Exploring Patient Factors, Engagement, and Symptom Outcomes in a Provider-Guided Online Symptom Management Intervention: A Mixed Methods Study

Yan Wang, Annette DeVito Dabbs, Teresa Hagan Thomas, Grace Campbell, Heidi Ann Donovan

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Yan Wang[1] PhD; Annette DeVito Dabbs[1] PhD; Teresa Hagan Thomas[1] PhD; Grace Campbell[1, 2] PhD, MSW; Heidi Ann Donovan[1] PhD

[1] University of Pittsburgh Pittsburgh US
[2] Duquesne University Pittsburgh US

Corresponding Author:
Yan Wang PhD

University of Pittsburgh
3500 Victoria Street, Victoria Building
Pittsburgh
US

Abstract

Background: Cancer survivors often experience declining engagement in digital health interventions (DHIs). However, predictors of engagement with provider-guided DHIs remain unclear. Nurse WRITE, an effective 8-week nurse-directed symptom management DHI, offers an opportunity to identify factors influencing engagement and enhance intervention efficacy evaluation.

Objective: This study aims to (1) understand engagement phenomena (dimensions, influencing factors, and challenges) and (2) assess the relationship between engagement and patient symptom control in Nurse WRITE.

Methods: The study included 68 women with recurrent ovarian cancer randomized to the Nurse WRITE arm of a 3-arm symptom management trial. We analyzed socio-affective and cognitive engagement through message board data and behavioral engagement using website usage data. Regression analyses examined patient characteristics, engagement, and symptom control perceptions. Through content analysis, we explored participant challenges and activities before disengagement.

Results: Regarding influencing factors, higher education was associated with a 22% increased likelihood of engagement ($p = 0.04$). Education positively influenced cognitive and socio-affective engagement, including total count of cognitive classes ($p = 0.01$) and total word count ($p = 0.03$), with marginal associations for socio-affective classes ($p = 0.07$). Comorbidities tended to reduce both socio-affective ($p = 0.06$) and cognitive class counts ($p = 0.07$). Regarding behavioral engagement, education increased the odds of completing an extra symptom care plan by 23% ($p = 0.02$) and a plan review by 29% ($p = 0.02$). We observed a trend that higher symptom severity increased the odds of completing an additional plan review by 21% ($p = 0.09$). The most common engagement challenges included worsening health and treatment, busy family life, and website difficulties. Moderate and low engagers also experienced confusion about the intervention timeline and process. Among low engagers, 63% discontinued communication at specific intervention phases: introduction (33%), symptom representational assessment (21%), and goal setting and planning (21%).
Regarding the relationship between engagement and symptom control at the end of the intervention, improved symptom control was associated with higher overall engagement ($p = 0.02$), a higher frequency of cognitive engagement classes ($p = 0.02$), average question completion percentage ($p = 0.01$), a higher frequency of socio-affective classes ($p = 0.01$) and total word count ($p = 0.01$), as well as a higher total count of completed symptom care plans ($p = 0.04$).

Conclusions: Participant education level significantly influenced Nurse WRITE engagement across socio-affective, cognitive, and behavioral dimensions. Comorbidity and symptom severity warrant further investigation. Future provider-guided DHIs should employ additional strategies to engage less well-educated participants, address challenges like health issues and family activities, and re-engage participants during critical phases. Our findings underscore the importance of meaningful engagement through socio-affective, cognitive, and behavioral dimensions in Nurse WRITE, informing future DHIs to aim for a balance of protocol adherence and flexibility to enhance engagement and improve outcomes.

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Exploring Patient Factors, Engagement, and Symptom Outcomes in a Provider-Guided Online Symptom Management Intervention: A Mixed Methods Study

Yan Wang[1], Annette DeVito Dabbs[2], Teresa H Thomas[3], Grace Campbell[4], Heidi AS Donovan[5]

[1] PhD, RN

Department of Health and Community Systems, School of Nursing, University of Pittsburgh, 3500 Victoria Street

[2] PhD, RN, ACNS-BC, FAAN

Department of Acute and Tertiary, School of Nursing, University of Pittsburgh, 3500 Victoria Street

[3] PhD, RN

Department of Health Promotion and Development, School of Nursing, University of Pittsburgh, 3500 Victoria Street

[4] PhD, MSW, BSN, RN, CNL, CRRN, FARN

School of Nursing, Duquesne University, Fisher Hall 517, Pittsburgh, PA; School of Medicine, Department of Gynecology, Oncology, and Reproductive Sciences, University of Pittsburgh, 3550 Terrace Street, Pittsburgh, PA

