



Original Investigation | Substance Use and Addiction

Patient Navigation Plus mHealth Incentives for Linkage to OUD Care for Adults Who Also Use Methamphetamines

A Pilot Randomized Clinical Trial

Elenore P. Bhatraju, MD, MPH; Kaitlin A. Zinsli, PhD, MPH; Devin N. Kennedy, BA; Alexander J. Gojic, MS; Matthew Iles-Shih, MD, MPH; Joseph O. Merrill, MD, MPH; Elizabeth C. Speaker, MS; Jeffrey H. Samet, MD, MA, MPH; Kevin A. Hallgren, PhD; Judith I. Tsui, MD, MPH

Abstract

IMPORTANCE Hospitalization is common among people with opioid use disorder (OUD) and is recognized as a reachable moment to start treatment. Methamphetamine use among people with OUD is associated with decreased linkage to postdischarge OUD care.

OBJECTIVE To determine the feasibility, acceptability, and exploratory clinical outcomes of a pilot randomized clinical trial (RCT) of an adherence-focused mobile health (mHealth) intervention aiming to increase linkage to and retention in outpatient buprenorphine services for patients hospitalized with OUD and methamphetamine use.

DESIGN, SETTING, AND PARTICIPANTS This single-site, 2-arm pilot RCT was conducted from January 3, 2024, to April 14, 2025, at a single-site, large urban safety net hospital in Seattle, Washington. Patients 18 years or older were eligible if they had initiated buprenorphine for OUD while in the hospital and had used methamphetamine within the past 30 days. Participants were randomized to the mHealth Incentivized Adherence Plus Patient Navigation (MIAPP) intervention or to treatment as usual (TAU).

INTERVENTION The MIAPP intervention combined financial incentives via mHealth-based adherence monitoring with a patient navigator (PN) during the first 30 days after discharge.

MAIN OUTCOMES AND MEASURES Feasibility was assessed by meeting the target enrollment of 40 participants and intervention delivery. Acceptability was measured by patient satisfaction ratings on a scale from 0 to 10, with 0 indicating not at all satisfied and 10 indicating extremely satisfied. The main pilot clinical outcome was linkage to outpatient OUD care within 30 days of hospital discharge, defined as medications for OUD being prescribed or dispensed. Other outcomes included retention in buprenorphine treatment and hospital readmissions at 90 days; past 30-day methamphetamine use was measured at the 30-day follow-up visit.

RESULTS The target enrollment of 40 participants (mean [SD] age, 43.4 [12.6] years) was met. Most participants (33 [82.5%]) were male. The intervention was allocated to 20 participants and delivered to 19 (95.0%); 20 participants received TAU. Participants reported being highly satisfied with the PN, with a mean (SD) patient satisfaction rating of 9.9 (0.3). Linkage to OUD care at 30 days occurred in 11 participants (55.0%) in the intervention arm compared with 10 (50.0%) in the TAU arm (risk ratio, 1.10; 95% CI, 0.61-1.99).

(continued)

Key Points

Question Is an intervention to improve linkage from inpatient to outpatient opioid use disorder (OUD) care for people who use both opioids and methamphetamine feasible and acceptable?

Findings In this pilot randomized clinical trial of 40 hospitalized adults with OUD, the combination of a patient navigator with mobile health-based incentives was both feasible and acceptable.

Meaning Further implementation and effectiveness research is warranted to evaluate this linkage intervention for a particularly vulnerable population.

+ [Visual Abstract](#)

+ [Supplemental content](#)

Author affiliations and article information are listed at the end of this article.

Open Access. This is an open access article distributed under the terms of the CC-BY-NC-ND License, which does not permit alteration or commercial use, including those for text and data mining, AI training, and similar technologies.

Abstract (continued)

CONCLUSIONS AND RELEVANCE In this pilot RCT of the MIAPP intervention, study procedures were feasible and acceptable. While no difference in linkage rates was noted in this pilot study, larger studies are needed to determine intervention effectiveness.

TRIAL REGISTRATION ClinicalTrials.gov Identifier: [NCT06027814](https://clinicaltrials.gov/ct2/show/study/NCT06027814)

JAMA Network Open. 2026;9(10):e2638542. doi:[10.1001/jamanetworkopen.2026.38542](https://doi.org/10.1001/jamanetworkopen.2026.38542)

Introduction

Hospitalization is common among people with opioid use disorder (OUD)^{1,2} and is recognized as a reachable moment to start treatment.³ Starting medications for opioid use disorder (MOUD), particularly buprenorphine, while patients are hospitalized is becoming more common and has been shown to improve engagement in postdischarge substance use treatment and decrease use.⁴⁻⁶ However, substantial attrition is observed after people leave the hospital, and this linkage is an important step in the cascade of care spanning prevention to recovery, as described by Williams et al.⁷ Multiple studies show a linkage rate from inpatient to outpatient care of 50% or lower.⁸⁻¹⁰ There is an urgent need to improve this step in the cascade of care.

The rise of stimulant use, specifically co-use of opioids and methamphetamine, has been coined the “fourth wave” of the overdose epidemic.¹¹ Methamphetamine use is associated with worse treatment outcomes among people with OUD.¹²⁻¹⁵ Patients receiving buprenorphine who use methamphetamine are less likely to link from inpatient to outpatient care,¹⁴ less likely to stay in treatment,¹³ and more likely to continue to use opioids.¹¹ We are not aware of interventions focused on people with OUD who also use methamphetamine. Therefore, we designed this pilot study of a mobile health (mHealth) intervention to improve linkage to outpatient care for hospitalized patients with OUD who also use methamphetamine and start buprenorphine.¹⁶

The mHealth Incentivized Adherence Plus Patient Navigation (MIAPP) intervention combines use of a smartphone-based application for remote medication monitoring and financial incentives with the human connection and motivational enhancement from a patient navigator (PN). Remote medication monitoring has been studied among people taking buprenorphine for OUD and has been found to be acceptable.^{17,18} For patients with stimulant use disorders, contingency management is one of the most effective strategies for treating and retaining people in treatment.¹⁹ Incorporation of a smartphone app and app-based payment for a contingency management intervention was feasible and acceptable in a pilot study that rewarded clinic attendance and negative urine toxicology results for people taking buprenorphine.²⁰ PNs have been found to be effective in reducing readmissions and subsequent acute care use among hospitalized patients with substance use disorders (SUDs).²¹

While prior studies have looked at the components of the intervention separately, this is the first intervention we know of to combine a PN with incentivized medication adherence. The population of people with OUD who also use methamphetamine is particularly vulnerable and underrepresented in research. The MIAPP intervention was developed using the information, motivation, behavioral skills behavior change (IMB) model.²² We hypothesized that an intervention based on the IMB model—that combines financial incentives for medication and appointment adherence with a PN who provides support, coaching, and motivational enhancement—has the potential to improve retention in buprenorphine care for hospitalized patients who use methamphetamine. This study reports on the feasibility, acceptability, and exploratory clinical outcomes of a pilot randomized clinical trial (RCT) of the MIAPP intervention.

