Feasibility, acceptability and preliminary efficacy of a cognitive behavior therapy text-message intervention among individuals with opioid use disorder in Kenya: a randomized feasibility trial

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Abstract

Background Opioid use disorder is associated with a huge burden of disease and treatment gap. Delivery of psychosocial treatment using digital platforms can bridge the treatment gap to improve treatment access among individuals with opioid use disorder. The aim of this study was to assess the acceptability, feasibility and preliminary efficacy of a text-message intervention in patients with opioid use disorder in Nairobi, Kenya.

Methods A feasibility pilot trial was conducted at a methadone clinic in Nairobi. A text-message intervention based on cognitive behaviour therapy was delivered for six weeks compared with a control group receiving standard treatment among 46 individuals on methadone treatment (30 in intervention and 16 in control group). Follow up was at six weeks and three months. Primary outcome was reduction in opioid use and retention in treatment. Implementation outcomes assessed were acceptability and feasibility of the intervention.

Results The participants comprised 89.1% male with a mean age of 32 years (SD 8.7). There was a reduction in opioid use among all the participants post-intervention with higher reduction in the intervention group compared the control group with prevalence of opioid use at 35.7% and 56.3%, respectively although there was no statistically significance difference. Retention in methadone was 93.3% at six weeks and 83.3% at 3 months follow up among participants in the intervention group. High acceptability and satisfaction were reported with the intervention based on quantitative assessment post-intervention.

Conclusion Results from this pilot feasibility study suggest that a text message intervention is acceptable and scan be implemented in substance use disorder treatment with promising effect in improving outcomes. Further research using a larger sample size is recommended.

Trial registration Pan African Clinical Trial Registry: Registration number: PACTR202201736072847. Date of registration: 10/01/2022.

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Introduction

Opioid use is prevalent with significant burden of disease globally. According to the world drug report 2022, 60 million people reported past-year opioid use in 2020 with a two-fold increase between 2010–2020 [1, 2]. In Kenya opioid use is also prevalent [3, 4] with reported increase in multiple areas in the country [5]. Opioid use is associated with negative effects such as risk for opioid overdose, risk of infections among those using via injection as well as negative impact on families and employment [4].

The recommended treatment for opioid use disorder (OUD) is pharmacotherapy of which methadone is the most commonly used [6–8]. Psychosocial interventions are provided as adjunct treatment and include cognitive behaviour therapy (CBT) [9–11]. Despite the available treatment options for OUD, there still remains a huge treatment gap and low uptake of treatment. This is due to factors such as limited availability of treatment programs, individual barriers such as difficulty with regular treatment attendance, societal factors such as stigma [12–15] and barriers faced by treatment facilities that limit availability of psychosocial treatment such as low staffing, high staff turnover, limited finances and administrative factors such as national policies on provision of substance use disorder (SUD) treatment [1, 16].

There is growing use of digital interventions in psychosocial treatment delivery [17, 18]. These interventions can help address some of the challenges to improve access to psychosocial treatment for patients with OUD [17, 19, 20]. Advantages of digital interventions include privacy, convenience, reach, cost effectiveness, ability for remote delivery which saves time and could address the stigma associated with having to consult a therapist [16, 21, 22]. Among the digital platforms, mobile phones have the added advantage in being more portable which increases their utility in connecting with people with limited access to health care settings and have thus been used to offer digital treatment in several conditions including SUD [21, 23–25]. Text-messaging is increasingly being used in SUD treatment [26–29] and text-message interventions can help facilitate delivery of CBT in individuals with SUDs, as these interventions are associated with low cost, are highly scalable, user friendly and allow flexibility in treatment delivery [26, 30]. Text-message interventions have been used among individuals with OUD and have shown effectiveness in improving opioid use and other outcomes with high acceptability [31, 32].

Cognitive behaviour therapy combines training in behaviour skills, cognitive interventions, and lifestyle modification strategies. The aim is relapse prevention with emphasis on developing self-management skills and strategies to maintain the change. CBT has been used in a wide range of SUDs and is effective both as monotherapy or in combination with other psychosocial therapies or pharmacological interventions [33–35]. In OUD, CBT has been shown to improve outcomes such as abstinence from opioids, addiction severity and quality of life [35–37]. CBT application for SUD treatment in low and middle-income countries (LMICs) is limited [38, 39]. This can be due to challenges such as limited availability of quality training and supervision, high number of patients and high rate of clinician turnover [40, 41]. Some of these challenges can be circumvented by use of technology to deliver CBT [40, 42, 43].

Increase in digital platforms especially access to mobile phone has enabled use of digital interventions in healthcare. In Kenya, there is high phone ownership in the general population with a prevalence of feature phones and smartphones at 67.9% and 53.4% respectively in 2021 [44]. Among specific populations the prevalence ranges from 69% among youth attending outpatient clinics [45], 79% among adults in informal settlements [46] and 77.1% among individuals with OUD with majority using basic phones [47]. In addition, those without phones report access through others such as family and friends [46–48]. Mobile phone interventions have been used in Kenya predominantly through text messaging. These interventions have been used in conditions such as immunization, cancer screening and infectious diseases with high acceptability and effectiveness [49–51]. There is limited research on use of text-message intervention among individuals with SUD.

In Kenya research on interventions targeting SUD is limited [4]. In addition, there is limited use of digital interventions in SUD treatment in Kenya and other LMICs [52]. In Kenya, only two studies report on use of digital interventions in SUD whereby one study was conducted at a rural clinic [53] and the other among university students in Nairobi [54]. Despite the increase in methadone treatment clinics in Kenya from one in 2014 to current eight [55, 56], the retention rate is low at 54% [57] which indicates need to seek measures to improve outcomes. Patients on methadone treatment indicate need for psychosocial services in addition to

methadone while on the other hand they report time limit as they have to go to work after the daily visit to the clinic [58]. This study therefore sought to assess the implementation of a digital intervention for psychosocial treatment among the patients with OUD. Prior to implementation of an intervention it is important to assess the acceptability (extent to which stakeholders think the intervention is agreeable and satisfactory) and feasibility (the extent to which an intervention can be applied in a given setting) in order to identify barriers and facilitators to the intervention [59]. Among individuals with SUD, use of a digital intervention as an add-on to an existing program and delivery in a clinic is more effective than those interventions used alone [60]. Majority of individuals on treatment at the clinic use text message and 88% were willing to receive psychosocial treatment via text message [47]. Therefore, the aim of this study was to describe the feasibility, acceptability and preliminary efficacy of a text-message intervention based on CBT among individuals with OUD on methadone treatment.

Methods

Study design
This study was a randomized feasibility trial conducted in accordance to consolidated standards of reporting trials (CONSORT) guidelines: extension for pilot and feasibility trials [61].

Study setting and population
This study was carried out at the Ngara Methadone Clinic in Nairobi, a public health facility offering treatment to individuals with OUD that has been in operation since February 2017. Treatment at the clinic is free of charge. The eligible participants had (1) age 18 years and above; (2) OUD as per DSM-5 criteria and were receiving methadone treatment [62]; (3) urine toxicology screen testing positive for non-medical opioids; (4) access to a phone that could send and receive text message; (5) ability to read and write in English or Kiswahili and (6) provided informed consent. Those with no access to phones with text message capability, unable to communicate via text message in English or Kiswahili were excluded.

