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Research paper

The impact of medication-assisted treatment for opioid use disorder on congestive heart failure outcomes

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ABSTRACT

Congestive heart failure (CHF) and opioid use disorder (OUD) commonly coexist and are major contributors to high healthcare utilization in the United States. Medication assisted treatment (MAT; e.g., buprenorphine and methadone) reduces opioid-related mortality by about 50 %; yet little is known about how OUD treatment impacts CHF outcomes in patients with both CHF and OUD. We examined the impact of MAT (buprenorphine, methadone, and naltrexone) on CHF outcomes in patients diagnosed with OUD and CHF, and which MAT (buprenorphine or methadone) medication is associated with the fewest CHF outcomes. A retrospective cohort study of patients 18 years or older diagnosed with both CHF and OUD was conducted using Optum's de-identified Clinformatics® Data Mart Database. Multivariate logistic regression modeling was used to compared patients who were prescribed MAT to those who were not. The primary outcomes were CHF hospitalizations and CHF emergency department visits. No significant differences in the primary outcomes between the MAT and non-MAT cohorts were observed. In conclusion, the lack of association of MAT with negative CHF outcomes suggest that life-saving MAT can be safely used for OUD treatment in the CHF setting.

1. Introduction

Congestive heart failure (CHF) and opioid use disorder (OUD) commonly co-occur and are major contributors to excess disability, high healthcare utilization, and premature death in the United States (US) [1–3]. OUD among CHF patients has been linked to more frequent emergency department (ER) encounters and hospitalizations for CHF exacerbations [4]. While studies exist on outcomes of chronic opioid use in hospitalized CHF patients [5,6], data is mixed on OUD and its treatment, and CHF-related outcomes. Medication assisted treatment [MAT; buprenorphine, methadone, and naltrexone] saves lives [7], with methadone and buprenorphine use decreasing opioid-related mortality by 59 % and 38 %, respectively [8]. Yet, prescribers have concerns about the potential for MAT drugs to worsen CHF-specific outcomes when prescribed for CHF patients with OUD [9,10]. Little data exist on whether MAT use vs non-use worsens CHF outcomes [11]. Effective treatment exists for OUD, but it is grossly underused, with MAT use ranging from 10 % to 20% [12–14]. The purpose of this study is to examine the association of MAT drug use with CHF-related clinical outcomes in patients with co-occurring OUD and CHF. Understanding whether MAT use worsens CHF can help clinicians and patients in MAT use decision-making.

2. Methods

2.1. Data source

A retrospective cohort study was conducted by using data obtained from administrative health claims in the Optum's de-identified Clinformatics® Data Mart Database. This is one of the largest commercial insurance databases in the US and contains patient demographic and clinical information. This information includes the type of prescription drugs dispensed as well as inpatient and outpatient claims. This study was reviewed and approved by the University of Texas Medical Branch Institutional Review Board.

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2.2. Study cohort

Included were patients aged 18 years and older who were diagnosed with OUD and CHF in each of the following 2-year periods: 2017–2018, 2018–2019, 2019–2020, and 2020–2021. Both OUD and CHF were identified using International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) codes, based on data from the Centers for Medicare and Medicaid Services Chronic Condition Data Warehouse (Supplementary Table 1). We selected the first period in which patients met the selection criteria. The index date was defined by OUD or CHF diagnosis, whichever came first within the 2-year period. Patients were excluded if they were not continuously enrolled in the 12 months prior to and after the index date. We selected patients with a newly diagnosis of OUD by excluding those with OUD event in the last 12 months prior to index date. We didn't exclude patients with CHF in the 12 months prior to index date because most common CHF are chronic [15]. The final analytical sample size was 24,542 patients (Supplementary Table 2).

The process for cohort selection is summarized in Fig. 1. For each patient, we identified whether they received MAT in the 12 months after the index date by searching for National Drug Codes in pharmacy claims and Common Procedural Terminology codes in medical claims for methadone, naltrexone, and buprenorphine (Supplementary Table 3). The control group included those without MAT in the 12 months after the index date.

