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Overdose education and naloxone distribution in jails: Examining the impact of the Communities That HEAL intervention in 4 states

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Abstract

Background Opioid-related overdose is the leading cause of mortality among individuals recently released from incarceration in the U.S. Naloxone is an FDA-approved opioid antagonist medication designed to rapidly reverse opioid overdose. Despite evidence of its acceptability and effectiveness at reducing the risk of opioid overdose death after release from incarceration, only an estimated 25% of US jails provide naloxone upon release. This study examines the effectiveness of the HEALing Communities Study (HCS) Communities That HEAL (CTH) intervention on enhancing access to overdose education and naloxone distribution (OEND) in participating jails in Kentucky, New York, Massachusetts, and Ohio.

Methods Communities were randomized to intervention ($n=34$) or wait-list control ($n=33$) arms stratified by state. Jail-based surveys ($n=59$) were implemented at three time points during 2019 to 2022. Generalized linear mixed models (GLMM) with imputation captured intervention effects during the evaluation period (July 1, 2021-June 30, 2022). Interpretation of results was informed by the Practical, Robust Implementation and Sustainability Model framework.

Results The CTH intervention was significantly associated with the hypothesized outcome, resulting in a greater number of jails providing overdose education (H1, relative $\text{risk}_{\text{Adj}} = 1.51$ [95% CI: 1.09, 2.08], $p=0.013$) and the number

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of jails providing naloxone upon release (H2, relative $risk_{Adj} = 1.49$ [95% CI: 1.05, 2.13)], $p = 0.027$). External factors related to OEND implementation, such as correctional health care models, available resources, and state COVID restrictions, varied across communities.

Conclusions The CTH intervention engaging community coalitions to deploy evidence-based practices was effective in increasing OEND implementation in jails, helping address elevated overdose risks for individuals during and post-release from incarceration. Partnerships between state, community, and jail-based stakeholders are needed to assure expanded access to this lifesaving, evidence-based approach.

Keywords Opioid epidemic, Naloxone distribution, Overdose education, Jail, Carceral settings

Background

Opioid-related overdose has proven over time to be the leading cause of death for individuals leaving incarceration (Binswanger et al., 2007, 2013; Cooper et al., 2023; Mital et al., 2020). Approximately 58% of people in prison and 63% of people in jail meet criteria for a substance use disorder (SUD), compared to only 5% of the general population (Bronson et al., 2017). Multiple studies have found that within the first two weeks of release, individuals who had been incarcerated were up to 129 times more likely to die from an overdose than the general population (Binswanger et al., 2007; Cooper et al., 2023; Lim et al., 2012; Merrall et al., 2010; Mital et al., 2020; Ranapurwala et al., 2022). Key factors contributing to increased overdose fatality risk post-release include reduced opioid tolerance from periods of abstinence during incarceration, limited access to effective and lifesaving pharmacotherapy options while incarcerated and upon release, lack of awareness of the increasing potency and changes in the drug supply that occurred while incarcerated, and disruptions to health care and social supports during incarceration (Brinkley-Rubinstein et al., 2018; Joudrey et al., 2019). Considering these risk factors, carceral settings are a key target for delivering evidence-based treatment and prevention interventions for opioid use disorder (OUD). While more research is needed comparing specific effects, medications for opioid use disorder (MOUD), including methadone, buprenorphine, and extended-release naltrexone increase engagement in treatment and delay opioid use onset post release, and thus may reduce likelihood of overdose (Moore et al., 2019). However, only a minority of carceral settings provide these medications to all clients with OUD or provide adequate linkage to them in the community (Maruschak et al., 2023; Springer, 2024). This limited MOUD availability during incarceration and during re-entry increases the imperative for correctional institutions to offer overdose education and naloxone, an FDA-approved opioid antagonist medication designed to rapidly reverse an opioid overdose. Despite evidence of its acceptability and effectiveness to reduce the risk of opioid overdose death after release from incarceration (Bird et al., 2016; Curtis et al., 2018), only an estimated 25% of US jails provide naloxone upon release (Maruschak et al., 2023; Scott et al., 2022).

Overdose education and naloxone distribution (OEND) initiatives provide naloxone to individuals at risk of experiencing or witnessing an opioid overdose and deliver structured brief education on overdose risk factors, recognition of overdose signs and symptoms, and administration of naloxone. OEND programs in communities and correctional settings increase participants' knowledge about overdose and their confidence and willingness to respond to an overdose (Bennett & Holloway, 2012; Grella et al., 2021; Petterson & Madah-Amiri, 2017). A program that provided OEND to jail visitors in New York City found that 12% of participants administered naloxone in the six months following training (Huxley-Reicher et al., 2018). Data from the San Francisco County Jail system's OEND program showed that 67% of participants opted to receive naloxone at release, 40% of participants who went through OEND training obtained a refill in the community, and 32% of those who requested a refill used their naloxone to reverse an overdose (Wenger et al., 2019). In Scotland, researchers found that OEND led to a 36% decrease in opioid overdose deaths in the four weeks following release from prison (Bird et al., 2016; Horsburgh & McAuley, 2018). Although OEND programs have documented the widespread distribution of naloxone and demonstrated effectiveness for reducing overdose mortality (Clark et al., 2014; Lambdin et al., 2020; McDonald & Strang, 2016), uptake in US jails is insufficient (Horton et al., 2017; Maruschak et al., 2023). To support OEND continuity, community MOUD programs may be leveraged to provide ongoing access to naloxone and other evidence-based treatments in jails and post-release with rigorous research on effectiveness among people leaving incarceration essential (Grella et al., 2021). Each state that took part in the HCS and CTH intervention has passed legislation to increase access to naloxone either in combination with MOUD or as a standalone strategy (Bohler et al., 2023; The Network for Public Health Law, 2023). Given these factors, increased investment in overdose prevention and response for individuals involved in the criminal legal system is needed, particularly following release and re-entry into the

community (Mital et al., 2020). Evidence suggests that heightened risk of overdose persists for the first year following release (Cooper et al., 2023).