Text-message intervention
This study used stage 1 of the National Institute of Health (NIH) stage model of development of a psychosocial intervention. This comprises stage 1a which involves development of the therapy and stage 1b which involves pilot testing of the intervention. A new intervention includes modification of an existing treatment method [63]. The initial step was a review of literature on use of CBT in SUD treatment and application of digital interventions to deliver CBT treatment. In addition, input was sought from clinicians (clinical psychologists and addiction counsellors) actively involved in provision of CBT for patients with substance use disorders to develop the actual messages to be sent to the participants. This is in line with previous research that involved development of a text message intervention [64]. Also the intervention was based on findings on mobile phone use and acceptability for digital interventions among individuals with OUD done prior to implementation [47].

The text message intervention in this study used CBT based on the CBT manual on the treatment of substance use [33]. Although designed for use in individuals with cocaine dependence, the structured format of the manual is recommended and has been used in several substance use disorders including OUD with digital delivery in some studies [42, 65–67]. There were six modules adapted for this study provided as one module per week over six weeks. In this study the module on HIV prevention was excluded since this is covered as part of standard treatment at the clinic. The adaptation in the context of this study was delivery of the modules via text messages compared to the face-to face delivery described in the manual [33]. The adapted model and contents of the modules is described in Table 1.

There were weekly text-messages for six weeks. The text message was in three parts: first to introduce the weekly module; second, teaching on the behaviour strategy; and finally, practical exercise for the strategies learnt in the module (homework). Participants were required to send the homework response back via text message and were allowed to ask any questions regarding the weekly module. The text-messages were sent on the same day to all participants. This sequence of text content was as proposed in the CBT manual therapists' guidelines for structuring sessions which begin with introduction of skill topic, didactic instructions, and assessment through practice exercise [33]. However, modelling and role play done during a face-to-face session were absent in the digital intervention. An additional text-message reminding the participants on weekly practical exercise/ homework was sent to those who did not respond within two days. The weekly messages sent are attached as supplementary material.

Standard treatment
Standard treatment at the methadone clinic includes daily methadone dosing; review by clinical team for methadone dose adjustment if required or for any physical or psychiatric symptoms; psychosocial services that are mainly focused on enhancing clinic rules and addressing any psychosocial stressor that may arise. In

Table 1 Modules for the text-message intervention

Week	Module	Objective	Content
1	Functional analysis	Establish treatment goals and explain the psychosocial skills to be gained	Identify the motivation to change Identify the triggers to substance use Identify the client's strengths and treatment goals
2	Coping with craving	To develop skills to recognize and cope with cravings for substance use	Identify high risk situations and develop a personal coping plan
3	Shoring up motivation and commitment to stop	Clarify and prioritize treatment goals and address any ambivalence	Assess current readiness for change and ambivalence Revisit and clarify targets/goals Identify and cope with thoughts about substance use
4	Drug refusal	To develop drug refusal skills	Learning drug refusal skills and strategies to avoid contacts with people who use substances Application of assertiveness skills
5	Decision making skills	To identify and change thoughts commonly associated with substance use and develop decision making skills	How to identify seemingly irrelevant decisions that put one closer to using substances How to make decisions when confronted with a high-risk situation
6	Problem-solving skills	To develop and apply problem-solving strategies Develop a concrete support plan to address the problem	Identify the common problems Consider various approaches that do not involve substance use Termination of therapy

addition, screening and treatment for co-occurring medical and psychiatric disorders is provided.

Recruitment

Participants were recruited during daily visits to the clinic. Staff at the clinic were notified about the study and asked to refer individuals meeting inclusion criteria to the research team. The research assistant then provided the individuals with information about the study and assessed for eligibility criteria. Those who met the inclusion criteria and were willing to participate in the study provided written informed consent. After an initial assessment (pre-intervention/baseline), participants were randomly assigned to either the treatment or control arm and then followed up. Participants received reimbursement of gift package worth Ksh 150 ($1.5) for time spent to fill questionnaire at baseline and 6-weeks follow up. Figure 1 shows the flow diagram of the recruitment, allocation to study arm and follow up.

Randomization and blinding

This was a two-arm randomized control feasibility trial. Participants were randomized to two groups, an intervention group that received text message intervention in addition to standard treatment as usual and a control group that received treatment as usual at 2:1 allocation ratio. Simple randomization using a computer program was used to generate the random numbers. Written allocation was sealed in individual opaque envelopes marked with study identification numbers. After an individual consented to participate in the study and had met the

inclusion criteria, the participant was enrolled and given the initial assessment. They were then assigned the randomized study arm by the research assistant opening the sealed envelope to determine allocation. There was no blinding since the participants allocated to either group were aware of their treatment allocation.

Sample size determination

The recommended minimum sample size for pilot trials is 12 [68] with a range of 10–75 participants [69]. In this study an unequal randomization ratio of treatment to control of 2:1 was used, to allow for learning curve and hence maximize the information gained on the text message intervention (potential to improve treatment outcomes and assessment of acceptability and feasibility) while including a control group since this was a new intervention not used previously in the study setting [70]. This being a pilot study to assess feasibility of implementing a newly adapted digital intervention, no power computations were performed [71, 72]. The total sample size was 46 (30 participants in the intervention group and 16 participants in the control group) to allow accommodation for possible dropout.

