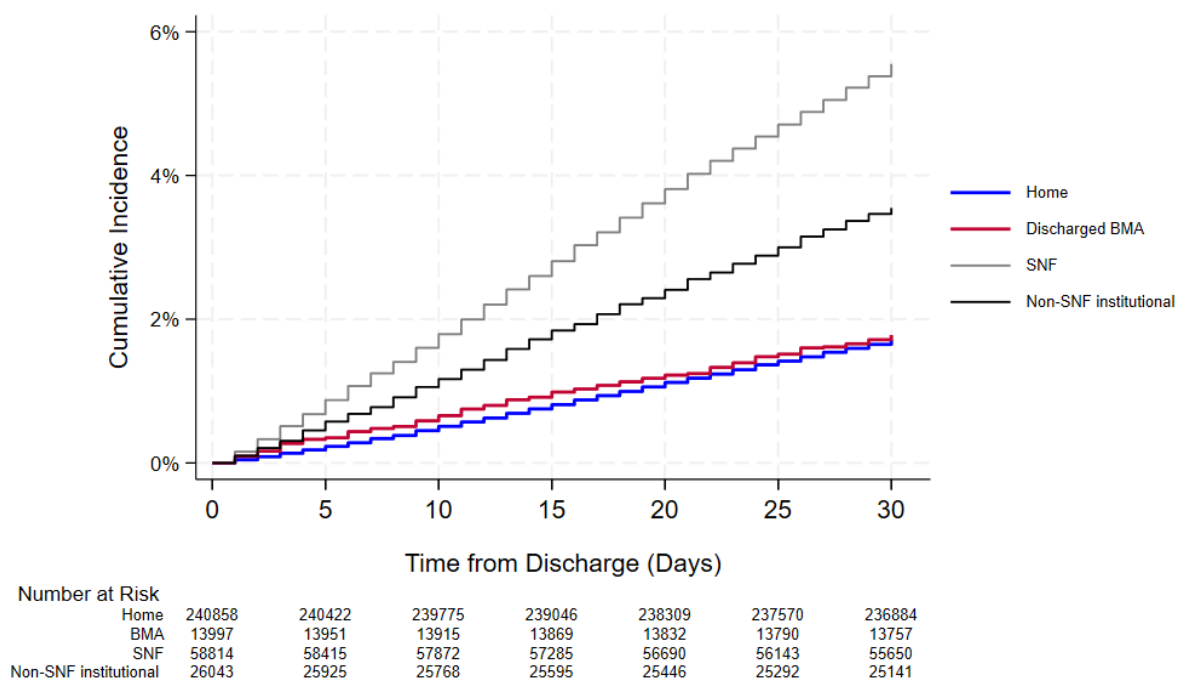
^b Refers to non-SNF institutional settings, including inpatient rehabilitation facilities, long-term care hospitals, and psychiatric hospitals.

^c 358 observations belonging to hospital groups with only a single patient were dropped from the fixed effects models.

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

Figure 1. Unadjusted cumulative incidence of 30-day readmissions by discharge status

Abbreviations: BMA, before medically advised; SNF: skilled nursing facility. Log-rank tests comparing survival curves between BMA discharge and all other discharge types were significant at the $p < 0.001$ level.

Figure 2. Unadjusted cumulative incidence of 30-day mortality by discharge status

Abbreviations: BMA, before medically advised; SNF: skilled nursing facility. Log-rank tests showed no significant difference in survival curves between BMA and home discharges ($p=0.56$). Survival curves for BMA discharges differed significantly from SNF and non-SNF discharges (both $p<0.001$).