2.3. Study outcomes and covariates

The primary outcomes were CHF hospitalizations and CHF ER visits. CHF hospitalizations were counted only if the primary diagnosis on the inpatient claim was for CHF. ER visits were counted if the diagnosis of CHF was included in the ER visit claim. To minimize the differences between the MAT and control groups, we utilized propensity score matching. The MAT propensity score was generated using a logistic regression model that included age, sex, race, comorbidities suspected to impact MAT, and CHF clinical outcomes. These comorbidities included alcohol abuse, cardiac arrhythmia, chronic obstructive pulmonary disease, diabetes, drug abuse, obesity, renal failure, fluid and electrolyte disorders, liver disease, and peripheral vascular disorders (Table 1).

For patients with MAT use during each period, we performed greedy nearest neighbor matching to select 3 patients without MAT within a caliper equal to 0.2 standard deviations (SD) of the propensity score logit at the same period. The date of first MAT use from the MAT user was assigned to the 3 matched non-MAT users as the index date. Then, we excluded pairs in which all control patients lost coverage or died before the index date. We also excluded the individual patients in the control group who lost coverage or passed away before the index date.

Our final propensity matched cohort included 1525 pairs, 1512 of which had 3 matched non-MAT users, 8 had 2 matched non-MAT users, and 5 had 1 matched non-MAT user. Then, we analyzed both groups to identify if any patients met the primary outcomes, starting from the MAT initiation date to whichever occurred first: the end of a 2-year follow up, the end of the study follow up in June 2022, or loss of coverage. Study covariates included age at the index date, race/ethnicity, and region, obtained from the CDM database. We adjusted for all conditions 12 months prior to MAT initiation or the index date, which was included in the Elixhauser Comorbidity Index. Each condition was examined as a separate covariate. In addition, we also accounted for CHF hospitalizations and CHF ER visits in the 12 months prior to MAT initiation or the index date.

2.4. Statistical analysis

Mean (SD) and frequency of patient characteristics and comorbidity were calculated for both groups before propensity match and compared by *t*-test for continuous variables and chi-square test for categorical variables. After the propensity score match, we used the standardized difference to assess the balance of covariates between the two groups. Conditional Cox Proportional Hazard (PH) regression models were built to determine the association between MAT use and each respective outcome, unadjusted and adjusted for patient demographics and comorbidities. We further compared the rate of each respective outcome across two MAT medications (buprenorphine and methadone) by conducting a subgroup analysis to assess which type of MAT medication was associated with the fewest CHF outcomes among the true MAT users. In these analyses, we excluded naltrexone users ($N = 68$) and all patients