In recognition of the need for OEND expansion and evaluation in jail settings, the Helping to End Addiction Long-term® (HEALing) Communities Study (Walsh et al., 2020) emphasized community selection of OEND strategies in the criminal legal sector in the Communities That HEAL (CTH) intervention to reduce overdose death rates (Winhusen et al., 2020). While the CTH intervention increased naloxone distribution at the community level (Freeman et al., 2024), this paper examines the impact of the CTH intervention specifically on OEND implementation in jails using a jail-based survey. Guided by the Practical, Robust Implementation and Sustainability Model (PRISM) framework (Glasgow & Chambers, 2012), multilevel contextual factors impacting implementation are also assessed, including perspectives on the intervention, characteristics of implementers and setting, external environment and infrastructure influence. We hypothesized that jails within the communities receiving the CTH intervention would have higher implementation rates of overdose education (H1), naloxone distribution programming (H2), and naloxone doses received by individuals upon release (H3).

Methods

Study design

The HCS is a multi-site, cluster randomized wait-list open-label comparison trial testing whether the CTH intervention reduces opioid overdose deaths relative to no intervention in communities ($n = 67$) across Kentucky, Massachusetts, New York, and Ohio (Walsh et al., 2020). HCS randomization was conducted by the HCS Data Coordinating Center using a covariate constrained randomization procedure stratified by state. Within each state, arms (Wave 1 or Wave 2) were balanced on community characteristics including urban/rural classification, opioid-related overdose death rates, and community population at baseline. Each community had an equal probability to be allocated to either wave; 34 communities were assigned to the immediate Intervention (Wave 1 in HCS) and 33 to wait-list Control (Wave 2 in HCS) (Walsh et al., 2020). Details on the CTH intervention (Knudsen et al., 2020; Lefebvre et al., 2020; Sprague Martinez et al., 2020; Winhusen et al., 2020) and community strategy selection (Chandler et al., 2023; Young et al., 2022) are previously described.

Intervention communities received the CTH intervention from January 1, 2020– June 30, 2022 and were compared to wait-list control communities on study outcomes from July 1, 2021– June 30, 2022 (measurement period). This paper examines the impact of the CTH intervention on OEND in jails using a jail-based survey implemented atthree time points. The study protocol was registered at ClinicalTrials.gov (NCT04111939), approved by Advarra Inc. (Pro00038088), the HCS single Institutional Review Board (sIRB), and monitored by a Data and Safety Monitoring Board convened by the National Institute on Drug Abuse.

Study population

Kentucky, Massachusetts, New York, and Ohio communities ($N = 67$) heavily impacted by opioid overdoses were selected for HCS. Inclusion criteria differed slightly by state and have been previously described (Walsh et al., 2020). This analysis focused on the number of jails and individuals detained in those jails across the 67 communities during the baseline and comparison period. While HCS in KY and OH defined communities served by the jail as a county, NY had both county level and 3 town/cities served, and MA defined communities served by the jail as towns/cities. The study's randomization of communities resulted in some jails ($n = 5$) that provided services to more than one community ($n = 11$). Additionally, one community housed more than one jail. Although the latter scenario was solved by aggregation at the community level, the former scenario required each shared-jail community to be assigned a weight of 1 divided by the number of communities served by the same jail.

Intervention

As described elsewhere (Sprague Martinez et al., 2020; Young et al., 2022), researchers facilitated coalition engagement in the phased CTH intervention to support the selection of evidence-based practices (EBPs) for opioid overdose reduction tailored to the needs of each local community. Coalitions were provided tools and guidelines to support strategy selection during the action planning process and implemented four tailored communication campaigns (Lefebvre et al., 2020), the first of which focused on raising awareness of naloxone. Strategies were selected from the Opioid-Overdose Reduction Continuum of Care Approach (ORCCA) (Winhusen et al., 2020), a menu of strategies for implementing evidence-based practices in three areas: (a) OEND; (b) expansion of, linkage to, and retention on MOUD; and (c) promotion of safer opioid prescribing/dispensing (Winhusen et al., 2020). HCS communities had to implement EBPs in three sectors: behavioral health, healthcare, and the criminal legal system (CLS), which included jails, probation and parole, and treatment court settings. Additionally, the structure of coalitions implementing the CTH included CLS representatives (e.g., sheriffs, chief of police, probation officers, etc.) and people with lived experience to guide selection and implementation of strategies informed by data and assessed to be feasible (Sprague Martinez et al., 2020). Naloxone distribution

for people re-entering the community from jails might be achieved by providing kits upon release with personal belongings, through a vending machine, or by a voucher that allowed immediate access to naloxone through a community-based organization or pharmacy. Communities were also required to select at least one strategy for "active" implementation of OEND, defined as hands-on efforts to reach those at high risk for an overdose or venues where these individuals could be located (Chandler et al., 2023). An optional fast-track protocol was developed, and single IRB approved in May 2020 with the onset of the SARS-CoV-2 pandemic, recognizing the increasing risk for overdose as jails moved to rapidly release individuals incarcerated to the community (Oser et al., 2024).

