Data supplement for Gustafson et al., Effects of Bundling Medication
for Opioid Use Disorder with an mHealth Intervention Targeting Addiction:
A Randomized Clinical Trial. Am J Psychiatry (doi: 10.1176/appi.ajp.20230055)

A-CHESS SMARTPHONE-BASED SYSTEM

Home Screen Features for Patients

The following services could be accessed by participants from the A-CHESS home screen (see Figure S1).

FIGURE S1.
A-CHESS home screen

My Motivation. Participants customized A-CHESS by adding text and photos motivating their recovery, including optional display of a personal motivation on their homepage. This area also included random gratitude prompts ("What are you grateful for?") and the ability to create favorites (i.e., items saved for easy reference).

Discussions. This chat room feature fostered the exchange of emotional, informational, and instrumental support among participants. Discussions were moderated by members of the research team who were trained on A-CHESS, risk identification, referral, and technology-based patient engagement; skilled in constructive interaction and engagement; and willing to work unusual hours. Moderators encouraged individuals to follow up with their healthcare providers regarding treatment questions. Participants could opt to receive notifications of new posts.

Private Messages. This email-type function allowed messages to be exchanged privately between participants. Moderators could also communicate one-to-one with participants to offer support, based on the content of their discussion posts and login data. Participants could opt to receive notifications of new private messages.

Information. Participants searched by keyword or browsed by topic to access recovery news and research, Quick Tips for coping and social skills, personal stories of others' recovery journeys, videos from counselors and clinicians offering information and encouragement, health resources in the community, and tech tutorials of the A-CHESS app. Quick Tips included "CBT boosters": brief, easy-to-remember reviews of cognitive behavioral therapy skills that participants learned during treatment to prepare them for future challenges, such as how to handle urges and how to anticipate, avoid, and mitigate the effects of high-risk people, places, and things related to past drug use.

Games and Relaxation. For entertainment, distraction, and de-stressing, participants could play games, watch fun videos, and listen to relaxation and meditation audio.

Help with Cravings. This area connected struggling participants with immediate support in the following ways: call or text a friend or treatment agency from a quick list of numbers loaded by the participant; link to positive, potentially distracting activities such as selected games, relaxation recordings, and discussion groups; find a nearby meeting; and review personal recovery motivations and reasons to stay clean.

Profiles. Here participants could share info about themselves, such as hobbies and interests, and view profiles of others. To protect privacy and ensure anonymity, participants were known by self-created usernames.

Meetings and Events. UW research and clinic staff continuously maintained lists of community and clinic meetings in the study locations.

Settings. Participants customized A-CHESS to get the support they needed in the following ways: add a personal motivation (picture or quote) to their homepage; enter high-risk locations; set a sobriety date goal; select desired notifications.

Automated Features for Patients

Location Tracker. If a participant approached a location he or she identified as high risk in Settings, A-CHESS initiated a participant-defined recovery process (e.g., first a beep, then a vibration, then a list of pre-approved contacts and options for distraction or mindfulness). The GPS service was also used to locate a 12-step or other recovery meeting. Participants could turn off the location tracker.

Weekly Survey. Every seven days participants were prompted to take a survey based on the Brief Addiction Monitor (BAM) (1). After completing the BAM, participants received tailored feedback that acknowledged their use of protective behaviors and provided recommendations for addressing risky behaviors, including links to A-CHESS content. Participants reporting drug use were encouraged to seek appropriate help.

Counselor Features

Counselor Dashboard. Developed by addiction clinicians, the dashboard harvested clinically relevant data from ACHESS and presented it to counselors to help them identify participants who might be at high risk for relapse and/or benefit from clinical intervention, see a detailed analysis of a participant's recent history (e.g., trends in individual BAM items, ACHESS use, and relapse data), and intervene (e.g., through texting in ACHESS) (2). Once a month, study clinics received a summary of all participants still completing the weekly BAM survey. Clinics also received a more detailed report for each of their participants so counselors could probe more deeply.

Counselor Alerts. ACHESS sent email notifications to an ACHESS moderator if a patient reported substance use or was over a pre-set risk threshold on self-monitoring items. The moderator could alert a counselor or encourage the patient to seek further support within ACHESS or professional help.

References

1. Nelson KG, Young K, Chapman H. Examining the performance of the Brief Addiction Monitor. J Subst Abuse Treat. 2014;46(4):472–81.
2. Voogt C, Kuntsche E, Kleinjan M, Poelen E, Engels R. Using ecological momentary assessment to test the effectiveness of a web-based brief alcohol intervention over time among heavy-drinking students: randomized controlled trial. J Med Internet Res. 2014;16(1):e5.

