167 (2024) 209511

Contents lists available at ScienceDirect

Journal of Substance Use and Addiction Treatment

journal homepage: www.journals.elsevier.com/journal-of-substance-use-and-addiction-treatment

# Buprenorphine discontinuation in telehealth-only treatment for opioid use disorder: A longitudinal cohort analysis

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ARTICLE INFO

*Keywords:*
Telemedicine
Opioid use disorder
Medications for opioid use disorder

ABSTRACT

*Introduction:* At the beginning of the COVID-19 pandemic, federal agencies permitted telehealth initiation of buprenorphine treatment for opioid use disorder (OUD) without in-person assessment. It remains unclear how telehealth-only buprenorphine treatment impacts time to discontinuation and patient reported treatment outcomes.

*Methods:* A longitudinal observational cohort study conducted September 2021 through March, 2023 enrolled participants with OUD initiating buprenorphine (≤ 45 days) with internet and phone access in Oregon and Washington. The intervention was a fully telehealth-only (THO) app versus treatment as usual (TAU) in office-based settings with some telehealth. We assessed self-reported buprenorphine discontinuation at 4-,12-, and 24-weeks. Generalized estimating equations (GEE) calculated unadjusted and adjusted relative risk ratios (RR) for discontinuation averaged over the study period. Secondary outcomes included change in the Brief Addiction Monitor (BAM) and the visual analogue craving scale. Generalized linear models estimated average within-group and between-group differences over time.

*Results:* Participants ($n = 103$ THO; $n = 56$ TAU) had a mean age of 37 years (SD = 9.8 years) and included 52 % women, 83 % with Medicaid insurance, 80 % identified as White, 65 % unemployed/student, and 19 % unhoused. There were differences in gender (THO = 54 % women vs. TAU = 44 %, $p = .04$), unemployed status (60 % vs 75 %, $p = .02$), and stable housing (84 % vs 73 %, $p = .02$). Rates of buprenorphine discontinuation were low in the THO (4 %) and TAU (13 %) groups across 24 weeks. In the adjusted analysis, the risk of discontinuation was 61 % lower in the THO group (aRR = 0.39, 95 % CI [0.17, 0.89], $p = .026$). Decreases occurred over time on the harms subscale of the BAM (within-group difference − 0.85, $p = .0004$ [THO], and − 0.68, $p = .04$ [TAU]) and cravings (within-group difference − 13.47, $p = .0001$ [THO] vs −7.65, $p = .01$ [TAU]).

*Conclusions:* A telehealth-only platform reduced the risk of buprenorphine discontinuation compared to office-based TAU. In-person evaluation to receive buprenorphine may not be necessary for treatment-seeking patients.

*Clinical trials identifier:* NCT03224858

## 1. Introduction

Buprenorphine treatment for opioid use disorder (OUD) reduces illicit opioid use (Thomas et al., 2014), opioid-use-associated risk behaviors, hospitalizations (Lo-Ciganic et al., 2016; Wakeman et al., 2020), and death (Schwartz et al., 2013). Despite this, more than half of US counties (predominantly rural) lack a buprenorphine prescriber (Flavin et al., 2020). Some people with OUD must travel long distances, join waitlists, or seek other treatments such as methadone or non-medication based behavioral treatments (Simpson et al., 2022). These barriers leave millions without treatment for OUD (C. W. Jones et al., 2018; Krawczyk et al., 2022; Saloner et al., 2022).

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https://doi.org/10.1016/j.josat.2024.209511
Received 15 March 2024; Received in revised form 5 August 2024; Accepted 27 August 2024
Available online 5 September 2024

Telehealth-based OUD treatment may overcome barriers to access and engagement. Prior to the 2020 COVID-19 public health emergency, telehealth use was uncommon because federal regulations required in-person visits before prescribing controlled substances (Chan et al., 2022). The studies, moreover, were completed prior to the elevated risk of overdose and death due to the widespread availability of illicitly manufactured fentanyl (Shover et al., 2020). Buprenorphine initiation is more complicated when individuals use fentanyl (Sue et al., 2022).

The COVID-19 pandemic prompted the Drug Enforcement Administration (DEA) and the Substance Abuse and Mental Health Services Administration (SAMHSA) to allow treatment of OUD and initiation of buprenorphine without an in-person assessment, and catalyzed opportunities to examine the effect of telehealth-only treatment initiation and care on outcomes. Studies conducted since the COVID-19 public health emergency suggest improved access to starting OUD treatment via telehealth, but generally describe academic-based programs that incorporated telehealth as a bridge to more permanent in-person community treatment programs, using retrospective study designs without control groups (Buchheit et al., 2021; Samuels et al., 2022; Tofighi et al., 2022). There are few studies of telehealth-only interventions operating in real-world settings that have potential to be implemented at a national scale. The Buprenorphine Evaluation and Telehealth Study (BEaTS) examined a longitudinal cohort and compared an intentionally designed telehealth-only (THO) treatment model to office-based treatment as usual (TAU) on rates of buprenorphine discontinuation. Notably, many TAU services integrated telehealth components into standard clinical practices but continued to require periodic office-based visits.

