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Enhancing wellbeing in cancer care: Engagement in smart-messaging programmes for symptom management

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Abstract

Background: Despite improved survival rates, cancer patients often face physical and mental health challenges during and post-treatment. With cancer care services under pressure, these issues may go unnoticed. Holistic Needs Assessments attempt to address such problems but can have limited impact, necessitating corresponding interventions. Automated, personalised text-messaging interventions, successful in health monitoring, may be an effective solution but evidence is lacking on their integration into cancer care settings.

Objective: To explore the feasibility and engagement in personalised smart-messaging programmes to manage common cancer-related issues.

Methods: Recruitment occurred via clinician referrals and flyers in cancer care services. Qualitative and quantitative methods explored engagement data, clinical outcome measures, and qualitative interviews. A workshop involving patients and referring staff explored factors affecting programme implementation.

Results: Twenty-seven patients enrolled, exhibiting varied engagement levels. Some participants reported symptom reduction particularly linked to higher engagement. The analysis of qualitative interviews on participant experience of the programmes resulted in themes related to enrolment rationale, sustaining engagement, and participation outcomes; and factors facilitating engagement included the practical and psychological dimensions of programme delivery. Twenty-seven participants responded to 49.95% of messages where responses were possible across 42.90% of enrolled days. The workshop emphasised the need for improved promotional materials and staff training.

Conclusion: A tailored text messaging intervention shows promise in alleviating cancer-related symptoms, yet enrolment and active engagement remain obstacles. Enhanced promotional strategies are required to increase programme visibility and impact. Further research and integration into routine care are recommended.

Keywords

Cancer < disease, digital health < general, mental health < psychology, depression < psychology, anxiety < psychology

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Introduction

Advancements in cancer treatment have led to a continuous decrease in mortality rates worldwide.[1] However, including those who are classed as cured from cancer, extensive physical and mental health difficulties arise during and after treatments either as a side effect of treatment or sequelae to the cancer itself.[2] With cancer services in the UK currently dealing with a backlog leading to long waiting times to access treatments,[3] these difficulties which may not be

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considered directly related to cancer itself can be overlooked or missed.

Physical and mental health are intertwined, evidenced by studies showing that being more physically active contributes to better mental health.[4] This connection is further reinforced by research indicating the co-occurrence of challenges in both physical and mental health, such as the relationship between schizophrenia and metabolic disorders,[5] as well as depression and cardiovascular disease.[6] In the context of cancer, the impact of mental health can be illustrated by the increased cost of care amongst those also experiencing anxiety and depression.[7,8] Recognising the significance of this link is pivotal, particularly in the context of cancer care.

Patients experiencing comorbid mental and physical health problems may face poorer clinical outcomes and reduced ability to effectively address physical symptoms, resulting in a lower quality of life, compared to those with multiple physical health conditions alone.[7] Unfortunately, only patients presenting with more severe psychological or physical health problems are typically referred for specialist support, whilst lower levels are often dismissed as common aspects of the cancer experience.[9]

The National Institute for Health and Care Excellence[10] suggests a four-step model for mental health care in the UK. Step 1 represents low-intensity interventions and resources that are openly available to all patients, with steps 2, 3 and 4 typically requiring greater involvement of professionals with specialist training. However, given that screening for psychological distress is not routine practice in cancer care and clinical judgement tends to be poor, lower intensity interventions can be missed or difficult to access, with nearly three in 10 surveyed cancer patients having encountered mental health issues, yet only one in 10 seeking guidance from a mental health professional.[11]

Presently, Holistic Needs Assessments (HNAs) are widely employed and nationally mandated in the UK NHS to identify and address the physical and psychological challenges faced by patients in cancer care.[12] Despite this, recent reports indicate that only a quarter of cancer survivors in the UK underwent a HNA.[13] Amongst those who did, some encountered difficulties expressing psychological concerns, fearing they might be perceived as unable to cope.[14] Furthermore, a recent trial illustrated that HNAs alone do not adequately support patients' difficulties, emphasising the need for additional support measures beyond HNAs.[15]

Technology, specifically automated smart text messaging, has been increasingly used to support symptom management and self-care.[16] Previous research demonstrates that smart text messaging can effectively be used to monitor and enhance treatment engagement and treatment attendance in long-term conditions such as diabetes.[17,18] Strategies supporting the messages may also be provided in the form of interaction with a care professional to support enrolment[19] or focus on patients' goals[20] although for the latter, those interactions did not affect engagement. Current understanding of key active ingredients to smart-messaging interventions suggests that supported enrolment of programmes enhances engagement, and that more personalised smart messages are more effective.[21–23]

Initial evidence suggests that smart-messaging interventions may be effective in cancer care to support engagement in a group mindfulness programme which reported significantly lower dropout and significantly greater improvement in depressive symptoms compared to those who did not.[24] The same text messaging technology was also employed to prevent relapse in individuals with multiple physical and mental health comorbidities who had health-related anxieties. It resulted in a 25% greater improvement in outcomes over 12-month follow-up compared to those not receiving messaging support.[25] However, there is little understanding of how such smart-messaging interventions could work in cancer care settings, across the whole treatment pathway.

Due to low completion and follow-up rates, HNAs may have limited impact in facilitating support for patients with non-urgent concerns.[12,26] Moreover, there is a need for a stronger connection between assessment and outcomes through targeted measures to address patient difficulties.[27] Therefore, there arises potential for easily initiated and implemented text messaging programmes, which could offer a straightforward intervention to address issues that may be difficult to apply in the existing care pathway.

Methods

Study design

A design integrating qualitative and quantitative methods to explore engagement and outcome data, alongside qualitative interviews to explore participant experiences of receiving a personalised smart messaging programme. The design was selected to provide both quantitative measures of engagement and qualitative insights into participant perspectives, ensuring a comprehensive understanding of programme efficacy. After recruitment completion, a workshop was conducted to better understand factors affecting patient enrolment and engagement, with a range of stakeholders attending including cancer care staff and patients with experience or knowledge of the smart messaging programmes. This workshop included a diverse range of stakeholders, such as cancer care staff and patients, to capture varied perspectives on the programmes.