Technical support

Participants were asked to inform and/or contact the researchers to address any technical difficulties they experienced. The research assistant was available at the clinic and participants were given a chance to seek any assistance during their daily visit to the clinic.
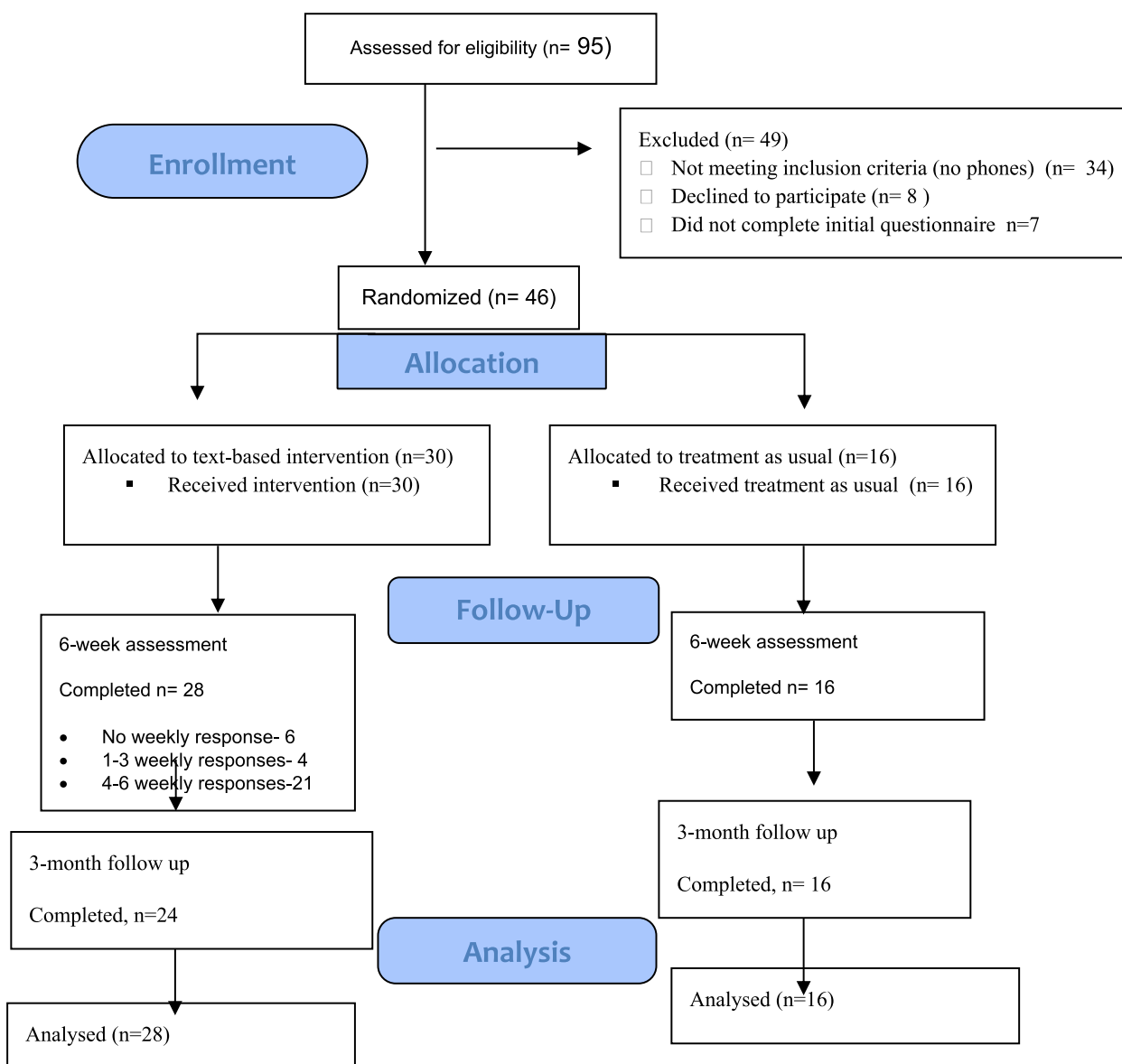
Fig. 1 Flow diagram showing recruitment process (CONSORT 2010 Flow Diagram, 94)

Outcomes and measures

Sociodemographic and clinical data

This was collected using a researcher-designed questionnaire. The variables collected include age, gender, educational level, marital status and employment, substance use, gambling history, current methadone dose and duration in treatment.

Primary outcomes

Opioid use

This was assessed using abstinence from opioids and change in frequency of use based on number of days a

participant used non-medication opioids assessed by self-report and urine drug screen (UDS). The self-report was done using WHO Alcohol Smoking and Substance Involvement Screening Test (ASSIST) at baseline and timeline follow-back (TLFB) tool during follow up. The ASSIST is a research tool used to screen for problematic or risky substance use. A total score for each substance is obtained by summing up responses for questions. This score categorizes an individual to a risk category that indicates the risk for problematic health consequences based on their response for each substance [for alcohol: Low = 0–10, Moderate = 11–26 High = 27+; for other

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substances: Low = 0–3; Moderate = 4–26, High = 27 +] [73]. It has been previously used in Kenya [74, 75]. In this study we assessed lifetime use and use in past three months. Use in past three months was used to calculate the risk category at baseline. Timeline follow-back is a calendar-assisted structured interview used in assessment of substance use scored by an individual tabulating the number of days they used substances [76–78]. It has been used previously in Kenya [79, 80]. In this study we asked about substance use in past 30 days which was used as self-reported substance use at baseline and at six weeks follow up.

Retention in treatment

Retention was defined as number of days that a participant continued and remained in treatment at six weeks and those actively receiving methadone treatment at three months.

Secondary outcomes
Use of other substances use

Use of other substances was assessed using the ASSIST questionnaire and UDS at baseline assessment then reassessed through self-report using TLFB tool (past 30-day use) and UDS at end of treatment.

Psychiatry comorbidity

Comorbid psychiatric disorders was assessed via Mini international neuropsychiatric interview (MINI version7.02) [81]. In this study five modules were assessed namely; major depressive disorder suicidality, generalized anxiety disorder, posttraumatic stress disorder and antisocial personality disorder. In Kenya MINI has been used in previous studies [82, 83]. MINI is a licensed tool and permission to use the tool was given by the author to the principal investigator.

Addiction severity

Addiction severity was assessed by use of Maudsley Addiction Profile (MAP) at baseline, a brief structured interview that assesses problem substance use in four domains [84, 85]. Though not previously used in Kenya, MAP has been use regionally in South Africa [86].

Quality of life

Quality of life was assessed using World Health Organization Quality of Life short version instrument (WHO-QOLBREF) It has 26 items that assess quality of life in four domains namely: Physical Health, Psychological Health, Social Health, and Environmental Health. The mean score of items within each domain is used to calculate the domain score which is then multiplied by 4 to make domain scores comparable with the scores used in the WHOQOL-100 [87, 88]. This tool has been used in Kenya [89].

Drug taking self-efficacy

The drug taking confidence questionnaire (DTCQ-8) which is a tool that assesses anticipatory coping self-efficacy over eight categories of high-risk situations for substance use was used. Participants respond how confident they are to resist substance use on a six-point scale ranging from 'not at all' to 'very confident' (20–100%). The means score for the eight questions gives the total score which then shows the level of self-efficacy with a lower the score signifying a lower the self-efficacy and vice versa [90].

Readiness to change

Readiness to change was assessed at baseline using Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES) which is a 19-item tool used to assess readiness and motivation for change with good validity and reliability [91]. The 19 items are scored on a five-point Likert scale to yield three subscales namely (1) Recognition which assesses acknowledgement of a substance-related problem and desire for change; (2) Ambivalence which assesses perceived control over substance use and substance problems; (3) Taking steps which measures the extent to which an individual is making positive efforts to change substance-using behaviour. From these a score is calculated and classified in low, moderate and severe category to change [91].

Implementation outcomes
Acceptability

At six-week post-treatment follow up, an evaluation survey was conducted on feedback regarding various aspects of using the text-based intervention. The quantitative assessment was via a Likert scale–based assessment tool. Some questions in this tool were adapted from Client Satisfaction Questionnaire (CSQ 8) and System Usability Scale and additional questions specific to the content of text-based intervention. In addition, the questionnaire included a qualitative segment with three open-ended questions at the end. The responses to these questions were analyzed qualitatively and are reported separately.

Client satisfaction questionnaire (CSQ)

Client Satisfaction Questionnaire (CSQ-8) was developed to assess satisfaction in psychotherapy treatment as a shorter version of the original CSQ that had 18 items. Validation studies have shown good internal consistency and high correlations with other tools. The CSQ-8 items are scored on a scale from 1 to 4 with total score ranging from 8 to 32 [92, 93]. In this study we summarized the

responses descriptively in Table 4. CSQ is a copyrighted tool, for which permission to use was requested from the author by the principal investigator. Detailed score of each item is attached as an Additional file 1.

System Usability Scale (SUS)

System Usability Scale (SUS) collects subjective data about technology product usability. A scoping review on methods used to test usability on developing eHealth technology reported that SUS was the most validated questionnaire. SUS is a 10- item scale in which the items are scored on a Likert scale from 0 (strongly disagree) to 4 (strongly agree) with half of the items reverse- scored [94]. In this study the term 'system' was replaced by 'intervention', but no other modification was made. We summarized the scores descriptively as shown in Table 4. Details of individual scores for all items is presented as Additional file 1: Appendix 2.

