Impact of a community-policing initiative promoting substance use disorder treatment over criminal charges on arrest recidivism

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ABSTRACT

Background: Overdose deaths, addiction, and drug-related crime have increased in the United States over the past decade. Treatment improves outcomes, including reducing crime, but few individuals with addiction receive treatment. Here, we determine whether the Madison Addiction Recovery Initiative (MARI), a community policing program implemented by the City of Madison (Wisconsin) Police Department (MPD) that diverts adults who committed a non-violent, drug use-related crime from criminal prosecution to addiction treatment, reduces the risk of recidivism (i.e., an arrest) in the 6-month period following the index crime.
Methods: Observational data were collected by the MPD for 12 months before through 6 months after an index crime from participants in the MARI program (n = 263) who referred to MARI between September 1, 2017 and August 31, 2020 and a Historical Comparison group (n = 52) who committed a comparable crime between September 1, 2015 and August 31, 2016. Average effects were estimated using intention-to-treat (ITT), a per-protocol, and a complier average causal effects (CACE) analyses, adjusted for covariates.
Results: ITT analysis did not show that MARI assignment lowered adjusted odds of 6-month recidivism (aOR = 0.59 [0.32, 1.12], $p = 0.11$). Per-protocol analysis showed that completing MARI lowered the adjusted odds of 6-month recidivism (aOR = 0.23 [0.10, 0.52], $p < 0.001$). CACE analysis indicated that assignment to MARI among individuals who would complete the MARI program if assigned to the program lowered the adjusted odds of 6-month recidivism (aOR = 0.85 [0.80, 0.90], $p < 0.001$).
Conclusions: Diverting adults who committed a non-violent, drug use-related crime from criminal prosecution to addiction treatment may reduce 6-month recidivism.

1. Introduction

In 2018, 20.3 million Americans aged 12 or older had a substance use disorder (SUD) involving alcohol, marijuana, cocaine, heroin, among others (Lipari and Park-Lee, n.d.). SUDs result in an annual loss of $500−740 billion in the United States (US) due to lost work productivity, healthcare expenses, and crime-related costs (The Council of Economic Advisers, 2019; "Trends and Statistics", n.d.). Additionally, from 1999 to 2018 more than 750,000 people have died in the US from a

drug overdose, with nearly 450,000 overdose deaths involving an opioid (Centers for Disease Control and Prevention, n.d.). SUDs affects community organizations, care providers and health systems, policymakers and legislators, and law enforcement and criminal justice agencies. Treatment has been shown to improve health outcomes and reduce harm related to SUD (Gordon et al., 2008; Lee et al., 2016; Wakeman and Rich, 2015) and, yet, less than 11 % of persons with a SUD receive treatment (Han et al., 2015).

Several initiatives have attempted to reduce the burden of SUDs by

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diverting adults who commit non-violent, drug use-related crimes to probation and treatment instead of incarceration (Bunn et al., 2019; Engel et al., 2019; Formica et al., 2018; Hser et al., 2007; Kopak et al., 2018; Longshore et al., 2006; Schiff et al., 2017, 2016; Varano et al., 2019). More than half of arrestees have at least one drug in their system at the time of arrest (Durose et al., 2014), and, therefore, the time of arrest provides an opportunity to offer addiction treatment (Caulkins et al., n.d.). Studies document that addiction treatment reduces crime, increases safety, and improves health outcomes among affected individuals and in communities where SUD, especially opioid use disorder, and related crime are prevalent (Gisev et al., n.d.; Håkansson and Berglund, 2012; Mitchell et al., 2012). This evidence, combined with an overwhelmed criminal justice system, have prompted additional "community policing" interventions to facilitate easier access to, and engagement in, treatment instead of incarceration. These interventions, which often rely on a collaborative community effort aimed at increasing the linkage between treatment and individuals in need of such services, have led to reduced crime, incarceration, and overdose rates (Dole and Freeman, 2018; Knopf, 2016; LEAD Program Manager, n.d.). The present study evaluates the impact on arrests of a similar initiative, known as the Madison Addiction Recovery Initiative (MARI), implemented by the City of Madison Police Department (MPD) in Madison, a medium-size city and the state capitol of Wisconsin, US (Comprehensive Opioid, Stimulant, and Substance Abuse Program (COSSAP), 2020; "The Madison Addiction Recovery Initiative", n.d.; Zgierska et al., 2021).