Programme participants and recruitment

Participants included English-speaking patients aged 18 years and older who were receiving cancer care regardless of the type or stage of cancer, and experiencing commonly reported challenges that could be addressed through one of

the programmes. This included programmes for pain, nausea, fatigue, anxiety, low mood, or sleep problems. The primary trigger for signposting or recommendations from a CNS was often the completion of a Holistic Needs Assessment, which may occur at various points in the patient journey—from diagnosis to discharge. Having a significant cognitive impairment or severe mental health condition preventing meaningful engagement with the programmes were exclusion criteria. The recruitment targets for the four-month recruitment period were: 50 patients to be enrolled in one of the programmes; 25 to consent to take part in the service evaluation; and 13 to be interviewed.

Participants were recruited across the East Midlands through two primary methods: (1) indirectly, by introducing the project via email to 204 staff members who attended a Level 2 psychological skills training session offered to cancer care staff in the East Midlands. This involved describing the programmes, their aims and potential benefits, talking staff through the enrolment process, and encouraging staff to offer this to eligible cancer patients; and (2) direct and indirect engagement with various services, introducing the programmes to staff and patients in hospitals, wellness and Macmillan information centres through presentations and flyers during handovers and team meetings. The programme flyers were distributed and placed strategically in relevant areas during hospital visits, ensuring visibility and accessibility for both patients and staff. Through this method, 114 staff members, and 31 patients were reached.

NHS cancer care professionals from the East Midlands region, comprising two cancer nurse specialists, two cancer coordinators, and a quality improvement officer for patient experience and engagement, integrated discussions about messaging programmes into their regular patient care practices. This integration was especially notable during HNAs or when patients reported symptoms relevant to any of the programmes. Upon enrolment in a programme, participants received an introductory text message through the text messaging intervention outlining the study, accompanied by a link directing them to an online participant information sheet and consent form.

The workshop aimed to involve cancer care staff who were aware of smart-messaging programmes after attending psychological support skills training delivered by the East Midlands Cancer Alliance Videotherapy Service. Additionally, discharged cancer patients who had been introduced to the programmes and consented to post-discharge contact for involvement in research, were also invited. In total, 204 staff members and 14 discharged patients were contacted.

Intervention: personalised smart-messaging for common cancer-related problems

This is a pragmatic system level intervention that delivers personalised smart text message support addressing common cancer-related issues across cancer care service. It included six programmes that ran for six-to-eight week, aligned with frequently identified concerns from HNAs: anxiety, low mood, sleep, pain, nausea, and fatigue. These programs were designed based on NHS interventions, incorporating tools recommended by NICE that are tailored to address specific concerns.

Text messages relevant to the enrolled programme were received daily or every other day. Content included psychoeducation and strategies based on Cognitive Behavioural Therapy (CBT) and Acceptance Commitment Therapy (ACT) approaches commonly used in one-to-one cancer therapy, lifestyle advice in accordance with NHS guidelines, and links to relevant NHS-approved webpages, audio files and videos. Audio and video resources were selected based on their brevity to facilitate ease and likelihood of use and were compiled on an informational webpage that participants were directed to at the start of the programme to aid access targeted by each smart-messaging programme.

Patients received one initial message each day designed to introduce a topic and generate interest. They could trigger a 'smart' feature of the programmes by replying with specified keywords to request additional details or engage further with the topic, and consequently receive up to three more messages which often included a weblink. Participants had a 90-min window to reply to each text and those who wished to discontinue the programme could text "STOP" to cease messages (see Supplementary Material 1 for more information).

Another key 'smart' feature was weekly check-in questions which recorded patients' problem severity in relation to target symptoms. Trends in these scores were monitored, and personalised replies to these check-ins were triggered based on these trends.

In this way the 'smart' programmes tailored responses to the level of problem severity and amount of guidance requested, allowing personalisation of the programmes despite the broad scope of content required for an intervention aimed at a varied population (see Supplementary Material 1 for more information and example of the messages).

Participants measures

Engagement data included the percentage of patient responses out of the maximum possible responses, the duration of participant activity (measured by the number of days they sent a text reply compared to the total number of texts where a response was possible), and the proportion of participants who withdrew from the programmes.

Emotional well-being was evaluated pre-, post- and at four-week follow-up from date of consent using the *PHQ-9, GAD-7, FACT-G7, and EQ5D-5L, validated tools with established psychometric properties (*Supplementary *M*aterial 2*):*

- PHQ-9: Patient Health Questionnaire, to evaluate symptoms of depression by assessing the recurrence of distress over nine items (e.g., "little interest or pleasure in doing things") within the preceding two weeks scored on a scale from 0 ("not at all") to 3 ("nearly or all the time"), with total scores ranging from 0 to 27, whereby a score of 10 is the threshold for moderate depression and our minimum score for participant inclusion in the trial.[28]
- GAD-7: Generalised Anxiety Disorder, to evaluate symptoms of anxiety by assessing the recurrence of distress over seven items (e.g., "not being able to stop or control worrying") within the preceding two weeks scored on a scale from 0 ("not at all") to 3 ("nearly or all the time"), with total scores ranging from 0 to 21, where 21 indicates severe anxiety.[29]
- FACT-G7: The Functional Assessment of Cancer Therapy, to assess participants' quality of life, with seven subscales (e.g., "I am able to enjoy life") each scored from 0 ("not at all") to 4 ("very much") with total score varying between 0 and 28 where higher scores indicate better quality of life, wellbeing and satisfaction thereby providing an indication of the impact of cancer and cancer treatment on participants' life.
- EQ5D-5L: To measure health-related quality of life, assessing five dimensions including mobility, usual activities, pain/discomfort and anxiety/depression through selecting the most appropriate level out of five where level 1 is "no problem", for each dimension.[30]

The PHQ-9 and GAD-7 have internationally established cut-offs for clinical severity of ≤10 and ≤8 respectively; changes in score of ≤6 (PHQ-9) and ≤4 (GAD-7) are deemed the minimum clinically important difference.[28] These are applied across NHS services for the determination of care provision. The FACT-G7 and the EQ5D-5L do not have established clinical cut-offs, but higher scores are reliably found to indicate better quality of life.

All applicable tools and questionnaires used in this study were either publicly available or used with permission from the respective copyright holders.