Methods

Study procedures for this pilot RCT were approved by the University of Washington Institutional Review Board. The study was conducted from January 3, 2024, to April 14, 2025. All participants provided written informed consent, which was obtained by study staff in person after explaining the consent form and allowing time for questions. The study followed the Consolidated Standards of Reporting Trials (CONSORT)²³ and the Consolidated Standards of Reporting Trials Extension to Randomized Pilot and Feasibility Trials (CONSORT Extension) reporting guidelines.

Study Design

The study design and the trial protocol have been described previously (Supplement 1).¹⁶ In brief, this 2-arm pilot RCT compared the MIAPP intervention plus treatment as usual (TAU) with TAU alone. The sample size of 40 was chosen based on anticipated feasibility of enrollment over a 1-year period.¹⁶ Participants randomized to the intervention arm received financial incentives for submitting videos of themselves taking buprenorphine via a smartphone app, and they worked with a PN who provided treatment adherence coaching, care coordination, and motivational enhancement.

Study Setting

The study took place at a single, large urban safety net hospital in Seattle, Washington, which serves as a level I trauma hospital for 4 states. The hospital has an established addiction consultation service (ACS) composed of a multidisciplinary team of physicians, nurse practitioners, registered nurses, peer support specialists, and administrators who specialize in the treatment of SUDs. The ACS is available to all inpatient hospital services (eg, medical, surgical, and psychiatric) and provides medication management recommendations, behavioral and harm reduction counseling, and support connecting with outpatient care.

Participants

Study staff worked closely with the ACS to identify potential participants. Staff were present during the morning team huddle when the patient list was discussed and flagged patients who met the study eligibility criteria. Patients who initiated buprenorphine for OUD while hospitalized were approached by the study staff for screening. Eligibility criteria were as follows: aged 18 years or older, English speaking, admitted to any inpatient service, initiated sublingual buprenorphine for OUD while in the hospital or at the time of discharge, planning to continue sublingual buprenorphine as an outpatient, methamphetamine use within the past 30 days, willingness to be randomized to the intervention, and willing and able to use a smartphone (which the study provided if the patient did not have one) on discharge. Exclusion criteria were as follows: cognitive impairment (acute or chronic) resulting in the inability to provide informed consent per study clinician judgment; current incarceration or planned discharge to jail or prison; exhibition of significant, active behavioral risks per the judgment of the research team; and discharge to a setting that would prohibit the use of a telephone. Cognitive status was assessed by the study team, with consultation from ACS clinicians or study clinicians if needed.

Study Procedures

Participants completed a baseline assessment on self-reported demographic data (age, sex, race and ethnicity, and other factors) and substance use patterns. Race and ethnicity data were collected in this study to ensure the generalizability of our findings across diverse patient populations. Participants self-reported race and ethnicity as American Indian or Alaska Native, Asian, Black or African American, Hispanic, or White. The baseline assessment occurred in person with a research coordinator (A.J.G. or D.N.K.) prior to discharge and lasted approximately 30 to 45 minutes. Afterward, participants were randomized using a research electronic data capture (REDCap) randomization module. Randomization occurred with permuted block sizes of 4 and was stratified by

whether the patient had received buprenorphine treatment in the prior year. The randomization sequence was generated by the study analyst (K.A.H.) and was concealed to participants and all other study staff. Participants, the PN, and study staff completing follow-up interviews were aware of study arm assignments once they were made; the study analyst remained blinded to study arm assignments. For a complete list of study measures and procedures, see the protocol by Bhatraju et al reported previously.¹⁶

Follow-up visits were conducted at 30 days after discharge. Visits lasted approximately 15 to 20 minutes and were conducted in person or over the telephone. The follow-up assessment included demographics, substance use patterns, medication adherence, and point-of-care urine toxicology testing. Urine toxicology data were not collected if the visit occurred by telephone. Adverse events (including any rehospitalizations) were defined and assessed systematically, collected in REDCap, and reviewed by a data and safety monitoring board.

Intervention

Participants were randomized to receive either TAU or the intervention (MIAPP plus TAU). The TAU arm was seen and followed by the ACS while hospitalized. The ACS provides medication recommendations to primary teams and assists with scheduling follow-up appointments. Patients followed by the ACS may also be seen by peer support specialists at the request of the team. The peer support specialists typically see the patient up to a few times while hospitalized but do not follow patients or provide any counseling after they leave the hospital.

The intervention group received TAU plus MIAPP. Prior to discharge and fitting within the IMB model, the PN met with the participant to provide motivational enhancement, care planning, and instruction on the mHealth smartphone application. After discharge, the PN completed weekly visits with participants. Patients used the Health Insurance Portability and Accountability Act-compliant, cloud-based mHealth application to securely transfer asynchronous time-stamped videos of themselves taking medications, which were viewed by the PN to confirm medication adherence on a daily basis. Participants were instructed to show their medication prior to taking and record for at least 3 minutes after placing sublingual buprenorphine under the tongue. The application also facilitated video check-ins, 2-way chats, and tracking of financial incentives. The PN role was filled by research coordinators (D.N.K. and A.J.G.), who received motivational enhancement training prior to study initiation. Fidelity to the intervention was monitored through quarterly audits and feedback sessions with the PN and study staff. Research staff completed checklists for PN activities completed during the initial visit that were reviewed to ensure intervention fidelity. The principal investigator or co-principal investigator (J.I.T. or E.P.B.) reviewed the initial week of videos submitted for the first 10 enrolled participants.