Feasibility assessment

This was assessed using participant engagement and adherence to the intervention. Engagement refers to the effort made by a client during course of treatment towards change, of which treatment participation is an early component [95, 96]. In this study engagement was defined a priori as use of the text message intervention for those enrolled assessed by response to the weekly practical homework at least once during the treatment period. This is based on findings whereby most studies define engagement in psychosocial treatment as attendance of at least one session or signing up for digital interventions [95, 97]. Adherence in digital interventions is based on usage behaviour such as number of logins or sessions completed [98, 99]. Adherence was defined a priori as those who used the digital intervention for at least half of the study duration (three weeks). This included those who acknowledged receipt of the text messages and/or responding to the weekly practical homework sent to the participants. This was based on past research whereby an attrition of 20–50% in psychosocial treatment is reported [95].

Data analysis

All analyses were conducted using Stata Version 13.1. Feasibility parameters were reported descriptively. Baseline population characteristics was summarized descriptively by treatment group whereby intervention and control groups were compared using Fisher's Exact and Wilcoxon rank-sum tests. Treatment duration at baseline was summarized as number of years in methadone treatment and status at baseline which was categorized as follows: those newly enrolled to methadone treatment during the study period (new), those who had been on

treatment but had resumed opioid use and were returning to treatment (Reinduction) and those who had positive urine test positive for opioids while on methadone treatment (continued treatment). To examine the efficacy of the intervention, opioid use rate at baseline and at follow up were compared. For post intervention evaluation data, a descriptive summary was done on individual responses to the questions on usability and satisfaction of the intervention. As a feasibility trial, the study was not powered for formal testing of intervention effectiveness; however, group differences for selected outcome measures were explored using Wilcoxon rank-sum tests conducted before and after overall and for each group separately for continuous outcomes and McNemar test for categorical outcomes. The significance level was set at $p < 0.05$.

Results

Participant enrollment

As shown in Fig. 1, 95 individuals with positive UDS for non-medical opioids were screened for eligibility of which 49 (51.5%) were excluded. The commonest reason for exclusion was lack of phones (35.7% of those screened and 69.3% of those excluded).

Sociodemographic and clinical characteristics of participants

The mean age of participants was 32 years (SD 8.7), range 22–63 years (IQR 10.5). Majority of participants were male (89.1%), had primary education of eight years or less (50%). As shown in Table 2 which summarizes the baseline sociodemographic and clinical profiles of participants, there was no significant difference among participants in intervention or control groups at baseline, except in age at first drug use ($p = 0.045$).

Based on ASSIST score the commonest substances used other than opioids were alcohol, cannabis, tobacco, and benzodiazepines. Majority (60.9%) of participants had high risk for opioid use as per ASSIST score at baseline. This is shown in Table 3.

Primary outcomes

Abstinence from opioid use

Overall, there was a reduction in opioid use from baseline to post intervention. There were more individuals with abstinence from opioids in the intervention group compared to controls both on self-report and based on UDS as shown in Fig. 2. However, there was no statistically significant difference between the groups (OR 0.43, 95% CI 0.12–1.51, $p = 0.19$). A reduction in frequency of use was also observed. At follow up, no participants reported use daily or almost daily; 3.6% reported weekly use compared to 23.3% at baseline and 21.4% reported

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Table 2 Baseline sociodemographic and clinical characteristics by treatment group allocation

Variable	Category	Overall	Study Group		*p*-value
			Intervention	Control	
		N(%)	n(%)	n(%)	
Study Group	Intervention	30(65.2)	-	-	-
	Control	16(34.8)	-	-	
Gender	Male	41(89.1)	26(86.7)	15(93.8)	0.645
	Female	5(10.9)	4(13.3)	1(6.3)	
Age in Years	Mean (SD)	32.0 (8.7)	31.9 (9.0)	32.1(8.6)	0.962
	Median	28.5	28.5	30.5	
	Range	22–63	23–63	22–49	
	IQR	10.5	10.3	12.3	
Education Level	Primary and below	23(50.0)	14(46.7)	9(56.3)	0.162
	Secondary/ High School	13(28.3)	7(23.3)	6(37.5)	
	College / University	10(21.7)	9(30.0)	1(6.3)	
Marital Status	Married	14(30.4)	10(33.3)	4(25.0)	0.435
	Divorced or separated	20(43.5)	11(36.7)	9(56.3)	
	Single	12(26.1)	9(30.0)	3(18.8)	
Employment Status	Employed	28(60.9)	17(56.7)	11(68.8)	0.533
	Unemployed	18(39.1)	13(43.3)	5(31.3)	
Monthly Income	< 20,000 Ksh	40(87.0)	24(80.0)	16(100.0)	0.078
	> 20, 000 Ksh	6(13.0)	6(20.0)	0(0.0)	
Age at First Use	11–15 Years	6(13.0)	6(20.0)	0(0.0)	0.045
	16–20 Years	28(60.9)	19(63.3)	9(56.3)	
	21 + Years	12(26.1)	5(16.7)	7(43.8)	
Adverse Childhood Experiences	No	12(26.1)	6(20.0)	6(37.5)	0.292
	Yes	34(73.9)	24(80.0)	10(62.5)	
Gambling Behavior	No	21(45.7)	13(43.3)	8(50.0)	0.760
	Yes	25(54.3)	17(56.7)	8(50.0)	
Number of years in methadone treatment	Less than 1 year	11(23.9)	6(20)	5(31.3)	0.195
	1–3 Years	20(43.4)	12(40.0)	8(50.0)	
	4–5 Years	15(32.6)	12(40.0)	3(18.8)	
Status at Baseline	Continuing treatment	16(34.8)	13(43.3)	3(18.8)	0.246
	New	12(26.1)	7(23.3)	5(31.3)	
	Reinduction	18(39.1)	10(33.3)	8(50.0)	
Medical comorbidity	No	42(91.3)	27(90.0)	15(93.8)	1.000
	Yes	4(8.7)	3(10.0)	1(6.3)	
Psychiatry comorbidity					
MDE	No	36(78.3)	24(80.0)	12(75.0)	0.720
	Yes	10(21.7)	6(20.0)	4(25.0)	
Suicidality	No	38(82.6)	25(83.3)	13(81.3)	1.000
	Yes	8(17.4)	5(16.7)	3(18.8)	
Posttraumatic stress disorder	No	32(69.6)	22(73.3)	10(62.5)	0.512
	Yes	14(30.4)	8(26.7)	6(37.5)	
Generalized Anxiety Disorder	No	39(84.8)	26(86.7)	13(81.3)	0.681
	Yes	7(15.2)	4(13.3)	3(18.8)	
Antisocial personality disorder	No	27(58.7)	17(56.7)	10(62.5)	0.762
	Yes	19(41.3)	13(43.3)	6(37.5)	
Current substance use (based on UDS)					
Amphetamines	No	45(97.8)	29(96.7)	16(100.0)	1.000
	Yes	1(2.2)	1(3.3)	0(0.0)	

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Table 2 (continued)