Procedure

After enrolling but before commencing a programme, participants were informed about the service evaluation via text and prompted to respond to receive a link to the participant information sheet and consent form for the service evaluation, with the option to consent for a qualitative interview. The one-to-one semi-structured telephone interviews were conducted within a week of programme completion by a male research assistant (CB) with an MSc in psychology and experience in conducting qualitative interviews and analysis. The research assistant was independent of care delivery and had not had any contact with the participants before participation in the study. The interviews were recorded and transcribed verbatim.

Participants who had enrolled in a programme and consented to participate in the study were sent a link to online questionnaires pre- and post-programme, and at four-week follow-up. Those who withdrew from the programme by texting "STOP" were not considered to have withdrawn from the study. To withdraw from the study, participants could contact the team directly.

Following the interviews, to better understand the poorer-than-expected uptake, an online workshop took place 10 weeks after recruitment completion. It was facilitated by a Research Assistant (CB) and by a Clinical Psychologist (JR) and detailed notes were taken throughout. The Clinical Psychologist led the workshop by asking questions to generate a practical discussion as described by Rogers (2010). Using this approach, the workshop was divided into two segments. Initially, the interim findings of the study were presented to the group, followed by a discussion phase delving into specific themes. This format also provided an opportunity to gather broader feedback.

Method of analysis

Quantitative analysis. Four outcome measures were employed to assess changes from baseline to programme completion and follow-up. Reliable change criteria were applied to identify participants achieving statistically reliable changes in their scores on these outcome measures. Criteria for PHQ-9 and GAD-7 were based on Gyani et al.,[31] whilst criteria for FACT-G7 and EQ5D-5L were derived from calculations following the method of Jacobson and Truax,[32] using standard deviation (SD) values observed at baseline in our own sample and reliability values cited from studies by Mah et al.[33] and Long et al..[34]

Data analysis focused on the proportion of participants achieving statistically reliable change (improvement or deterioration) in the outcome measures. This was determined by comparing each participant's scores from baseline to completion and from baseline to follow-up against the reliable change indices for each measure. Participants were categorised as "Improved", "No Change", or "Deteriorated" based on these comparisons. Secondary, group-level (average) changes were also computed. Effect sizes for the changes observed were expressed as standardised mean differences (Cohen's d), with associated 95% confidence intervals to assess statistical significance.

Engagement with the smart messaging system was quantified by the response rate to messages that allowed replies. Spearman correlations were computed between the percentage response rate and change in outcome scores to explore the strength and direction of the association between messaging engagement and outcome changes.

Qualitative analysis. The semi-structured interview topic guide was adapted from the change interview schedule[35] and aligned with the study aims. Consequently, the interviews encompassed areas such as decision-making regarding enrolment, the experience of the intervention, its effects, and potential areas for enhancement.

Interview transcripts were analysed using an inductive thematic analysis in NVIVO software, following Braun and Clarke's stages of analysis.[36] After initial transcript familiarisation, two researchers (CB and AK) coded one-third of the total number of transcripts. A consistent coding method was achieved, and one researcher (CB) completed the remaining coding, before organising the data into broad themes, whilst maintaining a reflective log. Regular theme discussions between researchers (CB and AK) with additional peer debriefs with the research lead (JR) ensured a robust theme development process whilst keeping thematic analysis organised such that it could be traced back to the original data.[35,37] An independent third analyst (PP) conducted an independent audit of the analysis produced. During this process, any disagreements were addressed through discussion to maintain consistency in coding. If unresolved after further discussion, the research lead (JR) intervened to make the final decision.

In qualitative research, ensuring trustworthiness is salient to establishing the validity and reliability of the study's findings. The concept of trustworthiness encompasses several key criteria: credibility, transferability, dependability, and confirmability.[38] These principles were integrated into the study to maintain rigor and enhance the credibility of the analysis.

Credibility. Triangulation: Data triangulation was achieved through the involvement of multiple researchers (CB, AK, and PP) in the coding and thematic development process. This helped ensure consistency and validity across different perspectives.

Peer Debriefing: Regular discussions between the researchers (CB and AK) and the research lead (JR) ensured that the themes developed accurately represented the participants' experiences.

Member Checking: The study involved participant validation of the findings during the interpretation phase to ensure the results accurately reflect their perspectives.

Transferability. Description: Contextual information about settings was provided, allowing readers to assess the applicability of the findings to similar populations or settings.

Sampling Strategy: A clear description of the sampling process ensured that the findings may be transferred to other contexts where similar research questions or interventions may apply.

Dependability. Audit Trail: All decisions, from data collection through to analysis, were thoroughly documented to ensure transparency. An independent third analyst (PP) conducted an audit of the analysis to verify the process.

Methodological Rigor: The coding and thematic development process was clearly documented and reviewed at multiple stages to maintain consistency across the study.

Confirmability. Reflexive Journaling: Researcher (CB) maintained a reflective log throughout the analysis stage to document thoughts, biases, and any decisions made during this process, which ensured objectivity.

Discrepancy Resolution: Any disagreements in coding or theme development were resolved through discussion between the researchers, with the final decision made by the research lead (JR) to ensure objectivity and consistency.

By incorporating these strategies into the research process, the study aimed to enhance its trustworthiness and provide robust, reliable findings that can be confidently applied in future research and practice. Besides, reporting followed the 32-item Consolidated Criteria for Reporting Qualitative Research (COREQ;[39] Supplementary Material 3).

Workshop. To inform the topic guide for the workshop (Supplementary Material 4), a team including a researcher, three clinical psychologists, an assistant psychologist and a psychology undergraduate student, held a Responsible Research and Innovation (RRI) session wherein they split into two groups of three and discussed each of the sections of the RRI framework[40] within their group and then all together, with the programme enrolment and engagement in mind. They designed questions aimed at helping to better understand barriers and facilitators to the process of signing up for smart-message programmes, alongside questions designed to gain a greater understanding of factors that may affect ongoing engagement with programmes. The workshop outputs were summarised from the notes and categorised into themes in the results section.

Ethics approval

Aligned with UK Health Research Authority assessment criteria, this study was deemed to be a service evaluation that did not require ethical approval. Participants were not allocated to conditions different to usual service delivery, data were collected as part of routine clinical practice, and the study was not designed to be generalisable. The evaluation was registered with the host NHS organisation.