In addition, the MIAPP intervention used financial incentives for medication adherence. In the intervention arm, participants received up to \$520 in financial incentives, including \$70 for linkage to an outpatient buprenorphine clinic and \$15 for each video documenting daily adherence to medication for up to 30 days ($\leq \$450$).

Outcomes

The primary goal of this study was to establish evidence of feasibility and acceptability of the MIAPP plus TAU intervention and research procedures, as assessed by our ability to fully recruit the planned sample of 40 and deliver the intervention. At the 30-day follow-up, participants also answered the following acceptability questions on a scale from 0 to 10, with 0 indicating not at all satisfied and 10 indicating extremely satisfied: "How satisfied were you with the services you received from your Patient Navigator, overall?" and "How helpful were the services you received from your Patient Navigator?"

Linkage to outpatient MOUD care within 30 days of hospital discharge was the main clinical effectiveness outcome. This measure, based on prior research, is defined as documentation of an outpatient clinical encounter (either in person or via telemedicine) in which MOUD (buprenorphine,

naltrexone, or methadone) is provided or prescribed.²⁴ The outcome was ascertained with the following data sources: (1) direct review of University of Washington electronic health records or records obtained from outside organizations via release of information requests if the participant self-reported outside linkage; and (2) Medicaid claims and encounter data indicating receipt of buprenorphine, methadone, or naltrexone from pharmacy or Centers for Medicare & Medicaid Services Healthcare Common Procedure Coding System records derived from the statewide ProviderOne database or the Behavioral Health Data System (BHDS) accessed by the Washington Department of Social and Health Services Research and Data Analysis Division. If a participant was not found to have a record of receiving MOUD within 30 days after discharge from any of these sources, they were categorized as not having linked to outpatient treatment. Because of restrictions on accessing data for research, we did not use data from the Washington State Prescription Monitoring Program.

Other secondary clinical outcomes included MOUD retention, hospital readmissions and emergency department (ED) visits, and past 30-day opioid and methamphetamine use. MOUD retention was measured as the number of days with MOUD treatment coverage (buprenorphine, naltrexone, or methadone) over the 90 days after discharge based on Medicaid claims data (for buprenorphine and naltrexone) and BHDS data (for methadone). The number of hospital admissions and ED visits within 90 days of discharge was based on Medicaid claims data. Past 30-day opioid and methamphetamine use was defined as the number of days using illicit opioids and methamphetamine in the past 30 days per self-report at the 30-day follow-up interview through the modified Addiction Severity Index.²⁵

Statistical Analysis

We first described recruitment and enrollment (feasibility), intervention delivery, and patient satisfaction (acceptability). Sample demographic and behavioral characteristics were analyzed descriptively. For our clinical outcome of linkage to outpatient MOUD care, we used Poisson regression with robust SEs to calculate the relative risk of linking by treatment group, with significance defined as $P < .05$. For our outcome of days of MOUD retention, we used linear regression to estimate the mean difference in days between the intervention and TAU groups. For all other outcomes, we used negative binomial regression with robust SEs to calculate the incidence rate ratios (IRRs). For outcomes derived from clinical records (eg, treatment linkage, inpatient readmissions, ED admissions, and MOUD retention), there were no missing data, as an absence of treatment records was assumed to indicate no such services. We conducted a sensitivity analysis restricted to participants with Medicaid. For patient-reported outcomes, analyses only included participants who completed the self-report measure at follow-up. All statistical analyses were performed using R, version 4.4.1 (R Project for Statistical Computing).

Results

Enrollment and Follow-Up

This study met our feasibility goal of enrolling 40 participants between January 3, 2024, and January 7, 2025. There were 208 patients identified as potentially eligible (**Figure 1**). Of those patients, 58 (27.9%) completed screening. The 3 most common reasons for not completing the screening were (1) the patient was not prescribed buprenorphine for OUD (77 [51.3%]), (2) the research staff were unable to screen before discharge (31 [20.7%]), and (3) the patient declined research participation (14 [9.3%]). Of the 58 patients screened, 46 (79.3%) were eligible. Of these 46, 40 (87.0%) agreed to participate and were enrolled, with 20 randomized to MIAPP plus TAU and 20 randomized to TAU. One participant randomized to the intervention arm did not receive the intervention because they were discharged before study staff could complete the baseline patient navigation session and could not be contacted after discharge. The 30-day follow-up interviews were completed for 25 of the 40 participants (62.5%). Twenty-nine participants (72.5%) had Medicaid outcome data available for the

90 days after hospital discharge (1 additional person had Medicaid coverage for part of the 90-day period after hospital discharge and was seen not to link within 30 days); this did not differ between the MIAPP (16 [80.0%]) and TAU (13 [65.0%]) groups.