MARI seeks to provide persons who are arrested for non-violent, drug use-related offenses an opportunity for assessment and treatment of addiction as an alternative to arrest, prosecution, and possible incarceration (Comprehensive Opioid, Stimulant, and Substance Abuse Program (COSSAP), 2020; "The Madison Addiction Recovery Initiative", n.d.). Treatment is personalized and can include inpatient, residential, or outpatient settings, behavioral care, and/or medications. Individuals enrolled in the MARI program agree to complete a clinical assessment for a SUD, comply with their personalized treatment plan, and not re-offend during the six-month MARI program. In exchange, the MPD agrees to hold in abeyance any arrest or criminal charges while the person is participating in MARI. When MARI participants successfully complete their six-month program, the MPD "voids" the index crime, which brought them to MARI, so that program completers do not have criminal record related to the MARI offense. Absence of a criminal record in relation to the index crime differentiates MARI from other community policing initiatives and may improve clients' future ability to obtain housing or employment (Bell, 2014). The present paper focuses on evaluating the impact of MARI on arrest reduction during the 6 months after their index crime, using existing MPD records data.

Evaluation of initiatives like the MPD's MARI program typically focus on measuring their association with improvement in recidivism and other outcomes. These associations, while suggestive, do not definitively demonstrate that they had a direct, or causal, effect on outcomes. Causal effects are difficult to measure, since participants were not randomly assigned to MARI. For example, individuals referred to MARI may be older or have had a longer criminal history than those who were not. These factors can create a more challenging socio-economic situation, negatively impacting recovery (Bell, 2014; Vaughn et al., 2016). Causal inference methods attempt to address this limitation by using conceptual knowledge to adjust for possible differences between intervention groups (Pearl, 2000, 2009; Imbens and Rubin, 2015; Morgan and Winship, 2015; Hernan and Robins, 2020).

The present study uses causal inference methods to estimate average causal effects of MARI on the risk of arrest recidivism in the 6-month period after the initial MARI-eligible index crime. We used observational data on MARI participants (n = 263) and a historical comparison group (n = 52) for 12 months before to 6 months after the index crime. We estimated average effects of (1) assignment (i.e., referral) to MARI via an intention-to-treat (ITT) analysis (Hernán and Hernández-Díaz,

2012; Peugh et al., 2017; Hernan and Robins, 2020), (2) completing MARI via a per protocol analysis (Hernan and Robins, 2020; Hernán and Hernández-Díaz, 2012; Peugh et al., 2017), and (3) assignment to MARI among those who completed the six month MARI program using a complier average causal effect (CACE) analysis, which adjusts for partially missing, or unobserved, compliance (Angrist et al., 1996; Cowen, 2008; Becque et al., 2015; Peugh et al., 2017). Each analysis seeks to shed light on whether the pre-arrest diversion to addiction treatment by law enforcement can reduce arrests.

2. Material and methods

2.1. Overview

This study focuses on a secondary analysis, focusing on evaluating the impact of MARI on whether or not an individual is arrested within 6 months after the index crime. The primary analysis, which is not part of the present paper, will investigate 12-month recidivism, along with other features of the MARI program. We refer the reader to the MARI protocol paper for additional details of this study (Zgierska et al., 2021).