[5] PhD, RN

Department of Health and Community Systems, School of Nursing, University of Pittsburgh, 3500 Victoria Street

=

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Keywords: Engagement; digital health intervention; intervention efficacy; symptom management; eHealth; gynecological cancer

Introduction

In 2024, an estimated 19,680 women will be diagnosed with ovarian cancer, and approximately 12,740 will die [1]. Despite aggressive surgery and initial chemotherapy response, 85% of these women will experience recurrence within two years [2,3]. The focus then shifts to balancing the potential of life-extending treatments with multiple severe symptoms, requiring novel interventions to improve patient's symptoms and quality of life.
In the past decade, digital technologies like mHealth and eHealth have been increasingly integrated into interventions for cancer survivors, addressing symptom management [4-5] and promoting healthy behaviors [6-8]. Active engagement with these technologies and interventions is crucial for effective symptom management and improved outcomes [9]. However, a concerning decline in technology utilization and engagement with digital health interventions (DHIs) has been observed across the intervention period [10, 11]. Previous studies have explored the impact of patient

characteristics (e.g., age, employment, education, marital status [9, 12, 13]), social support [14, 15], and self-efficacy [16] as well as clinical characteristics (e.g., comorbidities [13, 17], well-being experience [18], distress, depression, anxiety [17-20]) on engagement with DHIs. However, research on how these specific factors influence engagement in provider-guided DHIs remains limited. Moreover, understanding why some individuals disengage and potentially re-engage later is challenging since it may not always be documented or communicated in real-time during DHIs. Addressing participants' disengagement and challenges during the intervention is crucial to addressing this issue.

Nurse WRITE, a nurse-guided DHI, was one intervention arm of a 3-arm online randomized clinical trial that aimed to help women with recurrent ovarian cancer manage their symptoms [4]. Using the Representational Approach to patient education [21], the nurse interventionists assessed participants' symptom representations (beliefs and understandings about the cause, timeline, consequences, controllability, and emotional impact) and developed highly individualized care plans on asynchronous message boards. The nurse guided patients to develop problem-solving skills for managing other symptoms after the 8-week intervention. The other intervention arm (SD WRITE) engaged in self-directed online modules instead of nurse interaction. A key outcome of the intervention was perceived control over symptoms, which encompasses confidence and persistence in problem-solving and behavioral orientation [22], which has been shown to significantly predict long-term outcomes [23-25]. The Nurse WRITE intervention improved symptom control compared to the control-enhanced usual care arm [4]. Thus, evaluating the role of patient intervention engagement specifically related to perceptions of symptom control is crucial to understanding and interpreting the effectiveness of the Nurse WRITE and the potential translation of the intervention into clinical practice.

In previous studies [26, 27], we conceptualized engagement and developed an analytical framework and tool to measure engagement in socio-affective, cognitive, and behavioral dimensions with provider-guided DHI. However, it is imperative to prioritize the evaluation of this tool by understanding the engagement phenomena (dimensions, influencing patient factors, challenges) and examining the relationship between engagement dimensions and intervention outcomes.

Against this backdrop, this study aims to achieve two objectives: 1. identify patient (age, education, employment, marital status, optimism, social support) and clinical (anxiety, depressive symptoms, comorbidities, symptom severity, controllability, consequences, and distress) characteristics at baseline that influence engagement levels and challenges impeding engagement; 2. investigate the relationship between engagement dimensions and perceived symptom control at the end of the intervention. These valuable insights will guide the development and delivery of provider-guided DHIs for diverse patient populations to enhance learning and behavior change, ultimately improving outcomes.

Methods

Design

This ancillary analysis had two components. First, using a convergent mixed methods approach [28], we explored patient and clinical characteristics influencing engagement through quantitative analysis and identified challenges and pre-disengagement activities on asynchronous message boards via qualitative analysis. This provided both statistical insights and rich contextual nuances, offering a holistic view of engagement phenomena. Second, we conducted statistical analysis to assess the relationship between engagement and patient-perceived symptom control at the intervention's end.

Ethical Considerations

The WRITE symptoms interventions were approved by the University of Pittsburgh IRB (PRO09090033) and 34 clinical sites, allowing de-identified data sharing [4]. All activities and

questionnaires were conducted on a secure, HIPAA-compliant website developed at the University of Pittsburgh. This secondary data analysis used de-identified data, posing no risk to participants.