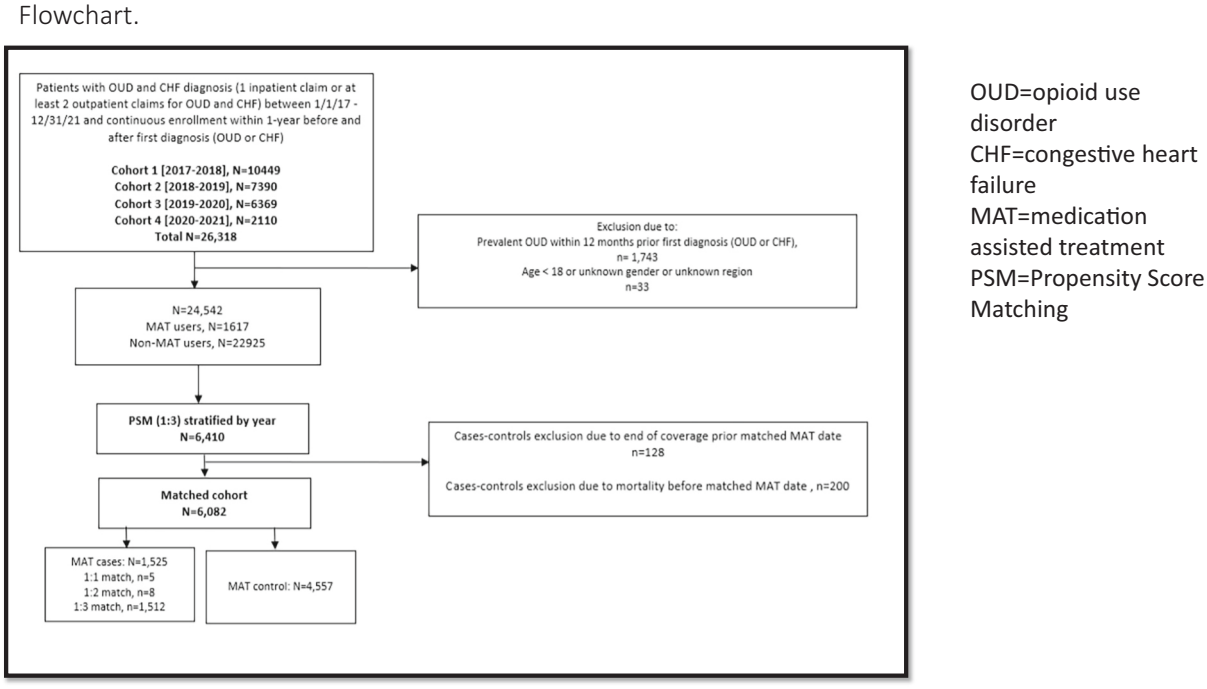


Fig. 1. Flowchart.

Table 1
Summary of patient characteristics and outcomes.

Characteristics	MAT *N* = 1525 N (%)	No MAT *N* = 4557 N (%)	Overall *N* = 6082	Standard difference	*P*-value
CHF hospitalization Event	174 (11.41)	540 (11.85)	714	–	0.5068
Censored due to loss of coverage	306 (20.07)	835 (18.32)	1141		
Censored due to end of study follow-up	895 (58.69)	2730 (59.91)	3625		
CHF ER Event	431 (28.26)	1166 (25.59)	1597	–	0.0821
Censored due to loss of coverage	267 (17.51)	753 (16.52)	1020		
Censored due to end of study follow-up	717 (47.02)	2269 (49.79)	2986		
Age, mean (SD)	63.82 (11.35)	64.02 (11.45)	63.97 (11.42)	−0.0179	0.5468
Sex					
Female	814 (53.38)	2476 (54.33)	3290	0.0192	0.5163
Male	711 (46.62)	2081 (45.67)	2792		
Race					
White	1069 (70.10)	3248 (71.27)	4317	0.0524	0.8397
Black	241 (15.80)	701 (15.38)	942		
Hispanic	114 (7.48)	324 (7.11)	438		
Unknown	101 (6.62)	284 (6.23)	385		
Region					
Midwest	177 (11.61)	617 (13.54)	794	–	0.0006
North	132 (8.66)	269 (5.90)	401		
South	797 (52.26)	2358 (51.74)	3155		
West	419 (27.48)	1313 (28.81)	1732		
Year					
2017	620 (40.66)	1853 (40.66)	2473	–	0.9998
2018	336 (22.03)	1002 (21.99)	1338		
2019	371 (24.33)	1113 (24.42)	1484		
2020	198 (12.98)	589 (12.93)	787		
CHF hospitalization in the 12 months prior index date (MAT date)	118 (7.74)	277 (6.08)	395	–	0.0229
CHF ER visit in the 12 months prior index date (MAT date)	322 (21.11)	778 (17.07)	1100	–	0.0004
Elixhauser comorbidity				–	
Alcohol abuse	199 (13.05)	617 (13.54)	816	−0.0144	0.6267
Cardiac arrhythmia	702 (46.03)	2103 (46.15)	2805	−0.0023	0.9373
Blood loss anemia	54 (3.54)	207 (4.54)	261	–	0.0948
Chronic pulmonary disease	917 (60.13)	2770 (60.79)	3687	−0.0134	0.6507
Coagulopathy	170 (11.15)	654 (14.35)	824	–	0.0016
Deficiency anemia	256 (16.79)	835 (18.32)	1091	–	0.1758
Depression	884 (57.97)	2397 (52.60)	3281	–	0.0003
Diabetes	713 (46.75)	2147 (47.11)	2860	−0.0072	0.8073
Drug abuse	1021 (66.95)	3060 (67.15)	4081	−0.0042	0.8864
Fluid and electrolyte disorders	699 (45.84)	2092 (45.91)	2791	−0.0014	0.9614
AIDS/HIV	12 (0.79)	37 (0.81)	49	–	0.9245
Hypertension	1359 (89.11)	4073 (89.38)	5432	–	0.7725
Hypothyroidism	390 (25.57)	1166 (25.59)	1556	–	0.9918
Cancer	162 (10.62)	489 (10.73)	651	–	0.9062
Liver disease	320 (20.98)	957 (21.00)	1277	−0.0004	0.9887
Obesity	610 (40.00)	1836 (40.29)	2446	−0.0059	0.8417
Other neurological disorders	378 (24.79)	1051 (23.06)	1429	–	0.1694
Pulmonary circulation disorders	227 (14.89)	745 (16.35)	972	–	0.1771
Peptic ulcer disease excluding bleeding	63 (4.13)	230 (5.05)	293	–	0.1482
Peripheral vascular disorders	566 (37.11)	1680 (36.87)	2246	0.0051	0.8619
Paralysis	44 (2.89)	198 (4.34)	242	–	0.0116
Psychoses	94 (6.16)	243 (5.33)	337	–	0.2192
Renal failure	446 (29.25)	1344 (29.49)	1790	−0.0054	0.8545
Rheumatoid arthritis/collagen	316 (20.72)	1003 (22.01)	1319	–	0.2905
Valvular disease	378 (24.79)	1127 (24.73)	1505	–	0.9652
Weight loss	179 (11.74)	560 (12.29)	739	–	0.5686