2.2. MARI

MARI provides persons who are arrested for non-violent, eligible drug use-related offenses an opportunity for a SUD assessment and referral to addiction treatment. Treatment needs are determined on an individual bases and can involve inpatient, residential, or outpatient settings; and behavioral care and/or medications, as an alternative to arrest, prosecution and possible incarceration. When an individual commits a MARI-eligible offense investigated by the MPD and agrees to enroll in the MARI program, they agree to (1) make contact with the MARI Assessment Hub within 72 hours, schedule and complete and MARI-funded clinical assessment for their SUD (estimated at approximately $400 per assessment), and (2) comply with their treatment plan and not re-offend during the six month MARI program. In exchange for enrolling in the MARI program, the MPD agrees to hold in abeyance any arrest or criminal charges while the person is participating in the MARI program. Once a person contacts the Assessment Hub, they schedule and completes an SUD assessment. The Assessment Hub connects the MARI participant with recovery peer support services provided by a trained recovery coach or peer support specialist who can assist MARI participants with treatment navigation and offer recovery support. When MARI participants successfully complete their six month program (i.e., are compliant with treatment and do not re-offend), the MPD "voids" the index crime, which brought them into MARI program, so that program completers do not have criminal record related to the MARI offense.

2.3. Participants

Participants were eligible for the MARI program if they resided in Dane County, were at least 18 years of age, did not have a history of violent crime, were not on a parole/probation, and had committed an eligible, non-violent, drug use-related crime between September 1, 2017 through August 31, 2020. Eligible crimes include possession of narcotics/drugs or drug paraphernalia (for personal use, not for dealing), prostitution, retail theft, theft from auto without property damage, burglary/theft from family members who are agreeable to not be pressing charges, and drug overdose (Zgierska et al., 2021).The crime which brought individuals to MARI is henceforth referred to as the 'index crime'. Arrest data were sourced from MPD records management system. Data were collected for 12 months before, and 6 months after the index crime. Therefore, the dataset for MARI participants was collected for a time period from September 1, 2016 through February 28, 2021. A historical comparison (HC) group was created consisting of adults who would have been eligible for MARI should it had existed at the time of their crime. Eligible crimes among the HC group were

primarily overdose related and took place between September 1, 2015 and August 31, 2016.

2.4. Variables

The MPD dataset contains baseline demographic variables (age, sex, race/ethnicity, residency, and arrest in the previous 0–12 months [y/n], an indicator of an arrest in the 12 months prior to the 'index crime'. Age, measured in years, was treated as a continuous variable. Sex was binary (female/male). Race/ethnicity was categorical indicating whether an individual was White, Black/African American, Hispanic, American Indian, or Asian/Pacific Islander. Residency was also categorical indicating whether an individual resides in Madison, outside of Madison, or had no permanent address at the time of their index crime. The outcome variable was six-month recidivism [y/n], a binary variable indicating whether an individual was arrested at least once in the six-month period following the index crime. There were no missing data. The dataset also contained number of previous year arrests, but due to its positive skew, was not included in this analysis.

The sample was divided into two groups. A Historical Comparison (HC) group (n = 52) consisted of adults arrested between September 1, 2015 and August 31, 2016 and would have been eligible for MARI should it have existed at that time. A MARI group (n = 263) consists of adults referred to the MARI program by MPD for a MARI-eligible crime committed between September 1, 2017 and August 31, 2020 who agreed to participate in the six-month MARI program. Additionally, the MARI group were subdivided into three categories: Completers (n = 100) who completed the six month MARI program; Non-Completers (n = 60) who completed the SUD assessment, but failed to complete MARI program; and Non-Engaged (n = 103) who agreed to the MARI program but did not even complete the SUD assessment. To simplify the analyses and increase statistical power, MARI Non-Completer and Non-Engaged subgroups were combined into one group, referred to as the MARI Non-Adherent group (n = 163).

2.5. Overview of analyses

We evaluated the MARI program's impact on arrest recidivism using the potential outcomes framework (Hernan and Robins, 2020; Neyman, 1923; Robins, 1986; Rubin, 2005, 1974) and using ITT, per-protocol, and CACE analyses. Complete treatment of these analyses, including assumptions made and concerns regarding identifiability of desired effect estimates, can be found in Supplemental Text. ITT analysis (Hernan and Robins, 2020; Hernán and Hernández-Díaz, 2012; Peugh et al., 2017) compares the risk of 6-month recidivism between the MARI group and the HC group, i.e., it estimates the average causal effect of MARI *assignment* on the outcome.