Sample and Nurse WRITE asynchronous message boards

Out of 497 women with recurrent ovarian cancer in the parent trial [4], 166 were assigned to the Nurse WRITE arm. This study selected a convenience sample of the first 68 participants randomized to Nurse WRITE, representing 50% of the total number of message board posts from the pool of 141 participants who posted at least once on the message boards.
This selection aimed to ensure alignment with the sample in the previous studies [26, 27] and to manage the qualitative analysis workload.
In Nurse WRITE, participants and nurses used private message boards to co-create personalized symptom care plans for three "target" symptoms. These interactions included open-ended prompts and protocolized questions. The message boards also captured unprompted patient narratives, including challenges faced during the intervention and activities performed before disengagement.

Measures

Participant Data

Patient characteristics included sociodemographic, optimism, and social support. Clinical characteristics measured at baseline included comorbidities, depressive symptoms, trait anxiety, symptom severity, controllability, consequences, and distress.
Sociodemographic factors (age, education, marital status, and employment) were assessed with the Center for Research in Chronic Disorders Socio-Demographic Survey [29].
Optimism was measured by the reliable and validated Revised Life Orientation Test (LOT-R) [30], an 8-item scale. Items were rated from 0 (agree a lot) to 4 (disagree a lot). The scores were aggregated to a total score.
Social support was measured by the validated Interpersonal Support Evaluation List 12-item short-form [31]. Items were rated from 1 (definitely false) to 4 (definitely true) and summed up for a total score.
Comorbidities were assessed using the validated Charlson comorbidity index (CCI), a 10-item self-report comorbidity index with each comorbidity weighted based on 1-year mortality risk [32].
Trait anxiety was assessed with the validated 20-item trait anxiety subscale of the Spielberger State/Trait Anxiety Inventory (STAI) [33], which evaluates how a participant feels on a 4-point scale (1= “Almost Never” to 4 = “Almost always”) and is summed for an overall score.

Depressive symptoms were assessed with the Brief Center for Epidemiologic Studies-Depression (CES-D) scale [34]. Ten items were rated on a 4-point scale (0 = “rarely or none of the time” to 3 = “All of the time”) and summed for a total score.
Symptom severity, consequences, distress, and controllability were assessed with the Symptom Representation Questionnaire (SRQ), which is a validated scale of symptom representations in women with ovarian cancer [35]. First, participants completed a 28-item symptom inventory reporting symptom severity (at its worst) in the past week from 0 (did not experience the symptom) to 10 (as bad as I can imagine). Second, participants identify three symptoms they want to improve or control over.
Another three subscales assess consequences (five items), distress (three items), and controllability (five items) for each target symptom on a scale of 0 (strongly disagree) to 4 (strongly agree). The mean scores for symptom representation items across three “target” symptoms at baseline are used for the statistical analysis in aim 1. Additionally, for aim 2, we also assessed the mean score for symptom controllability, our primary intervention outcome variable, at the eight-week mark. This measurement involved averaging the total scores of five items related to each of the three "target" symptoms. These items included statements like "I have a significant degree of control over this

symptom" and "My actions can influence whether this symptom improves or worsens."

Engagement measures and engagement patterns

Table 1 describes our analysis framework, which comprises six measures across three dimensions, as developed in our earlier study [27]. In that study, we also categorized participants into three main groups: high engagers (n = 13), moderate engagers (n = 17), and low engagers (n = 38), based on their engagement levels across the six measures within the three dimensions.

Table 1. Descriptions of six engagement measures across three dimensions.

Engagement measures	Description
Socio-affective dimension	
Total count of socio-affective classes	A summary score of seven socio-affective engagement classes (i.e., intervention information, acknowledgment, information-seeking question, clarification question, agreement, disagreement, and initiative-taking).
Total word count	Total word count in participant's posts throughout the intervention.
Cognitive dimension	
Total count of cognitive classes	A summary score of eight cognitive engagement classes (i.e., positive sentiment, negative sentiment, appreciation, cancer-related experience, personal information, vocatives, interest in further communication, and greetings).
Average question completion percentage	The percentage of the nurse's questions and requests that each participant addressed.
Behavioral dimension	
Total count of symptom care plans	Total count of symptom care plans participants co-created with the nurse
Total count of plan reviews	Total count of plans reviewed and revised by participants

Analysis

Aim 1 Understanding engagement phenomena (dimensions, influencing factors, and challenges)

After listwise deletion, 66 participants were included in the quantitative analysis for Aim 1. We conducted preliminary bivariate correlations between engagement and patients and their baseline clinical characteristics. With a significance level of $p \leq 0.2$, we identified potential variables for further analysis. We employed ordinal linear regression to predict overall engagement levels (high, moderate, and low). We then used multiple linear regression to identify specific patient characteristics influencing engagement in socio-affective, cognitive, and behavioral dimensions (6 measures), with a significance level set at $p < 0.05$.