Baseline Characteristics

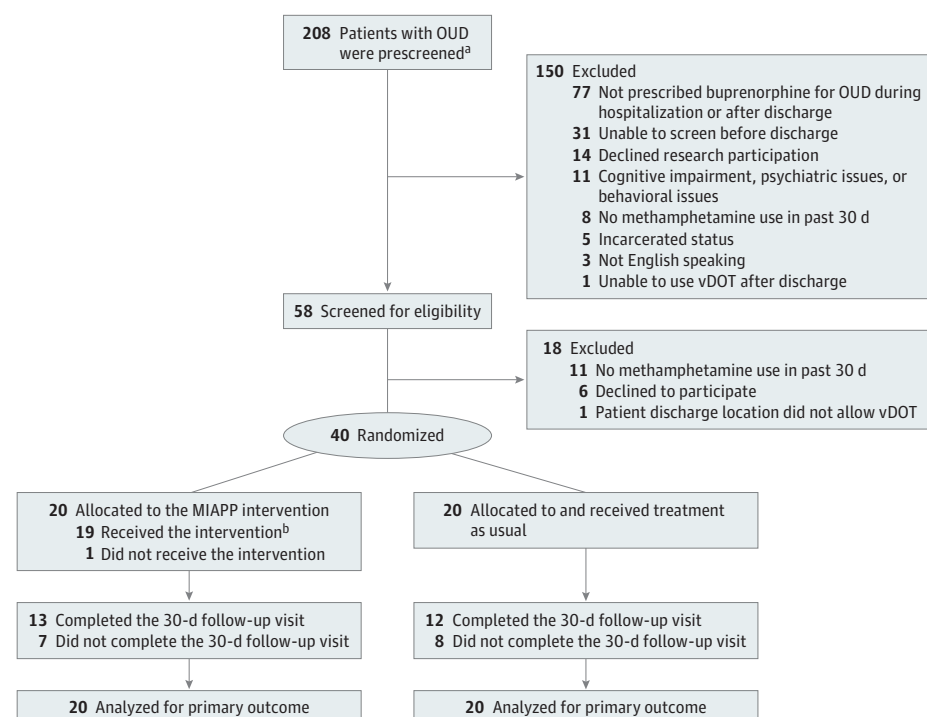
Among the 40 participants, 7 (17.5%) were female and 33 (82.5%) were male (**Table 1**). Participants identified as American Indian or Alaska Native (1 [2.5%]), Asian (4 [10.0%]), Black or African American (5 [12.5%]), Hispanic (5 [12.5%]), or White (25 [62.5%]). Their mean (SD) age was 43.4 (12.6) years (range, 23-69 years). Nearly half (19 [47.5%]) reported living on the street, and the majority (31 [77.5%]) self-reported having Medicaid insurance at baseline. In terms of baseline past 30-day substance use patterns, 13 (32.5%) reported injection drug use and 30 (75.0%) reported using at least 1 other drug in addition to opioids and methamphetamine (**Table 2**).

A larger proportion of study participants who did not have a follow-up visit reported less than high school education compared with those who completed follow-up visits (8 of 15 [53.3%] vs 2 of 25 [8.0%]); demographic characteristics were otherwise similar (eTable 1 in [Supplement 2](#)). When comparing participants without vs with Medicaid data availability, those without available Medicaid data more commonly had high school education or greater (9 of 11 [81.8%] vs 21 of 29 [72.4%]) and full-time or part-time employment (2 of 11 [18.2%] vs 2 of 29 [6.9%]) (eTable 2 in [Supplement 2](#)).

Clinical Outcomes

For the 30-day MOUD treatment linkage outcome, 11 participants (55.0%) in the MIAPP arm linked to outpatient MOUD care compared with 10 (50.0%) in the TAU arm (**Table 3**). The risk ratio (RR) was 1.10 (95% CI, 0.61-1.99) when comparing MIAPP with TAU. The mean (SD) number of days with MOUD coverage in the 90 days after hospital discharge was 18.7 (19.3) in the MIAPP arm and 23.9 (26.6) in the TAU arm (mean difference, -5.20; 95% CI, -20.06 to 9.66). The mean (SD) number of inpatient hospitalizations in the 90 days after discharge was 0.1 (0.3) in the MIAPP arm compared with 0.9 (1.3) in the TAU arm (IRR, 0.11; 95% CI, 0.03-0.48). The mean (SD) number of ED encounters

Figure 1. CONSORT Flow Diagram



MIAPP indicates mHealth Incentivized Adherence Plus Patient Navigation; OUD, opioid use disorder; vDOT, video directly observed therapy.

^a Patients on the addiction consultation service list were flagged as potential participants (ie, were planning to start or had started buprenorphine).

^b Participants met with a patient navigator and received the app plus training.

in the MIAPP arm was 0.4 (1.0) compared with 0.7 (1.1) in the TAU arm (IRR, 0.57; 95% CI, 0.16-2.03). The mean (SD) number of days reported using opioids and methamphetamine, respectively, was 4.7 (7.2) days and 4.8 (7.6) days in the MIAPP arm compared with 3.7 (8.6) days and 5.8 (11.4) days in the TAU arm (opioid use days: IRR, 1.28 [95% CI, 0.29-5.76]; methamphetamine use days: IRR, 0.82 [95% CI, 0.21-3.13]). The results of sensitivity analysis restricted to only include participants with Medicaid was not notably different. For the MIAPP arm, there was a mean (SD) of 1.8 (1.6) PN

Table 1. Baseline Characteristics of Hospitalized Patients With Opioid Use Disorder and Methamphetamine Use Who Initiated Buprenorphine^a

Characteristic	All patients (N = 40)	TAU arm (n = 20)	MIAPP arm (n = 20)
Age, mean (SD), y	43.4 (12.6)	45.7 (13.2)	41.2 (11.9)
Sex			
Female	7 (17.5)	3 (15.0)	4 (20.0)
Male	33 (82.5)	17 (85.0)	16 (80.0)
Race and ethnicity			
Hispanic	5 (12.5)	4 (20.0)	1 (5.0)
Non-Hispanic American Indian or Alaska Native	1 (2.5)	1 (5.0)	0
Non-Hispanic Asian	4 (10.0)	2 (10.0)	2 (10.0)
Non-Hispanic Black or African American	5 (12.5)	4 (20.0)	1 (5.0)
Non-Hispanic White	25 (62.5)	9 (45.0)	16 (80.0)
Relationship status			
Married or living with partner	3 (7.5)	0	3 (15.0)
Not married or living with partner ^b	37 (92.5)	20 (100)	17 (85.0)
Dependents			
Zero dependents ^c	30 (75.0)	17 (85.0)	13 (65.0)
Education status			
Less than high school	10 (25.0)	6 (30.0)	4 (20.0)
High school diploma or GED	17 (42.5)	7 (35.0)	10 (50.0)
Some college or associate degree	9 (22.5)	5 (25.0)	4 (20.0)
≥4 y of college	4 (10.0)	2 (10.0)	2 (10.0)
Employment status			
Full-time or part-time employed	4 (10.0)	3 (15.0)	1 (5.0)
Unemployed	26 (65.0)	13 (65.0)	13 (65.0)
Disabled	4 (10.0)	1 (5.0)	3 (15.0)
Other ^d	6 (15.0)	3 (15.0)	3 (15.0)
Housing status			
Own or rent	6 (15.0)	2 (10.0)	4 (20.0)
Staying with friends, family, or other	15 (37.5)	7 (35.0)	8 (40.0)
Street	19 (47.5)	11 (55.0)	8 (40.0)
Incarcerated in the past 3 mo	9 (22.5)	5 (25.0)	4 (20.0)
Insurance type ^e			
Private health plan	1 (2.5)	0	1 (5.0)
Medicaid	31 (77.5)	16 (80.0)	15 (75.0)
Medicare	4 (10.0)	1 (5.0)	3 (15.0)
Other or unsure	4 (10.0)	3 (15.0)	1 (5.0)
Primary diagnosis at hospital discharge			
Trauma	15 (37.5)	7 (35.0)	8 (40.0)
Infection	17 (42.5)	9 (45.0)	8 (40.0)
Kidney dysfunction or ESKD	1 (2.5)	1 (5.0)	0
Other	7 (17.5)	3 (15.0)	4 (20.0)