Data collection

Data comes from the baseline and two follow-ups of the HCS annual jail survey collecting administrative data about the availability, accessibility, and utilization of interventions to address OUD within jails serving HCS communities, including OEND. The annual survey was completed by key jail employees knowledgeable about opioid-related services provided at their site. The survey was administered via REDCap, paper, or phone. The baseline survey was either collected in partnership with the Justice Community Opioid Innovation Network (JCOIN) (Scott et al., 2022) or via HCS for jails choosing not to participate in the JCOIN survey. For baseline (Time 1), jails reported data for a 12-month period, which varied (e.g., 2018 or 2019 calendar year depending on available data). Time 2 and 3 follow-up HCS annual jail surveys covered the respective previous fiscal year (i.e., 2) 7/1/20 to 6/30/21 and 3) 7/1/21 to 6/30/22); data collection occurred for up to 5 months for each survey during the year following the period of interest.

Primary outcomes

The primary outcomes examined in this paper include the number of: (1) jails providing overdose education; (2) jails providing naloxone to individuals detained at the time of release; and (3) individuals receiving naloxone upon release from jail.

Statistical methods

Summary statistics were provided at the community-level and jail-level at baseline and evaluation period time points. At the community-level at baseline, frequencies and percentages were provided for hypotheses with binary outcomes (i.e., number of communities providing overdose education [H1] and jail-based naloxone [H2]) as well as community characteristics such as age, site, urban/rural classification, sex, race and ethnicity. The mean and standard deviation of the rate of jail-based naloxone kits distributed to persons detained upon release was provided for the third hypothesis. All items were summarized by intervention or control arm, and rurality during the evaluation period for the sample overall. Similarly, the community-level summary statistics were provided for site, rurality, and all outcomes during the evaluation period by intervention and control condition and the overall sample.

To evaluate the effect of the CTH intervention on outcomes, generalized linear mixed models (GLMM) were applied for our first and second hypotheses; due to the high rate of missingness for the H3 outcome (48%), it was inappropriate for us to estimate a model. Specifically, Poisson regression models with robust variance estimators and log link function were used to assess the effect of the intervention for H1 (number of jails providing overdose education) and H2 (number of jails which provided naloxone) due to their binary outcomes. These models estimated the relative risk of communities with no jails providing overdose education or naloxone relative to communities with one or more jails during the third iteration of the survey- the evaluation period from July 1, 2021 to June 30, 2022 between Intervention and Control; baseline data from the first iteration of the survey were used as covariates. Models for H1 and H2 contained the following fixed effects: site, urban/rural classification, baseline community overdose rate, baseline outcome, baseline time indicator, and the intervention effect. The baseline time indicator was included as a covariate to account for the varying baseline years used in the JCOIN survey. For each model, within each condition, the absolute risk and its 95% confidence interval is provided in addition to the relative risk and its 95% confidence interval. The p-value is also provided to assess the effect of the intervention.

Although weighting allowed us to analyze our outcomes at the community-level, the weighting approach can result in biases in estimates and standard errors such as the violation of independence of communities—given they use the same jail information—and cross-contamination of the CTH intervention effect for jails serving communities in both Intervention and Control conditions. To account for these biases, two sensitivity analyses were conducted for each outcome.

The first sensitivity analysis assigned an intervention covariate to all communities using the same jail if at least one of those were assigned to Intervention, regardless of whether they were randomized to Intervention or Control. We note there still may be bias given that the communities are not fully independent. The second sensitivity analysis removed communities randomized to different conditions but sharing the same jail. This analysis eliminated the two previous biases mentioned but may still result in bias towards the original randomization scheme. We focus primarily on the intent-to-treat

population (ITT) for these sensitivity analyses and note any major changes in modeling assumptions or conclusions observed when evaluating the per-protocol population (PP). Communities without data for outcomes of interest at baseline or during the evaluation period were excluded from their respective analyses. Imputation was performed for the H1 and H2 outcomes at the community level; imputation was inappropriate given the high rate of missingness for the H3 outcome. Multiple imputation under a missing at random assumption was performed using 20 imputations per outcome (Rubin, 1987). PROC MIANALYZE was used to combine results across imputation. All analyses were conducted using SAS v9.4.

Results

Baseline characteristics of participating communities

The 67 communities in the study were comprised of $N = 4{,}439{,}170$ residents (18 or over) within the Intervention and $N = 3{,}772{,}336$ residents in the Control (Table 1). Population distribution of age, sex, and race and ethnicity were similar between the two waves with over 69% of residents identifying as 35 or older, 52% female, and 73% non-Hispanic white. The number of communities per wave per site was roughly equal ($n = 8$) except for communities in Ohio. Baseline overdose death rates were similar across conditions, with Intervention communities reporting a mean of 38.2 (SD = 22.8) and Control communities at 37.1 (SD = 20.3) per 100,000 adult residents.