We conducted a content analysis of 68 participants' posts on the message boards to summarize the challenges to engagement mentioned by participants without nurse prompts during the intervention. Additionally, for the 39 participants who discontinued participation on the message boards during the intervention, two investigators (YW and RD) examined the specific intervention elements participants were working on before they stopped responding. Inter-rater reliability was assessed based on the posts from these 39 participants, with a Cohen Kappa of 0.98. The intervention elements and goals are available in Multimedia Appendix (Multimedia Appendix 1).

Aim 2 Relationship between patient engagement levels and symptom controllability.

After listwise deletion, 66 participants were included in the analysis of Aim 2. We used multiple linear regression to explore the relationship between symptom controllability at eight weeks and engagement across the three dimensions (6 measures) after controlling for baseline symptom controllability scores and other patient and clinical covariates, with a significance level set at $p < .05$. Patient and clinical co-variates were determined based on preliminary bivariate correlations ($p \leq 0.2$) with perceived symptom controllability scores at eight weeks.

Results

Sample characteristics

Table 2 provides data on baseline patient and clinical characteristics. On average, participants were 59.7 years old (SD = 9.5) and had 15.3 years of formal education (SD = 2.6). Most were white (63/68, 92.6%) and married/cohabitating (51/68, 75%). Over half (37/68, 54.4%) of the participants were unemployed due to disability, retirement, or unemployment. Over three target symptoms, symptom-related factors revealed moderate mean severity (5.3), controllability (2.2), distress (2.2), and low consequences (2.0). Over half (38/68, 55.9%) had at least one comorbidity (e.g., hypertension, diabetes).

Table 2. Patient and clinical characteristics at baseline (n = 68).

Patient and clinical characteristics at baseline	Mean (SD[a])	Range	n (%)
Age	59.7 (9.5)	24 – 83	
Education	15.3 (2.6)	11 – 22	
Employment			
Working			24 (35.3)
Not working			37 (54.4)
Other			7 (10.3)
Marital status			
Married/cohabitant			51 (75)
Other			17 (25)
Trait anxiety	36.7 (9.2)	20 – 80	
Depression	8.3 (5.7)	0 – 30	
Social support	40.6 (6.7)	12 – 48	
Optimism	22.8 (4.2)	0 – 32	
Symptom severity	5.3(2.2)	0 –10	
Symptom controllability	2.2 (0.7)	0 – 4	
Symptom consequences	2.0 (0.6)	0 – 4	
Symptom distress	2.2 (0.7)	0 – 4	
Comorbidity			
Yes			38 (55.9)
No			30 (44.1)

[a]SD = standard deviation.

Aim 1 Understanding engagement phenomena (dimensions, influencing factors, and challenges)

Relationship between patient and clinical factors and engagement levels in three dimensions

Table 3 lists ordinal and multiple linear regression models of patient and clinical characteristics associated with engagement. In terms of overall engagement, each additional year of formal education was associated with a 22% increase in the odds of being in a more engaged group (OR = 1.22, p = 0.04).

Table 3. Regressions models of patient and clinical characteristics predicting engagement in women with recurrent ovarian cancer (n=66). [a-f]

Engagement and patient characteristics	B[a]	SE[b]	OR[c]	95% CI lower	95% CI upper	p value[d]	McFadden's R^2[e]	p value[f]
High vs. moderate vs. low engagers							0.05	< .01
Education	0.2	0.1	1.22	1.01	1.5	0.04		
Comorbidity (Yes vs. No)	- 0.78	0.5	0.46	0.17	1.2	0.12		
Behavioral dimension								
Total count of symptom care plans							0.03	< .01
Education	0.21	0.09	1.23	1.04	1.47	0.02		
Total count of plan reviews							0.07	< .01
Education	0.26	0.1	1.29	1.07	1.59	0.01		
Symptom severity at baseline	0.19	0.11	1.21	0.97	1.52	0.09		
	B[a]	SE[b]	β[g]	95% CI lower	95% CI upper	p value[d]	AdjR^2[h]	p value[f]
Socio-affective dimension								
Total count of socio-affective classes							0.06	0.04
Education	2.44	1.33	0.22	- 0.21	5.08	0.07		
Comorbidity (≥ 1)	- 13.32	6.96	- 0.23	- 27.23	0.59	0.06		
Total word count							0.06	0.03
Education	1467.8	647.2	0.27	174.99	2760.65	0.02		
Cognitive dimension								
Total count of cognitive classes							0.1	0.02
Education	1.89	0.74	0.3	0.41	3.37	0.01		
Comorbidity (≥ 1)	- 7.13	3.89	- 0.22	- 14.89	0.64	0.07		