Abbreviations: ESKD, end-stage kidney disease; GED, general educational development; MIAPP, mHealth Incentivized Adherence Plus Patient Navigation; MOUD, medications for opioid use disorder; TAU, treatment as usual.

^a Unless indicated otherwise, values are presented as the No. (%) of participants.

^b Includes individuals who reported being widowed, separated, divorced, and never married.

^c The reference group is individuals with at least 1 dependent.

^d Other employment status includes individuals who reported being retired or having other status.

^e Insurance status was self-reported and does not 100% reflect availability of Medicaid outcome (treatment linkage, MOUD retention, hospitalization) data during the study period.

sessions per participant (**Figure 2A**). Participants in the intervention arm submitted a mean (SD) of 11.9 (10.3) videos documenting buprenorphine adherence in the 30 days after discharge (**Figure 2B**). Participants in the intervention arm received a mean (SD) of \$213.75 (\$179.75) for MOUD treatment linkage and video submissions. The initial PN checklist was complete for all participants who were assigned to the intervention, except for 2 participants: one participant completed 89% of checklist items, and the other was discharged prior to receiving the intervention and completed no items.

There were 13 participants in the intervention arm who completed the follow-up satisfaction questionnaire. Participants reported high satisfaction with the PN (mean [SD], 9.9 [0.3] of 10) and the PN's helpfulness (mean [SD], 9.7 [0.9] of 10).

There were 36 documented adverse events (eTable 3 in [Supplement 2](#)). Most adverse events (34 [94.4%]) were ED admissions or rehospitalizations; none were determined to be related to the study.

Table 2. Study Population Substance Use Behaviors by Treatment Group at Baseline^a

Characteristic	All patients (N = 40)	TAU arm (n = 20)	MIAPP arm (n = 20)
Injected drugs in the past 30 d	13 (32.5)	6 (30.0)	7 (35.0)
Substance use in the past 30 d ^{b,c}			
Heroin	16 (40.0)	8 (40.0)	8 (40.0)
Fentanyl	38 (95.0)	18 (90.0)	20 (100)
Prescription opioids	9 (22.5)	4 (20.0)	5 (25.0)
Methamphetamine ^d	38 (97.4)	18 (94.7)	20 (100)
Amphetamine	0	0	0
Cocaine	12 (30.0)	7 (35.0)	5 (25.0)
Marijuana	26 (65.0)	12 (60.0)	14 (70.0)
Synthetic marijuana	1 (2.5)	0	1 (5.0)
Hallucinogen	5 (12.5)	4 (20.0)	1 (5.0)
Benzodiazepines ^d	6 (15.4)	4 (21.1)	2 (10.0)
Alcohol	16 (40.0)	9 (45.0)	7 (35.0)
Substances used in the past 30 d, mean (SD), No. ^c	4.0 (1.6)	3.9 (1.7)	4.1 (1.5)
Used ≥1 other drug in addition to opioids and methamphetamine in the past 30 d ^c	30 (75.0)	14 (70.0)	16 (80.0)

Abbreviations: MIAPP, mHealth Incentivized Adherence Plus Patient Navigation; TAU, treatment as usual.

^a Unless indicated otherwise, values are presented as the No. (%) of participants.

^b Substance use categories are not mutually exclusive. Participants could report more than 1 substance.

^c Two included individuals did not answer every single question about every substance to be included.

^d Responses were missing for 2 participants (one each for the questions on methamphetamine use and benzodiazepine use in the past 30 days).

Table 3. Clinical Outcomes by Treatment Group^a

Outcome	TAU arm (n = 20)	MIAPP arm (n = 20)	Effect estimate (95% CI)	P value
Linked to buprenorphine, No. (%)	10 (50.0)	11 (55.0)	1.10 (0.61-1.99) ^b	.75
Clinical outcome assessed in the 90 d after discharge, mean (SD)				
MOUD coverage, d	23.9 (26.6)	18.7 (19.3)	-5.20 (-20.06 to 9.66) ^c	.48
Inpatient hospitalizations, No.	0.9 (1.3)	0.1 (0.3)	0.11 (0.03-0.48) ^d	.003
ED outpatient admissions, No.	0.7 (1.1)	0.4 (1.0)	0.57 (0.16-2.03) ^d	.39
Substance use in the 30 d before follow-up, mean (SD) ^e				
Opioid use, d	3.7 (8.6)	4.7 (7.2)	1.28 (0.29-5.76) ^d	.75
Methamphetamine use, d	5.8 (11.4)	4.8 (7.6)	0.82 (0.21-3.13) ^d	.77

Abbreviations: ED, emergency department; MIAPP, mHealth Incentivized Adherence Plus Patient Navigation; MOUD, medications for opioid use disorder; NA, not applicable; TAU, treatment as usual.

^a Unless indicated otherwise, values are presented as the mean (SD).

^b The risk ratio was calculated via Poisson regression with robust SEs.

^c The mean difference was calculated via linear regression.

^d Incidence rate ratios were calculated via negative binomial regression with robust SEs.

^e Follow-up data for 15 individuals were missing due to not attending the follow-up visit.

Discussion

This pilot RCT demonstrated the feasibility and acceptability of a novel intervention to improve linkage to outpatient care for patients with OUD and methamphetamine use, who started buprenorphine for the treatment of OUD in the hospital. We reached our recruitment goal of 40 hospitalized patients and delivered the intervention to 95.0% of those randomized to the intervention. Participants reported high levels of satisfaction with the intervention and with the PN. Linkage to outpatient MOUD care was 55.0% in the MIAPP arm and 50.0% in the TAU arm.