Informed consent was obtained from all individual participants included in the study. All participants provided written consent to participate for the surveys and verbal consent for the interviews, which was audio recorded, before the interview commenced.

Results

Twenty-seven patients enrolled in one of the programmes during the recruitment period of four months, of whom 15

consented to take part in the service evaluation, and 12 to do the additional interview, with six of them attending (see Table 1 and Supplementary Material 5). The mean interview length was 19 min (range: 15–29 min). Half of the interviewed participants were female, with a mean age of 56 (SD = 8.0). Interviewed participants were mostly partway through or had completed chemotherapy at the time of enrolment, except for one participant who was not receiving active treatment.

Quantitative findings

Engagement. Of 27 patients signing up for a smartmessaging programme, 23 completed their programme (85.2%). On average patients responded on 38.30 occasions, constituting 49.95% of all messages where responses were possible. On average, participants were on a programme for 24 days, participants responded on 13.60 days (42.9% of days engaged) while enrolled on a smartmessaging programme (see Table 1).

Outcome data. Participants reported improvement in PHQ-9 scores across time points (baseline M = 11.5; completion M = 8.6; follow up M = 5.9) with a large effect size (1.3). Twenty-two per cent and 57% of participants reported reliable improvement upon completion of the programme and at follow-up respectively. Improvements in GAD-7 scores were also reported (baseline M = 8.7; completion M = 6.6; follow up M = 7.2)with a small effect size (0.2). Thirty-three per cent and 22% of participants reported reliable improvement at programme completion and follow-up respectively. Whilst 22% of participants initially experienced worsening GAD-7 scores post-programme completion, this was rectified by the time of follow-up (described further in section 4.1.3). Regarding quality of life, as measured by FACT-G7 and EQ5D-5L, improvements were observed at programme completion and persisted through follow-up, characterised by a moderate to large effect size (refer to Figures 1 and 2 for details).

Association between engagement and outcomes. Taking response rate to messages allowing replies as an indicator of active engagement, we examined correlations between response rate and change in outcome scores. Examining changes from baseline to completion and follow-up, associations were observed to be in the desired directions: greater engagement appeared to be associated with greater reductions in depression (PHQ-9) and anxiety (GAD-7), and with greater increases in quality of life (FACT-G-7) and health state (EQ5D5L). However, although point-estimates for most relationships were of moderate-to-large magnitude (where coefficients ≥.10 = 'small', ≥.30 = 'moderate', and ≥.50 = 'large'), limited power (6–8 paired observations) meant that most estimates were not statistically significant. Exceptionally, there was a significant association between engagement and GAD-7 change from baseline to follow-up: Participants who engaged more actively with smart messaging tended to show greater reductions in anxiety at follow-up (Table 2).

For the 22% of participants who initially showed reliable deterioration on the GAD-7 from baseline to completion, it was notable that they showed relatively high levels of engagement with the messaging system (with 69–89% adherence, based on the rate of responding to messages allowing replies). Deteriorations in anxiety appeared transient: by the point of follow-up, both deteriorations had resolved (relative to baseline GAD-7 scores, one participant showed no change and one ultimately showed reliable improvement).

Table 1. Summary of enrolments and engagement per programme.

	Enrollment (withdrawal)			Text messages replies			Days of activity		
Programmes	*n* Enrolled[a] (withdrew)	*n* SE participants (withdrew)	*n* Interviewed	M expected replies	M received replies	Ratio	n total days	n active days	Ratio
Anxiety	15 (3)	9 (1)	3	1047	456	43.55%	436	460	36.70%
Low mood	3 (0)	1 (0)	1	248	202	81.45%	78	64	82.05%
Fatigue	4 (1)	4 (1)	2	136	126	92.65%	54	45	83.33%
Pain	2 (0)	1 (0)	0	66	42	63.64%	26	15	57.69%
Sleep	3 (0)	0 (0)	0	199	66	33.17%	105	33	31.43%
Grand Total / Overall Mean	**27 (4)**	**15 (2)**	**6**	**1696**	**892**	**52.59%**	**699**	**317**	**45.35%**

SE: Service evaluation; M: Mean; n: Number.
[a]Enrolled in a programme: treatment as usual.

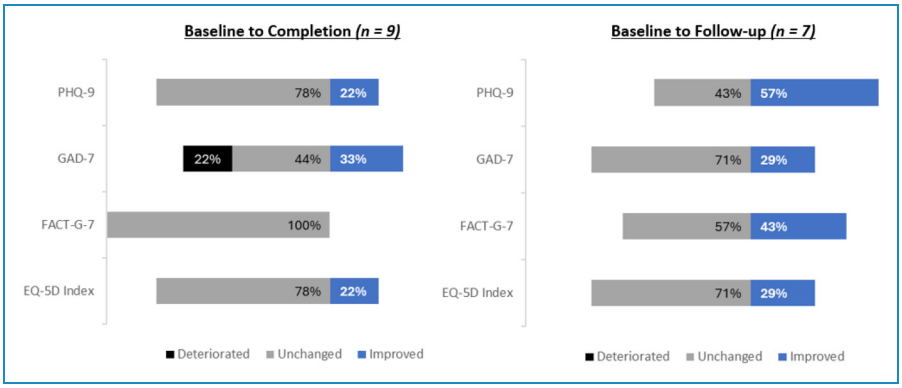

Figure 1. Proportion of participants with deteriorated, no change, or improved outcomes at post-programme versus follow-up.
Note. Reported *n*s reflect participants with paired observations; due to missing data at some timepoints, these *n*s are lower than completion *n*s in the Consort diagram. Established reliable change criterion values were used for the PHQ-9 (absolute changes ≥6) and GAD-7 (≥4; Gyani et al., 2013). Reliable change criterion values were computed for the FACT-G7 (≥5) and EQ-5D (≥0.22) applying the method outlined by Jacobson and Truax (1991). These calculations used the standard deviation values observed at baseline and reliability values cited from studies by Mah et al. (2020) for the FACT-G-7 and Long et al. (2021) for the EQ-5D. Individuals who showed a reliable change were classified as either 'improved' or 'deteriorated' based on whether their change indicated a move towards better or worse functioning, respectively.