Since participants may not adhere to their assigned protocol, the per-protocol analysis seeks to better evaluate the true effectiveness of MARI. It estimates the average causal effect of MARI if all individuals had complied with their assigned protocol; that is, the average causal effect of MARI if all individuals assigned to MARI actually completed the program, and if individuals in the HC group could never have accessed MARI-related programs (Hernan and Robins, 2020; Hernán and Hernández-Díaz, 2012; Peugh et al., 2017). The latter is guaranteed, since MARI did not exist at the time of the index crime for the HC group. This analysis only compares individuals who adhered to MARI (i.e., MARI Completers) vs. the HC group (Hernan and Robins, 2020; Hernán and Hernández-Díaz, 2012; Peugh et al., 2017). Per-protocol analysis stipulates that MARI Completers were comparable to the HC group prior to their index crime (Hernan and Robins, 2020; Hernán and Hernández-Díaz, 2012; Peugh et al., 2017). Thus, the magnitude of the effect of completing MARI may be biased without making adjustments.

While the per-protocol analysis distinguishes between Completer and Non-Adherent subgroups, it assumes all individuals in the HC group would have completed the MARI program had it been offered, which may introduce bias in our estimates of the effect of MARI assignment. An attempt at reducing this bias is the CACE analysis, which estimates the causal effect of assignment to MARI on 6-month arrest recidivism among individuals who would complete MARI *if* they were assigned to the program (Angrist et al., 1996; Becque et al., 2015). In what follows, we describe each analysis (ITT, per-protocol, and CACE).

2.6. Intent-to-treat analysis

ITT analysis estimates the effect of assignment to MARI on the risk of 6-month recidivism using an adjusted OR (aOR). To avoid potentially biased estimates and separation, we use Firth logistic regression to estimate the aOR (Firth, 1993; Heinze, 2006; Heinze and Schemper, 2002). The logistic regression model is fit to data from MARI and HC participants. Possible covariates were age, sex, race/ethnicity, residency, and presence of arrest in 0–12 months prior to the index crime. Covariates to include in the regression model were selected in two steps. We first looked for differences between MARI and the HC groups at baseline, using two-tailed, two-sample t-tests for continuous variables and Pearson chi-squared tests for categorical variables. Covariates that differed significantly between these groups ($p < 0.05$) were included in the final model. Second, each covariate was added one at a time into the model and included in the final model if its 95 % confidence interval (CI) did not include zero. For reference, we also estimated the unadjusted OR of 6-month arrest recidivism between MARI and the HC groups, with a statistical significance level established at $p < 0.05$. Because index crimes for the HC group occurred before the implementation of MARI, sensitivity of this model was conducted by including time in years, centered to its average.

2.7. Per-protocol analysis

Per-protocol analysis estimated the effect of MARI completion on the risk of 6-month arrest recidivism. This analysis included only individuals who adhered to their assignment, i.e., only MARI Completers and the HC group. Thus, our approach is similar to our ITT analysis except that the comparison was between MARI Completers and HC. For the a OR, a Firth logistic regression model of 6-month recidivism was fit to data from MARI Completers and HC-Controls. Model selection followed the same approach used in the ITT analysis described above.

2.8. Complier average causal effect (CACE) analysis

We performed a CACE analysis to estimate the effect of MARI assignment among individuals who would have completed MARI if assigned to the program. This analysis assumes individuals either receive all treatment (i.e., MARI) or none and divides individuals into (1) never-takers; (2) always-takers; (3) compliers; and (4) defiers. Because MARI eligible crimes among the HC group occurred before the MARI program existed, always-takers and defiers are not possible in our sample. Thus, we can focus on compliers and never-takers only. We introduce a binary variable C to denote whether or not an individual is a complier.

