Original Investigation | Health Policy

Provision of Digital Health Technologies for Opioid Use Disorder Treatment by US Health Care Organizations

Chris Miller-Rosales, PhD, MSPH; Nancy E. Morden, MD, MPH; Mary F. Brunette, MD; Susan H. Busch, PhD; John B. Torous, MD, MBI; Ellen R. Meara, PhD

Abstract

IMPORTANCE Digital health technologies may expand organizational capacity to treat opioid use disorder (OUD). However, it remains unclear whether these technologies serve as substitutes for or complements to traditional substance use disorder (SUD) treatment resources in health care organizations.

OBJECTIVE To characterize the use of patient-facing digital health technologies for OUD by US organizations with accountable care organization (ACO) contracts.

DESIGN, SETTING, AND PARTICIPANTS This cross-sectional study analyzed responses to the 2022 National Survey of Accountable Care Organizations (NSACO), collected between October 1, 2021, and June 30, 2022, from US organizations with Medicare and Medicaid ACO contracts. Data analysis was performed between December 15, 2022, and January 6, 2023.

EXPOSURES Treatment resources for SUD (eg, an addiction medicine specialist, sufficient staff to treat SUD, medications for OUD, a specialty SUD treatment facility, a registry to identify patients with OUD, or a registry to track mental health for patients with OUD) and organizational characteristics (eg, organization type, Medicaid ACO contract).

MAIN OUTCOMES AND MEASURES The main outcomes included survey-reported use of 3 categories of digital health technologies for OUD: remote mental health therapy and tracking, virtual peer recovery support programs, and digital recovery support for adjuvant cognitive behavior therapy (CBT). Statistical analysis was conducted using descriptive statistics and multivariable logistic regression models.

RESULTS Overall, 276 of 505 organizations responded to the NSACO (54.7% response rate), with a total of 304 respondents. Of these, 161 (53.1%) were from a hospital or health system, 74 (24.2%) were from a physician- or medical group–led organization, and 23 (7.8%) were from a safety-net organization. One-third of respondents (101 [33.5%]) reported that their organization used at least 1 of the 3 digital health technology categories, including remote mental health therapy and tracking (80 [26.5%]), virtual peer recovery support programs (46 [15.1%]), and digital recovery support for adjuvant CBT (27 [9.0%]). In an adjusted analysis, organizations with an addiction medicine specialist (average marginal effect [SE], 32.3 [4.7] percentage points; *P* < .001) or a registry to track mental health (average marginal effect [SE], 27.2 [3.8] percentage points; *P* < .001) were more likely to use at least 1 category of technology compared with otherwise similar organizations lacking these capabilities.

CONCLUSIONS AND RELEVANCE In this cross-sectional study of 276 organizations with ACO contracts, organizations used patient-facing digital health technologies for OUD as complements to available SUD treatment capabilities rather than as substitutes for unavailable resources. Future

(continued)

Key Points

Question How often are digital health technologies for opioid use disorder used by US health care organizations, and which organizational features are associated with their use?

Findings In this cross-sectional study using data from a national survey of 276 organizations with accountable care organization contracts, 34% used at least 1 category of technology, including remote mental health therapy and tracking (27%), virtual peer recovery support programs (15%), and digital recovery support for adjuvant cognitive behavior therapy (9%). Organizations with traditional substance use disorder resources were significantly more likely to use technologies.

Meaning These results suggest that health care organizations use digital health technologies as complements to, rather than substitutes for, traditional resources.

+ **Supplemental content**

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

Abstract (continued)

studies should examine implementation facilitators to realize the potential of emerging technologies to support organizations facing health care practitioner shortages and other barriers to OUD treatment delivery.

Introduction

Although estimates suggest that 2.5% of US residents have opioid use disorder (OUD), medication and behavioral treatment for OUD is scarce.[1-3] Numerous barriers impede access to OUD treatment, including transportation barriers[2] and insufficient numbers of mental health and substance use disorder (SUD) clinicians.[4-7] Digital health technologies have the potential to mitigate such barriers and expand access to treatment for patients with OUD.[8-10] However, the diffusion of digital health technologies could exacerbate disparities without careful attention to equity concerns, including understanding the clinical settings in which they are offered.[11-13] Currently, scant information documents which emerging patient-facing digital health technologies for OUD are used by health care organizations and the types of organizations most likely to deploy them.

Three technology categories that can support OUD treatment include remote mental health therapy and tracking, virtual peer recovery support programs, and digital recovery support for adjuvant cognitive behavior therapy (CBT) for OUD. Remote mental health therapy and tracking includes telemedicine counseling and mobile resources to promote OUD self-management and treatment adherence. Mobile applications may support patients to continuously track patient-reported outcomes or reach a therapist for concerns related to pain and withdrawal symptoms. Research has demonstrated the feasibility and acceptability of remote mental health applications, although evidence on clinical effectiveness is limited.[14-17] Virtual peer recovery support programs offer access to self-help groups to support long-term recovery. A recent Cochrane review suggested that 12-step programs supported abstinence from alcohol and may extend to support OUD recovery as well.[18] Programs such as SMART Recovery (Self-Management and Recovery Training) provide remote services that can complement or extend professional treatment. Digital recovery support for adjuvant CBT includes technologies that can deliver behavioral interventions to support OUD treatment. For example, reSET-O is a software program with US Food and Drug Administration clearance for use as a medical device, with some evidence of improving adherence to treatment involving evidence-based medications for OUD (MOUD).[19,20]

It remains unclear whether health care organizations use emerging technologies for OUD as substitutes for or complements to available SUD treatment resources. Important SUD treatment resources include staffing to treat patients with SUD, MOUD prescribing capability, registries to track mental health and OUD, and close relationships with specialty SUD treatment facilities that may treat those with more severe illnesses. Organizations with substantial resources may have the ability to effectively integrate digital services. On one hand, organizations can extend treatment provided by their clinicians through mobile tools to track mental health symptoms remotely.[21] On the other hand, technologies could substitute for insufficient SUD resources to meet clinical demand for patients with OUD. If technologies are primarily available in organizations with robust SUD treatment resources, then they are not yet reaching their full potential to advance access to care for patients with unmet needs in organizations without traditional treatment alternatives.