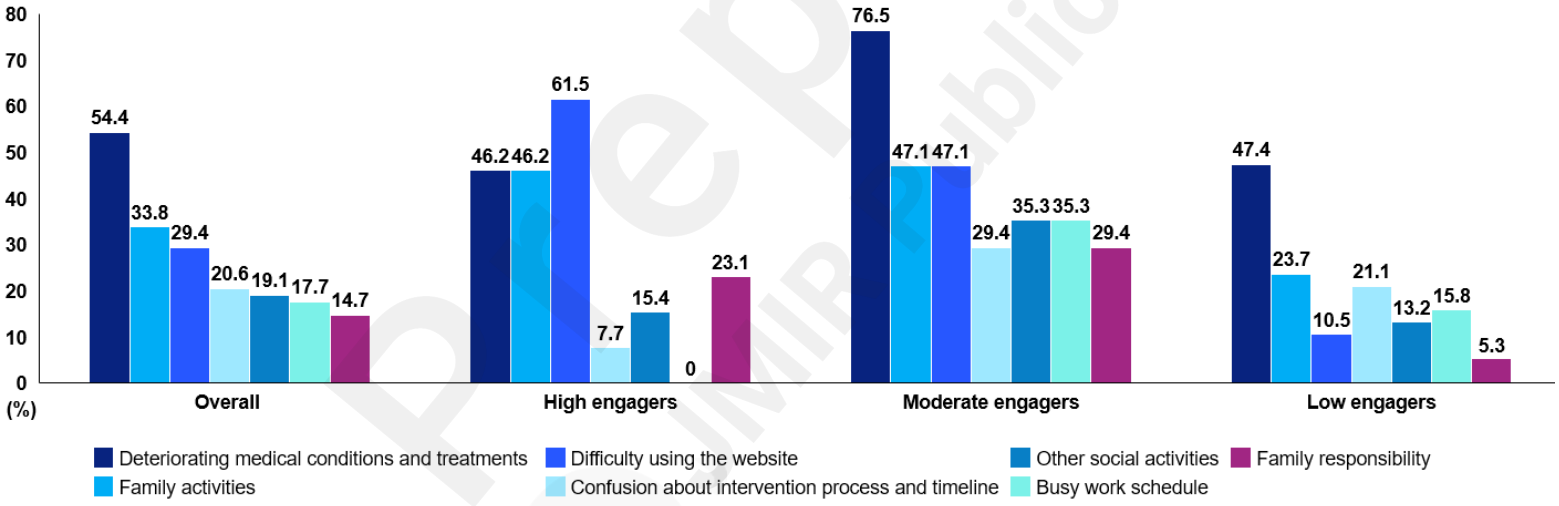
[a]B: unstandardized coefficient.
[b]SE: standard error of the unstandardized coefficient.
[c]OR: odds ratio.
[d]P: value for the independent variable.
[e]McFadden's R^2: McFadden's pseudo R-squared for the model.
[f]P: value for the model
[g]β: standardized coefficient

[h]AdjR[2]: Adjusted R-squared for the model

In the socio-affective dimension, a trend suggests that higher education levels (B= 2.44, p = 0.07) and the absence of comorbidities (B = 13.32, p = 0.06) were associated with more frequent engagement activities, such as sharing personal experiences and expressing positive emotions. Participants with higher education levels wrote more words in their posts (B = 1467.8, p = 0.02).
In the cognitive dimension, education was significantly and positively associated with more frequent engagement activities (B = 1.89, p = 0.01), such as answering nurses' protocolized questions and agreeing with nurses' suggestions. Additionally, patients without comorbidity tended to have more engagement activities (B = 7.13, p = 0.07). No patient or clinical factors were associated with the average question completion percentage.
In the behavioral dimension, each additional year of formal education was associated with a 23% increase in the odds of completing one more symptom care plan (OR = 1.23, p = 0.02). Similarly, each additional year of formal education was associated with a 29 % increase in the odds of completing one more care plan review during the intervention (OR = 1.29, p = 0.01). Additionally, although only a trend, each additional unit of symptom severity was associated with a 21% increase in the odds of completing one more care plan review during the intervention (OR = 1.21, p = 0.09).