Variable	Category	Overall	Study Group		p-value
			Intervention	Control	
		N(%)	n(%)	n(%)	
Barbiturates	No	45(97.8)	30(100.0)	15(93.8)	0.348
	Yes	1(2.2)	0(0.0)	1(6.3)	
Marijuana	No	5(10.9)	4(13.3)	1(6.3)	0.645
	Yes	41(89.1)	26(86.7)	15(93.8)	
Benzodiazepines	No	31(67.4)	19(63.3)	12(75.0)	0.520
	Yes	15(32.6)	11(36.7)	4(25.0)	
Phencyclidine	No	42(91.3)	27(90.0)	15(93.8)	1.000
	Yes	4(8.7)	3(10.0)	1(6.3)	
Self-efficacy – DTCQ scores					
DCTCQ-8	Low self-Efficacy	7(15.2)	5(16.7)	2(12.5)	0.167
	Moderate Self-efficacy	29(63.0)	21(70.0)	8(50.0)	
	High Self-efficacy	10(21.7)	4(13.3)	6(37.5)	
DCTCQ-8 scores	Mean ± SD	56.2 ± 30.2	50.4 ± 27.4	67.0 ± 33.1	0.075
Quality of life—WHOQOLBREF Scores					
Physical Quality of life	Mean ± SD	60.9 ± 18.0	59.0 ± 17.2	65.1 ± 19.7	0.315
Psychological Quality of life	Mean ± SD	63.6 ± 17.6	64.2 ± 17.0	62.2 ± 19.4	0.738
Social Quality of life	Mean ± SD	57.6 ± 21.3	57.5 ± 21.4	57.7 ± 22.2	0.979
Environmental Quality of life	Mean ± SD	52.1 ± 16.3	50.8 ± 15.7	55.0 ± 17.8	0.442
Current methadone dose	Mean ± SD	50.9 ± 20.7	53.8 ± 21.3	45.3 ± 18.8	0.186

using once or twice compared to 10.0% at baseline. This is summarized in Fig. 4.

Retention in treatment
Two participants (4.3%) were lost to follow up at six weeks and five (10.9%) at 3 months follow up. All participants lost to follow up were in the intervention group.

Implementation outcomes
Feasibility

System use   Overall, only five of 30 participants (16.7%) did not respond to any homework question and six (20%) responded to all the questions while 26.7% responded to five messages; 23.3% responded to four messages and 3.3% responded to one and two messages each.

Engagement
Twenty-five participants (83.3%) responded to at least one homework question.
Adherence
Twenty-three (76.7%) responded to at least half of the messages.

No participant requested to withdraw from the study and the post-intervention interview, most participants responded to the follow-up questionnaire whereby invite to respond was sent via message. Also, two participants who had not responded to any message participated in the qualitative interviews and gave feedback on the intervention.

Response to weekly homework questions
Figure 3 shows response to the messages by week. There was higher use of the intervention at week 1 and 6 with dips at week 3,4,5. When participants were asked which module, they found most helpful there was an almost similar average score for all the modules. This is shown in Additional file 1: Appendix 2. We did comparisons based on: 1) type of phone used during the intervention which whereby 53.6% used smartphones, 39.3% used regular phone and 7.1% used both types at different times during the study period. A higher number of those using smartphones responded in four and more weeks. 2) Status at baseline: majority of those who did not provide any response were those with continued opioid use during treatment while those who had been reinducted to treatment comprised majority of those who responded to five- and six-weeks' homework questions. This is shown in figures attached as Additional file 1: Appendices 3 and 4.

Table 3 Summary of other secondary outcomes assessed at baseline

ASSIST scores at baseline for all participants

Substance	ASSIST Scores		Risk levels		
	Mean	Range	Low risk n (%)	Moderate risk n(%)	High risk n(%)
Alcohol	17.8±8.5	0–31	40 (87.0)	4(8.7)	2 (4.3)
Tobacco	4.7±8.8	0–34	3 (6.5)	36 (78.3)	7 (15.2)
Cannabis	20.0±19.3	0–80	8 (17.4)	25(54.3)	13 (28.3)
Cocaine	3.2±9.2	0–39	40 (87.0)	3 (6.5)	3 (6.5)
Inhalants	0.0±0.3	0–2	46 (100.0)	0 (0.0)	0 (0.0)
Sedatives	2.4±6.5	0–32	39 (84.8)	6 (13.0)	1 (2.2)
Hallucinogens	0.2±1.1	0–6	44 (95.7)	2 (4.3)	0 (0.0)
Opioids	28.5±12.9	6–88	0 (0.0)	18 (39.1)	28 (60.9)
Khat	1.1±2.9	0–15	41(89.1)	5 (10.9)	0 (0.0)

Readiness to change (SOCRATES Score)

Variable	Category		Frequency (*N*=46)		Percentage (%)
Recognition Decile	10 -30 Very Low-Low		33		71.8
	40–60 Medium		7		15.2
	70 High		6		13.0
Ambivalence Decile	10 -30 Very Low-Low		13		28.3
	40–60 Medium		19		41.3
	70 -90 High-Very high		14		30.4
Taking Steps Decile	10 -30 Very Low-Low		12		26.1
	40–60 Medium		14		30.4
	70–90 High-Very high		20		43.5

Measure	Recognition Decile		Ambivalence Decile		Taking Steps Decile
Mean	28.5		14.8		33.8
Median	28.0		15.0		34.0
Std. Deviation	4.3		3.2		5.0
Minimum	20.0		6.0		24.0
Maximum	35.0		20.0		40.0
Interquartile Range	6.3		4.0		8.5

Maudsley addiction profile – risk

Domain	Measure		n		%
Risk	Number reporting drug overdose		5		10.9
	Number reporting injecting drugs		5		10.9
	Number reporting shared needle		5		10.9
	Number reporting unprotected sex		19		41.3
Relationship	Partner conflict		5		10.9
	Friend conflict		9		19.5
Employment	One or more days of paid employment		32		69.6
	Missed work due to illness		15		46.9
	One or more days of unemployment		25		54.3
Illegal activities leading to arrest in past 30 days	Possession/selling drugs		21		45.6
	Stealing/theft/fraud		20		43.4
	Fight/criminal damage		14		30.4
	Loitering/touting		16		34.7

Acceptability and satisfaction

System usability As shown in Table 4, the majority of participants reported the intervention as easy to use based on system usability scores with only 7.4% reporting that the intervention was complex. Majority of participants agreed (66.7%) or strongly agreed (25.9%) that the various components of the intervention were well
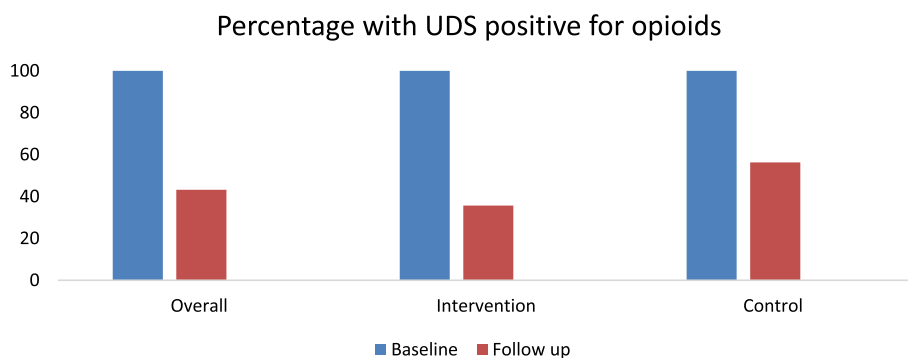
Percentage with UDS positive for opioids