Because compliance is missing, or latent, in the HC group, we use a structural equation modeling approach (Becque et al., 2015; Cowen, 2008; Skrondal and Rabe-Hesketh, 2004). This entailed constructing three logistic regression models: one to predict an individual's compliance, another to predict 6-month recidivism among compliers, and another to predict 6-month recidivism among non-compliers. Specifically, we proposed the following joint model of compliance C and 6-month recidivism Y:

$$\text{logit } P(C = 1 | X, \theta) = \alpha_0 + \alpha_1 X$$

$$\text{logit } P(Y | X, Z, C = 1, Z, \theta) = \beta_0 + \beta_1 X + \beta_2 Z$$
$$\text{logit } P(Y, X, Z, C = 0, \theta) = \beta_0 + \beta_1 X$$

where Z denotes assignment to MARI; the row vector $\theta = (\alpha_0, \alpha_1, \beta_0, \beta_1, \beta_2)$ corresponds to model parameters; and covariates X are the same as those used included in per-protocol analysis. Model parameters θ are estimated using maximum likelihood estimation via a version of the Expectation-Maximization (EM) algorithm (Dempster et al., 1977) that handles Firth logistic regression to account for separation due to small sample size (Ibrahim and Lipsitz, 1996; Maity et al., 2019). The CACE aOR is given by e^{β_2}. Bootstrapping was performed to recover corresponding 95 % Cis (Efron and Tibshirani, 1993).

3. Results

3.1. Intention-to-treat analysis

Baseline characteristics of the MARI and HC group participants are summarized in Table 1. A total of 315 individuals comprised the sample for this analysis, with 263 MARI and 52 HC participants. The sample was predominantly white (80 % among MARI, 88 % among HC participants) and male (63 % among MARI, 65 % among HC participants). The HC group was on average younger ($p = 0.005$), with higher proportion of individuals with a record of previous-year arrests ($p < 0.001$) than MARI participants. We estimated that assignment to MARI carried a statistically non-significant lower unadjusted odds of 6-month recidivism in the unadjusted ITT analysis (OR = 0.61, 95 % CI: [0.33, 1.13], $p = 0.24$) (Table 2).

Age and presence of previous-year arrests were included in the model for the ITT analysis approach, because they differed significantly ($p < 0.05$) between MARI and HC groups. Sex, race, and residency were not included, because they did not differ significantly between the two groups and stayed statistically non-significant after added to the logistic

Table 1

Baseline characteristics of MARI-Participants (n = 263), MARI-Completers (n = 100), MARI Non-Adherent group (n = 163), and the Historical Comparison group (n = 52).

	Historical-Comparison (n = 52)	MARI-Participants (n = 263)	MARI-Completers (n = 100)	Non-Adherent (n = 163)
Variable	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
Age, years	30.00 (9.05)	34.94 (10.48)***	34.64 (9.92)***	35.13 (10.83)
Variable	**Count (%)**	**Count (%)**	**Count (%)**	**Count (%)**
Female	18 (35%)	97 (37%)	27 (27%)	70 (43%)†††
Race/Ethnicity				
White	46 (88%)	210 (80%)	83 (83%)	127 (78%)
Black/African American	6 (12%)	34 (13%)	8 (8%)	26 (16%)
Hispanic	0	13 (5%)	7 (7%)	6 (4%)
American Indian	0	5 (2%)	1 (1%)	4 (2%)
American Asian/Pacific Islander	0	1 (0%)	1 (1%)	0 (0%)
Madison Residency				
Yes	28 (54%)	163 (62%)*	64 (69%)*	94 (58%)††
No	17 (33%)	70 (27%)*	27 (27%)*	43 (26%)††
No Permanent Address	7 (13%)	30 (11%)*	4 (4%)*	26 (16%)††
Arrested in previous year	24 (46%)	82 (31%)***	18 (18%)***	64 (39%)†††

Note. MARI-Participants and MARI-Completers were compared to the Historical-Comparison group with a two-sample *t*-test for continuous variables and a chi-squared test for categorical variables, with * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. MARI-Completers were similarly compared to the Non-Adherent group, with † $p < 0.1$; †† $p < 0.05$; ††† $p < 0.01$.