TABLE S1. Number of participants who reported using a MOUD at each timepoint

MOUD type		**Base-line**	**4 mos.**	**8 mos.**	**12 mos.**	**16 mos.**	**20 mos.**	**24 mos.**
MOUD+A-CHESS (N=208)								
	Methadone	150	139	128	119	108	99	86
	Buprenorphine	46	40	35	32	30	29	28
	Naltrexone	12	8	8	1	1	0	1
	None	0	7	12	11	18	16	30
	Missing	0	14	25	45	51	64	63
MOUD-only (N=206)								
	Methadone	150	136	129	116	112	104	98
	Buprenorphine	44	39	35	31	28	28	28
	Naltrexone	12	8	5	1	1	1	1
	None	0	4	13	11	16	17	21
	Missing	0	19	24	47	49	56	58

FIGURE S2. CONSORT flow of participants through the study

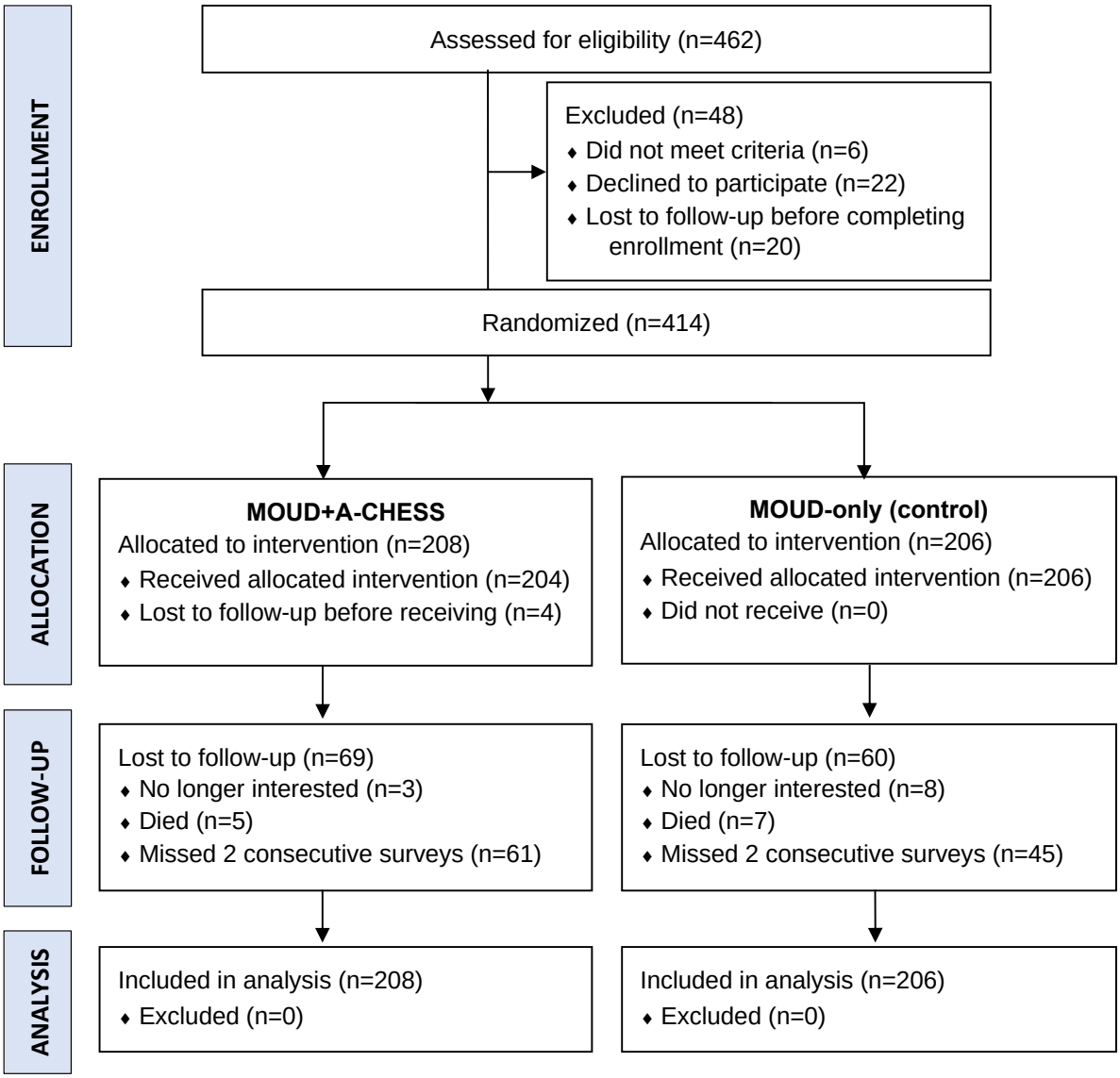

TABLE S2. Number of days of A-CHESS use by MOUD+A-CHESS participants

Time period	Mean	SD	Median
Months 1–12 (360 days)	116.36	80.48	104.50
Months 13–24 (360 days)	65.78	51.21	54.00