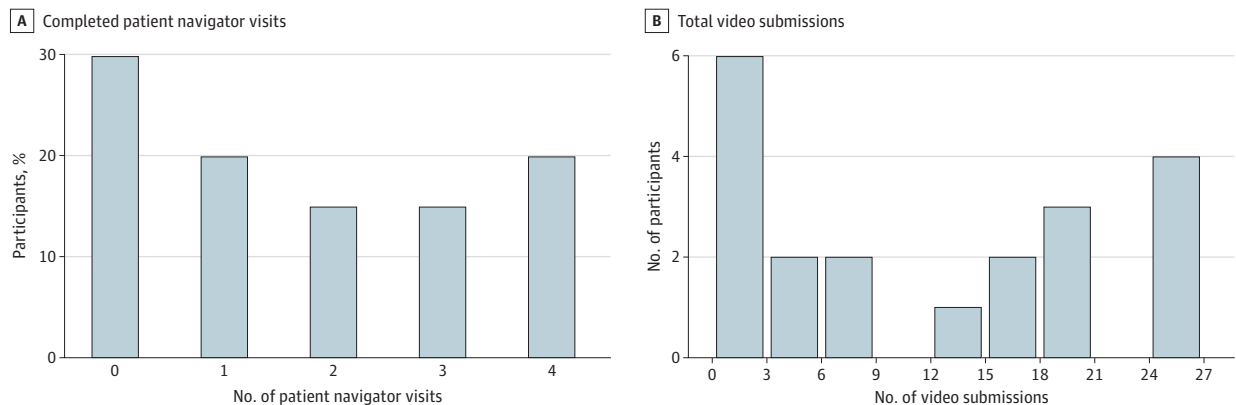
This is the first study we are aware of targeting MOUD treatment linkage outcomes specifically for people with OUD who also use methamphetamine. The treatment linkage rate of approximately 50% in both arms is consistent with prior study findings examining buprenorphine continuation after hospitalization.^{8,26} These results underscore that the 30-day period after hospital discharge is a critical time in the care cascade that would benefit from service enhancements to better facilitate MOUD treatment linkage. This may be especially important for people with OUD who also use methamphetamine, as we have seen that the MOUD treatment linkage rates for this group are 40% lower than among people with OUD who do not use methamphetamine.¹⁵ Participants in the MIAPP arm had fewer hospital admissions during the 90-day postdischarge follow-up period. Although the numbers were small in both arms and this result did not account for our assessing multiple secondary outcomes, this finding could be further explored in a larger trial.

The MIAPP intervention is novel in that it combines multiple approaches to improving MOUD treatment linkage: financial incentives for medication adherence, personal motivational coaching from a navigator, and use of a video-based mobile app. The financial incentives are an adaptation of contingency management (CM), a care model based on operant conditioning in which a desired behavior is reinforced with a positive reward.²⁷ Prior studies of CM for OUD rewarded abstinence as determined by urine drug testing and provided prize-based awards.²⁸ The use of a mobile app to provide financial incentives for medication adherence is a novel adaptation. We previously conducted research among people with OUD taking buprenorphine in the outpatient setting without use of financial incentives,¹³ and we observed low rates of video submissions; the financial incentives in the current trial possibly led to more frequent video submissions.

Use of mobile apps for check-ins and reminders has been shown previously to be acceptable to patients taking buprenorphine,²⁹ with recommended improvements including personalization and real-time responses. The MIAPP intervention provided these characteristics by using a mobile app platform paired with a PN.

In addition to the outcomes reported in this study, important lessons were learned regarding enrollment of hospitalized patients with OUD who are initiating buprenorphine. First, there were challenges to screening and enrolling participants while they were hospitalized. For example, many

Figure 2. Bar Graphs of the Distribution of Completed Patient Navigator Visits and Total Video Submissions by the Intervention Group



patients were discharged before screening and enrollment could be completed. Additionally, patients often received medical interventions that interrupted or delayed study screening, enrollment, or baseline interviews.

Second, the study occurred during a clinical practice change regarding the use of long-acting injectable (LAI) buprenorphine. Over the study period, the ACS implemented a pathway to enable patients to initiate LAI formulations of buprenorphine. As a result, fewer patients were eligible for the study, which required initiation and continuation of sublingual buprenorphine. Despite this change, we were still able to meet enrollment targets. While LAI buprenorphine is increasingly becoming available, the dominant form of buprenorphine is still the sublingual formulation.³⁰

Limitations

This study has several limitations. It was conducted at a single urban hospital with a robust multidisciplinary ACS and therefore may not be generalizable to other health care settings and services. However, the hospital is a level I trauma hospital that serves multiple states with predominantly rural populations and thus sees a variety of patients with a wide variety of medical needs, risks, and follow-up complexity. The outcomes relating to MOUD retention, hospital readmissions, and ED visits were only captured by Medicaid data, but missingness did not differ significantly between treatment arms. The rate of completed 30-day follow-up visits was somewhat low (62.5%), which speaks to the difficulty in achieving longitudinal follow-up with members of this patient population and thus the limitations of self-report measures for outcome ascertainment—an issue we anticipated and attenuated by collecting electronic health record and Medicaid claim records for the linkage outcome measurement. In future trials, we will collect information on potential connections through community programs, shelters, case managers, and syringe service programs. Finally, research staff who conducted the follow-up visits were not blinded to participant group assignments, which could introduce interviewer bias.

Conclusions

In this pilot RCT, the MIAPP intervention was feasible and acceptable. Further research is needed to establish the effectiveness of interventions like MIAPP to ensure that patients who initiate MOUD while hospitalized can be linked to and retained in MOUD treatment care.

ARTICLE INFORMATION

Accepted for Publication: August 18, 2026.

Published: October 13, 2026. doi:10.1001/jamanetworkopen.2026.38542

Open Access: This is an open access article distributed under the terms of the [CC-BY-NC-ND License](#), which does not permit alteration or commercial use, including those for text and data mining, AI training, and similar technologies. © 2026 Bhatraju EP et al. *JAMA Network Open*.