Table 2

Unadjusted odds ratios (ORs) for 6-month recidivism when comparing the MARI (n = 263) and Historical Comparison (n = 52) groups.

	Arrested within 6 months			
	No	Yes	OR (95 % CI)	p
Historical Comparison	31	21	Ref.	–
MARI Group	186	77	0.61 (0.33, 1.12)	0.24
Completer Subgroup	88	12	0.20 (0.09, 0.46)	0.003
Non-Adherent Subgroup	98	65	0.97 (0.52, 1.85)	0.72

regression model one at a time (sex: $p = 0.18$, race: $p = 0.37$, residency: $p = 0.10$). Adding the linear term for 'time' also did not impact the model ($p = 0.74$). As a result, the final model only included age and indicator of previous-year arrests. We used the final model (Table 3) to estimate that MARI assignment carried a statistically non-significant lower adjusted odds of 6-month recidivism (aOR = 0.59, 95 % CI: [0.32, 1.12], $p = 0.11$).

3.2. Per-protocol effect analysis

Baseline characteristics of MARI Completers and HC are summarized in Table 1. For this analysis, a total of 152 individuals comprised the sample for this analysis (100 MARI Completers, 52 HC). The MARI Completers were predominantly white (83 %) and male (73 %). The HC group was younger ($p = 0.005$) and had a higher proportion of individuals with previous-year arrests ($p < 0.001$) than the MARI Completers. Using a per-protocol analysis approach, we estimated that MARI completion lowered the unadjusted odds of 6-month recidivism by a factor of 0.20 (95 % CI: [0.09, 0.46], $p = 0.003$) (Table 2).

Age and proportion of individuals with previous-year arrests were included in the final per-protocol model, because they differed significantly between MARI Completers and the HC group. Sex, race, residency were not included in the final model, because they did not differ significantly between MARI Completers and the HC group and remained non-significant when added to the logistic regression model one at a time (sex: $p = 0.89$, race: $p = 0.11$, residency: $p = 0.29$). The linear term for time was also nonsignificant when added to the model ($p = 0.69$). The final per-protocol model (Table 4) estimated that MARI completion carried a lower adjusted odds of 6-month recidivism (aOR = 0.23, 95 % CI: [0.10, 0.52], $p < 0.001$).

3.3. Complier average causal effects analysis

Baseline characteristics of MARI Completers and MARI Non-Adherent groups are summarized in Table 1. A total of 315 individuals comprised the sample for this analysis (100 MARI Completers, 163 Non-Adherent), and 52 in the HC group. The MARI subgroups were predominantly white (83 % for Completers, 78 % for Non-Adherent) and male (73 % for Completers, 57 % for Non-Adherent). Non-Adherent group had a higher proportion of individuals with previous-year arrests than the Completers ($p < 0.001$) as well as a greater proportion of females ($p = 0.009$) and a lower proportion of Madison residents ($p = 0.01$).

Age and indicator of previous-year arrests were included in the final CACE model, because they were found to differ significantly between

Table 3

Adjusted odds ratios (95 % CI) for 6-month recidivism when comparing the MARI (n = 263) and Historical Comparison (n = 52) groups using an intent-to-treat analysis.

Variables	Adjusted OR (95 % CI)	p
Age, years	0.99 (0.96, 1.01)	0.26
Arrests in prior year	3.25 (1.97, 5.39)	<0.001
Assignment to MARI	0.59 (0.32, 1.12)	0.11

Table 4

Adjusted per-protocol odds ratios (95 % CI) for 6-month recidivism when comparing the MARI Completers (n = 100) and Historical Comparison (n = 52) groups using a per-protocol analysis.