Value-based payment structures may promote the use of emerging technologies if they improve outcomes and reduce costs.[22] Accountable care organizations (ACOs) are health care organizations in the US responsible for the quality and costs of care of a designated population. These organizations tend to be leaders in the adoption of care delivery innovations designed to meet population health goals while limiting costs; therefore, they are well positioned to implement digital health technologies for OUD.

Despite the potential for value-based care organizations to be digital health leaders and the fact that health care organizations are purchasers for the majority of digital health technologies,[23] no study to date has characterized the use of patient-facing digital health technologies for OUD in organizations with ACO contracts. Using data from a national survey of ACOs, we examined 2 research questions: (1) How often are patient-facing digital health technologies for OUD deployed by ACOs in the US? and (2) Which organizational features are associated with the use of digital health technologies for OUD? Specifically, we examined whether organizations with greater SUD treatment resources were more likely to use digital health technologies for patients with OUD.

Methods

Study Design

We administered the 2022 National Survey of Accountable Care Organizations (NSACO) to all organizations participating in Medicare and Medicaid ACO contracts. Building on prior waves of the NSACO, the 2022 survey added questions related to SUD treatment resources. We sent paper and electronic surveys to leaders (population health officers, chief operating officers, and Medicare ACO public contacts) of 505 organizations between October 1, 2021, and June 30, 2022, yielding 304 respondents from 276 organizations (54.7% response rate). The eFigure in Supplement 1 summarizes survey administration, and eTable 1 in Supplement 1 displays the survey questions used. The study outreach, including informed consent, was approved by the Harvard University Institutional Review Board. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

Study Variables

Outcomes

Based on recommendations from authors and an external advisory board with subject matter expertise in mental health and SUD services, we identified 3 technology categories: remote mental health therapy and tracking, virtual peer recovery support programs, and digital recovery support for adjuvant CBT, as displayed in **Table 1**. We generated binary indicators of whether organizations used each individual category. We then generated a count of the total categories of digital health technologies used overall (range, 0-3) as well as a binary measure of whether the ACO offered at least 1 technology.

SUD Treatment Resources

Respondents reported whether their organization included an addiction medicine specialist (yes or no) and whether they agreed that the organization had sufficient staff to treat the needs of patients with SUD (strongly agree or somewhat agree).

The gold-standard treatment for OUD is the prescription of MOUD, yet attitudinal, training, regulatory, and administrative barriers have limited MOUD availability.[24,25] Until 2023, clinicians required additional training to prescribe buprenorphine, and methadone treatment has been limited to a small number of highly regulated certified programs. Consequently, ACOs may not include clinicians who are able to prescribe MOUD. We included a binary measure of whether the ACO had the capability to prescribe at least 1 MOUD (buprenorphine, naltrexone, or methadone [yes or no]).

We created a binary measure of whether the largest ACO contract participated with at least 1 specialty SUD treatment facility, including outpatient (eg, certified opioid treatment programs), inpatient, and residential treatment facilities (yes or no). Organizations reported whether they had a patient registry to identify patients with OUD or a registry to track mental health symptoms and treatment response, reported as binary outcomes. Beyond having functionality within the electronic health record to create registries, our survey asked whether clinicians in the organization routinely used registries or dashboards to facilitate treatment for patients with OUD.

ACO Characteristics

We included a categorical measure of organization type, including hospital or health system, physician or medical group led, safety-net organization (eg, Federally Qualified Health Center or coalition), or other organization. We included binary variables measuring the following: whether the organization included a Medicaid ACO contract; whether respondents agreed or strongly agreed that staffing, specialized training, and other costs can be a barrier to delivering mental health and SUD treatment services; and whether the ACO had a management partner (a third-party organization that could provide data, administrative, or educational services[26]). Last, we included a measure for the census region of the state where the ACO was based (Midwest, Northeast, South, or West) as well as a binary measure of whether the survey was taken on paper or online.

Statistical Analysis

First, we described characteristics of the overall sample of ACOs; second, we used χ^2 tests to test whether descriptive characteristics differed comparing organizations that used at least 1 category of technology vs organizations that used none. We then calculated the use of each category of digital health technology for OUD as well as the number of categories used.

We fit 4 separate models estimating the likelihood of reporting using the following: (1) at least 1 patient-facing technology category (vs none), (2) remote mental health therapy and tracking, (3) virtual peer recovery support programs, and (4) digital recovery support for adjuvant CBT. Each multivariable logistic regression model included variables to test whether ACOs with greater resources (included an addiction medicine specialist, reported sufficient staff to treat SUD, offered MOUD, included a specialty SUD treatment facility, had a registry to identify patients with OUD, or had a registry to track mental health for patients with OUD) were more likely to use digital health technologies for OUD compared with ACOs lacking these resources, after adjusting for organization type, inclusion of a Medicaid contract, financial barriers to treatment, having a management partner, census region, and survey type. Results are reported as average marginal effects, or the estimated change in the probability of reporting patient-facing technology use for a change in each

Table 1. Survey Items Measuring 3 Categories of Digital Health Technologies for Opioid Use Disorder (OUD) Included in the 2022 National Survey of Accountable Care Organizations