## 2. Methods

### 2.1. Overview of the study design

A prospective observational longitudinal cohort study recruited participants living in Oregon or Washington State recently starting or restarting buprenorphine for treatment of OUD. We recruited one cohort of participants enrolled in a novel telehealth-only OUD treatment program and recruited a comparison cohort from academic affiliated office-based programs. Individuals were recruited directly in person and using contact lists of recent admissions. The study collected self-reports on treatment discontinuation data from both treatment arms at baseline, 4-, 12-, and 24-weeks post study initiation.

### 2.2. Exposure: fully remote telehealth-only (audio-visual via mobile application) (THO)

The telehealth-only (THO) intervention was a proprietary digital treatment platform offering long-term care for OUD and serving patients in Oregon, Washington, Ohio, Alaska, Colorado, and North Carolina. The platform was developed in anticipation of the SUPPORT Act's requirement for telehealth-only pathways for OUD care; this pathway was not ultimately established (Uscher-Pines, 2023). The application-based (app) platform allowed ongoing participant communication with an interdisciplinary care team (Prescribing Clinician, Care Advocate, and Peer Recovery Specialist for each patient) via secure video or chat. Care Advocates navigated the broader health care system (e.g., pharmacies, insurance) to overcome access gaps, discontinuity, and stigma that can destabilize a patient's recovery. Peer Recovery Specialists use their direct or indirect experience of recovery from mental illness, substance use disorders, and/or significant trauma, combined with skills learned in formal training, to deliver peer-based recovery support services with a focus on improving overall health and well-being, and quality of life. Patients without video access received audio-only care in the interim, and the program facilitated patient acquisition of a subsidized smartphone and network. Prospective patients began enrollment either via telephone or a web-based form with a goal of a buprenorphine prescription within 48 h if indicated. Visit frequency is similar to that of providers in physical settings and guided by a tiering system (Angier et al., 2021). Toxicology testing varied based on state regulations using either LC/MS oral fluid or urine testing (patient choice). The Care Team also included Care Managers as needed to help with social needs and Advanced Practice Providers with specialized training in psychiatry. The study fostered in-person referrals for counseling, complex medical needs, and other care on an individual basis (Bosse et al., 2022). The THO organization primarily serves patients with Medicaid (~90 %) and was contracted with all Medicaid providers in the study region. Word of mouth and focused social media marketing informed the public of the services.

### 2.3. Comparison: TAU at a university clinic and affiliated community health centers (TAU) with selective telehealth

Usual care participants were recruited from clinics that provided office-based opioid treatment within an academic health system and affiliated community health clinics in the Portland, Oregon, and Southwest Washington area. One study site was an innovative low-barrier buprenorphine bridge clinic (Buchheit et al., 2021) that started buprenorphine initially in a brick and mortar setting and transitioned to telehealth prescribing during the COVID pandemic. Buprenorphine bridge prescribing continued until individuals transitioned to office-based care and were followed for the remainder of the study period. The onset of the pandemic coincided with the study's launch and largely inhibited enrollments in office-based practices (e.g., office closures, reduced hours), causing the TAU group to become a mixture of telehealth and office-based care (as was the case for many office-based opioid treatment clinics during the COVID-19 public health emergency). TAU participants were also recruited from community health centers that generally required in-person evaluation prior to initiating MOUD and used a low-barrier approach (Jakubowski & Fox, 2020) with selective use of telehealth visits for continued prescribing.

### 2.4. Eligibility criteria, recruitment, consent, and baseline questionnaire

Eligible participants were English speaking adults (18 years of age and older) within 45 days of initiating or restarting buprenorphine for OUD treatment, who had internet and mobile phone access, and were not legally mandated to treatment. Screening questions included "Is this your first time having a prescription for buprenorphine?" and "Have you started a new buprenorphine prescription in the last 45 days?" Buprenorphine initiation or restart was independent of setting—participants who recently changed clinics or settings where they received buprenorphine were not eligible if they were regularly receiving prescriptions >45 days at their prior clinic. Recruitment strategies varied over the study period due to the evolving COVID-19 pandemic (Pertl et al., 2023). Research staff presented the study to clinical staff and encouraged them to offer study participation to patients; recruitment fliers were placed in physical clinical spaces when permitted, and online recruitment through social media. Fliers had a QR (quick response) code linking potential participants to the BEaTS webpage for study information. Participants called or emailed study staff to confirm eligibility and complete informed consent. Clinic administrative records were also used to identify potential participants; research associates called eligible participants to determine interest in study participation.

Following consent, participants completed baseline questionnaires and recorded demographic, psychosocial (e.g., education, employment, housing status) characteristics, prior treatment history, and self-reported baseline addiction measures. Participants were compensated with a reloadable debit card (ClinCard®) for each survey completed, with escalating compensation for completed questionnaires (total possible compensation was $155). The Oregon Health & Science University (OHSU) Institutional Review Board approved study procedures (IRB 22996). The first participant was enrolled on September 27, 2021, and the last participant enrolled on September 14, 2022.