MAT = medication assisted treatment.
CHF = congestive heart failure.
ER = emergency room.
SD = standard deviation.
AIDS/HIV = Acquired ImmunoDeficiency Syndrome/Human Immunodeficiency Virus.

with more than one type of MAT medication in the 12 months after the index date ($N = 8$) (Table 2).

Multivariable Cox PH regression models were built to examine the respective differences in outcomes across buprenorphine and methadone, unadjusted and adjusted for patient demographics and comorbidities. Patients were censored at the time of losing coverage, at 2 years of follow up, or at the end of the study (6/30/2022). Mortality was treated as a competing risk event for the following outcomes: CHF hospitalization and CHF ER. The PH assumption for all the Cox PH models, visually assessed by the graph on the transform of the martingale residuals against follow-up time and by the Kolmogorov Supremum test, was not violated. All tests of statistical significance were 2-sided, and analyses were performed with SAS 9.4 (SAS Inc., Cary, NC).

3. Results

From our matched cohort of 6082 patients, 1525 (25.1 %) were

Table 2
Summary by MAT drug category.

Characteristics	Overall $N = 1449$[a]	Buprenorphine $N = 1137$ N (%)	Methadone $N = 312$ N (%)	*P*-value
CHF hospitalization				
Event	167	126 (11.08)	41 (13.14)	0.0214
Censored due to loss of coverage	281	229 (20.14)	52 (16.67)	
Censored due to end of study follow-up	856	681 (59.89)	175 (56.09)	
CHF ER				
Event	409	319 (28.06)	90 (28.85)	0.0005
Censored due to loss of coverage	246	205 (18.03)	41 (13.14)	
Censored due to end of study follow-up	687	545 (47.93)	142 (45.51)	
Age, mean (SD)	64.15 (11.20)	63.94 (11.32)	64.90 (10.77)	0.0001
Sex				
Female	785	647 (56.9)	138 (44.23)	0.0001
Male	664	490 (43.1)	174 (55.77)	
Race				
White	1010	792 (69.66)	218 (69.87)	0.9329
Black	232	184 (16.18)	48 (15.38)	
Hispanic	110	84 (7.39)	26 (8.33)	
Unknown	97	77 (6.77)	20 (6.41)	
Region				
Midwest	157	123 (10.82)	34 (10.90)	0.0003
North	122	83 (7.30)	39 (12.50)	
South	766	631 (55.50)	135 (43.27)	
West	404	300 (26.39)	104 (33.33)	
Year				
2017	584	408 (35.88)	176 (56.41)	0.0001
2018	319	275 (24.19)	44 (14.10)	
2019	357	306 (26.91)	51 (16.35)	
2020	189	148 (13.02)	41 (13.14)	
Total days' supply category				
1–3 months	521	432 (38.40)	89 (35.18)	0.2983
3–6 months	142	120 (10.67)	22 (8.70)	
6+ months	715	573 (50.93)	142 (56.13)	
CHF hospitalization in the 12 months prior index date (MAT date)	107	78 (6.86)	29 (9.29)	0.1452
CHF ER visit in the 12 months prior index date (MAT date)	307	241 (21.20)	66 (21.15)	0.9871
Elixhauser comorbidity				
Alcohol abuse	155	125 (10.99)	30 (9.62)	0.4853
Cardiac arrhythmia	666	513 (45.12)	153 (49.04)	0.2185
Blood loss anemia	52	39 (3.43)	13 (4.17)	0.5355
Chronic pulmonary disease	877	693 (60.95)	184 (58.97)	0.5271
Coagulopathy	154	116 (10.20)	38 (12.18)	0.3155
Deficiency anemia	242	193 (16.97)	49 (15.71)	0.5944
Depression	835	663 (58.31)	172 (55.13)	0.3135
Diabetes	690	542 (47.67)	148 (47.44)	0.9417
Drug abuse	971	755 (66.40)	216 (69.23)	0.3466
Fluid and electrolyte disorders	655	501 (44.06)	154 (49.36)	0.0959
AIDS/HIV	12	11 (0.97)	1 (0.32)	0.2640
Hypertension	1295	1016 (89.36)	279 (89.42)	0.9736
Hypothyroidism	372	301 (26.47)	71 (22.76)	0.1831
Cancer	158	116 (10.20)	42 (13.46)	0.1018
Liver disease	288	218 (19.17)	70 (22.44)	0.2008
Obesity	589	477 (41.95)	112 (35.90)	0.0537
Other neurological disorders	356	281 (24.71)	75 (24.04)	0.8060
Pulmonary circulation disorders	215	159 (13.98)	56 (17.95)	0.0810
Peptic ulcer disease excluding bleeding	59	49 (4.31)	10 (3.21)	0.3819
Peripheral vascular disorders	548	406 (35.71)	142 (45.51)	0.0016
Paralysis	41	30 (2.64)	11 (3.53)	0.4025
Psychoses	80	65 (5.72)	15 (4.81)	0.5334
Renal failure	437	325 (28.58)	112 (35.9)	0.0127
Rheumatoid arthritis/collagen	307	255 (22.43)	52 (16.67)	0.0274
Valvular disease	358	278 (24.45)	80 (25.64)	0.6658
Weight loss	172	124 (10.91)	48 (15.38)	0.0303