Variables	Adjusted OR (95 % CI)	p
Age, years	1.01 (0.96, 1.05)	0.74
Arrests in prior year	2.75 (1.17, 6.44)	0.02
Completion of MARI	0.23 (0.10, 0.52)	<0.001

the MARI and HC groups. Sex and residency were also included because they differed significantly between the Completer and Non-Adherent groups. We used the final joint model of compliance and 6-month recidivism across the compliance type groups (Table 5) and estimated using the CACE analysis that MARI assignment among compliers (i.e., MARI Completers) carried a lower adjusted odds of 6-month recidivism (aOR = 0.85, 95 % CI: [0.80, 0.90], p < 0.001).

4. Discussion

We examined the impact of the MARI program on the risk of arrest recidivism among adults who committed a non-violent, drug use-related crime. Using observational data (n = 315) from the MPD, we estimated the causal effect of assignment to MARI, completing MARI, and assignment to MARI among compliers on the risk of 6-month recidivism. Estimated effects were recovered using ITT, per-protocol, and CACE analyses, respectively. Three methodological issues had to be addressed. First, a Historical Comparison (HC) group consisted of a relatively small number individuals who committed offenses before MARI was implemented. Second, the HC group may not be a comparable group at baseline to MARI participants. Third, compliance among the HC group was unobserved. To address the first and second issues, we proposed a (Firth) logistic regression model of 6-month recidivism in all three approaches, where we adjusted for baseline characteristics that differed significantly between the compared groups, and tested whether adding a linear term in time improved the model fit. Firth logistic regression was used to avoid potentially biased estimates, and complete or quasi-complete separation due our small sample size. To address unobserved compliance, we proposed a structural equation model of compliance and outcomes based on a latent-variable approach for estimating the CACE risk of 6-month recidivism.

Our main findings are that MARI assignment alone (i.e., being referred to, and becoming a MARI participant) did not lower the adjusted odds of 6-month recidivism. Rather, MARI participation and completion lowered both the unadjusted and adjusted odds of 6-month recidivism over individuals not assigned MARI by a factor 0.2 and 0.23, respectively. Further, MARI participation and completion also lowered the adjusted odds of 6-month recidivism by a factor 0.85 over individuals who were not assigned MARI but would have completed MARI if given the opportunity. As a result, community policing initiatives or pre-arrest diversion strategies by law enforcement, such as MARI, may wish to focus on individuals who are more likely to complete the program. However, by focusing solely on these individuals could further propagate the disparities between various groups and exacerbate the existing problems of recidivism and inequity encountered by certain groups within the criminal justice system. Therefore, it is essential to work in parallel on improving the program itself, while improving program entry and completion of those less likely to benefit from it in the initial iterations of the program.

Each analysis and their resulting estimates are sensitive to modeling assumptions, which were formalized in a causal diagram in the Supplemental Text. Estimates should be interpreted with caution as one does with all attempted causal inferences made from observational rather than from randomized control trial data, before making recommendations for continuing, adapting, and/or adopting community policing initiatives such as the MARI program.

There are several limitations to consider. Although all three effects suggested a reduction in the risk of arrest recidivism from MARI, not all estimated effects were statistically significant. Since each method relied on modeling assumptions, it is possible that some of these assumptions are more valid than others or that none of the assumptions are sufficiently valid to yield useful estimates. For example, all approaches only adjust for measured confounding, and so may have not have adequately adjusted for unmeasured confounding, leading to biased estimates. Another limitation is that outside environmental factors may influence effectiveness of MARI. These may include a time-lag until MARI protocols were standardized after its implementation started. Further, certain choices made in data analysis and collection may be considered limitations. For example, confidence intervals may have understated the uncertainty in estimates. Additionally, we may be including individuals who do not have a yes for their 6-month recidivism outcome after their MARI-eligible arrest because they were incarcerated. Though including such individuals may actually mean that MARI has stronger effect than what we are reporting, since individuals who are incarcerated were included in the MARI Non-Adherent group.