### 2.5. Follow-up procedures: (4, 12, and 24 weeks)

The study emailed data collection reminders to study participants for each follow-up time point. Voice mail and text reminders supplemented the emails.

### 2.6. Primary outcome: buprenorphine discontinuation over time

Each follow-up survery assessed the primary outcome, buprenorphine discontinuation, with one question: "*Do you still have a prescription for buprenorphine*? (Yes/No)."

### 2.7. Secondary outcomes

The Brief Addiction Monitor (BAM) (Cacciola et al., 2013) has three subscales assessing an individual's past 30 days: "Use" (0–12, higher means more use), "Risk Factors" (0–24, higher means higher risk), and "Protective Factors" (0–24, higher scores indicate more protection). Participants rated their craving from 0 (no craving) to 100 (most craving ever) using the Opioid Visual Analogue Scale (VAS) (Boyett et al., 2021). Modified questions from the Telehealth Usability Questionnaire's (TUQ) assessed access, ease of use, reliability, and usability (higher average score indicates better performance) (Parmanto et al., 2016). We calculated mean differences in scores for each TUQ domain within and between groups.

### 2.8. Covariates

The analysis adjusted for potential confounders including age, gender, ethnicity, race, education, employment status, insurance, living situation at baseline, and past 30-day substance use. In the final model, non-significant variables were removed (e.g., gender identity, ethnicity), and collapsed measures of education, employment, insurance, living situation due to zero cell sizes that made models unstable. The final model adjusted for age, sex at birth, race, education (some high school vs none), employment status (some employment vs unemployed), insurance (Medicaid vs other), living situation (stable housing vs unstable housing/homeless), and past 30-day substance use (heroin, fentanyl, other illicit opioids, and methamphetamine).

### 2.9. Statistical analysis

Two methods assessed risk of buprenorphine discontinuation overall and risk of first instance of discontinuation. Risk of discontinuation was determined a priori to be important because patients early in recovery may have return to use episodes (and discontinue buprenorphine) but can later restart care (Martin et al., 2018),

A longitudinal generalized estimating equation (GEE) model calculated and compared the risk of discontinuation during study follow-up between treatment groups (THO vs. TAU). Group, time (baseline, 4-, 12-, and 24-weeks) and their interaction were the predictors of interest. The model utilized a Poisson distribution and log link to estimate unadjusted and adjusted risks of discontinuation for each study group, which were averaged across follow-up timepoints using linear contrasts. To test the primary study hypothesis, the time-averaged risk of discontinuation was compared between groups (tests were conducted on the log risk scale). Robust standard errors (sandwich estimator) were used for hypothesis tests; the optimal working covariance structure for the model was chosen using fit statistics (quasi-information criteria).

A Cox-proportional hazards model compared time to first reported discontinuation between groups. Participants who did not report a discontinuation were censored at last follow-up. Prior to the analysis, plots of scaled Schoenfeld residuals assessed reasonableness of the proportional hazards assumption.

Because there was more missing data for secondary outcomes than the primary outcome, linear mixed models analyzed secondary outcomes, with treatment group, time, and their interaction as the predictors of interest. Subject-level random intercepts were included to account for repeated measurements on individuals. As in the primary analysis, expected outcome values were averaged across follow-up timepoints and compared between groups using linear contrasts. Analyses adjusted for the covariates to address potential confounding due to participant self-selection into treatment condition. Significance tests were conducted at alpha = 0.05 using RStudio v.2022.07.2.

## 3. Results

The study enrolled 159 participants (THO = 103, TAU = 56). One-third of the TAU cohort (36 %) were enrolled in the low-barrier clinic, 27 % from academic affiliated office-based primary care, 20 % from federally qualified health center; the rest (17 %) came from other community office-based practices. Half of the cohort (50 %) reported that it was their first time having a prescription for buprenorphine at time of screening, with 56 % of THO and 39 % of TAU participants initiating buprenorphine for the first time ($p = .003$). Overall contact information was obtained for 1851 potential participants of which, 36 % responded to outreach attempts, 15 % completed the online screening assessment, and 9 % completed the informed consent, met eligibility criteria, and enrolled in the study (Fig. A) (Pertl et al., 2023).

### 3.1. Cohort demographics

Overall, the mean age was 37.1 years (SD 10.2), with 52 % women and a majority non-Hispanic (93.7 %), and white race (80.5 %) (Table 1). Over half (57.9 %) had greater than high school education, were unemployed or students (65.4 %), and had Medicaid primary insurance (83.6 %). Most were stably housed (80.5 %). Thirty-eight percent of participants reported past 30-day heroin use, 38 % fentanyl use, 20 % reported using other illicit opioids, and 37 % reported using methamphetamine. The TAU group had higher rates of unemployed/student status (75.0 % vs 60.2 %, $p = .02$) and lower rates of stably housed participants (73.2 % vs 84.5 %, $p = .01$), compared to the THO group.