MAT = medication assisted treatment.
CHF = congestive heart failure.
ER = emergency room.
SD = standard deviation.
AIDS/HIV = Acquired ImmunoDeficiency Syndrome/Human Immunodeficiency Virus.
[a] Excludes naltrexone users (N = 68) and all patients with more than one type of MAT medication in the 12 months after the index date (N = 8).

treated with MAT. Among MAT users, the average age was 64 years old and 53 % of the population was female. MAT users were predominantly White at 70.1 %, followed by Black at 15.8 %. The most common comorbidities were hypertension, depression, and diabetes. Patients were typically residents in the Western and Southern regions of the US.

In the unadjusted Cox regression analysis, the hazard ratio (HR) of CHF ER visits was significantly higher in the MAT cohort than in the non-MAT group (HR = 1.12, 95 % confidence interval (CI) = 1.02–1.23, $p = 0.018$). However, these results became non-significant between the cohorts in the adjusted model (Table 3). Kaplan Meier failure curves are shown in Fig. 2.

In the unadjusted subgroup Cox regression analysis comparing buprenorphine to methadone, differences in rates of CHF hospitalizations and CHF ER visits were non-significant (Table 3).

4. Discussion

Our results demonstrate that, among patients with concurrent CHF and OUD, treatment with MAT did not significantly impact the rates of CHF hospitalizations and CHF ER visits. To our knowledge, this is the first study to assess CHF outcomes for patients diagnosed with both CHF and OUD who were treated with MAT. It is unclear why MAT users had similar rates of CHF-related outcomes as non-users. One possibility is that prescribers engage in closer monitoring for cardiovascular toxicities and side effects in CHF patients receiving MAT, compared to CHF patients not on MAT. In that scenario, any emergence of early changes in patient clinical presentation, electrocardiogram (EKG), or echocardiography suggesting early CHF or any clinical worsening can prompt MAT dose reduction or discontinuation. The intensive monitoring of MAT users might have attenuated the differences between MAT users and non-users in any CHF-related outcome (e.g., CHF hospitalization and CHF ER). One way to study this possibility is to examine the differences between MAT users vs non-users in frequency of physician visits and rates of EKG and echo procedures, and to seek out any relationship to changes/adjustment in MAT dose or discontinuation. Our findings suggest that clinicians should offer MAT drugs to treat OUD in CHF patients without concerns that these life-saving drugs would worsen CHF-related outcomes.