At baseline, 88.1% ($N = 59$) of communities responded to the survey and non-response accounted for all missing data for naloxone distribution (11.9%) and overdose education (11.9%) outcomes. Missingness for naloxone distribution rates was due to both non-response (11.9%) to the survey and non-response for this item (10.4%). There was no missing data due to suppression. At baseline, few communities had jails providing overdose education (25 of 59) or naloxone upon release (21 of 59). The mean rate of jail-based naloxone distribution in the Intervention communities was 8.6 per 1,000 individuals released (SD = 23.2) and 6.4 (SD = 13.0) in Control communities (not statistically significant) (Table 1).

Jail characteristics

Table 2 displays baseline characteristics of $N = 54$ jails responding to JCOIN or jail-based surveys. Intervention community jails reported 294,663 people detained while Controls reported 155,389. Most reported a healthcare delivery model by an external contracted provider ($n = 9$[50%] Intervention, $n = 15$ [60%] Control), followed by hybrid ($n = 7$ [39%] Intervention, $n = 4$ [16%] Control) and direct services model ($n = 2$[11%] Intervention, $n = 5$ [20%] Control). Only three jails (two from the intervention and one control condition) reported that naloxone was not available for staff to reverse opioid overdoses within the jail.

Treatment effects on overdose education and Naloxone distribution

Higher percentages of Intervention communities provided overdose education and naloxone upon jail release (77.4% and 71.0%, respectively) relative to Control communities (55.2% and 55.2%, respectively) during the evaluation period (Table 3). There was a significant association of the CTH intervention with the number of jails providing overdose education (H1, relative risk$_{Adj}$ = 1.51 [95% CI: 1.09, 2.08], $p = 0.013$) (Table 4). The adjusted absolute risk for Intervention communities was estimated at 73.5% (95% CI: 58.2%, 93.0%) and 48.8% (95% CI: 36.7%, 65.0%) for Control. The CTH intervention effect remained significant in the first and second sensitivity analyses, with adjusted relative risks of 1.52 (95% CI: 1.08,2.14; $p = 0.016$) and 1.56 (95% CI: 1.10, 2.22; $p = 0.013$), respectively. Neither site nor urban/rural classification moderated the CTH intervention effect for number of jails providing overdose education (p_{Site} =0.062; $p_{Rurality}$ = 0.081, respectively).

As above, there was a significant relationship between the CTH intervention and the number of jails providing naloxone kits upon release (relative risk$_{Adj}$ = 1.49 [95% CI: 1.05, 2.13)], $p = 0.027$). The adjusted absolute risk for Intervention communities was 67.3% (95% CI: 51.3%, 88.2%) and 45.0% (95% CI: 33.0%, 61.4%) for Control (Table 4). The CTH intervention association remained significant in the first and second sensitivity analyses, with adjusted relative risks of 1.54 (95% CI: 1.05,2.27; $p = 0.027$) and 1.55 (95% CI: 1.05, 2.30; $p = 0.028$), respectively. Neither site nor urban/rural classification moderated the CTH intervention effect for number of jails providing naloxone upon release (p_{Site} = 0.062; $p_{Ruraltiy}$ = 0.081, respectively).

Control communities showed a mean raw rate of 129.7 (SD = 299.4) naloxone kits distributed per 1,000 jailed individuals released and the Intervention communities had a raw rate of 113.4 (SD = 216.3) (raw relative rate = 0.87; Table S1) [see Additional File 1]. However, given the high rate of missingness for this outcome (48%), the rates of naloxone distributed should be interpreted with caution. We present contextual factors highlighted in the PRISM framework that varied by site that may have influenced the implementation of jail-based OEND strategies in Table S2 [see Additional File 1]. Facilitators and barriers to implementation include site specific examples of correctional health models of service delivery and staffing solutions, engagement of CLS representatives in HCS CTH coalitions to champion implementation, policies and regulations, COVID restrictions and response (Oser et al., 2024), bail reform and jail census changes

Table 1 Baseline demographic characteristics of communities participating in the healing communities study by condition