### 3.2. Buprenorphine discontinuation analysis

#### 3.2.1. Longitudinal analysis

Rates of buprenorphine discontinuation at 24 weeks were 4.1 % in the THO group and 12.5 % in TAU (Table 2). In the unadjusted GEE analysis averaged across all follow-up timepoints, participants in the THO group had a 3.3 % risk of buprenorphine discontinuation compared to 8.2 % in TAU, a 59 % reduced risk of discontinuation in the THO group (RR = 0.41 [95 % CI: 0.16, 1.04], $p = .061$). When adjusted for covariates, THO participants had 61 % reduced risk of discontinuation compared to treatment as usual (THO group 3.8 % vs TAU 9.7 %, aRR = 0.39 [95 % CI: 0.17, 0.89], $p = .026$) (Table 3).

#### 3.2.2. Cox-proportional hazards analysis

Fig. B shows the Kaplan-Meier treatment discontinuation cumulative incidence curve for the study. In the unadjusted Cox-proportional hazards model, participants in the THO arm had a 53 % reduced hazard of discontinuation compared to TAU participants, but associations were not statistically significant (HR = 0.47 [95 % CI: 0.18, 1.17], $p = .10$). This association strengthened after adjustment but remained non-significant (aHR = 0.37 [95 % CI: 0.14, 1.01], $p = .052$). (Table A1).

### 3.3. Patient reported addiction monitoring analyses

#### 3.3.1. Brief Addiction Monitor (BAM) and Cravings (VAS)

The THO group reported statistically significant decreases in the substance use behaviors of the BAM (THO: −0.84, $p < .001$ vs. TAU: −0.62, $p = .07$) but there were no within-group differences in the

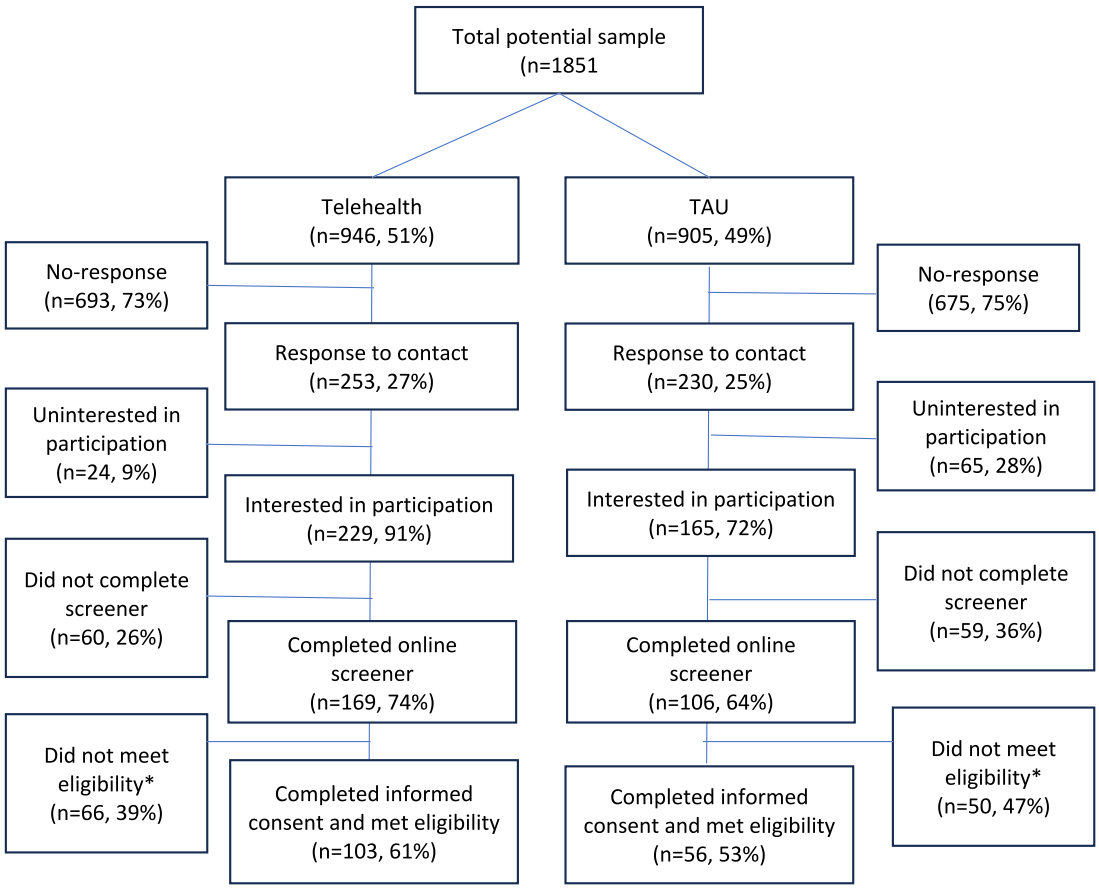


**Fig. A.** Consort diagram.

substance use-related risks or protective behaviors and no between-group differences for all domains. Both groups experienced statistically significant decreases in cravings over time (THO: −13.48, p < .001; TAU: -7.68, $P = .01$) but no significant between-group differences were observed (Diff: 5.8, $p = .11$) (Table 4).