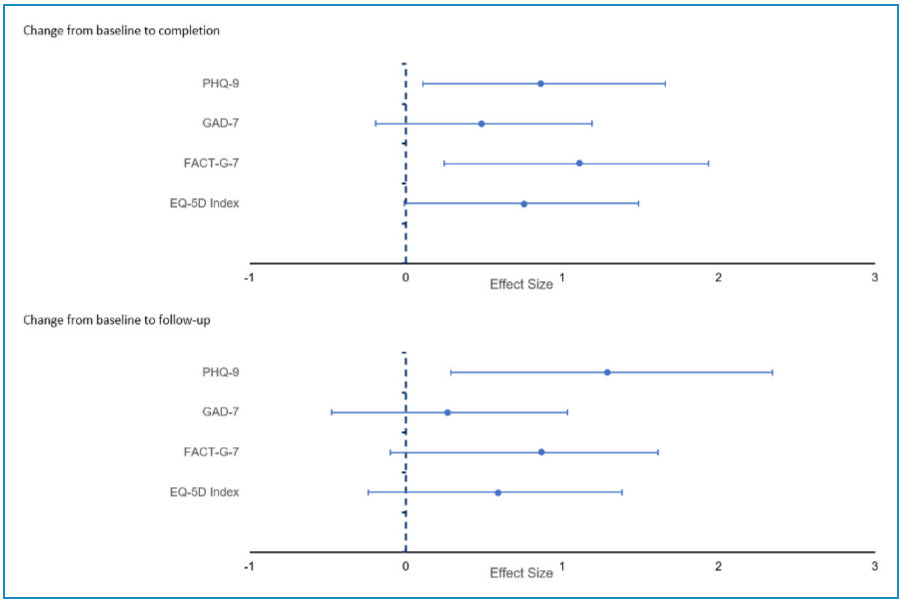

Figure 2. Average effect sizes by outcome: change from baseline to completion and from baseline to follow-up.
Note. Error bars represent 95% Confidence Intervals. Where error bars do not cross 0 (the possibility of no effect), there is a statistically significant effect (change in outcome from baseline). Effect size is expressed as standardised mean difference (SMD; calculated as Cohen's *d*), where 0.20 = 'small,' 0.50 = 'moderate,' and 0.80 = 'large' magnitude of effect.[41]

Qualitative findings

To understand the engagement and the perceived outcomes of the programmes from the participants' perspective in one of the programmes, three themes, divided into eight sub-themes, were identified from the qualitative interviews. Themes and subthemes are reported below with illustrative quotes with the participant number and the programme they enrolled (A = anxiety, LM = low mood, F = fatigue). See Table 3 for a summary of the themes and sub-themes.

Theme 1 – rationale for enrolment. Participants reported various reasons for signing up for smart-messaging programmes, including expectation of benefits, the straightforward enrolment process, or as a means to address

Table 2. Spearman correlations between smart-messaging engagement (% response rate to messages received) and outcome change scores.

	PHQ-9 change		GAD-7 change		FACT-G-7 change		EQ-5D index change	
	Baseline to completion	Baseline to Follow-up	Baseline to completion	Baseline to Follow-up	Baseline to completion	Baseline to Follow-up	Baseline to completion	Baseline to Follow-up
Coefficient	−0.50	−0.64	−0.46	−0.81	0.42	0.09	0.29	0.62
p-value	0.204	0.173	0.251	0.050	0.300	0.872	0.493	192
n	8	6	8	6	8	6	8	6

Table 3. Summary of themes and sub-themes.

Rationale for enrolment	Sustaining engagement	Outcomes of participation
Initial impression and enrolment process	Practical fit with participant lifestyle	Personal impact of participation
Hope for recovery	Psychological dimension	Enablers to change
Waitlist for other therapy	Engagement hindrance	

their difficulties until they could access more formal treatments.

Initial impression and enrolment process. Upon learning about the programmes, participants found the concept interesting, feeling that support was available to them and expressing a desire to enrol at their earliest opportunity. They generally perceived the enrolment process as easy. However, participants who learned about the programmes through flyers expressed concerns about potential charges for receiving text messages and had uncertainties about whom to approach for clarification. Staff support, such as providing programme explanations, further facilitated the enrolment process.

> "I had had a chat with [staff member] then yes I think, "Had I just seen it on a piece of paper then I would not have intrigued and probably fascinated […] but at least because I had the opportunity to speak to [staff member] I have felt excited that it was going to happen, […] I understood what was coming out from it." (001-A)

Hope for recovery. Above all else, participants exhibited a strong hope of improvement from their current situation, primarily due to the challenges they faced in managing their symptoms, rendering the programmes relevant to their situation. They saw the programmes as a fitting solution, whether as a standalone treatment or to supplement other treatments. This sense of desperation stemmed from their willingness to try anything to alleviate the symptoms targeted by the programmes; for them, the programmes were the last resort.

> "When [oncologists] turn round and say, there's nothing we can do, […], that's when you start losing faith really about it. […] I'm open to anything really" (004-F)

Waitlist for other therapy. Furthermore, the programmes appeared to be a suitable option for participants who were in the midst of waiting for other interventions, which could potentially entail several weeks or months of delay.

> "I think in the beginning I was very very low and I had to wait for the counselling" (005-LM)

Theme 2 – sustaining engagement. Participants discussed factors that facilitated their active participation in the programmes, motivating them to respond to text messages to gain further information from the programmes. Specifically, the programme's format and its method of delivery were highly practical, and when combined with psychological aspects like feeling understood, it enhanced participant engagement. Nevertheless, barriers to engagement were also reported, primarily the limited 90-min window for responding to text messages.

Practical fit with participant lifestyle. It was highlighted during interviews that a strength of the programme delivery was its flexibility. The programmes conveniently fitted into participants' routines without much intrusion, even for those with a busy lifestyle, given its remote delivery. In addition, the ability to access the information whenever they wished to, even after completion of the programme gave more flexibility in their level of engagement.

> "You didn't need to pick up the phone and ring the doctor about it, but it was there and it was comforting to know that

> [the programme] was going to text or Flo [the programme's pseudonym] did text and if I wanted to answer I could answer and if I didn't want to answer I didn't need to." (001-A)

Participants found the delivery to be "*straightforward and easy to understand*" " (002-A), and the incorporation of YouTube videos with subtitles enhanced content accessibility and diversity.