Characteristic, Statistic	Condition		Overall
	Intervention	Wait-list Control	
Number of Randomized Communities	34	33	67
Research Site, n (%)			
Kentucky	8 (23.5)	8 (24.2)	16 (23.9)
Massachusetts	8 (23.5)	8 (24.2)	16 (23.9)
New York	8 (23.5)	8 (24.2)	16 (23.9)
Ohio	10 (29.4)	9 (27.3)	19 (28.4)
Urban/Rural Classification, n (%)			
Urban	19 (55.9)	19 (57.6)	38 (56.7)
Rural	15 (44.1)	14 (42.4)	29 (43.3)
Population Aged 18 + [1]			
Total	8,211,506	3,772,336	8,211,506
Mean (SD)	122,559.80 (199,385.00)	114,313.20 (201,417.30)	122,559.80 (199,385.00)
Age[1], n (%)			
18–34 Years	2,513,090 (30.6)	1,178,210 (31.2)	2,513,090 (30.6)
35–54 Years	2,533,733 (30.9)	1,180,392 (31.3)	2,533,733 (30.9)
55 + Years	3,164,683 (38.5)	1,413,734 (37.5)	3,164,683 (38.5)
Sex[1], n (%)			
Male	3,959,603 (48.2)	1,825,776 (48.4)	3,959,603 (48.2)
Female	4,251,903 (51.8)	1,946,560 (51.6)	4,251,903 (51.8)
Race/Ethnicity[1], n (%)			
Non-Hispanic White	5,979,602 (72.8)	2,750,369 (72.9)	5,979,602 (72.8)
Non-Hispanic Black	1,272,394 (15.5)	545,357 (14.5)	1,273,394 (15.5)
Non-Hispanic Other	354,527 (4.3)	153,956 (4.1)	354,527 (4.3)
Hispanic	603,983 (7.4)	322,654 (8.6)	603,983 (7.4)
Rate of Opioid Overdose Deaths[2]			
Mean Rate (SD)	38.2 (22.8)	37.1 (20.3)	37.7 (21.4)
Communities with at least one responding Jail, n (%)	30 (88.2)	29 (87.9)	59 (88.1)
Provide Naloxone Kits Upon Release[3]			
Yes	9 (26.5)	12 (36.4)	21 (31.3)
No	21 (61.8)	17 (51.5)	38 (56.7)
Missing Data	4 (11.8)	4 (12.1)	8 (11.9)
Rate of Individuals that Received Naloxone Kits Upon Release[4]			
Mean Rate (SD)	8.6 (23.2)	6.4 (13.0)	7.6 (18.8)
Median Rate (Q1, Q3)	0.0 (0.0, 4.6)	0.0 (0.0, 4.4)	0.0 (0.0, 4.5)
Do Not Provide Naloxone Kits Upon Release, n (%)	21 (61.8)	17 (51.5)	38 (56.7)
Missing Data, n (%)	6 (17.7)	9 (27.3)	15 (22.3)
Provide overdose education[5], n (%)			
Yes	13 (38.2)	12 (36.4)	25 (37.3)
No	17 (50.0)	17 (51.5)	34 (50.7)
Missing Data	4 (11.8)	4 (12.1)	8 (11.9)

Note: Percentages may not add up to 100 due to rounding.

[1] For communities that represent counties ($n = 48$ of 67), population estimates are from 2020 Bridged-Race Population Estimates retrieved via https://www.cdc.gov/nchs/nvss/bridged_race.htm on February 22nd, 2024

For communities that represent units smaller than counties ($n = 19$ of 67), population estimates are from 2017 to 2021 American Community Survey 5-Year Estimates retrieved via https://data.census.gov/cedsci on February 22, 2024

[2] Rate per 100,000 individuals aged 18 + calculated as the observed number of events as measured from January 2019 to December 2019 over the observed community population size of individuals 18 years of age or older measured from the 2020 Bridged-Race Population Estimates or the 2017–2021 American Community Survey 5-Year Estimates multiplied by 100,000

[3] Number and percentage of communities that have at least one jail that provides naloxone kits upon release in the respective Wave

[4] Rate per 1,000 individuals released from the community's jail(s)

[5] Number and percentage of communities that have at least one jail that provides overdose education in the respective Wave

(Wu & McDowall, 2024), state efforts to support OEND, and statutes beginning to mandate programs in carceral settings to address treatment for OUD, harm reduction and opioid overdose reduction (Pourtaher et al., 2024).

Discussion

To our knowledge, this is the first study examining the effects of a community-engaged intervention which utilizes coalitions to promote action planning and OEND

Table 2 Baseline characteristics of jails responding to JCOIN or JAIL surveys by condition, site, and rurality

Characteristic, Statistic	Condition		Overall
	Intervention	Control	
Number of Jails within Randomized Communities[1]	27	27	54
Research Site, n (%)			
Kentucky	8 (29.6)	7 (25.9)	15 (27.8)
Massachusetts	5 (18.5)	6 (22.2)	11 (20.4)
New York	5 (18.5)	7 (25.9)	12 (22.2)
Ohio	9 (33.3)	7 (25.)	16 (29.6)
Urban-Rural Classification[2] **n (%)**			
Urban	15 (55.6)	14 (51.9)	29 (53.7)
Rural	12 (44.4)	13 (48.1)	25 (46.3)
Number of Individuals Detained	294,663	155,389	450,052
Which model below best describes the healthcare delivery system in the jail? n (%)			
Direct Services Model	2 (11.1)	5 (20)	7 (16.3)
Contracted Model	9 (50.0)	15 (60)	24 (55.8)
Hybrid Model	7 (38.9)	5 (20)	12 (27.9)
Naloxone available for staff to reverse opioid overdoses within the jail, n (%)			
Yes	25 (92.6)	26 (96.3)	51 (94.4)
No	2 (7.4)	1 (3.7)	3 (5.6)

Note: $N = 5$ jails did not respond to baseline but reported data at follow-up

[1] If a jail served communities in different conditions the jail was assigned to the intervention

[2] If a jail served communities with different urban-rural classification statuses the jail was assigned to a status of urban

*Percentages may not add up to 100 due to rounding

implementation to address opioid overdose for people impacted by incarceration. Overall, this analysis found the HCS CTH intervention was significantly associated with an increase in the number of jails that provided overdose education and delivery of naloxone upon jail release. This positive outcome is a particularly notable finding given an accelerated intervention implementation period, a system and venue of implementation that is highly structured, and the COVID-19 pandemic and post-pandemic challenges that jails faced (Nowotny et al., 2020). External state and organizational-level factors likely explain some variation in implementation of the CTH intervention across the four states resulting in unique approaches to jail-based OEND (see Table S2). (Oser et al., 2024; Wu & McDowall, 2024), state efforts to support OEND, and statutes beginning to mandate programs in carceral settings to address treatment for OUD, harm reduction and opioid overdose reduction (Pourtaher et al., 2024).