As mentioned, individuals who enrolled in MARI but ultimately did not complete the program still accessed a part of the program. The extent of this partial compliance was not observed and may also lead to biased estimates. The impact of MARI may also vary throughout different months, years, and treatment plans, resulting in different estimates between methods. For example, MARI may be more or less effective depending on whether an individual received inpatient or residential treatment over other options. Additionally, while an indicator of previous year arrest was compared between the different groups and included in the model, the present analysis did not account for the type of arrest or presence of incarceration during that period. The type of arrest or history of incarceration in the year prior to the index crime may impact recidivism and the effectiveness of the intervention; future analysis of the primary 12-month outcomes, based on a larger sample size, will evaluate the potential impact of these events. We also had a small sample of MARI participants as well as a small sample of individuals in the HC group that could lead to variable estimates, especially for the CACE analysis.

Interestingly, women constituted 37 % of adults referred to MARI;

Table 5

Adjusted odds ratios (95 % CI) for 6-month recidivism among individuals who would complete MARI if assigned to MARI, when comparing the MARI (n = 263) and Historical Comparison (n = 52) groups using a complier average causal effects analysis.

Variables	Compliance		Recidivism Compliers		Recidivism Non-compliers	
	Adjusted OR (95 % CI)	p	Adjusted OR (95 % CI)	p	Adjusted OR (95 % CI)	p
Age, years	1.00 (1.00, 1.01)	< 0.66	1.00 (1.00, 1.01)	< 0.001	1.00 (1.00, 1.01)	< 0.001
Arrested in previous year	0.89 (0.82, 0.96)	< 0.001	1.21 (1.13, 1.30)	< 0.001	1.21 (1.13, 1.30)	< 0.001
Residency	1.06 (1.01,1.11)	< 0.001	0.95 (0.91,1.00)	< 0.001	0.95 (0.91,1.00)	< 0.001
Sex	0.94 (0.87,1.02)	< 0.001	1.09 (1.01,1.16)	< 0.001	1.09 (1.01,1.16)	< 0.001
MARI assignment	N/A	N/A	0.85 (0.80, 0.90)	< 0.001	N/A	N/A

yet only 27 % of the program completers were women, with the Non-Adherent group composed of 43 % of women. Although this project did not elucidate the reasons underlying this gender-related disparity, some of the prior research also noted lower retention in addiction treatment among women compared to men (Arfken et al., 2001; Fernández-Montalvo et al., 2017), underscoring the importance of gender as the potential factor for differential treatment engagement and outcomes (Ashley et al., 2003; Tuchman, 2010). Future work should look to better understand and reduce this disparity, and MARI-modeled programs should consider gender-targeted interventions to promote better treatment outcomes across the genders. Lastly, our sample was relatively homogeneous in terms of race/ethnicity (i.e., predominantly white), limiting the generalizability of our findings to more diverse populations. A program such as MARI depends on the relationship of the police with its community. Police perceptions greatly vary between and within communities, with race affecting perception of the police and police services (Gill et al., 2014; Schafer et al., 2003). Additionally, a program such as MARI depends on the ability of the assigned individuals to successfully complete treatment. Staff, service, and facility capacity limitations may influence the ability of an individual to successfully complete service. While these capacity limitations were not an issue for MARI, they may be a potential barrier in other settings where a large number of adults who commit drug use-related crimes were diverted to treatment programs (Hser et al., 2007).

4.1. Conclusion

In summary, this work extends our understanding of the benefits from community policing initiatives such as MARI that have been proliferating nationwide. Finding reductions in the risk of 6-month recidivism may support the adoption of MARI-like initiatives in other communities. Our results are not conclusive based on the limitations mentioned above, yet they add to a growing body of literature suggesting that diversion of adults who commit a non-violent, drug-use related crime to addiction treatment, instead of criminal charges, may yield benefits, pointing to the necessity of further assessment of their effectiveness and guiding the optimal adoption of such approaches.

Role of funding source

Author contributions

All authors contributed to the conceptualization of the paper. VMW, SAA, and GZC designed and performed the data analysis. AEZ and JB led data collection. AEZ, GZC, and LAA secured funding and supervised trainees. GZC, VMW, and SAA drafted the paper. All authors provided critical feedback of the paper and gave final approval of the paper.

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.drugalcdep.2021.108915.

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