Variable	Survey wording	Response
Remote mental health therapy and tracking	Which of the following strategies, if any, do clinicians in your organization use to integrate treatment for OUD and mental illness? If provided directly and via referral, check both.	Yes, provide directly
		Yes, refer out
		No
		Descriptive analyses reported 4 response categories: the above 3 plus 1 (Yes, both provide directly and refer out)
	Digital therapy or other resources to track mental health symptoms and promote OUD self-management (eg, BetterHelp or similar digital tools for smartphone or computer)	For our multivariable regression model, we collapsed responses to reflect any use of remote mental health therapy and tracking, either provided directly or referred out (vs No)
Virtual peer recovery support programs	Do clinicians in your organization delivering services to patients with opioid use disorder provide any of the following services, either directly or via referral?	Yes
	Virtual recovery programs (eg, SMART Recovery or other virtual peer recovery groups accessed via mobile device or computer)	No
Digital recovery support for adjuvant cognitive behavior therapy	Do clinicians in your organization delivering services to patients with opioid use disorder provide any of the following services, either directly or via referral?	Yes
	Digital recovery support services (eg, reSET-O or similar prescription digital therapeutic intended to provide adjuvant cognitive behavioral therapy)	No

Abbreviation: SMART, Self-Management and Recovery Training.

independent variable, to improve interpretability and to enable comparisons with models based on different explanatory variables and study samples.[27,28]

We designated missing responses to the binary availability of resources as not available. As a sensitivity analysis, we conducted a complete case analysis, only estimating models based on respondents who completed all survey items. Because outreach included more than 1 respondent per organization and respondents were encouraged to share surveys with colleagues if they were uncertain about survey items, estimates accounted for 26 organizations with more than 1 respondent. For each organization, we created an analytic weight equal to $1/k$ responses, where k was the total number of responses per organization, and we clustered SEs at the organization level. We conducted all analyses including weights in the svy suite of commands in Stata, version 17.0 (StataCorp LLC). Data analysis was performed between December 15, 2022, and January 6, 2023.

Results

Descriptive Characteristics of ACO Respondents

Of the 276 organizations with an ACO contract, there were 304 respondents; 161 (53.1%) were from a hospital or health system (52.7%), 74 (24.2%) were from a physician- or medical group–led organization, and 23 (7.8%) were from a safety-net organization (**Table 2**). Specialty SUD resource availability varied widely, from sufficient staff to treat SUD reported by 40 respondents (12.6%) to having a registry to identify patients with OUD reported by 172 respondents (57.0%). Table 2 reports organizational characteristics overall and by the main outcome: presence of a digital health technology. Medicare Shared Savings Program data on structural, contract, and performance

Table 2. Unadjusted Characteristics of Accountable Care Organizations, Overall and by Users of Digital Health Technologies for Opioid Use Disorder (OUD)[a]

Characteristic	Overall sample (N = 304)	No. of digital health technology categories reported		
		None (n = 203 [66.5])	At least 1 (1-3) (n = 101 [33.5])	P value
SUD treatment resource				
Addiction medicine specialist	115 (37.4)	38 (18.7)	77 (74.5)	<.001
Sufficient staff to treat SUDs	40 (12.6)	16 (7.8)	24 (22.3)	<.001
Specialty SUD treatment facility	159 (52.6)	90 (45.1)	69 (67.4)	<.001
Medications for OUD	159 (52.0)	86 (41.8)	73 (72.3)	<.001
Registry to identify patients with OUD	172 (57.0)	95 (47.1)	77 (76.6)	<.001
Registry to track mental health for patients with OUD	84 (27.5)	23 (11.5)	61 (59.5)	<.001
Accountable care organization				
Organization type				
Hospital or health system	161 (53.1)	104 (51.6)	57 (56.0)	
Physician or medical group led	74 (24.2)	52 (25.7)	22 (21.7)	.01
Safety-net hospital	23 (7.8)	9 (4.5)	14 (14.4)	
Other (eg, payers)	48 (14.9)	39 (18.4)	9 (8.4)	
Includes Medicaid contract	154 (49.5)	91 (43.0)	63 (62.5)	.002
Reports financial barriers to treatment	164 (55.3)	95 (48.9)	69 (67.9)	.01
Management partnership	66 (21.7)	40 (20.5)	26 (24.2)	.48
Region				
South	72 (23.3)	50 (24.3)	22 (21.2)	
Midwest	67 (22.9)	45 (23.5)	22 (21.7)	.77
Northeast	110 (37.1)	70 (35.0)	40 (41.3)	
West	55 (16.7)	38 (17.2)	17 (15.8)	
Paper survey (vs online)	23 (6.6)	12 (5.1)	11 (9.5)	.15

Abbreviation: SUD, substance use disorder.

[a] Unless indicated otherwise, values are presented as No. (%) of respondents. These data are from the 2022 National Survey of Accountable Care Organizations. Survey respondents participated in at least 1 Medicare or Medicaid accountable care organization contract. Differences between organizations that used at least 1 category of digital health technology for OUD vs organizations that used none were compared with χ^2 tests. Analytic weights were applied to 26 organizations with more than 1 respondent so that each of the 276 unique organizations had equal weight in all estimates, and clustered SEs at the organization level accounted for correlation of responses within an organization. Unweighted frequencies and weighted percentages are reported.

characteristics indicated that the respondent sample was similar along nearly all domains to nonrespondent peers in the Medicare Shared Savings Program (eTable 2 in Supplement 1).

Prevalence of Digital Health Technologies for OUD

One-third of ACOs (101 [33.5%]) used at least 1 category of technology (**Table 3**). The most commonly used category was remote mental health therapy and tracking, reported by 80 respondents (26.5%). Remote mental therapy and tracking was more likely to occur via referral (57 [19.5%] overall) than direct provision (17 [5.6%] overall), while 6 respondents (1.4%) provided this technology both directly and referred externally. In total, 46 respondents (15.1%) used virtual peer recovery support programs and 27 (9.0%) used digital recovery support for adjuvant CBT.