Fig. 2 Percentage with opioid use based on Urine Drug screen (UDS)
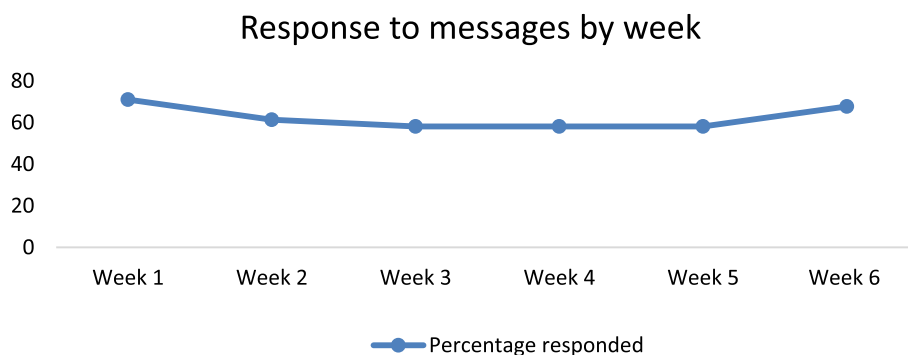
Response to messages by week

Fig. 3 Response to messages by week

integrated and majority disagreed or strongly disagreed that they need to learn a lot of things before using the intervention.

Satisfaction with intervention There was high satisfaction with the intervention based on client satisfaction questionnaire, summarized in Table 4. All the participants reported that they got the service they wanted, 66.7% reported that most of their needs were met and 70% were satisfied or very satisfied with the intervention. Regarding the delivery of the intervention, 66.7% found the treatment duration as just right; 92.6% found the frequency of messages as right and all participants reported the message content as right or adequate.

Secondary outcomes

Reduction in other substance use

There was an overall reduction in other substance use at follow up based on urinary drug screen and self-report. A similar pattern of reduction in frequency use

was also noted, whereby less participants reported daily or almost daily use of substances at follow up. Of note is that tobacco was the most used substance at follow up. This is summarized in Figs. 4 and 5.

Self-efficacy

There was an overall significant increase in DCTQ-8D scores after the intervention ($p < 0.001$). When subgroup analyses were conducted using Wilcoxon signed rank test, there was a significant increase in the intervention group ($p < 0.001$), while no significant increase was observed in the control group ($p = 0.075$). This is shown in Table 5.

Readiness to change

As shown in Table 3, the SOCRATES score showed majority in very low to low score in recognition docile, majority in medium score for the ambivalence docile and majority had high scores in the taking steps docile.

Table 4 Participant responses on system usability, acceptability and satisfaction with the intervention

| Question	Score	Frequency (*N* = 27)	%
System Usability			
1. Would like to use this text message intervention frequently	Agree/strongly agree	19	70.4
2. Found the text-message intervention unnecessarily complex	Agree/strongly agree	2	7.4
3. Thought text-message intervention was easy	Agree/strongly agree	24	88.9
4. Would need support of a technical person to be able to use the text message intervention	Agree/strongly agree	1	3.7
5. Found the various functions in the text message intervention well integrated	Agree/strongly agree	25	92.6
6. Thought there was too much inconsistency in the text-message intervention	Agree/strongly agree	0	0
7. Most people would learn to use the text-message intervention quickly	Agree/strongly agree	25	92.6
8. The text-message intervention very cumbersome to use	Agree/strongly agree	2	7.4
9. Felt confident using the text-message intervention	Agree/strongly agree	24	88.9
10. Needed to learn a lot of things before getting going with the text-message intervention	Agree/strongly agree	3	11.1
Client satisfaction			
11. Overall rating the quality of service received	Good/ excellent	26	96.2
12. Got the kind of service wanted	Yes	27	100
13. Extent to which the text-message program met participants needs	Most/almost all my needs have been met	21	77.8
14. Would recommend the text-message program to a friend	Yes	27	100
15. Satisfaction with the help received from the text-message intervention?	Satisfied /very satisfied	25	92.6
16. The text-message intervention received helped to deal more effectively with substance use problems	Helped a lot / a little	17	63
17. Overall satisfaction with the text message intervention	Satisfied /very satisfied	19	70.4
18. Would enroll to a text-message intervention again if required	Yes	26	96.2
Satisfaction with delivery of the intervention			
Opinion about the length of treatment	Just right	18	66.7
Opinion about the frequency of text messages	Just right	25	92.6
Opinion about the content of text messages	Just right	18	66.7
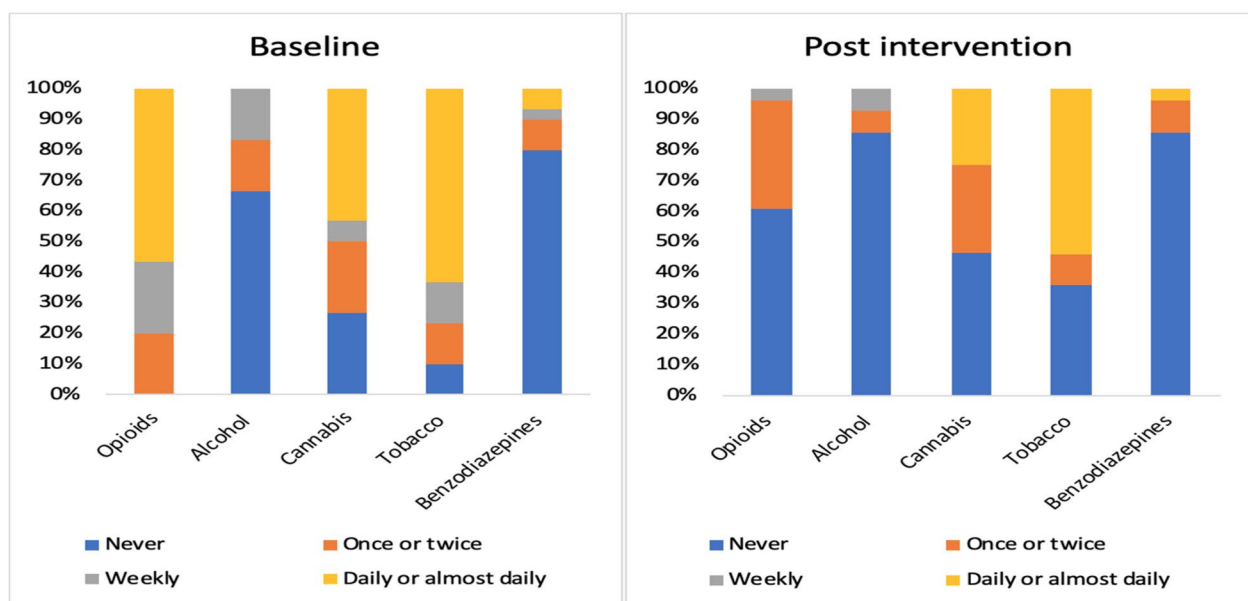
Fig. 4 Frequency of self-reported substance use in past 30 days at baseline and at follow up for intervention group participants
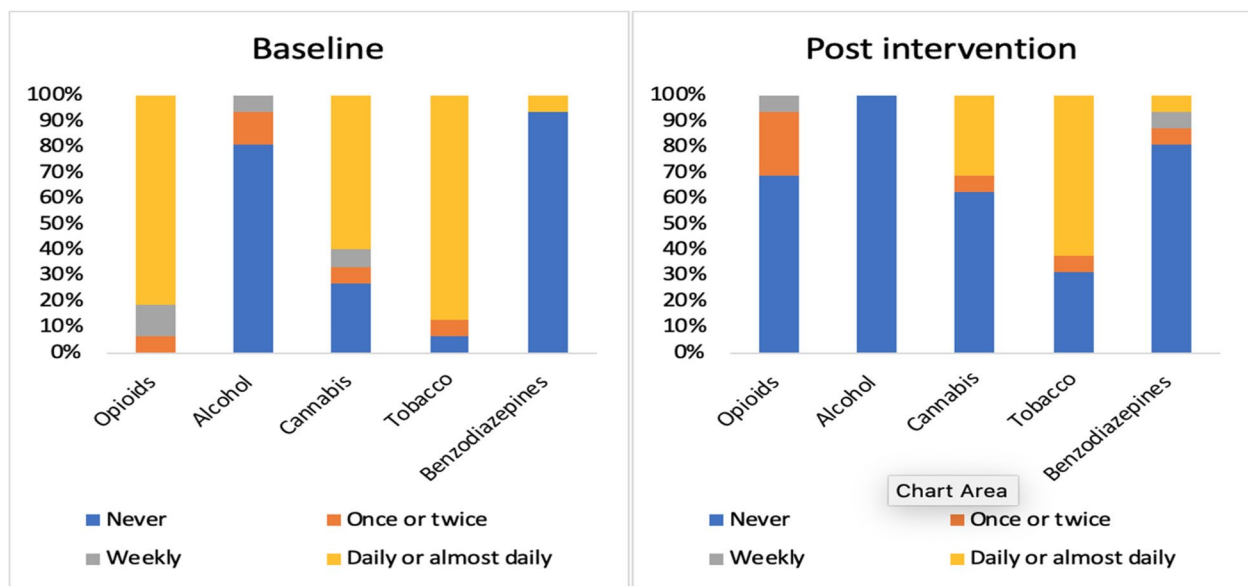
Fig. 5 Frequency of self-reported substance use in past 30 days at baseline and at follow up for control group participants