Prior studies have suggested that MAT treatment—particularly methadone—may have underlying cardiotoxic effects that are not well understood, including precipitation of cardiac arrhythmias and cardiac arrest [9,16–18]. Our results illustrated that MAT use was not associated with the primary CHF outcomes. One possible explanation for this finding may be that MAT therapies have little to no effect on cardiac contractility or ejection fraction [19]. Furthermore, methadone is a full

Table 3
Cox PH regression analysis assessing the effect of MAT vs. non-MAT and buprenorphine vs. methadone on the respective outcomes.

Outcomes	MAT vs. no MAT (ref)				Buprenorphine vs. methadone (ref)			
	HR	95 % CI		P-value	HR	95 % CI		P-value
	Unadjusted				Unadjusted			
CHF hospitalization	0.93	0.81	1.08	0.3639	0.85	0.60	1.20	0.3552
CHF ER	1.12	1.02	1.23	0.0177	1.00	0.80	1.26	0.9871
	Adjusted[a]				Adjusted[b]			
CHF hospitalization	0.92	0.79	1.09	0.3308	0.90	0.62	1.31	0.5830
CHF ER	1.06	0.95	1.18	0.2867	1.12	0.88	1.42	0.3642

PH = proportional hazard.
MAT = medication assisted treatment.
HR = hazard ratio.
CI = confidence interval.
CHF = Congestive Heart Failure.
ER = emergency room.
[a] Adjusted for the following covariates not used in propensity score matching: Region, CHF hospitalization in the 12 months prior index date (MAT date), CHF ER visit in the 12 months prior index date (MAT date), blood loss anemia, coagulopathy, deficiency anemia, depression, hypertension, hypothyroidism, cancer, other neurological disorders, pulmonary circulation disorders, peptic ulcer disease excluding bleeding, paralysis, psychoses, rheumatoid arthritis/collagen, valvular disease, weight loss.
[b] Adjusted for the following covariates with significant difference among MAT drug category (buprenorphine vs. methadone): age, sex, region, year, peripheral vascular disorders, renal failure, rheumatoid arthritis/collagen, weight loss.

opioid agonist and a full antagonist of the cardiac delayed rectifier potassium ion channel, while buprenorphine is a partial opioid agonist [20,21]. More aggressive activation of the opioid receptor when taking a full agonist such as methadone may result in worsened bradycardia and decreased systemic vascular resistance [19,22]. Subsequently, a patient with heart failure may fail to mount an adequate increase in cardiac output while taking a full agonist, resulting in worse outcomes.

In comparing the MAT and non-MAT groups, unaccounted differences between these two populations may have played a role in the outcomes of our investigation. For example, prior studies have demonstrated that patients on MAT are predominantly non-Hispanic Whites with optimal access to health insurance and residence in large metropolitan areas [23–25]. The patient population in this analysis was similar to this demographic, with 70.1 % being non-Hispanic White. Moreover, Knudsen et al. [26] demonstrated that substance abuse treatment centers were more likely to adopt a MAT program if they had adequate funding and access to medical personnel, which are more likely in metropolitan areas. However, our results were not stratified by type of residence such as urban, rural, or metropolitan. As shown by prior research, these factors may have impacted the results, underscoring the need to expand future studies to include more ethnic and racial minorities as well as rural residents.