TABLE S3. Differences in survey completion rates over time between MOUD+A-CHESS and MOUD-only arms

Timepoint	MOUD+A-CHESS (N=208)		MOUD-only (N=206)		Completion rate (%)	χ^2	p-value
	Complete	Missing	Complete	Missing			
Baseline	208	0	206	0	–	–	–
4 mos.	180	28	163	43	82.85	4.00	.045
8 mos.	166	42	163	43	79.47	0.03	.86
12 mos.	150	58	151	55	72.71	0.07	.79
16 mos.	144	64	148	58	70.53	0.34	.46
20 mos.	116	92	140	66	61.84	6.52	.011
24 mos.	123	85	144	62	64.49	5.24	.022

TABLE S4. Number of participants by arm using opioids at each timepoint

Timepoint		No opioid use	Opioid use	Missing
MOUD+A-CHESS (N=208)				
	Baseline	140	68	0
	4 mos.	120	66	22
	8 mos.	117	55	36
	12 mos.	115	37	56
	16 mos.	110	35	63
	20 mos.	88	34	86
	24 mos.	96	28	84
MOUD-only (N=206)				
	Baseline	129	77	0
	4 mos.	121	50	35
	8 mos.	118	50	38
	12 mos.	114	38	54
	16 mos.	108	42	56
	20 mos.	106	34	66
	24 mos.	103	41	62

FIGURE S3. Probability of abstinence in the past 30 days for MOUD+A-CHESS and MOUD-only groups over time

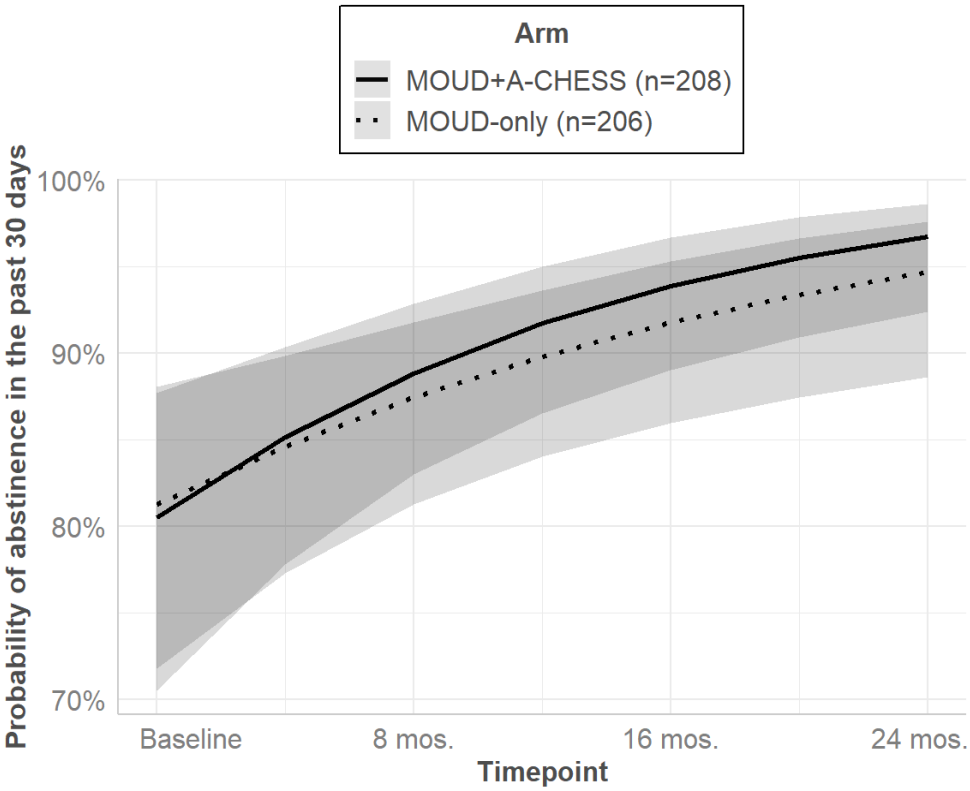

TABLE S5. Inferential statistics for all moderators of abstinence (arm x timepoint x moderator)