### 3.3.2. *Telehealth usability questionnaire: access, satisfaction, usefulness*

Among participants in the THO arm, 85 %, 86 %, and 86 % reported that at least 50 % of their visits were conducted using telehealth at 4, 12, and 24 weeks, respectively, versus 54 %, 56 %, and 63 % of TAU participants. There were no statistically or clinically significant mean within-group or between-group differences in the TUQ domains over time, except for the telehealth access domain (Table 4). On average, THO participants reported an increase of 0.22 (SE 0.10, $p = .05$) rating in access, while TAU clients reported decline of −0.20 (SE 0.15, $p = .17$) over the 24-week period, with a statistically significant between-group increase in telehealth access reported by the THO group of 0.43 (SE 0.18, $p = .02$).

## 4. Discussion

This prospective observational longitudinal cohort study of 159 participants with OUD starting or restarting outpatient buprenorphine found low rates of buprenorphine discontinuation for both groups. Those enrolled in the THO intervention had lower risk of discontinuation across 24 weeks compared to treatment as usual office-based buprenorphine with selective telehealth. Both groups experienced significant reductions in cravings and the telehealth-only group reported decreased substance use behaviors as measured by the BAM.

The COVID-19 pandemic expanded use of telehealth, a change that has potential to reduce treatment gaps as few people with an OUD (13–20 %) currently receive MOUD (C. M. Jones et al., 2023; Krawczyk et al., 2022). Multiple retrospective case series and uncontrolled observational studies demonstrate the feasibility and acceptability of telehealth to deliver treatment and initiate MOUD (Hailu et al., 2023; C. M. Jones et al., 2022; L. A. Lin et al., 2022; Samuels et al., 2022; Tofighi et al., 2022). It is less clear whether telehealth-only interventions also affect rates of buprenorphine discontinuation or retention, though a large cross-sectional analysis of Veterans Health Administration demonstrated increased 90-day retention on buprenorphine compared to people only receiving in-person buprenorphine (Frost et al., 2022). The current study is one of the first conducted in the COVID-19 and fentanyl era to compare buprenorphine discontinuation and other related treatment experience outcomes for patients receiving buprenorphine treatment through a THO platform versus TAU.

Lower buprenorphine discontinuation in the THO arm may reflect the removal of required in-person visits, enhanced access to and utilization of care and reduced chances of treatment disruption. Distance to treatment with buprenorphine is inversely associated with retention due to time and travel costs (Saloner et al., 2022). Patients may also prefer THO models because they encountered stigma during in-person addiction treatment (Volkow, 2020), when delivered in medical (i.e., primary care) settings (Austin et al., 2023).

The evidence of a relative benefit for THO compared to in-person or office-based/mixed telehealth treatment contrasts with recent studies that showed no differences in outcomes or harms with telehealth use (Guille et al., 2020; Hailu et al., 2023). One difference is that the telehealth-only intervention in the current study was a stand-alone model separated from office-based treatment delivered in primary care or an addictions clinic within a primary care setting. Features of the telehealth-only platform (e.g., multiple pathways for synchronous or asynchronous enrollment; visits with multiple Care Team members

**Table 1**
Description of the cohort, by treatment arm.

| | Total | Telehealth (THO) | Treatment as Usual (TAU) | P |
|---|---|---|---|---|
| n | 159 | 103 | 56 | |
| Age (mean (SD)) | 37.06 (10.20) | 36.85 (9.66) | 37.45 (11.21) | 0.73 |
| Gender (%) | | | | 0.06 |
| Man | 73 (45.9) | 47 (45.6) | 26 (46.4) | |
| Woman | 83 (52.2) | 56 (54.4) | 27 (48.2) | |
| Transgender/non-binary | 3 (1.9) | 0 (0.0) | 3 (5.4) | |
| Hispanic Ethnicity (%) | 13 (8.2) | 9 (8.7) | 4 (7.1) | 0.96 |
| Race (%) | | | | 0.60 |
| American Indian/Alaska Native | 3 (1.9) | 2 (1.9) | 1 (1.8) | |
| Black | 3 (1.9) | 1 (1.0) | 2 (3.6) | |
| More than one race | 15 (9.4) | 9 (8.7) | 6 (10.7) | |
| Other/Prefer not to say | 10 (6.3) | 5 (4.9) | 5 (8.9) | |
| White | 128 (80.5) | 86 (83.5) | 42 (75.0) | |
| Education (%) | | | | 0.86 |
| Less than High School (HS) | 19 (11.9) | 13 (12.6) | 6 (10.7) | |
| HS | 48 (30.2) | 32 (31.1) | 16 (28.6) | |
| >HS | 92 (57.9) | 58 (56.3) | 34 (60.7) | |
| Employment (%) | | | | 0.02 |
| Full time | 40 (25.2) | 33 (32.0) | 7 (12.5) | |
| Part time | 15 (9.4) | 8 (7.8) | 7 (12.5) | |
| Unemployed/Student | 104 (65.4) | 62 (60.2) | 42 (75.0) | |
| Insurance (%) | | | | 0.34 |
| Medicaid | 133 (83.6) | 83 (80.6) | 50 (89.3) | |
| Other insurance | 20 (12.6) | 15 (14.6) | 5 (8.9) | |
| None | 6 (3.8) | 5 (4.9) | 1 (1.8) | |
| Living situation (%) | | | | 0.02 |
| Housed | 128 (80.5) | 87 (84.5) | 41 (73.2) | |
| Institution | 4 (2.5) | 2 (1.9) | 2 (3.6) | |
| Shelter | 5 (3.1) | 0 (0.0) | 5 (8.9) | |
| Street/Car/Trailer/Squat | 22 (13.8) | 14 (13.6) | 8 (14.3) | |
| Past 30-day substance use | | | | |
| Heroin | 60 (37.7) | 38 (36.9) | 22 (39.3) | 0.90 |
| Fentanyl | 61 (38.4) | 38 (36.9) | 23 (41.1) | 0.73 |
| Other illicit opioids | 31 (19.5) | 19 (18.4) | 12 (21.4) | 0.81 |
| Methamphetamine | 59 (37.1) | 35 (34.0) | 24 (42.9) | 0.35 |
| Brief Addiction Monitor subscale scores (mean (SD)) | | | | |
| Use | 1.85 (2.55) | 1.92 (2.46) | 1.71 (2.76) | 0.74 |
| Risk factors | 15.32 (7.62) | 14.07 (8.26) | 18.0 (5.63) | 0.27 |
| Protective factors | 9.65 (5.11) | 9.73 (5.05) | 9.48 (5.38) | 0.85 |