Table 5 Comparisons of Substance use and self-efficacy before and after treatment disaggregated by allocation

Substance use based on UDS

Toxicology Test	Overall		Intervention		Control	
	Before n(%)	After n(%)	Before n(%)	After n(%)	Before n(%)	After n(%)
Opioids	46 (100.0)	19(43.2)	30(100.0)	10(35.7)	16(100.0)	9(56.3)
Marijuana	41(89.1)	26(59.1)	26(86.7)	17(60.7)	15(93.8)	9(56.3)
Amphetamines	1(2.2)	0(0.0)	1(3.3)	0(0.0)	0(0.0)	0(0.0)
Benzodiazepines	15(32.6)	11(25.0)	11(36.7)	7(25.0)	4(25.0)	4(25.0)
Phencyclidine	4(8.7)	3(6.8)	3(10.0)	2(7.1)	1(6.3)	1(6.3)
Barbiturates	1(2.2)	0(0.0)	0(0.0)	0(0.0)	1(6.3)	0(0.0)
Cocaine	0(0.0)	2(4.5)	0(0.0)	1(3.6)	0(0.0)	1(6.3)

Substance use based on self-report

Self-reported	Overall		Intervention		Control	
	Before n(%)	After n(%)	Before n(%)	After n(%)	Before n (%)	After n(%)
Opioids	46(100.0)	15(34.1)	30(100.0)	10(35.7)	16(100.0)	5(31.3)
Alcohol	6(13.0)	4(9.1)	4(13.3)	4(14.3)	2(12.5)	0(0.0)
Cannabis	34(73.9)	21(47.7)	24(80.0)	15(53.6)	10(62.5)	6(37.5)
Tobacco	37(80.4)	29(67.4)	22(73.3)	18(66.7)	15(93.8)	11(68.8)
Benzodiazepines	2(4.3)	7(15.9)	1(3.3)	4(14.3)	1(6.3)	3(18.8)

Self-efficacy based on DTCQ scores

DCTQ-8D Score	Overall*		Intervention*		Control	
	Before	After	Before	After	Before	After
Mean (SD)	56.9(30.3)	88.2(17.9)	51.1(27.5)	90.4(14.7)	67.0(33.1)	84.2(22.4)
Median	56.3	97.5	52.5	100	75	88.8
Range	0; 100	20; 100	0; 100	35; 100	0; 100	20; 100
IQR	45.6	20	47.5	20	58.8	19.4
Low self-efficacy	7(15.2)	0(0.0)	5(16.7)	0(0.0)	2(12.5)	0(0.0)
Moderate Self-efficacy	29(63.0)	12(27.3)	21(70.0)	8(28.6)	8(50.0)	4(25.0)
High Self-efficacy	10(21.7)	32(72.7)	4(13.3)	20(71.4)	6(37.5)	12(75.0)

IQR Interquartile Range, *TLFB* Timeline follow-back, *SD* Standard deviations

* *p* < 0.001

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Addiction severity

The scores in MAP shown high risk at baseline based on risky behaviour, missed employment and engagement in illegal activities. This is shown in details on Table 3.

Discussion

This study aimed to assess the feasibility, acceptability, and preliminary efficacy of a text message intervention among individuals with OUD. The findings showed that use of a text message intervention is feasible, acceptable and has clinical effect on reducing opioid and other substance use.

At enrollment, majority were excluded due to lack of access to a phone. This percentage although high is similar to the pattern observed for mHealth interventions in other patient populations in Kenya where main reason for exclusion was lack of phone [100–102]. It could be partly related to the fact that the study enrolled participants who had current opioid use hence may have lost phones or not stable enough to maintain a phone. Also, there is a high phone turnover among individuals with OUD with some reporting to sell phones to buy drugs [47, 103, 104]. This shows a possible challenge that needs to be considered when designing similar interventions in the study population. Some studies assessing digital interventions among individuals with OUD have provided phones to participants [16] or provided access to computers at the clinic for patients, but this may not be applicable in our setting or for long-term treatment. An approach that can be used to circumvent this, is to also include participants with access to phone through other family members which is common in our setting [47]. This can be explored in future studies.

There was an overall reduction in opioid use among all the participants with greater proportion in the intervention group. Although no statistical difference was observed, these findings show promising effect of a digital intervention in OUD treatment. Similar findings have been reported in use of text message intervention among individuals with OUD although some studies are feasibility trials with short treatment duration ranging from seven to 28 days [105, 106]. In a study with a sample of 25 participants in each arm using a text-message CBT intervention among individuals with opioid and stimulant use, those in intervention group had lower odds of opioid use although the differences were not observed for other substances. Self-reported frequency of use was also lower at follow up compared to baseline [31]. These findings imply that a text message intervention can be used in individuals with OUD to improve outcomes.

The retention in treatment was 93.3% at 6 weeks and 83.3% at 3 months in the intervention arm of this study. This is similar to retention in treatment for individuals with OUD in previous studies [107]. This can be explained partly by the fact that treatment as usual meant participants come to the clinic daily for the methadone treatment hence were more likely to be notified of the follow up evaluation during the clinic visits. Although all the individuals lost to follow up were in the intervention group, reasons for the loss to follow were not identified. Of note however is that the loss to follow up was based on those not coming to the clinic for methadone treatment at three months follow up and therefore may not be related to the intervention.