Factors Associated With the Use of Technologies in Adjusted Models

After adjusting for all model covariates, ACOs with an addiction medicine specialist were 32.3 (SE, 4.7) percentage points (P < .001) more likely to use at least 1 category of technology compared with ACOs without an addiction medicine specialist (**Table 4**). Accountable care organizations that had a registry to track mental health were 27.2 (SE, 3.8) percentage points (P < .001) more likely to use at least 1 category of technology compared with ACOs that did not have a registry. Reports of sufficient staffing, a specialty SUD treatment facility, prescription of MOUD, and a registry to identify patients with OUD were not associated with technology use in an adjusted model. Physician- or medical group–led organizations were 13.2 (SE, 5.6) percentage points (P = .02) more likely to use at least 1 category of technology compared with hospital or health systems after adjusting for model covariates. Financial barriers, inclusion of a Medicaid contract, and management partnerships were not associated with technology use in an adjusted model.

Adjusted models estimating the use of individual technology categories as outcomes demonstrated that ACOs that were a safety-net organization were 12.1 (SE, 5.2) percentage points (P = .02) less likely to use remote mental health therapy and tracking compared with hospital or health systems. After adjusting for model covariates, ACOs that agreed that costs could be a barrier to treatment were 10.7 (SE, 4.7) percentage points (P = .02) more likely to use virtual peer recovery support programs compared with ACOs without financial barriers. The results of sensitivity analyses using a complete case approach for missing responses estimated nearly identical associations, except the statistical significance of several variables was attenuated (eTable 3 in Supplement 1).

Discussion

In this national cross-sectional study of 276 organizations with Medicare or Medicaid ACO contracts, we observed low and varied use of digital health technologies for OUD. Organizations with an addiction medicine specialist or a registry to track mental health were more likely to use at least 1 category of digital health technology for OUD compared with organizations lacking these resources. Although emerging technologies for OUD treatment represent a promising way to improve OUD service availability[4-6] and thereby potentially advance equity in treatment access, our results suggest that their distribution, which was more prominent in organizations with other SUD treatment capabilities, is not yet addressing treatment access gaps.

Remote technologies can create or expand the availability of OUD services in health care organizations facing practitioner shortages and other limitations to OUD care delivery, but they can only achieve this if their uptake aligns with need. Our findings suggest a mismatch between need and deployment. Organizations with fewer SUD treatment resources were less likely to adopt emerging technologies. To address this mismatch, policy initiatives could focus efforts on overcoming barriers to technology implementation in high-need, resource-limited health care settings. For example, policy makers and payers might test policies and reimbursement schemes that support health care organizations without local SUD treatment resources to integrate digital health technologies for OUD into their practices and workflow. Initiatives to advance the uptake of technologies may address

Table 3. Overall Use of Digital Health Technologies for Opioid Use Disorder in Accountable Care Organizations[a]

	Overall use (N = 304)
Digital health technology	
Remote mental health therapy and tracking, any use	80 (26.5)
Provided directly	17 (5.6)
Provided both directly and referred out	6 (1.4)
Referred out	57 (19.5)
Virtual peer recovery support programs	46 (15.1)
Digital recovery support for adjuvant cognitive behavior therapy	27 (9.0)
No. of technology categories used (0-3)	
0	203 (66.5)
1	66 (22.2)
2	18 (5.5)
3	17 (5.8)
≥1	101 (33.5)

[a] Unless indicated otherwise, values are presented as No. (%) of respondents. These data are from the 2022 National Survey of Accountable Care Organizations. Analytic weights were applied to 26 organizations with more than 1 respondent so that each of the 276 unique organizations had equal weight in all estimates, and clustered SEs at the organization level accounted for correlation of responses within an organization. Unweighted frequencies and weighted percentages are reported.

costs, knowledge, user engagement, organizational culture, leadership, interoperability, and data security concerns.[9,29-39] Training and education for patients and clinicians may be a productive avenue to increase adoption.[36,40,41] For example, Kaiser Permanente used both clinician referrals and direct-to-patient approaches to drive service use during a large-scale integration of digital mental health technologies.[42] Future efforts may require investing in trained staff, such as digital navigators, to support patients and clinicians to overcome technological, workflow, and digital literacy constraints.[43,44] Digital navigators offer an opportunity to overcome both patient- and staff-level barriers to technology use even in low-resource settings.

This study adds to an ongoing discussion of how digital health transformation might contribute to existing health disparities.[11,12,39,45-47] Disparities in technology use may emerge through differential access for patients with limited health literacy and members of racial and ethnic minority groups, as documented during the diffusion of patient portal use[48,49] and telehealth.[50-52] Disparities may also emerge if uptake of innovations lags among organizations serving vulnerable patient populations, such as the challenges safety-net organizations have faced in the uptake of health information technology.[53-57] Our unadjusted results showed that organizations serving vulnerable patient populations (safety-net organizations and organizations with a Medicaid ACO contract) were implementing digital health technologies; however, safety-net organizations were notably less likely to use remote mental health therapy and tracking compared with otherwise similar hospital and health systems. One possible explanation is that hospital and health system organizations have additional resources such as internal implementation assistance and greater technological infrastructure.[58] Evidence on the effectiveness of emerging technologies among users of diverse racial, ethnic, and socioeconomic backgrounds may contribute to greater adoption among safety-net

Table 4. Association Between Substance Use Disorder (SUD) Treatment Resources and Adoption of Digital Health Technologies for Opioid Use Disorder (OUD) in Accountable Care Organizations[a]