Variation in healthcare delivery models, staffing and OEND implementation in jails

Correctional health in jails varied by state and county depending on contracted or county provided, or some hybrid service delivery. Correctional health staffing generally comprised some combination of nursing, prescribing provider, substance use counselor/social worker, and discharge or re-entry planner. As noted earlier, the dominant model for healthcare delivery reported in HCS communities was jails staffed with a combination of direct hires and externally contracted. OEND could be provided by varying staff and/or collaboration with community-based programs. One key to OEND strategy adoption is a flexible implementation approach for jail administrators based on their chosen model of delivery. Direct hiring of health and behavioral health staff available for OEND offers greater control over practices but is costly in terms of time, training and funding. An externally contracted staffing model can be more cost effective if evidence-based practices such as OEND are bundled into required services (McGladrey et al., 2024). Sufficient leadership including a champion, resources, and staffing support are needed to assure success of mandated interventions (Fortino et al., 2024).

In Kentucky, several jails were also able to incorporate educational content into communications devices available throughout the facility (e.g., iPads, kiosks). Jail staff could then track OE completion, simplifying the process by separating OE from ND and enabling tracking/quick identification of who should receive naloxone (Oser et al., 2024). In one urban jail, a vending machine was placed in the exit lobby to overcome staffing challenges, limited access for peer support specialists to move within the jail, and distrust of officers by individuals incarcerated at the facility. Individuals were able to access the machine at release (as were family/friends). To ensure education was provided while still addressing staffing and access challenges, an educational video was played in the booking area of the jail where individuals were held up to 4 hours while waiting to be processed into the facility. In general, facilities that had previous experience with naloxone via prior projects were more responsive to HCS' plan to target specific subsets rather than universal OEND; these facilities understood that universal naloxone distribution was expensive and occasionally resulted in discarded naloxone found in and around the facility. This targeted approach aligned with the "trialability" of the innovation (Oser et al., 2024; Rogers, 2003), with a specific focus on

Table 3 Descriptive information for Jail-based opioid overdose education and Naloxone distribution by condition, site, and rurality during the evaluation period

Outcome	Group	Intervention				Control			
		N (%)[1]	Communities Providing Service[2]	Total Responding Communities	%[3]	N (%)[1]	Communitiess Providing Service[2]	Total Responding Communities[2]	%[3]
Provide Overdose Education	**Overall**	31 (91.2)	24	31	77.4	29 (87.9)	16	29	55.2
	Research Site								
	Kentucky	8 (100.0)	5	8	62.5	8 (100.0)	1	8	12.5
	Massachusetts	8 (100.0)	8	8	100.0	7 (87.5)	7	7	100.0
	New York	7 (87.5)	6	7	85.7	8 (100.0)	6	8	75.0
	Ohio	8 (80.0)	5	8	62.5	6 (66.7)	2	6	33.3
	Urban/Rural								
	Urban	17 (89.5)	12	17	70.6	18 (94.7)	11	18	61.1
	Rural	14 (93.3)	12	14	85.7	11 (78.6)	5	11	45.5
Provide Naloxone Kits Upon Release	**Overall**	31 (91.2)	22	31	71.0	29 (87.9)	16	29	55.2
	Research Site								
	Kentucky	8 (100.0)	5	8	62.5	8 (100.0)	1	8	12.5
	Massachusetts	8 (100.0)	6	8	75.0	7 (87.5)	6	7	85.7
	New York	7 (87.5)	7	7	100.0	8 (100.0)	7	8	87.5
	Ohio	8 (80.0)	4	8	50.0	6 (66.7)	2	6	33.3
	Urban/Rural								
	Urban	17 (89.5)	12	17	70.6	18 (94.7)	12	18	66.7
	Rural	14 (93.3)	10	14	71.4	11 (78.6)	4	11	36.4

Note: The evaluation period lasted from July 1, 2021 through June 30, 2022

[1] Number of communities (%) within the specified group that are included in the calculation of the descriptive statistics provided. Communities with missing or undefined rates are excluded from the calculations within their respective waves and subgroups

[2] Sum of all communities in that group and Wave

[3] Percentage calculated as 100 multiplied by the sum of all communities with the outcome in that group and Wave divided by the sum of all communities in that group and Wave

Table 4 Effect of the CTH intervention on Jail-based opioid overdose education and Naloxone distribution during the evaluation period using the Intention-to-Treat population

Outcome	Inter-vention	Control	Unadjusted	Intervention	Control	Adjusted	*p*-value
	n/N* (%)	*n*/N* (%)	Relative Risk (95% CI)	Absolute Risk (95% CI)	Absolute Risk (95% CI)	Relative Risk (95% CI)[1]	
Provide overdose education[2]	26/33 (77.9)	17/32 (53.8)	1.45 (0.78, 2.68)	73.53 (58.15, 92.98)	48.81 (36.65, 65.00)	1.51 (1.09, 2.08)	0.013
Provide naloxone kits upon release[2]	24/33 (71.5)	17/32 (52.8)	1.35 (0.72, 2.56)	67.26 (51.32, 88.15)	45.03 (33.04, 61.38)	1.49 (1.05, 2.13)	0.027