Feasibility of using a text message intervention was demonstrated by high engagement and adherence in the intervention group. These results are comparable to other studies assessing use of digital interventions in OUD treatment [31, 32]. Of note is that in this study, engagement was based on response to homework questions during the study period. However, as noted above, the invite to respond to the follow-up questionnaire was sent by message and most participants responded. Also, two participants who had not responded to any message participated in the interviews and gave feedback on the intervention. This implies that although some participants did not respond to the questions, they read the messages and participated in the intervention. Future studies need to have strategies to assess use of intervention throughout the intervention period.

A higher response was noted at the start of the intervention and the final week compared to week 3, 4, and 5. On the other hand, when asked on preference for the modules, there was almost similar preference for all modules. This shows that different modules may appeal differently to participants. A similar pattern of use of intervention more at the start with reduced use over time is reported in other studies [28]. In the study by Glasner et al., [31] there was variable engagement reported depending on the type of response required for the messages e.g. an average response to 80% of text message that required yes or no, 48% to messages with multiple-choice questions and 57% of messages with open-ended questions. There was also variable utilization of additional features with the option for craving support having highest use. This shows response to the messages may be affected by requiring long responses for the weekly homework question. Also, variable response rate can arise due to habituation, response fatigue and perceived intrusive by participants [108]. This highlights the role of personalization in a text message intervention [109, 110].

Comparison done for response to homework based on status at enrollment showed that those who were being reinducted in treatment were more likely to respond to more questions. Past research shows that previous treatment attendance is associated with better outcomes for

digital interventions [111, 112]. This can be related to motivation to remain abstinent or the current treatment enhances what was learnt in previous treatment. Also, those with smartphones provided more responses compared to regular phones. This shows that the interface of message display may affect the response rate which is a limitation of text message interventions [109]. These are factors that need to be considered in future studies.

Overall, there was good acceptability and satisfaction with the text message intervention. Majority of the participants found the intervention easy to use, intervention met their expectations and would recommend to a friend. In addition, duration and frequency of messages was reported as adequate. This is comparable to findings of studies on use of text message intervention for other substance [28, 113] and opioid use disorder [32, 114, 115]. This shows that a text message intervention is acceptable and can be implemented in the study population.

For the secondary outcomes, there was reduced use of other substances such as alcohol, cannabis and benzodiazepines although statistical significance was not assessed. This is similar previous research, as in one study on web-based intervention for OUD, there was no significant difference in effectiveness of the intervention based on primary substance of use [116]. This further shows promising effect of a text-message intervention in improving substance use outcomes since majority of individuals with OUD use multiple substances. In addition, drug-using self-efficacy improved following treatment with significant difference in the intervention arm. This is similar to a finding following use of a digital intervention among individuals with OUD [31, 117]. This is significant since higher self-efficacy is related to lower risk of substance use recurrence [118, 119].

A reduction in substance use was also observed in the control group. This can be explained by the fact that those in control group were receiving standard treatment which includes psychosocial treatment hence this may have influenced the results. The study findings may have also been influenced by factors observed in the study at baseline. These include: polysubstance use by majority, difference between participants in intervention and control groups based on age at first substance use, high risk score for opioid use on ASSIST and low to medium scores by majority in the readiness to change scale These factors need to be explored in future studies with large sample size to allow assessment of association between these factors and observed outcomes from the intervention.

Strengths and limitations
The strengths of this study include use of a CBT theory-based digital intervention approach in treatment for patients with OUD, with focus on a well-defined population comprising adults with OUD on methadone treatment and use of a control group that received active treatment which allowed for comparison on outcomes.

Limitations for this study include: first the study population was individuals with current opioid use hence limits the generalizability of the findings to other individuals with substance use disorders or those on methadone treatment but not currently using opioids. Second, there was lack of a control group that was matched for time and attention with the intervention group since text messages were only sent to the intervention group who were required to read and respond to the text message while the control received treatment as usual. Third, the short duration of intervention and follow up may have affected the outcomes observed. This has been cited as a limitation in previous studies on use of digital intervention in patients with SUD. However, this being a feasibility study, duration of treatment is among the factors that were assessed in the post treatment evaluation. Fourth, there was no blinding and most outcomes were self-reported and not objective, hence biases such as social desirability and recall bias might have occurred whereby those who knew they received the intervention (or even those who did not) might have reported a reduction in substance use without actually doing so. This is partly reflected in the difference between self-reported substance use and substance use based on UDS. Finally, due to the small sample size, this study may have not had enough power to allow detection of small effect from the text message intervention.

Conclusion
The study findings demonstrated that implementing a text-message intervention among individuals with OUD was feasible, the intervention was rated as acceptable and there was reduced opioid and other substance use post-intervention. Although the study was not powered to detect statistically significant difference, these findings have clinical implications that a text-message intervention can be used to provide/augment psychosocial treatment to individuals with OUD on methadone treatment with the potential to reduce opioid and other substance use and enhance self-efficacy.

In addition, there are implications for research. This was a feasibility trial hence further research is recommended with firstly using a larger sample powered to detect statistical difference and secondly with longer follow up period among participants with other substance use disorders without limitation at a methadone clinic to compare if there is a difference in effectiveness of the text-message intervention based on primary drug used.

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Abbreviations

ASSIST	Alcohol, smoking and substance involvement tool
CBT	Cognitive behaviour therapy
CI	Confidence interval
CONSORT	Consolidated standards of reporting trials
CSQ	Client satisfaction questionnaire
DSM	Diagnostic and statistical manual for mental Disorders
DTCQ	Drug taking confidence questionnaire
HIV	Human Immunodeficiency Virus
IQR	Inter-quartile range
MAP	Maudsley addiction profile
MINI	Mini International neuropsychiatric interview
OR	Odds Ratio
OUD	Opioid use disorder
SOCRATES	Stages of change, readiness and treatment eagerness scale
SD	Standard Deviation
SUD	Substance use disorder
SUS	System Usability Scale
TLFB	Timeline follow-back
UDS	Urine drug screen
WHOQOLBREF	World health organization quality of life short version instrument

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s44247-023-00014-3.

> **Additional file 1: Appendix 1.** Table showing a summary of schedule for the outcome assessments during the study period. **Appendix 2.** Participant responses on system usability, acceptability and satisfaction with the intervention – with details for each score category. **Appendix 3.** Figure showing the comparison of response to weekly homework based on status at enrollment. **Appendix 4.** Figure showing the comparison of response to weekly homework based on type of phone (smartphone versus regular phones).

Authors' contribution

SKK was in the study conception and design, acquisition, analysis and interpretation of data and drafting and revising the manuscript. SP and BC were involved in design, interpretation of data, drafting and revising the manuscript. EKK was involved in interpretation of data and revising the manuscript. All authors read and approved the final manuscript.

Availability of data and materials

All data used and reported in this current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

All methods in this study were performed in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Biomedical Research Ethics Committee of the University of KwaZulu-Natal and Kenyatta National Hospital/University of Nairobi ethics review committee. Participation in the study was voluntary and written informed consent was obtained from the participants prior to enrolling in the study.

Consent to publication

Not applicable.

Competing interests

The authors declare no competing interests.

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