Characteristic	Average marginal effect (SE)			
	Any technology category used (1-3 total)	Remote mental health therapy and tracking	Virtual peer recovery support programs	Digital recovery support for adjuvant CBT
SUD treatment resource				
Addiction medicine specialist	44.0 (7.6)[b]	47.2 (6.8)[b]	15.3 (5.0)[c]	4.3 (4.1)
Sufficient staff to treat SUDs	3.9 (7.6)	−1.2 (5.8)	9.6 (5.6)	4.7 (4.6)
Specialty SUD treatment facility	−0.6 (5.1)	−4.6 (4.7)	1.7 (4.2)	7.5 (3.6)[d]
Medications for OUD	−0.9 (5.3)	−6.8 (4.7)	2.4 (5.3)	4.2 (3.0)
Registry to identify patients with OUD	0 (4.7)	2.0 (5.0)	4.6 (4.8)	−1.4 (4.2)
Registry to track mental health for patients with OUD	36.3 (6.7)[b]	38.0 (6.6)[b]	7.7 (4.5)	8.9 (4.4)[d]
Accountable care organization				
Organization type				
Hospital or health system	[Reference]	[Reference]	[Reference]	[Reference]
Physician or medical group led	13.0 (5.5)[d]	9.8 (5.3)	4.8 (5.8)	13.4 (5.6)[c]
Safety-net hospital	13.2 (10.0)	−13.0 (5.1)[d]	11.4 (7.3)	11.5 (8.4)
Other	4.5 (6.5)	6.6 (6.3)	−6.7 (4.9)	−0.2 (4.9)
Includes Medicaid contract	1.8 (4.5)	3.8 (4.4)	2.0 (3.8)	−2.1 (3.8)
Reports financial barriers to treatment	−2.0 (4.3)	−4.4 (3.9)	9.9 (3.9)[c]	6.9 (3.3)[d]
Management partnership	4.9 (5.3)	6.6 (4.8)	3.1 (4.7)	−2.2 (3.7)
Region				
South	[Reference]	[Reference]	[Reference]	[Reference]
Midwest	−13.0 (5.2)[d]	−14.2 (4.8)[c]	−0.3 (4.9)	0.1 (4.7)
Northeast	−12.7 (5.9)[d]	−6.3 (5.2)	−6.5 (5.1)	−7.3 (4.0)
West	−15.6 (5.9)[c]	−8.2 (5.7)	−7.6 (4.7)	−6.6 (3.9)
Paper survey (vs online)	14.5 (9.5)	12.6 (9.1)	8.4 (6.5)	2.5 (6.5)

Abbreviation: CBT, cognitive behavior therapy.

[a] These data are from the 2022 National Survey of Accountable Care Organizations. There were 304 respondents. Results are from 4 multivariable logistic regressions with separate outcomes: (1) whether the organization reported any of 3 digital health technology categories (1-3 used), (2) remote mental health therapy and tracking, (3) virtual peer recovery support programs, and (4) digital recovery support for adjuvant CBT. Average marginal effects were calculated to represent the expected average change in the probability of technology use, holding other variables at their observed values. Analytic weights were applied to 26 organizations with more than 1 respondent so that each of the 276 unique organizations had equal weight in all estimates, and clustered SEs at the organization level accounted for correlation of responses within an organization.

[b] $P < .001$.

[c] $P < .01$.

[d] $P < .05$.

organizations and may make certain that the uptake of emerging technologies does not mirror existing disparities in access to SUD and mental health treatment.[59-64]

Limitations

This study has important limitations. First, we reported statistical associations and cannot make causal inference. For example, we cannot identify direction or causality in our finding that ACOs reporting financial barriers to care were more likely to use virtual peer recovery support programs. Accountable care organizations might offer these programs because they face cost barriers, or they may face cost barriers due to offering these programs. Given the lack of research on current technology use, this descriptive analysis provides a foundation for developing causal hypotheses to test in future research. Second, we were unable to assess where organizations deployed technologies, how consistently local sites offered them, and individual patient uptake. For example, both primary care and specialist organizations can use technologies. Further, technologies may be both complements to and substitutes for SUD treatment resources, depending on heterogenous local site needs within large organizations. Future research should identify which health care organizations in the ACO network offer technologies. Third, our measure of specialty resources may overestimate patient access if they are not consistently available throughout the ACO—for example, if only a single clinician prescribes MOUD in the organization. Similarly, we were unable to measure characteristics of patients using the technologies for a more nuanced understanding of potential disparities. Fourth, we were unable to measure direct motivators for technology use or nonuse. For example, organizations may delay technology investment until there is greater evidence of their effectiveness through rigorous randomized studies or clearer identified local demand for their use. However, opioids currently contribute to most drug overdose deaths, and death rates due to overdose are high throughout the US (at least 18 per 100 000 in 46 states), suggesting that all organizations should build resources for patients with OUD.[65] Fifth, we had a survey response rate of 54.7% and relied on individual respondents to measure organization-wide resources. Although we were unable to assess potential selection bias of respondents, available Medicare Shared Savings Program data on structural, contract, and performance characteristics indicate that the respondent sample was similar along nearly all domains to nonrespondent peers in the Medicare Shared Savings Program. Despite these limitations, this survey analysis provides important data on deployment of technologies for OUD in the context of ACOs, organizations that should have the capability to implement novel treatment practices to improve quality and access.

Conclusions

Health care organizations are purchasers for the majority of digital health technologies,[23] yet there is little research on their use of patient-facing digital health technologies for OUD at a national scale. In this cross-sectional study with national survey data, we measured the current use of digital health technologies for OUD in US organizations holding Medicare or Medicaid ACO contracts. Our results suggest that digital health technologies for OUD are more likely to be deployed by organizations with relatively robust traditional SUD treatment resources. As such, the technology appears to complement existing SUD treatment resources rather than substitute for unavailable SUD treatment resources. Future studies should examine implementation facilitators to realize the potential of digital health technologies to support organizations facing practitioner shortages and other barriers to OUD treatment delivery.

Corresponding Author: Chris Miller-Rosales, PhD, MSPH, Department of Health Care Policy, Harvard Medical School, 180A Longwood Ave, Boston, MA 02115 (miller@hcp.med.harvard.edu).

Author Affiliations: Department of Health Care Policy, Harvard Medical School, Boston, Massachusetts (Miller-Rosales); Dartmouth Institute for Health Policy and Clinical Practice, Geisel School of Medicine, Lebanon, New Hampshire (Morden, Brunette); UnitedHealthcare, Minnetonka, Minnesota (Morden); Department of Psychiatry, Geisel School of Medicine, Dartmouth College, Hanover, New Hampshire (Brunette); Bureau of Mental Health Services, New Hampshire Department of Health and Human Services, Concord (Brunette); Department of Health Policy and Management, Yale School of Public Health, New Haven, Connecticut (Busch); Department of Psychiatry, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts (Torous); Department of Health Policy and Management, Harvard T.H. Chan School of Public Health, Boston, Massachusetts (Meara).