**Table 2**
Unadjusted rates of buprenorphine discontinuation during study period.

| Time Point | Total | Telehealth Discontinuation (n, %) | TAU Discontinuation (n, %) |
|---|---|---|---|
| Baseline (Week 0) | 0/159 (0 %) | 0/103 (0 %) | 0/56 (0 %) |
| Week 4 | 6/154 (3.8 %) | 3/100 (3 %) | 3/54 (5.6 %) |
| Week 12 | 7/150 (4.7 %) | 3/99 (3 %) | 4/51 (7.8 %) |
| Week 24 | 10/146 (6.8 %) | 4/98 (4.1 %) | 6/48 (12.5 %) |
| Week 36[a] | | 6/97 (6.2 %) | N/A |
| Week 48[a] | | 14/89 (15.7 %) | N/A |

[a] Due to study completion, TAU participants were not able to complete week 36- and 48-week assessment; only THO raw data are presented here.

**Table 3**
Analyses of buprenorphine discontinuation using generalized estimating equation model.

| | Unadjusted estimate (95 % CI) | *p* | Adjusted estimate[a] (95 % CI) | *p* |
|---|---|---|---|---|
| Average THO discontinuation | 3.3 % (1.7 %, 6.5 %) | | 3.8 % (1.4 %, 9.9 %) | |
| Average TAU discontinuation | 8.2 % (4.2 %, 15.7 %) | | 9.7 % (4.2 %, 22.3 %) | |
| Risk Ratio | 0.41 (0.16, 1.04) | 0.061 | 0.39 (0.17, 0.89) | 0.026 |

[a] Adjusted for: age, sex at birth, race, education (some high school vs none), employment status (some employment vs unemployed), insurance (Medicaid vs other), living situation (stable housing vs unstable housing/homeless), and baseline substance use (heroin, fentanyl, other illicit opioids, and methamphetamine).

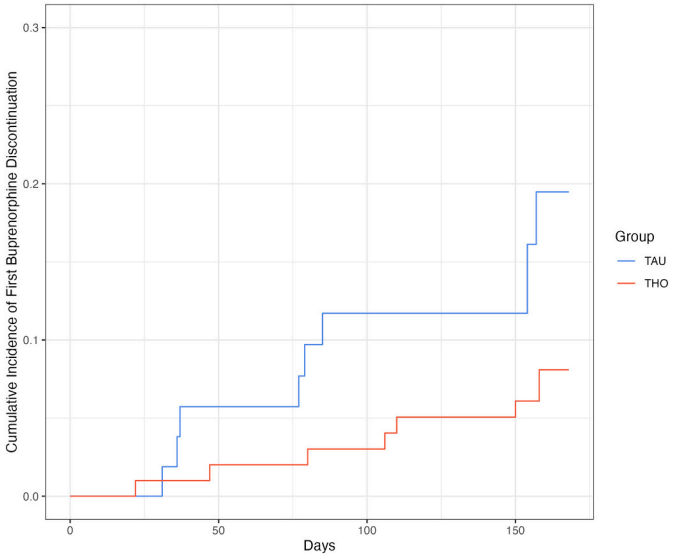


**Fig. B.** Kaplan Meier curve for buprenorphine treatment discontinuation over 24-week study period.

including Peer Recovery Specialists; electronic scheduling and reminders; on-demand support for insurance, prescription, or financial issues; at-home saliva (as opposed to urine) toxicology testing; and secure texting) were intentionally designed for telehealth treatment as opposed to substitutes for in-person office-based approaches (Bosse et al., 2022).