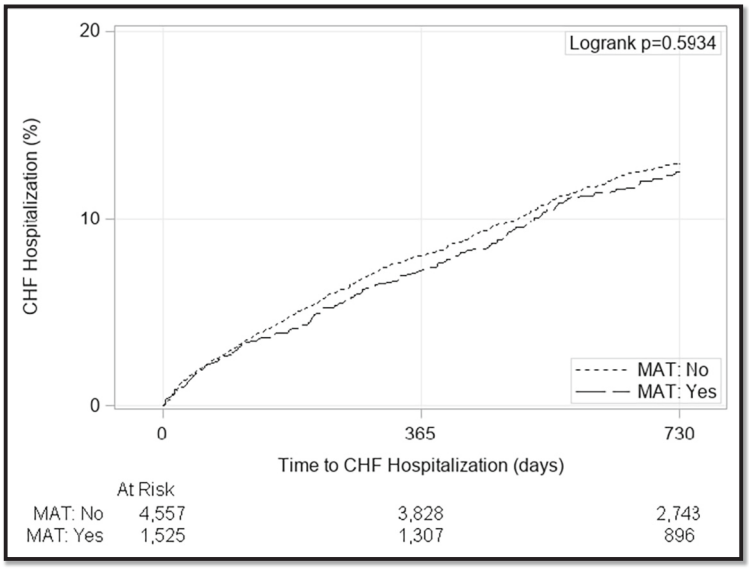
Several limitations of the study should be noted. First, the study cohort predominantly comprises individuals covered by commercial insurance, with a majority being of White ethnicity. Consequently, the findings may not be readily applicable to other populations, such as fee-for-service Medicare beneficiaries or non-White individuals. Enhancing the inclusivity of the sample would bolster the study's generalizability for future studies. Second, unmeasured confounders, including social determinants of health (e.g., income insecurity, transportation challenges, and housing instability), as well as severity and type of CHF can significantly influence CHF outcomes among patients with OUD. Incorporating these variables would yield a more holistic understanding of MAT's effects on CHF outcomes for future studies. Thoroughly addressing these confounding factors would enrich the analysis and yield more nuanced insights for future studies. Third, the data extracted from administrative claims may be incomplete due to erroneous ICD-10-CM coding, leading to incorrect labelling of hospitalizations or ER visits as CHF-related. Relying on administrative claims data introduces potential gaps and inaccuracies stemming from coding errors. Such inaccuracies could distort the identification of CHF-related hospitalizations or ER visits, thereby impacting the precision of the results. Strengthening data accuracy and completeness through validation studies or supplementary data sources would bolster the reliability of the findings for future studies.

In addition, the study cohort may include patients with a predetermined diagnosis of OUD since the exclusion range for prevalent OUD was of 12 months prior to index date but not over 12 months. We did not confirm whether patients have CHF diagnosis in the 12 months before index date, because most common CHF are chronic [15]. However, we adopted the Chronic Conditions Data Warehouse (CCW) CHF algorithm which included acute CHF, representing another limitation in this study.

MAT was defined as a prescription of MAT within 1-year after index date. According to Table 2, around 50 % of MAT users (Buprenorphine and Methadone) were prescribed the drug with a mean duration of 6 months which is consistent with the literature [27,28] with a higher rate of discontinuation observed in this group. There was no cross-over between MAT users and non-users in the 12 months after index date. However, our analysis was intent-to-treat. We did not conduct a per protocol analysis to censor non-users when they initiated MAT during follow-up, Future studies should focus on per-protocol analysis to observe the different variations between MAT and non-MAT users. One possible reason why there was no statistically significant differences between users and non-users in outcomes such as CHF hospitalizations and CHF ER visits could be variation in duration of MAT prescription and adherence, the latter of which is unique among each OUD patient. A limitation to our study is the lack of data on patient's adherence and whether patients actually take the prescribed MAT drug, suggesting that some of the patients classified as MAT users are more like the control non-user group; this has potential to reduce the difference between the 2 groups. Lastly, not stratifying results by geographic location or ethnicity precludes valuable insights into how these factors modulate MAT's impact on CHF outcomes. Including a diverse patient cohort could have enhanced the study's relevance across varied populations and shed light on geographic and ethnic disparities in CHF outcomes among MAT recipients.

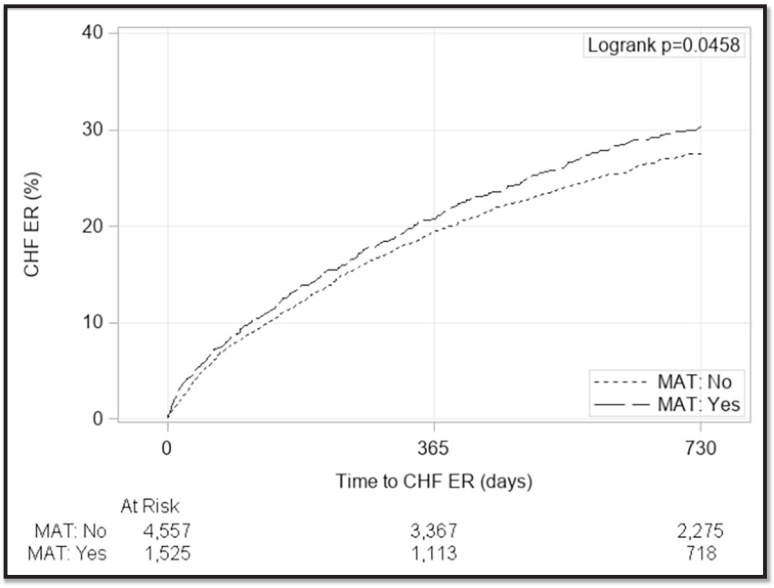
Overall, our study found that MAT therapies do not worsen outcomes for patients with concomitant OUD and CHF. Given that medications for OUD save lives and reduce opioid-related morbidity, our findings support their use in patients with co-occurring CHF/OUD in the context of risk-benefit shared decision-making by providers and patients. Our study findings can help guide clinicians caring for patients with OUD as they balance the risks and benefits of MAT prescribing in the context of each patient's unique cardiovascular comorbidities.