REFERENCES

1. Keyes KM, Rutherford C, Hamilton A, et al. What is the prevalence of and trend in opioid use disorder in the United States from 2010 to 2019? using multiplier approaches to estimate prevalence for an unknown population size. *Drug Alcohol Depend Rep*. 2022;3:100052. doi:10.1016/j.dadr.2022.100052

2. Kiang MV, Barnett ML, Wakeman SE, Humphreys K, Tsai AC. Robustness of estimated access to opioid use disorder treatment providers in rural vs. urban areas of the United States. *Drug Alcohol Depend*. 2021;228: 109081. doi:10.1016/j.drugalcdep.2021.109081

3. Haffajee RL, Lin LA, Bohnert ASB, Goldstick JE. Characteristics of US counties with high opioid overdose mortality and low capacity to deliver medications for opioid use disorder. *JAMA Netw Open*. 2019;2(6):e196373. doi:10.1001/jamanetworkopen.2019.6373

4. Hutchinson E, Catlin M, Andrilla CHA, Baldwin LM, Rosenblatt RA. Barriers to primary care physicians prescribing buprenorphine. *Ann Fam Med*. 2014;12(2):128-133. doi:10.1370/afm.1595

5. Jones CM, Campopiano M, Baldwin G, McCance-Katz E. National and state treatment need and capacity for opioid agonist medication-assisted treatment. *Am J Public Health*. 2015;105(8):e55-e63. doi:10.2105/AJPH.2015. 302664

6. Snell-Rood C, Pollini RA, Willging C. Barriers to integrated medication-assisted treatment for rural patients with co-occurring disorders: the gap in managing addiction. *Psychiatr Serv*. 2021;72(8):935-942. doi:10.1176/appi.ps. 202000312

7. Andrilla CHA, Moore TE, Patterson DG. Overcoming barriers to prescribing buprenorphine for the treatment of opioid use disorder: recommendations from rural physicians. *J Rural Health*. 2019;35(1):113-121. doi:10.1111/jrh.12328

8. National Advisory Mental Health Council. Opportunities and challenges of developing information technologies on behavioral and social science clinical research. National Institute of Mental Health; 2018. Accessed October 31, 2022. https://www.nimh.nih.gov/about/advisory-boards-and-groups/namhc/reports/opportunities-and-challenges-of-developing-information-technologies-on-behavioral-and-social-science-clinical-research

9. Molfenter T, Brown R, O'Neill A, Kopetsky E, Toy A. Use of telemedicine in addiction treatment: current practices and organizational implementation characteristics. *Int J Telemed Appl*. 2018;2018:3932643. doi:10.1155/2018/3932643

10. Marsch LA. Leveraging technology to enhance addiction treatment and recovery. *J Addict Dis*. 2012;31(3):313-318. doi:10.1080/10550887.2012.694606

11. Richardson S, Lawrence K, Schoenthaler AM, Mann D. A framework for digital health equity. *NPJ Digit Med*. 2022;5(1):119. doi:10.1038/s41746-022-00663-0

12. Lyles CR, Wachter RM, Sarkar U. Focusing on digital health equity. *JAMA*. 2021;326(18):1795-1796. doi:10.1001/jama.2021.18459

13. Schueller SM, Hunter JF, Figueroa C, Aguilera A. Use of digital mental health for marginalized and underserved populations. *Curr Treat Options Psychiatry*. 2019;6(3):243-255. doi:10.1007/s40501-019-00181-z

14. Steinkamp JM, Goldblatt N, Borodovsky JT, et al. Technological interventions for medication adherence in adult mental health and substance use disorders: a systematic review. *JMIR Ment Health*. 2019;6(3):e12493. doi:10.2196/12493

15. Wang K, Varma DS, Prosperi M. A systematic review of the effectiveness of mobile apps for monitoring and management of mental health symptoms or disorders. *J Psychiatr Res*. 2018;107:73-78. doi:10.1016/j.jpsychires.2018.10.006

16. Naslund JA, Marsch LA, McHugo GJ, Bartels SJ. Emerging mHealth and eHealth interventions for serious mental illness: a review of the literature. *J Ment Health*. 2015;24(5):321-332. doi:10.3109/09638237.2015.1019054

17. Marzano L, Bardill A, Fields B, et al. The application of mHealth to mental health: opportunities and challenges. *Lancet Psychiatry*. 2015;2(10):942-948. doi:10.1016/S2215-0366(15)00268-0

18. Kelly JF, Humphreys K, Ferri M. Alcoholics Anonymous and other 12-step programs for alcohol use disorder. *Cochrane Database Syst Rev*. 2020;3(3):CD012880. doi:10.1002/14651858.CD012880.pub2

19. Velez FF, Colman S, Kauffman L, Ruetsch C, Anastassopoulos K. Real-world reduction in healthcare resource utilization following treatment of opioid use disorder with reSET-O, a novel prescription digital therapeutic. *Expert Rev Pharmacoecon Outcomes Res*. 2021;21(1):69-76. doi:10.1080/14737167.2021.1840357

20. Velez FF, Ruetsch C, Maricich Y. Evidence of long-term real-world reduction in healthcare resource utilization following treatment of opioid use disorder with reSET-O, a novel prescription digital therapeutic. *Expert Rev Pharmacoecon Outcomes Res*. 2021;21(4):519-520. doi:10.1080/14737167.2021.1939687

21. Raney L, Bergman D, Torous J, Hasselberg M. Digitally driven integrated primary care and behavioral health: how technology can expand access to effective treatment. *Curr Psychiatry Rep*. 2017;19(11):86. doi:10.1007/s11920-017-0838-y