Note. The evaluation period was between July 1, 2021 and June 30, 2022. The tests for effects were Poisson models with logistic link adjusting for urban-rural classification (urban, rural), research site (Kentucky, Massachusetts, New York, Ohio), baseline time indicator, and intervention group (Wave 1 Intervention, Wave 2 Control)

[1] Adjusted relative risk of Intervention communities over Control communities

[2] Outcome includes imputed values

*Count based on average estimate from imputed outcome

highly impacted populations (e.g., people in jail-based substance use treatment).

Massachusetts communities struggled to engage corrections as the communities were town-based (in contrast to other sites) whereas the jails (called Houses of Corrections or HOCs) are county-based, which means that the HOCs had a substantially larger focus and scope than individual towns. Thus, the coalitions struggled to engage the HOCs. Although several intervention communities in the same county employed an in-reach worker in the HOC who was able to distribute a small amount of naloxone, in general Massachusetts did not engage its jails in a systematic manner.

In New York, CTH coalitions frequently engaged the sheriff, undersheriff and warden overseeing jails to champion system change needed for OEND implementation. Advocacy for overdose education and state-provided naloxone was strong during the intervention period. The New York State Department of Health provides free naloxone to registered opioid overdose prevention programs

which could be a jail or community-based organization (CBO). OEND strategies varied by timing (i.e., could be provided at entry with naloxone being placed in personal belongings, offered upon release, from a vending machine or through a voucher to a CBO) and focused population (i.e., OEND for all detainees versus only those with OUD or SUD). Many NY jails shared a common contracted correctional health organization, but each contract still required localized negotiation of the scope of work to incorporate OEND.

In Ohio, two counties had existing jail-based OEND programs (one in each Intervention arm) and did not need to implement anything new with HCS. In the past, one Intervention county had an external agency volunteer to provide OEND to people being discharged; however, this effort failed due to poor organization that made the jail skeptical about pursuing an HCS OEND strategy. In general, OEND strategies in urban jails were easier to implement with jail administration and sheriff's departments involved in coalitions, tending to have more staff to administer these programs, more funding available, and less reports of stigmatizing language to community-engagement staff. They were more aware of current expectations regarding OEND from state partners and how addiction-related standard practices were evolving. Rural counties generally struggled to implement jail-based OEND. The sheriff's department and CLS representation were limited in rural coalitions. Partnerships between community organizations and the CLS were non-existent or weak. Staffing shortages were widespread, and funding for programs was limited outside of HCS. In general, rural communities struggled with more stigma and a perception that providing OEND represents addiction-enabling behavior. As Sheriffs are elected officials, concern for public opinion likely played a role in at least some of their hesitancy to engage. In some communities, HCS needed to demonstrate implementation success with OEND in other venues to develop buy-in from the coalition to then approve reaching out to the Sheriff about jail-based strategies.

Policy

Regulation changes helped assuage concerns about liability and legality from jail partners and might have impacted the impetus to provide naloxone at jail release. During COVID, the Kentucky Department of Corrections (KY-DOC) provided 17,000 naloxone units to prisons and jails for distribution to individuals being rapidly released (Oser et al., 2024). This action increased familiarity with naloxone and signaled DOC support to jails, facilitating OEND engagement. KY-DOC houses people convicted of class-C or D felonies in local jails for a daily detainment fee. The SAMHSA-sponsored Kentucky Opioid Response Effort (KORE) provided funds for the naloxone, as did the Office of Drug Control Policy (ODCP) via COSSUP funding. In 2019, New York ended the use of bail money and jail for most cases involving misdemeanors and lower-level felonies. The law, implemented in January 2020 as the CTH intervention was launched, sought to make release rather than detention the default in these cases and had the impact of reducing census in jails and requiring staffing adjustments. This along with COVID mandates for release and isolation required service delivery, including OEND, to be reconfigured excluding in-person community engagement and disrupting community partnerships for a period. In 2021, New York state passed a law (S1795/A533, executed October 2022) that requires jails to screen, assess and provide treatment during incarceration for SUD including all FDA-approved formularies for opioid use disorder, and re-entry planning. State implementation guidance and toolkit include harm reduction with OEND (Pourtaher et al., 2024). In Massachusetts, naloxone is already widely available for free from community agencies through a program of the Massachusetts Department of Public Health, which might have affected the jails perception of OEND need. The onset of COVID during the intervention resulted in a "Survival Kit Program" for Massachusetts residents released from incarceration in March of 2020. Similarly, New York and Ohio have substantial community naloxone programs (see Table S2) -- New York since 2006 and the Ohio Department of Health's Project DAWN (Deaths Avoided with Naloxone) since 2012 (Bohler et al., 2023). In both New York and Ohio, jail naloxone programs may partner with or become a program to obtain state-supplied naloxone.