The THO intervention is similar to another study that also reported higher retention at 6 months in a non-controlled observational cohort (Williams, Aronowitz, et al., 2023). Differences in defining buprenorphine discontinuation, however, make direct comparison across studies difficult. We thought it important to analyze our outcome both in a time to first discontinuation and discontinuation across six months because office-based buprenorphine treatment can involve restarting MOUD after brief treatment gaps, and the clinical benefit of buprenorphine for preventing overdose or return to use may be more about overall time on buprenorphine as opposed to continuous use of buprenorphine.

**Table 4**
Patient reported outcomes: Brief Addiction Monitor (BAM), cravings, and telehealth usability within-group and between group differences estimated using general linear mixed model[a].

| Clinic | Avg Diff over Time | SE | *P*-Value |
|---|---|---|---|
| BAM: PROTECT | | | |
| THO | 0.88 | 0.60 | 0.15 |
| TAU | 1.44 | 1.02 | 0.16 |
| THO – TAU | −0.56 | 1.18 | 0.64 |
| BAM: RISK | | | |
| THO | −1.62 | 1.98 | 0.40 |
| TAU | −9.16 | 5.71 | 0.04 |
| THO – TAU | 7.54 | 5.85 | 0.10 |
| BAM: USE | | | |
| THO | −0.85 | 0.24 | <0.01 |
| TAU | −0.68 | 0.34 | 0.04 |
| THO – TAU | −0.18 | 0.41 | 0.67 |
| Visual Analog Scale: Cravings | | | |
| THO | −13.47 | 2.18 | <0.01 |
| TAU | −7.65 | 2.98 | 0.01 |
| THO – TAU | −5.82 | 3.70 | 0.12 |
| Telehealth Usability Assessment (TUA): Teleaccess | | | |
| THO | 0.22 | 0.11 | 0.05 |
| TAU | −0.20 | 0.15 | 0.17 |
| THO – TAU | 0.42 | 0.18 | 0.02 |
| TUA: Usefulness | | | |
| THO | 0.18 | 0.16 | 0.25 |
| TAU | 0.07 | 0.21 | 0.74 |
| THO – TAU | 0.11 | 0.26 | 0.68 |
| TUA: Satisfaction | | | |
| THO | 0.09 | 0.21 | 0.69 |
| TAU | 0.14 | 0.29 | 0.62 |
| THO – TAU | −0.06 | 0.36 | 0.87 |

[a] Adjusted for: age, sex at birth, race, education (some high school vs none), employment status (some employment vs unemployed), insurance (Medicaid vs other), and living situation (stable housing vs unstable housing/homeless).

National efforts to define retention include the use of National Committee for Quality Assurance (NCQA) Healthcare Effectiveness Data and Information Set (HEDIS) measure, which includes 180 consecutive days of treatment enrollment with medication treatment for OUD with no more than a 7-day treatment gap based on claims data and medical plan data (Pharmacotherapy for Opioid Use Disorder [HEDIS Measures and Technical Resources]. NCQA, 2023). We did not have ability to collect these types of data for this analysis and instead relied on participant self-report. There is ongoing work to achieve consensus regarding defining clinically-relevant retention, including whether use of a HEDIS endorsed engagement measure is associated with longer term retention (Williams, Mauro, et al., 2023).

Improving treatment access is not enough; interventions that can aid patients in maintaining recovery and improve clinically meaningful outcomes are needed. In this regard, we did not see differences between the groups. The BAM measure assesses clinically relevant patient-reported measures of recovery (Cacciola et al., 2013) and were probably similar between groups due to participants having overall low rates of buprenorphine discontinuation. Both groups had significant within-group decreases in cravings, also likely explained by the effects of buprenorphine. Finally, the mixed findings in the TUQ domains between THO and TAU may not be all that surprising given that there was telehealth use in both groups. Future TAU interventions that include buprenorphine will also likely involve some proportion of telehealth.

### 4.1. Limitations

Recruitment challenges related to COVD-19 and restrictions on in-person research activities during the study period were greater for the TAU recruitment arm and we did not achieve the recruitment target (Pertl et al., 2023). Also, in the setting of COVID-19, most office-based clinics shifted in-person visits to phone or video visits. Some clinics, including the low-barrier buprenorphine bridge clinic, were remote-only during most of the recruitment phase. The observational cohort design may have created selection bias favoring the intervention group: participants who enrolled in the telehealth-only program may be more comfortable and responsive to telehealth interventions in general. Similarly, while the entire target population was 'treatment seeking,' those who sought out and enrolled in telehealth-only care may differ in their treatment preferences than those seeking treatment in primary care and office-based settings. Also, unmeasured confounding might contribute to the findings.