22. Mohr DC, Azocar F, Bertagnolli A, et al; Banbury Forum on Digital Mental Health. Banbury Forum consensus statement on the path forward for digital mental health treatment. *Psychiatr Serv*. 2021;72(6):677-683. doi:10.1176/appi.ps.202000561

23. Cohen AB, Dorsey ER, Mathews SC, Bates DW, Safavi K. A digital health industry cohort across the health continuum. *NPJ Digit Med*. 2020;3(1):68. doi:10.1038/s41746-020-0276-9

24. Samet JH, Kertesz SG. Suggested paths to fixing the opioid crisis: directions and misdirections. *JAMA Netw Open*. 2018;1(2):e180218. doi:10.1001/jamanetworkopen.2018.0218

25. Mackey K, Veazie S, Anderson J, Bourne D, Peterson K. Barriers and facilitators to the use of medications for opioid use disorder: a rapid review. *J Gen Intern Med*. 2020;35(suppl 3):954-963. doi:10.1007/s11606-020-06257-4

26. Lewis VA, D'Aunno T, Murray GF, Shortell SM, Colla CH. The hidden roles that management partners play in accountable care organizations. *Health Aff (Millwood)*. 2018;37(2):292-298. doi:10.1377/hlthaff.2017.1025

27. Norton EC, Dowd BE. Log odds and the interpretation of logit models. *Health Serv Res*. 2018;53(2):859-878. doi:10.1111/1475-6773.12712

28. Norton EC, Dowd BE, Maciejewski ML. Marginal effects—quantifying the effect of changes in risk factors in logistic regression models. *JAMA*. 2019;321(13):1304-1305. doi:10.1001/jama.2019.1954

29. Schlieter H, Marsch LA, Whitehouse D, et al. Scale-up of digital innovations in health care: expert commentary on enablers and barriers. *J Med Internet Res*. 2022;24(3):e24582. doi:10.2196/24582

30. Ramsey A, Lord S, Torrey J, Marsch L, Lardiere M. Paving the way to successful implementation: identifying key barriers to use of technology-based therapeutic tools for behavioral health care. *J Behav Health Serv Res*. 2016;43(1):54-70. doi:10.1007/s11414-014-9436-5

31. Graham AK, Lattie EG, Powell BJ, et al. Implementation strategies for digital mental health interventions in health care settings. *Am Psychol*. 2020;75(8):1080-1092. doi:10.1037/amp0000686

32. O'Loughlin K, Neary M, Adkins EC, Schueller SM. Reviewing the data security and privacy policies of mobile apps for depression. *Internet Interv*. 2018;15:110-115. doi:10.1016/j.invent.2018.12.001

33. Lattie EG, Stiles-Shields C, Graham AK. An overview of and recommendations for more accessible digital mental health services. *Nat Rev Psychol*. 2022;1(2):87-100. doi:10.1038/s44159-021-00003-1

34. Mathews SC, McShea MJ, Hanley CL, Ravitz A, Labrique AB, Cohen AB. Digital health: a path to validation. *NPJ Digit Med*. 2019;2(1):38. doi:10.1038/s41746-019-0111-3

35. Patel NA, Butte AJ. Characteristics and challenges of the clinical pipeline of digital therapeutics. *NPJ Digit Med*. 2020;3(1):159. doi:10.1038/s41746-020-00370-8

36. Gordon WJ, Landman A, Zhang H, Bates DW. Beyond validation: getting health apps into clinical practice. *NPJ Digit Med*. 2020;3(1):14. doi:10.1038/s41746-019-0212-z

37. Chien I, Enrique A, Palacios J, et al. A machine learning approach to understanding patterns of engagement with internet-delivered mental health interventions. *JAMA Netw Open*. 2020;3(7):e2010791. doi:10.1001/jamanetworkopen.2020.10791

38. Carlo AD, Hosseini Ghomi R, Renn BN, Strong MA, Areán PA. Assessment of real-world use of behavioral health mobile applications by a novel stickiness metric. *JAMA Netw Open*. 2020;3(8):e2011978. doi:10.1001/jamanetworkopen.2020.11978

39. Uscher-Pines L, Riedel LE, Mehrotra A, Rose S, Busch AB, Huskamp HA. Many clinicians implement digital equity strategies to treat opioid use disorder. *Health Aff (Millwood)*. 2023;42(2):182-186. doi:10.1377/hlthaff.2022.00803

40. Balaskas A, Schueller SM, Cox AL, Doherty G. Understanding users' perspectives on mobile apps for anxiety management. *Front Digit Health*. 2022;4:854263. doi:10.3389/fdgth.2022.854263

41. Suggs BG, Sanderfer Stull M, Baker SR, Erwin KT, Savinsky DM. A tide of technical trends: technology competence among licensed counselors. *Journal of Technology in Counseling Education and Supervision.* 2022;2(1):2. doi:10.22371/tces/0011

42. Mordecai D, Histon T, Neuwirth E, et al. How Kaiser Permanente created a mental health and wellness digital ecosystem. *NEJM Catal Innov Care Deliv*. 2021;2(1). doi:10.1056/CAT.20.0295

43. Chang S, Gray L, Torous J. Smartphone app engagement and clinical outcomes in a hybrid clinic. *Psychiatry Res*. 2023;319:115015. doi:10.1016/j.psychres.2022.115015

44. Wisniewski H, Gorrindo T, Rauseo-Ricupero N, Hilty D, Torous J. The role of digital navigators in promoting clinical care and technology integration into practice. *Digit Biomark*. 2020;4(suppl 1):119-135. doi:10.1159/000510144

45. Sieck CJ, Sheon A, Ancker JS, Castek J, Callahan B, Siefer A. Digital inclusion as a social determinant of health. *NPJ Digit Med*. 2021;4(1):52. doi:10.1038/s41746-021-00413-8