Moderator	Odds Ratio (OR)	95% CI	p-value
MOUD type	0.57	0.34–0.97	.039
Withdrawal symptoms severity	0.95	0.91–1.00	.047
Gender	1.04	0.70–1.54	.85
Pain severity	0.98	0.92–1.05	.60
Loneliness	1.02	0.85–1.22	.84

FIGURE S4. Probability density plots for withdrawal symptoms severity at each timepoint (probability range = 0–1; withdrawal symptoms severity rating 0 = no symptoms, 1 = symptoms "not at all severe," 10 = symptoms "very severe")

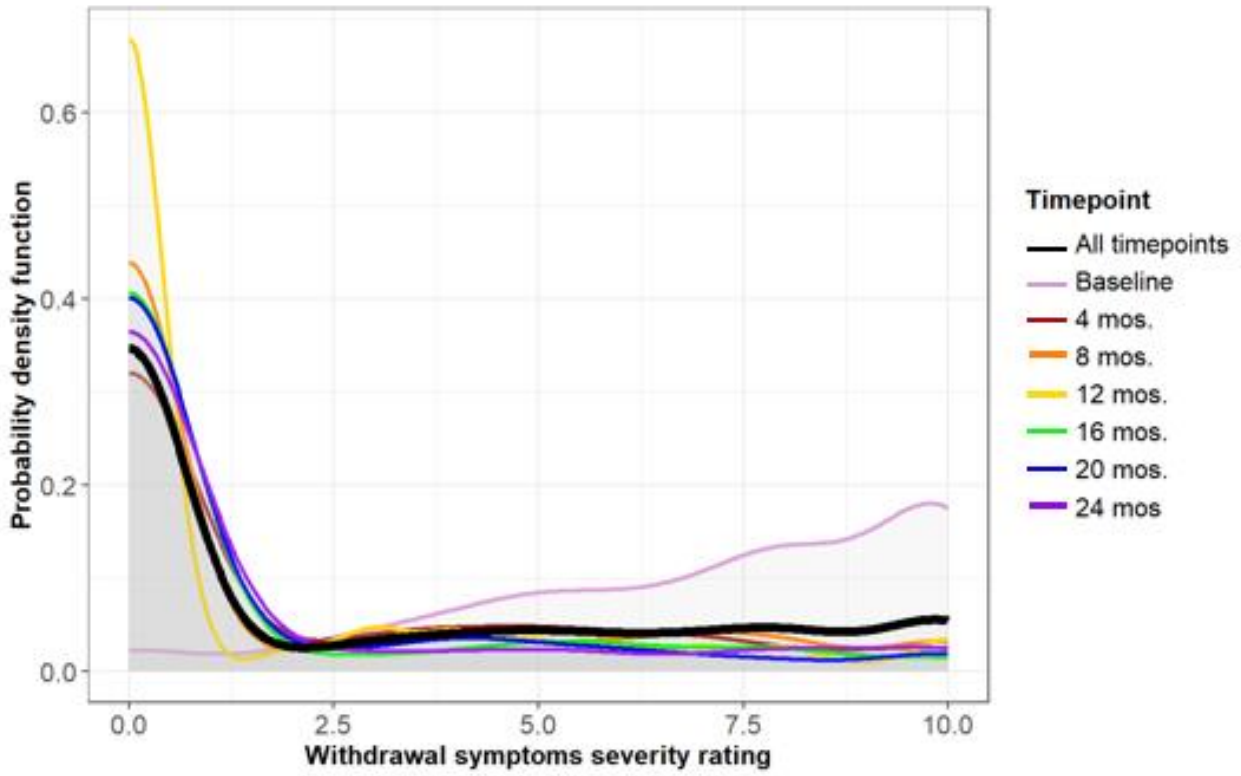

TABLE S6. Inferential statistics for secondary outcomes (arm x timepoint)

Outcome	**Odds Ratio (OR)**	**95% CI**	**p-value**
Illicit marijuana use	1.13	0.94–1.37	.20
Illicit sedative use	0.98	0.76–1.26	.86
Illicit stimulant use	0.95	0.82–1.10	.51
Alcohol use	0.95	0.81–1.12	.54
MOUD status (staying on MOUD)	0.90	0.75–1.07	.22
Meetings attendance	1.25	1.05–1.49	**.014**
Outpatient visits	0.98	0.79–1.23	.88
Therapy/counseling	0.97	0.69–1.38	.88
Overnight hospitalizations	0.91	0.72–1.14	.40
Emergency room/urgent care visits	0.88	0.78–0.99	**.034**
Any other provider visits	0.96	0.86–1.07	.46
	Mean estimate	**95% CI**	**p-value**
Quality of life	-0.01	-0.04–0.01	.33