> "It wasn't just one thing like a text to give you information, it was also good to watch videos as well because sometimes I can be visual more than just reading something, its good to see different ways of doings things" (006-F)

Participants expressed satisfaction with the information delivery, noting that it was "*nicely spread over the time period" (003-A).*

Psychological dimension. Although participants reported that they did not "*always want to talk to a person about your problems*" (003-A), they felt a sense of being understood. Their symptoms were acknowledged and validated, which was sometimes a departure from their experiences with healthcare professionals who they felt didn't prioritise their concerns. The texts acknowledging their symptoms gave participants the perception of the programmes having a human touch as if they were being provided access to healthcare professionals with expertise for one-on-one discussions.

> "Having someone there you know to talk to, even though they're not there is, makes a difference and I know it's a texting service but it's like talking to a healthcare professional isn't it? One that believes you when you tell them what the symptoms are." (004-F)

A key element that fostered engagement with the text messages was intrinsic motivation. Participants found that the programmes gave them a sense of purpose, providing something to focus on or contemplate. Participants interviewed felt inspired to respond to as many texts as possible to maximise the benefits derived from the programmes.

> "It made me want to do it to obviously go through, I didn't want to just do bits here and there I did want to complete the whole course because otherwise I didn't think it was worth joining if I didn't see it through." (002-A)

Engagement hindrance. The primary obstacle to engagement, mentioned in all interviews, was the 90-min window for responding to text messages. Participants expressed emotional responses such as concerns about not being available or "*feeling pressured*" (002-A), such as when they were in the hospital, which led to missed responses. Some participants were concerned about missing messages, with one person feeling "*a bit angry with myself*" (Participant 006-F) when missing a text message. Participants suggested selecting the message delivery time, setting reminders within the 90-min window, or extending the response window to three or even 24 h.

> "There were only a couple I missed because I was busy, I was driving, and you've got 90 min to reply, or to respond and if you don't respond then that's it for that day." (004-F)

Additional programme features reportedly reduced engagement. The weekly questionnaires including goal setting and clinical measures seemed redundant, as some participants felt that "*you were finding it wasn't changing enough on a weekly basis" (005-LM)*. Certain individuals also found some skills to be too challenging.

> "They said drain your mind of all-sorts, no that's not possible, I can't do that. Who can do that? Well maybe some people can, I can't. I've always got to be thinking of something." (004-F)

Finally, external factors beyond participants' control may have influenced engagement.

> "I did try to to start with until March when my mum got taken ill and then I couldn't, and then I sort of lost track where I had got to" (002-A)

Theme 3 – outcomes of participation. Participants reported the positive impact that engaging with the programmes had on their symptoms and life in general, whilst also reflecting on the factors that facilitated the changes.

Personal impact of participation. Participants observed symptom reduction and improved symptom management, finding the programmes helpful. Beyond addressing the targeted symptoms, they also reported increased motivation and the ability to engage in additional activities, such as socialising, which was beneficial. As a result, the programmes empowered participants to "*move on with the rest of my life " (001-A).*

> "I am a lot better than I was, I'm not as fatigued, I don't overdo myself, I carefully plan what I am doing because of it. […] I can do a little bit more with my family when I feel like it, I have a little bit more energy. I am glad because I've got a lot of grandchildren, so I spend a lot of time with them." (006-F)

Enablers to change. Participants discovered valuable tips, techniques, and information within the programmes that guided them and prompted positive changes, with an emphasis on planning implementation for change. Since the content was delivered directly to their phones,

participants perceived it as "*kind of a personal approach* " (Participant 003-A).

> "I liked the goal setting because I'm a very busy person, [and] you have to explain how you are going to set this goal and what changes you are going to do it, and […] it makes you make sure you actually set it then." (001-A)

Nevertheless, certain changes were also influenced by external factors, such as undergoing counselling or experiencing life changes like going into remission or reducing medication with side effects.

> "I feel stronger than I did eight weeks ago in my mind but then that's because I've probably had a CT scan and I'm now clear, I've seen the doctor and I've finished by treatment so I don't take tablets every day." (001-A)

Workshop

The two-hour workshop was attended by five discharged patients (who previously received specialist psychological therapy in cancer care and had previously used or were introduced to the smart-messaging programmes), and four staff members (who were aware of the programmes following participation in psychological skills training for cancer care staff).

Overall, workshop attendees perceived the programmes as a valuable service. However, they were viewed as under-promoted as there was insufficient awareness and understanding amongst staff and patients about the programmes and their potential advantages such as being offered immediate patient-led intervention, with the potential to bridge the gap between treatments. This under-promotion may explain low sign-up levels.

Promotional materials. Attendees reported that flyers should be made more visible and their content clearer through stakeholder collaboration. Diverse populations could be targeted with tailored language and design, also applicable to programme content. It was suggested that using posters at GP surgeries, religious institutions, and community hubs may be a strategic approach to further reach a diverse group of patients.

Integrating short video clips featuring programme explanations and patient feedback when introducing the intervention directly to staff or as part of level 2 training was suggested to address staff concerns including simplicity, free access and lack of human contact thereby encouraging them to promote the programmes. These videos could also be available through the flyer via a QR code to reach patients directly.

Participants proposed that including flyers in patient information packs at the point of diagnosis could enable patients to choose to sign up autonomously when they find it relevant, with the option to review during follow-up appointments with staff for further exploration. It was highlighted that the information must be current through ongoing communication with services.

Improving enrolment through cancer care staff. Staff only recognised the value of the programmes after hearing patients discuss their benefits, with less value placed on them when only described at Level 2 psychological skills training. Allocating more time for programme presentations at training and incorporating short video clips with patient testimonials were suggested routes to highlight benefits. Even if in doubt, patients expressed that staff should mention the programmes due to the scarcity of services, as some patients are willing to explore any option available to them.

To enhance staff understanding of what programmes involve and confidence in informing patients, participants recommended encouraging staff to sign up for one of the programmes themselves or access a brief version during training. This programme could focus on a topic other than cancer to showcase benefits to them. It was highlighted that whilst staff are mindful of overwhelming patients with information, discussing programmes in HNAs as a standard practice was another suggested promotion opportunity. Alternatively, an automatic enrolment option was considered, requiring them to opt out if they prefer not to receive the intervention. Patients believe that this approach would ensure programme awareness.