46. Lyles C, Horn I, Sarkar U. In digital health, partnerships between business and academia are needed to advance health equity. *Health Affairs Blog*. April 16, 2021. Accessed January 21, 2023. http://www.healthaffairs.org/action/oidcStart?redirectUri=%2Fdo%2F10.1377%2Fforefront.20210413.13025

47. Golden B, Asiodu IV, Franck LS, et al. Emerging approaches to redressing multi-level racism and reproductive health disparities. *NPJ Digit Med*. 2022;5(1):169. doi:10.1038/s41746-022-00718-2

48. Sarkar U, Karter AJ, Liu JY, et al. Social disparities in internet patient portal use in diabetes: evidence that the digital divide extends beyond access. *J Am Med Inform Assoc*. 2011;18(3):318-321. doi:10.1136/jamia.2010.006015

49. Sarkar U, Karter AJ, Liu JY, et al. The literacy divide: health literacy and the use of an internet-based patient portal in an integrated health system—results from the Diabetes Study of Northern California (DISTANCE). *J Health Commun*. 2010;15(suppl 2):183-196. doi:10.1080/10810730.2010.499988

50. Adepoju OE, Chae M, Ojinnaka CO, Shetty S, Angelocci T. Utilization gaps during the COVID-19 pandemic: racial and ethnic disparities in telemedicine uptake in Federally Qualified Health Center clinics. *J Gen Intern Med*. 2022;37(5):1191-1197. doi:10.1007/s11606-021-07304-4

51. Fischer SH, Ray KN, Mehrotra A, Bloom EL, Uscher-Pines L. Prevalence and characteristics of telehealth utilization in the United States. *JAMA Netw Open*. 2020;3(10):e2022302. doi:10.1001/jamanetworkopen.2020.22302

52. Patel SY, Rose S, Barnett ML, Huskamp HA, Uscher-Pines L, Mehrotra A. Community factors associated with telemedicine use during the COVID-19 pandemic. *JAMA Netw Open*. 2021;4(5):e2110330. doi:10.1001/jamanetworkopen.2021.10330

53. Lewis VA, Spivack S, Murray GF, Rodriguez HP. FQHC designation and safety net patient revenue associated with primary care practice capabilities for access and quality. *J Gen Intern Med*. 2021;36(10):2922-2928. doi:10.1007/s11606-021-06746-0

54. Furukawa MF, King J, Patel V, Hsiao CJ, Adler-Milstein J, Jha AK. Despite substantial progress in EHR adoption, health information exchange and patient engagement remain low in office settings. *Health Aff (Millwood)*. 2014;33(9):1672-1679. doi:10.1377/hlthaff.2014.0445

55. Doty MM, Abrams MK, Hernandez SE, Stremikis K, Beal AC. Enhancing the capacity of community health centers to achieve high performance. Commonwealth Fund. 2010. Accessed January 20, 2023. https://www.commonwealthfund.org/publications/fund-reports/2010/may/enhancing-capacity-community-health-centers-achieve-high

56. Lewis VA, Colla CH, Schoenherr KE, Shortell SM, Fisher ES. Innovation in the safety net: integrating community health centers through accountable care. *J Gen Intern Med*. 2014;29(11):1484-1490. doi:10.1007/s11606-014-2911-0

57. Shortell S, Weinberger S, Chayt M, Marciarille AM. Safety net challenges in delivering accountable care. *Health Affairs Blog*. November 1, 2012. Accessed January 20, 2023. https://www.healthaffairs.org/content/forefront/safety-net-challenges-delivering-accountable-care

58. Rodriguez HP, McClellan SR, Bibi S, Casalino LP, Ramsay PP, Shortell SM. Increased use of care management processes and expanded health information technology functions by practice ownership and Medicaid revenue. *Med Care Res Rev*. 2016;73(3):308-328. doi:10.1177/1077558715613233

59. Andraka-Christou B. Addressing racial and ethnic disparities in the use of medications for opioid use disorder. *Health Aff (Millwood)*. 2021;40(6):920-927. doi:10.1377/hlthaff.2020.02261

60. Creedon TB, Cook BL. Access to mental health care increased but not for substance use, while disparities remain. *Health Aff (Millwood)*. 2016;35(6):1017-1021. doi:10.1377/hlthaff.2016.0098

61. Lagisetty PA, Ross R, Bohnert A, Clay M, Maust DT. Buprenorphine treatment divide by race/ethnicity and payment. *JAMA Psychiatry*. 2019;76(9):979-981. doi:10.1001/jamapsychiatry.2019.0876

62. Stein BD, Dick AW, Sorbero M, et al. A population-based examination of trends and disparities in medication treatment for opioid use disorders among Medicaid enrollees. *Subst Abus*. 2018;39(4):419-425. doi:10.1080/08897077.2018.1449166

63. Dong H, Stringfellow EJ, Russell WA, Jalali MS. Racial and ethnic disparities in buprenorphine treatment duration in the US. *JAMA Psychiatry*. 2023;80(1):93-95. doi:10.1001/jamapsychiatry.2022.3673

64. McCall T, Schwartz TA, Khairat S. The acceptability of text messaging to help African American women manage anxiety and depression: cross-sectional survey study. *JMIR Ment Health*. 2020;7(2):e15801. doi:10.2196/15801

65. US Centers for Disease Control and Prevention. Wide-Ranging Online Data for Epidemiologic Research (WONDER). US Dept of Health and Human Services; 2021. Accessed May 5, 2023. https://wonder.cdc.gov

SUPPLEMENT 1.
eFigure. Flowchart of the 2022 National Survey of Accountable Care Organizations
eTable 1. Survey Questions for Variables Included in the Study Analysis
eTable 2. Comparisons Between Characteristics of Respondents to the National Survey of Accountable Care Organizations and Nonrespondent Organizations in the Medicare Shared Savings Program
eTable 3. The Association Between Substance Use Disorder Treatment Resources and Adoption of Digital Health Technologies for Opioid Use Disorder in Accountable Care Organizations

SUPPLEMENT 2.
Data Sharing Statement