a)
Kaplan Meier Failure Curve on the time to CHF Hospitalization between MAT vs Non-MAT Users



CHF=congestive heart failure
MAT=medication assisted treatment

b)
Kaplan Meier Failure Curve on the time to CHF ER between MAT vs Non-MAT Use



CHF=congestive heart failure
ER=emergency department visit
MAT=medication assisted treatment

Fig. 2. a. Kaplan Meier failure curve on the time to CHF hospitalization between MAT vs non-MAT users.
b. Kaplan Meier failure curve on the time to CHF ER between MAT vs non-MAT use.

5. Clinical practice implications

Both CHF and OUD have high mortality, so clinicians and patients have to make a shared treatment decision such that treating one condition does not worsen the other. Cost effective and lifesaving treatments exist for both conditions. For CHF, we have angiotensin-converting enzyme inhibitors, angiotensin-receptor blockers, and angiotensin receptor-neprilysin inhibitors [29]; for OUD, there are guideline recommendations for MAT drugs [8]. While CHF drugs are widely used in clinical practice [29], there is gross underuse of MAT drugs, with use rates in OUD patients ranging from 10 % to 20% [12–14]. A concern in patients with both OUD and CHF is the potential for OUD treatment (MAT drugs) to worsen CHF outcomes (e.g., CHF exacerbations leading to ER visits). The current study addressed that concern by showing no significant differences between MAT and non-MAT users in rates of CHF hospitalizations and CHF ER visits. Treating OUD in CHF patients is especially important because CHF patients with untreated OUD who continue to use opioids (intravenous opioid in particular) are at high risk of heart valve damage (a major CHF exacerbator) from bacterial endocarditis and other infections (e.g., hepatitis C virus) related to intravenous drug use [30]. Screening and treatment of OUD in patients with CHF and other cardiovascular conditions are key to improving quality of life in patients with co-existing CHF and OUD.

Our goal was to address the concerns that MAT prescribing to patients with co-occurring OUD and CHF would worsen CHF-related outcomes. Our goal is not to examine whether MAT reduces opioid-related outcomes (opioid overdose, opioid-related Er/Hospital visit, and opioid deaths); that is already well established. The impetus for our study is to address clinician inertia related to MAT prescribing on the assumption that MAT might worsen CHF-related outcomes. Our findings did not

support that assumption since there was no significant difference in CHF-related outcomes (our study outcome of interest) between exposure to MAT vs. non-exposure among patients with co-occurring OUD and CHF. Our overall message is OUD/CHF patients should be offered MAT within a shared decision-making framework with evidence-informed discussion of pros and cons of use and non-use.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ahjo.2024.100456.

Ethical statement

We the authors are in accordance with the ethical publishing policies as described by Elsevier and the American Heart Journal Plus: Cardiology Research and Practice.

We received approval for this study by the Institutional Review Board at the University of Texas Medical Branch.

CRediT authorship contribution statement

Peter Rasmussen: Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Yong-Fang Kuo:** Methodology, Investigation, Funding acquisition, Formal analysis, Data curation. **Biai Dominique Elmir Digbeu:** Methodology, Investigation, Formal analysis, Data curation. **Wissam Harmouch:** Writing – review & editing, Writing – original draft. **Steven Mai:** Writing – review & editing, Writing – original draft. **Mukaila Raji:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Yong-Fang Kuo reports a relationship with National Institute on Drug Abuse that includes: funding grants. Mukaila Raji reports a relationship with National Institute on Drug Abuse that includes: funding grants.

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