Discussion

There is limited evidence on openly available interventions to support patients in cancer care who are experiencing cancer-related problems, raising the question of whether further development is needed. To address this gap, our study explored engagement, outcomes and qualitative experiences for 27 participants who used one of six personalised smart-messaging programmes that targeted common impacts of cancer. Participants reported improvements in anxiety, depression and quality of life directly after the intervention and at 4-week follow-up. However, data revealed significant variations in participant engagement.

Qualitative findings suggest that implementing strategies to boost enrolment may involve promoting programmes to relevant services and patients, as well as integrating the intervention into standard cancer care. For instance, incorporating the intervention into informational brochures for patients in cancer care may prove to be an effective approach. The promotional material co-produced with patients may include testimonies and be more inclusive of minorities. Additionally, actively training cancer care staff in psychological skills, accompanied by firsthand

experience with the programmes, serves as another avenue for promoting the intervention.

Previous research

The findings indicate that engagement was a predictor of improved clinical outcomes, highlighting the positive impact of the programmes. This finding is novel, as previous studies on text message interventions had not established a connection between engagement and outcomes. This echoes previous research on digital intervention such as a digital mental health intervention for trauma recovery.[42] A systematic review of digital mental health interventions suggested that engagement in intervention predicts outcomes regardless of the intervention type (guided/unguided), diagnosis status and mental health condition targeted.[43] This underscores the significance of prioritising engagement when implementing such interventions.

Our engagement findings align with observed patterns from previous research such as varying levels of engagement between participants and a small subset of "high engagers" contributing to increasing the overall engagement percentage.[17,18,44] Nonetheless, overall reported engagement was lower compared to other studies (Redfern et al., 2016; Zhang et al., 2018). Previous research focused on adolescents and young adults, a noteworthy factor given the association of younger age with increased engagement in text messaging interventions[23] whilst incidences of cancer increase with age, peaking at aged 85–89 years.[45] Furthermore, Zhang et al.[18] noted that females exhibited higher levels of engagement than males. Although we did not report the participants' sex, except for qualitative interviews, this difference in engagement based on gender was noteworthy. This suggests that the demographics of the targeted population may be an important consideration when devising strategies to improve engagement.

Additionally, Zhang et al.[17] reported that engagement varied depending on the type of message, such as those querying about personal experience resulted in higher engagement, whilst our programmes focused on psycho-education. This indicates that text format alone was not the sole determinant for high engagement. Besides, their programmes offered more interactive features, allowing participants to ask questions creating a two-way communication which is a reported factor of engagement.[22] Here, the two-way communication was restricted to specific keywords. As such personalisation of the messages that focus on the patient experience may further improve engagement.

Despite its significance for the success of digital health interventions,[46] research on the enrolment process of text messaging interventions is scarce. Increased support and face-to-face contact with providers have been identified as factors that enhance engagement and enrolment,[22] with an emphasis on the supporting role of clinicians for recruitment and enrolment.[47] Vluggen et al.'s.[47] findings suggest that integrating the programme into routine consultations and supporting patients with enrolment by providing information, addressing queries, and explaining the benefits may enhance intake. Our workshop echoes the crucial role of care staff in the enrolment process, to present the programmes and address queries. The workshop also suggests incorporating discussions about the programmes during routine HNAs and follow-up appointments which may increase their impact on non-urgent concerns. This approach necessitates in-depth programme knowledge, requiring staff training. Consequently, having trained staff present and discuss the programmes with patients during routine HNA and follow-up appointments may enhance enrolments.

Currently, in the UK, cancer patients receive an information pack with flyers detailing various accessible interventions, allowing them to "opt in" for those of interest. The workshop explored the potential of introducing an "opt out" option to enhance both access and enrolment. Under this approach, patients would be automatically enrolled and could choose to withdraw. Existing evidence indicates that automatic enrolment in relevant interventions could benefit patients in addition to resulting in significantly higher enrolment rates, making it a valid and ethical choice.[48] However, implementing this option requires ensuring that patients are fully informed about the programmes and their right to "opt out" preventing any sense of pressure or misconception that programme completion is mandatory.[49] Thus, the "opt out" option does not eliminate the need for staff training, as discussed earlier.

A reported strength of the text messaging programmes was the ability to access information at any time, even after programme completion. This echoes existing evidence that attributes increased engagement to features allowing users to save and share messages.[22] However, a weakness identified in our programmes was the limited 90-min window for answering texts, after which the programmes would not recognise responses. Whilst patients understood that the information provided by the programmes remained accessible online via a weblink provided to them at the start of the programme, the drawback was the inability to directly access it from the texting programmes. Extending the response window appears crucial to enhance information accessibility. Alternatively, a strategy could involve compiling all the programme's weblinks and sending them at the programme's outset, enabling participants to access information as needed. This approach offers patients the chance to preview programme content before starting, potentially boosting adherence through managing expectations of the programmes.[50] Furthermore, the ability to revisit texts provides patients with the flexibility to access information during their free time.

The success of the programmes hinged significantly on their flexibility. The majority of our participants were

undergoing treatment at the time of enrolment. Cancer treatment is frequently perceived as a significant challenge for patients who must regularly travel for treatment whilst also managing symptoms.[51] This challenge extends to individuals in remission with lingering symptoms impacting their ability to resume their pre-cancer routine.[52,53] Therefore, having an intervention that integrates into an existing routine, given that they engage with the programme from their phone anywhere, is especially crucial for patients in cancer care.

The identified themes relating to participant motivations and sustained engagement align with prior research highlighting the significance of tailored interventions[54] and user-friendly programme designs.[55] The personalisation aspect based on their symptoms and progress contributed to the programmes feeling more human-like, creating a sense of receiving advice from a healthcare professional. Redfern et al.[22] further emphasised the strength of two-way communication in an intervention, supporting the concept of texting back for additional information in our programmes, despite the communication being limited to some keywords.