Corresponding Author: Elenore P. Bhatraju, MD, MPH, Division of General Internal Medicine, Department of Medicine, University of Washington, 325 Ninth Ave, Box 359780, Seattle, WA 98104 (epb6@uw.edu).

Author Affiliations: Division of General Internal Medicine, Department of Medicine, University of Washington, Seattle (Bhatraju, Zinsli, Kennedy, Gojic, Merrill, Tsui); Department of Psychiatry and Behavioral Sciences, University of Washington, Seattle (Iles-Shih, Hallgren); Research and Data Analysis Division, Washington State Department of Social and Health Services, Olympia (Speaker); Clinical Addiction Research and Education Unit, Section of General Internal Medicine, Department of Medicine, Boston University Chobanian and Avedisian School of Medicine, Boston Medical Center, Boston, Massachusetts (Samet).

Author Contributions: Drs Bhatraju and Tsui had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Concept and design: Bhatraju, Merrill, Hallgren, Tsui.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Bhatraju, Zinsli, Kennedy, Gojic.

Critical review of the manuscript for important intellectual content: Bhatraju, Zinsli, Iles-Shih, Merrill, Speaker, Samet, Hallgren, Tsui.

Statistical analysis: Bhatraju, Zinsli, Hallgren.

Obtained funding: Tsui.

Administrative, technical, or material support: Gojic, Iles-Shih, Merrill, Speaker, Hallgren, Tsui.

Supervision: Iles-Shih, Samet, Hallgren, Tsui.

Conflict of Interest Disclosures: Dr Bhatraju reported serving as the site principal investigator for an Eli Lilly-sponsored clinical trial of an investigational glucagonlike peptide-1 for opioid use disorder outside the submitted work. Dr Hallgren and Dr Tsui reported receiving grants from the National Institutes of Health during the conduct of the study. No other disclosures were reported.

Funding/Support: This study was supported by grants 1R34DA057609-01, K23DA058751 (Dr Bhatraju), and T32DA057920 (Dr Zinsli) from the National Institute on Drug Abuse. The collection of data for this research was made possible utilizing the University of Washington Institute of Translational Health Sciences REDCap servers, which receive support from grants UL1TR002319, KL2TR002317, and TL1TR002318 from the National Center for Advancing Translational Sciences.

Role of the Funder/Sponsor: The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Data Sharing Statement: See [Supplement 3](#).

Additional Contributions: The authors acknowledge and thank Charissa Fotinos, MD, for her support and guidance under her leadership at the Washington Health Care Authority. Additionally, the authors thank Scene Health for its assistance with and training for their platform (ie, the patient mobile application and the Health Insurance Portability and Accountability Act-compliant web portal used by the study site). No financial compensation was provided for these contributions.

REFERENCES

1. Merchant E, Burke D, Shaw L, et al. Hospitalization outcomes of people who use drugs: one size does not fit all. *J Subst Abuse Treat*. 2020;112:23-28. doi:10.1016/j.jsat.2020.01.010
2. Howell BA, Bart G, Wang EA, Winkelman TNA. Service involvement across multiple sectors among people who use opioids, methamphetamine, or both, United States: 2015-2018. *Med Care*. 2021;59(3):238-244. doi:10.1097/MLR.0000000000001460
3. Velez CM, Nicolaidis C, Korthuis PT, Englander H. "It's been an experience, a life learning experience": a qualitative study of hospitalized patients with substance use disorders. *J Gen Intern Med*. 2017;32(3):296-303. doi:10.1007/s11606-016-3919-4
4. Liebschutz JM, Crooks D, Herman D, et al. Buprenorphine treatment for hospitalized, opioid-dependent patients: a randomized clinical trial. *JAMA Intern Med*. 2014;174(8):1369-1376. doi:10.1001/jamainternmed.2014.2556
5. French R, Aronowitz SV, Brooks Carthon JM, Schmidt HD, Compton P. Interventions for hospitalized medical and surgical patients with opioid use disorder: a systematic review. *Subst Abuse*. 2022;43(1):495-507. doi:10.1080/08897077.2021.1949663
6. Nordeck CD, Welsh C, Schwartz RP, Mitchell SG, O'Grady KE, Gryczynski J. Opioid agonist treatment initiation and linkage for hospitalized patients seen by a substance use disorder consultation service. *Drug Alcohol Depend Rep*. 2022;2:100031. doi:10.1016/j.dadr.2022.100031
7. Williams AR, Johnson KA, Thomas CP, et al. Opioid use disorder cascade of care framework design: a roadmap. *Subst Abuse*. 2022;43(1):1207-1214. doi:10.1080/08897077.2022.2074604
8. Trowbridge P, Weinstein ZM, Kerensky T, et al. Addiction consultation services: linking hospitalized patients to outpatient addiction treatment. *J Subst Abuse Treat*. 2017;79:1-5. doi:10.1016/j.jsat.2017.05.007
9. Jack HE, Denisiuk ED, Collins BA, et al. Peer providers and linkage with buprenorphine care after hospitalization: a retrospective cohort study. *Subst Abuse*. 2022;43(1):1308-1316. doi:10.1080/08897077.2022.2095078
10. Thakrar AP, Furfaro D, Keller S, Graddy R, Buresh M, Feldman L. A resident-led intervention to increase initiation of buprenorphine maintenance for hospitalized patients with opioid use disorder. *J Hosp Med*. 2021;16(6):339-344. doi:10.12788/jhm.3544