The low rates of buprenorphine discontinuation contrasted with those reported in similar treatment populations (Samples et al., 2018). While the study intentionally lowered barriers to participation and enrollment (e.g., proactive participant contact, online survey tools, incentives for participation), only a small percentage of the target population in both arms enrolled in the trial, potentially decreasing external validity and generalizability by enrolling those more likely to be retained. In addition, the low barrier approach used in both study arms may have also promoted increased retention above what was expected (Jakubowski & Fox, 2020). The study only recruited English-speaking participants and few minoritized populations were enrolled, reflecting the demographics of the recruitment sites. We acknowledge this limitation as telehealth interventions can worsen inequities (Schifeling et al., 2020).

### 4.2. Implications

National policies regarding required in-person visits and telehealth-based buprenorphine treatment remain unresolved. The requirement for an in-person evaluation originates from the Ryan Haight Act's purview over remotely prescribed controlled substances. The Drug Enforcement Administration has issued a ruling to continue allowing telehealth initiation of buprenorphine until December 31, 2024, pending further study (Practice of Telemedicine: Listening Sessions. Federal Register.In: Administration. DE, Editor, 2023). Our findings suggest in-person care may not be necessary for achieving high retention levels with buprenorphine. An in-person requirement could instead prevent access to buprenorphine, a life-saving treatment that has defied two decades of policy efforts to increase in scale. Alternatively, having in-person visits as an option may complement remote/telehealth modalities for some patients. Identifying patients who might have increased benefit from a hybrid model (vs telehealth-only) (J. J. Lin et al., 2023) requires further exploration. An understanding of telehealth program elements that patients and staff find helpful and beneficial—particularly for those with additional medical or behavioral complexity—is also needed. Regardless, too many people lack access to any form of buprenorphine treatment.

## 5. Conclusion

A telehealth-only platform reduced risk of buprenorphine discontinuation compared to treatment as usual office-based/mixed telehealth opioid treatment. This finding provides additional evidence that an in-person evaluation to receive buprenorphine may not be necessary for some treatment-seeking patients.

## CRediT authorship contribution statement

**Brian Chan:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Ryan Cook:** Writing – review & editing, Validation, Methodology, Investigation, Formal analysis, Conceptualization. **Ximena Levander:** Writing – review & editing, Validation, Investigation, Conceptualization. **Katharina Wiest:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Kim Hoffman:** Writing – review & editing, Validation, Investigation. **Kellie Pertl:** Writing – review & editing, Validation,

Investigation, Data curation. **Ritwika Petluri:** Writing – review & editing, Project administration, Investigation, Data curation. **Dennis McCarty:** Writing – review & editing, Supervision, Project administration, Investigation, Funding acquisition, Conceptualization. **P. Todd Korthuis:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Stephen A. Martin:** Writing – review & editing, Supervision, Resources, Project administration, Investigation, Funding acquisition, Conceptualization.

## Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Dr. Stephen Martin, Dr. Wiest, Ms. Pertl, and Ms. Petluri reports financial support was provided by Boulder Care. Brian Chan reports financial support was provided by National Institute on Drug Abuse. Ryan Cook reports financial support was provided by National Institute on Drug Abuse. Ximena Levander reports financial support was provided by Agency for Healthcare Research and Quality. P. Todd Korthuis reports financial support was provided by National Institute on Drug Abuse. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

*Acknowledgments*

A National Institute on Drug Abuse Small Business Innovations Research (SBIR) award (R44-DA050354) to Boulder Care supported the study. NIDA did not participate in the design of the study, nor in collection, analysis, interpretation of data, or writing of the manuscript. SBIR awards require partnership with a small business to advance innovative products. Dr. Martin is Boulder Care's Research Director. Drs. Wiest, and Ms. Pertl and Ms. Petluri were employees of Boulder Care during the study. A subaward to the Oregon Health and Science University supported the analysis (Drs. Chan and Cook) and preparation of the manuscript. Dr. Martin has equity in Boulder Care. The other authors have no investment in Boulder Care.

*Funding*

This work was supported by the following: National Institute on Drug Abuse (NIDA) SBIR 1R44DA050354-02 (Martin, Wiest, Pertl, Petluri, Hoffman), National Institute on Drug Abuse (NIDA) K23DA053390 (Chan), NIDA K01DA55130 (Cook), Agency for Health Research and Quality (AHRQ) K12 HS026370 (Levander), NIH/NIDA UG1DA015815 (Korthuis).

## Appendix A

**Table A1**
Cox-proportional hazards analyses - Hazard Ratio (HR) for discontinuation[a].

| Clinic | Unadjusted HR (95 % CI) | *p* | Adjusted HR (95 % CI) | *p* |
|---|---|---|---|---|
| TAU | Ref | | Ref | |
| Telehealth | 0.47 (0.18, 1.17) | 0.10 | 0.37 (0.14, 1.01) | 0.052 |

[a] Adjusted for: age, sex at birth, race, education (some high school vs none), employment status (some employment vs unemployed), insurance (Medicaid vs other), living situation (stable housing vs unstable housing/homeless), and baseline substance use (heroin, fentanyl, other illicit opioids, and methamphetamine).

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