Our sample expressed satisfaction with the 6–8 week programmes length and the message frequency, unlike previous qualitative research on text messaging, where patients suggested longer interventions with post-completion ongoing text messages.[22] Notably, in previous research, the focus was on patients seeking lifestyle changes like weight loss and smoking cessation, rather than addressing symptoms affecting daily life. After completing six-month programmes focused on life and routine changes, participants found themselves reverting to old habits and felt the need for ongoing support. However, in our study, interviews occurred right after programme completion, and the benefits from the programmes were described as sustained, negating the need for further support. Additionally, participants reported that being able to access the content at any time, even after completion, was sufficient. Nevertheless, it is noteworthy that anxiety scores showed an increase between the completion of the intervention and the four-week follow-up assessment. Despite this slight uptick, the scores continued to stay below the baseline levels and within the sub-clinical range, offering a potential explanation for the observations made in the qualitative interviews.

Study strengths and limitations

The study's strengths lie in its dual (qualitative and quantitative) approach, providing a comprehensive understanding of participant engagement and further exploring ways to increase enrolment in response to low recruitment figures. The integration of the workshop enriched our insights from both patients and cancer care staff perspectives, providing recommendations for the implementation of such text messaging interventions.

Despite the valuable insights gained, the small sample size limits the generalisability and reliability of the findings. Whilst there were no new codes emerging from the later interviews, suggesting saturation, it may be difficult to draw conclusions from this sample given the risk of introducing bias. Primarily, the interview sample only included participants who engaged in and reported benefitting from the programmes, as others did not answer the interview invitations. Such interviews could have provided key aspects for improvements, and factors which may render the programmes unsuitable for some populations whilst also suggesting further improvements. Furthermore, the clinical outcome data with the study's single-arm design precludes direct comparison with a control group and the short duration of follow-up may not capture long-term effects.

The small sample size constrained the statistical power of the quantitative analysis, thereby limiting the generalizability of the findings. Consequently, results should be regarded as preliminary findings. Moreover, the absence of a control group, coupled with variability in participant engagement with the programmes, precludes causal inference and may have contributed to heterogeneity in outcomes. Additionally, the inability to systematically track the effectiveness of specific intervention components represents a methodological limitation, underscoring the need for further research to refine and optimise the intervention.

One unaddressed limitation here is the accessibility of the intervention for patients lacking internet-enabled phones, rendering them unable to access the links embedded within the text messages. Digital exclusion, particularly prevalent amongst older generations[56] is pertinent to the cancer population due to the increasing prevalence of cancer with advancing age.[57] To mitigate the risk of excluding those without internet-enabled phones, patients were able to manually enter the web link provided in the text messages into an internet-enabled device such as a laptop as explained in the first text message that they received. However, this alternative is not viable for individuals lacking internet access.

Clinical implications

Cancer staff plays a crucial role in the successful implementation of text messaging programmes by introducing them to patients, thereby boosting enrolment. Staff members need training to comprehend, experience, discuss, and recommend the programmes to patients. Enhancing accessibility may involve introducing an "opt out" option to ensure that patients are aware of the programmes, aligning with the belief that patients are often willing to explore any available options, ultimately expanding patient choice.

Our findings underscore the importance of tailoring intervention programmes to individual needs and preferences. Addressing barriers to engagement, such as the

restricted response window, may further enhance programme accessibility. Furthermore, our study highlights the potential benefits of incorporating flexible and user-friendly features into digital health interventions to promote sustained engagement and positive outcomes.

Implementation of findings

We recognise the value of the intervention, as evidenced by positive feedback and recommendations from engaged participants. The primary obstacle lies in the enrolment process into the programmes. In response to workshop feedback, we plan to allocate more time to the intervention during level 2 training. This will involve incorporating text message examples and providing attendees with the opportunity to try one of the programmes. We also believe incorporating patient testimonials could be beneficial whilst providing live examples of introducing a protocol using deliberate practice principles to the core training. Improving and refining the informational flyers, with input from public involvement, tailored to diverse populations could further enhance enrolment. We will suggest including the flyers in the cancer information packs.

To facilitate engagement after enrolling in a programme, cancer nurses could introduce the intervention during follow-up assessments. As for improvements to the intervention itself, we have removed the 90-min window, replacing it with the option to respond to a specific text until the next one arrives. We are contemplating reducing the frequency of goal-setting messages and measures to once every other week.

Conclusions

In conclusion, our study offers insights into participant engagement with novel low-cost evidenced based smart messaging intervention programmes for cancer patients. It demonstrates they are feasible and have potential to impact on outcomes and engagement in cancer care. The identified variations in engagement, coupled with diverse participant motivations and reported outcomes, contribute to the growing body of literature on digital health interventions. Recognising the limitations and building on the strengths of this study, future research should explore larger samples, incorporate control groups, and employ longer follow-up periods to further elucidate the nuances of participant engagement and programme effectiveness in real-world settings.

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Statements and Declarations

Author Contributions/CRediT

CB: Contributed to the design of the study, participated in recruitment, conducted interviews, oversaw data collection, analysed qualitative data, co-led the workshop, and drafted the manuscript.
CM: Contributed to the design of the intervention, participated in recruitment, and reviewed the manuscript.
AK: Conducted second coding of qualitative analysis and contributed to drafting the manuscript.
NM: Contributed to data analysis, interpretation of findings, and reviewed the manuscript.
PP: Conducted an independent audit and reviewed the manuscript.
EW: Participated in recruitment and reviewed the manuscript.
MD: Supervised AK's work throughout the study.
FG: Contributed to the design of the intervention and supervised CM's work throughout the study.
SM: Contributed to the intervention and study design, supervised recruitment, and reviewed the manuscript.
JR: Contributed to the design of the intervention, supervised recruitment, monitored data collection, run-lead the workshop, and oversaw data analysis and the drafting of the manuscript.

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Conflicting Interests

The authors declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: The primary researcher for this study was independent of the team responsible for implementing the intervention being evaluated. However, the supervisors of the research were members of the team using the intervention. To address any potential bias, an independent audit was conducted for the qualitative analysis, by an external researcher not affiliated with the intervention, and independent researchers performed all data analyses. There was no financial gain associated with the intervention or the study. These measures were implemented to ensure objectivity in the evaluation.

Supplemental material

Supplemental material for this article is available online.

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