11. Ciccarone D. The rise of illicit fentanyl, stimulants and the fourth wave of the opioid overdose crisis. *Curr Opin Psychiatry*. 2021;34(4):344-350. doi:[10.1097/YCO.0000000000000717](https://doi.org/10.1097/YCO.0000000000000717)
12. Kratina-Hathaway Z, Radick AC, Leroux BG, et al. Methamphetamine use and illicit opioid use during buprenorphine treatment. *J Subst Use Addict Treat*. 2023;151:208934. doi:[10.1016/j.josat.2022.208934](https://doi.org/10.1016/j.josat.2022.208934)
13. Tsui JI, Leroux BG, Radick AC, et al. Video directly observed therapy for patients receiving office-based buprenorphine: a pilot randomized controlled trial. *Drug Alcohol Depend*. 2021;227:108917. doi:[10.1016/j.drugalcdep.2021.108917](https://doi.org/10.1016/j.drugalcdep.2021.108917)
14. Tsui JI, Mayfield J, Speaker EC, et al. Association between methamphetamine use and retention among patients with opioid use disorders treated with buprenorphine. *J Subst Abuse Treat*. 2020;109:80-85. doi:[10.1016/j.josat.2019.10.005](https://doi.org/10.1016/j.josat.2019.10.005)
15. Tsui JI, Stephens D, Collins B, et al. Co-use of methamphetamine is associated with lower rates of linkage to outpatient treatment for hospitalized patients who initiate buprenorphine. *J Addict Med*. 2023;17(4):491-492. doi:[10.1097/ADM.0000000000001129](https://doi.org/10.1097/ADM.0000000000001129)
16. Bhatraju EP, Kennedy DN, Gojic AJ, et al. mHealth Incentivized Adherence Plus Patient Navigation (MIAPP): protocol for a pilot randomized controlled trial to improve linkage and retention on buprenorphine for hospitalized patients with methamphetamine use and opioid use disorder. *Addict Sci Clin Pract*. 2025;20(1):6. doi:[10.1186/s13722-025-00538-1](https://doi.org/10.1186/s13722-025-00538-1)
17. Godersky ME, Klein JW, Merrill JO, et al. Acceptability and feasibility of a mobile health application for video directly observed therapy of buprenorphine for opioid use disorders in an office-based setting. *J Addict Med*. 2020;14(4):319-325. doi:[10.1097/ADM.0000000000000608](https://doi.org/10.1097/ADM.0000000000000608)
18. Schramm ZA, Leroux BG, Radick AC, et al. Video directly observed therapy intervention using a mobile health application among opioid use disorder patients receiving office-based buprenorphine treatment: protocol for a pilot randomized controlled trial. *Addict Sci Clin Pract*. 2020;15(1):30. doi:[10.1186/s13722-020-00203-9](https://doi.org/10.1186/s13722-020-00203-9)
19. Minozzi S, Saulle R, Amato L, Tracis F, Agabio R. Psychosocial interventions for stimulant use disorder. *Cochrane Database Syst Rev*. 2024;2(2):CD011866.
20. DeFulio A, Furgeson J, Brown HD, Ryan S. A smartphone-smartcard platform for implementing contingency management in buprenorphine maintenance patients with concurrent stimulant use disorder. *Front Psychiatry*. 2021;12:778992. doi:[10.3389/fpsy.2021.778992](https://doi.org/10.3389/fpsy.2021.778992)
21. Gryczynski J, Nordeck CD, Welsh C, Mitchell SG, O'Grady KE, Schwartz RP. Preventing hospital readmission for patients with comorbid substance use disorder: a randomized trial. *Ann Intern Med*. 2021;174(7):899-909. doi:[10.7326/M20-5475](https://doi.org/10.7326/M20-5475)
22. Fisher JD, Fisher WA. Changing AIDS-risk behavior. *Psychol Bull*. 1992;111(3):455-474. doi:[10.1037/0033-2909.111.3.455](https://doi.org/10.1037/0033-2909.111.3.455)
23. Hopewell S, Chan AW, Collins GS, et al. CONSORT 2025 statement: updated guideline for reporting randomized trials. *JAMA*. 2025;333(22):1998-2005. doi:[10.1001/jama.2025.4347](https://doi.org/10.1001/jama.2025.4347)
24. D'Onofrio G, Edelman EJ, Hawk KF, et al. Implementation facilitation to promote emergency department-initiated buprenorphine for opioid use disorder: protocol for a hybrid type III effectiveness-implementation study (Project ED HEALTH). *Implement Sci*. 2019;14(1):48. doi:[10.1186/s13012-019-0891-5](https://doi.org/10.1186/s13012-019-0891-5)
25. McLellan AT, Luborsky L, Woody GE, O'Brien CP. An improved diagnostic evaluation instrument for substance abuse patients: the Addiction Severity Index. *J Nerv Ment Dis*. 1980;168(1):26-33. doi:[10.1097/00005053-198001000-00006](https://doi.org/10.1097/00005053-198001000-00006)
26. Christian N, Bottner R, Baysinger A, et al. Hospital buprenorphine program for opioid use disorder is associated with increased inpatient and outpatient addiction treatment. *J Hosp Med*. 2021;16(6):345-348. doi:[10.12788/jhm.3591](https://doi.org/10.12788/jhm.3591)
27. Benishek LA, Dugosh KL, Kirby KC, et al. Prize-based contingency management for the treatment of substance abusers: a meta-analysis. *Addiction*. 2014;109(9):1426-1436. doi:[10.1111/add.12589](https://doi.org/10.1111/add.12589)
28. Griffith JD, Rowan-Szal GA, Roark RR, Simpson DD. Contingency management in outpatient methadone treatment: a meta-analysis. *Drug Alcohol Depend*. 2000;58(1-2):55-66. doi:[10.1016/S0376-8716\(99\)00068-X](https://doi.org/10.1016/S0376-8716(99)00068-X)
29. Tofighi B, Durr M, Marini C, Lewis CF, Lee JD. A mixed-methods evaluation of the feasibility of a medical management-based text messaging intervention combined with buprenorphine in primary care. *Subst Abuse*. 2022;16:11782218221078253. doi:[10.1177/11782218221078253](https://doi.org/10.1177/11782218221078253)
30. Vidyasagar N, Bunting SR, Arora VM, Ari M. Availability of long-acting injectable buprenorphine at substance use treatment facilities in 2021. *JAMA*. 2024;331(6):524-526. doi:[10.1001/jama.2023.26522](https://doi.org/10.1001/jama.2023.26522)

SUPPLEMENT 1.

Trial Protocol

SUPPLEMENT 2.

eTable 1. Study Population Characteristics by Status of Follow-Up Visit Completion

eTable 2. Study Population Characteristics by Status of Medicaid Data Availability

eTable 3. Serious Adverse Events (SAEs) and Adverse Events (AEs) Reported by Study Arm

SUPPLEMENT 3.

Data Sharing Statement