Implications

These findings have several implications for jails interested in providing OEND at community release. Firstly, the significant effect of the CTH intervention on the number of jails providing both naloxone upon release and overdose education highlights the benefit of engaging local coalitions in promoting OEND and working with local jails on implementation strategies (e.g., connections to harm reduction agencies for OE programming or explicitly incorporating OEND in the scope of correctional health). Second, financial resources are needed for jail staff time to implement and oversee jail-based programs and to cover the cost of naloxone should the state not supply. While the FDA's March 2023 designation of 4-milligram naloxone hydrochloride nasal spray as an over-the-counter medication has reduced the cost of naloxone (U.S. Food & Drug Administration, 2023), it is unknown if this change has affected implementation in jail-based settings. Concerns still exist about the high price point and accessibility of the medication within key-impacted racial and ethnic communities (Hetrick,

2024; Pérez-Figueroa et al., 2023). Facilitated by implementation of the CTH intervention, jails can partner with local public health departments, harm reduction service providers, recovery community centers, state opioid abatement commissions, and/or SAMHSA-funded state opioid response efforts to reduce the financial barriers to implementing OEND (Oser et al., 2024). Third, correctional environments face substantial workforce challenges such as staff intention to quit and subsequent turnover (Stinchcomb & Leip, 2013). Due to staffing constraints, jails may not have the human resources to implement OEND programs. Technological solutions (e.g., the provision of OE through a course delivered on jail-based tablets or vending machine naloxone distribution) or interorganizational partnerships with local community agencies (e.g., recovery community centers) promoted by the CTH protocol (Sprague Martinez et al., 2020; Winhusen et al., 2020; Young et al., 2022) have been noted as reducing burden on jail staff in the OEND implementation process (Oser et al., 2024) and may help with tracking the number of naloxone units distributed. Jails interested in increasing data accuracy could collaborate with their jail management software systems to efficiently manage data of persons incarcerated (including data on the number of naloxone units distributed). Grella et al., 2021 provide a scoping review of factors influencing OEND in jails and other CLS settings that may be useful to community coalitions and jails implementing and sustaining OEND programming. Finally, stigma against people who use opioids and intervention stigma (i.e., stigmatizing attitudes toward EBPs used by stigmatized groups, such as naloxone) are widespread and need to be considered at all phases of overdose response (Davis et al., 2023; Madden et al., 2021) but can be addressed through community-engaged interventions such as the CTH (Davis et al., 2023).

Limitations

Data reported by the staff at the jail is subject to recall or reporting bias and staff turnover. Jails are limited in the data they customarily provide primarily reserved for state-level required performance factors. We had high rates of missingness across all outcome variables. Specifically, almost half (48%) of responses about the number of persons who received naloxone from the jail were missing. We also could not validate the accuracy of the data provided by the jails. Thus, the quality and completeness of these data cannot be ascertained as the jails generally did not have processes in place to systematically report historical naloxone distribution. Further, individuals providing responses to the survey may not have been the same individuals in charge of providing OEND on release. An effort to mitigate this limitation was engaging teams to report within the facility to represent administration and healthcare. Most communities had one jail associated with them, which limited the sample size for the study. Missing data and possible contamination from jails serving more than one community assigned to differing study conditions such as in Massachusetts with further limited power and thus caution is warranted in making inferences. Finally, this analysis does not examine access to OEND at the individual level with demographics needed to inform equitable access by race/ethnicity and gender central to the CTH intervention.

Conclusion

The CTH intervention was associated with an expansion in OEND during incarceration and upon release in jails in HCS communities and should be considered an effective, community-engaged intervention to promote this evidence-based practice. Although more can be done to capture the rate of naloxone kits distributed, the significant increase in the number of jails educating people who are incarcerated about the signs of overdose and providing them with naloxone and how to use it upon re-entry into their communities means that more naloxone is in the hands of knowledgeable people at elevated risk of fatal opioid overdose to help prevent fatal opioid overdose. The provision of naloxone saves lives, allowing people to survive and engage in recovery work (Townsend et al., 2020). County- and state-level policymakers should expand OEND programming in jail-based settings as a strategy to reduce overdose-related mortality.

Supplementary Information

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Supplementary Material 1

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Author contributions

Concept and design: RKC, NE, LG, PDF, BF, TH, MWK, EO, KBO, SLW, GZ. Acquisition, curation, analysis, or interpretation of data: JLD, LD, SF, PDF, DRH, TH, PAL, EO, CBO, NM, MRR, ES, SLW, GZ. Drafting of the manuscript: PB, RKC, PDF, BF, DRH, KH, TH, KBO, NM, JGS. Critical revision of the manuscript for important intellectual content: PDF, LG, SH, BE, AA, MB, PB, MB, AGC, JLD, NE, DGE, SG, HH, SH, DRH, MH, TH, EK, CK, MWK, PAL, ML, MM, FM, SM, CBO, JP, MRR, SS, JGS, MS, DSW, HLS, SLW, JW, GZStatistical analysis: LD, BE, JH, CK, PAL, EO. Obtained funding: NE, CK, EO, SLW, JW. All authors reviewed, edited, and approved the final manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
This study protocol (Pro00038088) was approved by Advarra Inc., the HEALing Communities Study Single Institutional Review Board. Consent to participate was not required by the Advarra IRB for this project because it is an analysis of implementation at the community and agency level rather than at the individual human participant level.

Consent for publication
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Competing interests
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