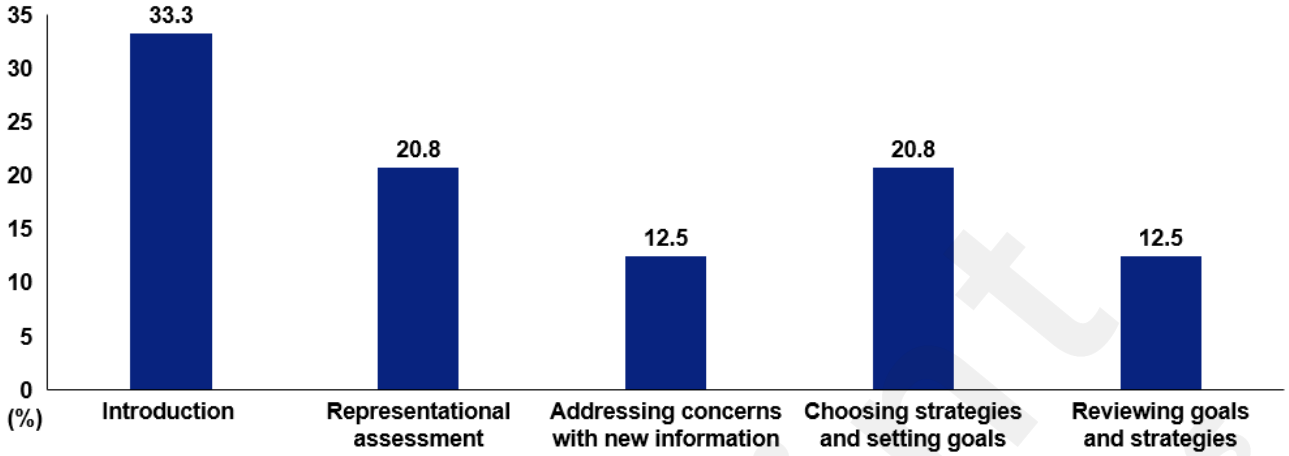
Engagement challenges and participants' activities before disengagement

Across all engagement levels, the most common challenges to engaging in the intervention, reported by 54.4% (37/68) of participants, were related to deteriorating medical conditions and treatments. This included new or worsening symptoms, infections, surgeries, hospitalizations, cancer treatments,



medical appointments, and clinical trials. The second significant challenge, cited by 33.8% (23/68) of participants, was being occupied with family activities such as vacations, visits, celebrations, reunions, funerals, and sports. The third challenge, noted by 29.4% (20/68) of participants, involved difficulties using the website or message boards, such as locating documents or reading nurses' posts. Figure 1 depicts the most frequently endorsed challenges for engagers as a whole and within each group. Other less prevalent challenges reported by engagers encompassed limited computer literacy and internet and hardware issues.
Figure 1 Most frequent challenges faced by engagers (n=68).
Considering engagement challenges by group, high engagers faced the same top three challenges, albeit in a different order. Besides the same common challenges, busy work schedules (6/17, 35.3%) and other social activities (6/17, 35.3%) were frequently cited for moderate engagers. Compared to high engagers, a significant portion of moderate engagers (5/17, 29.4%) felt confused about the intervention process and timeline and mentioned challenges related to family responsibilities.

Low engagers who mentioned challenges, apart from declining health (18/38, 47.4%) and family activities (9/38, 23.7%), also reported confusion about the intervention (8/38, 21.1%), like some moderate engagers. Of 38 low engagers, 24 (63%) stopped participating on the message boards before the intervention ended. Figure 2 illustrates the intervention activities in which low engagers



were involved before discontinuing participation on the message boards. In contrast, none of the high engagers ceased responding, and only one moderate engager stopped responding when asked by the nurse to select symptom management strategies.

Figure 2 The percentage of pre-disengagement intervention activities of low engagers in the order of Nurse WRITE intervention elements (n=38).

Aim 2 Relationship between patient engagement levels and symptom controllability.

The engagement pattern regression model showed significant results ($F(7, 48) = 7.05$, $adjR^2 = 0.44$, $p < 0.01$). Higher overall engagement (high vs. moderate vs. low) was associated with improved symptom control at the end of the intervention ($B = 0.44$, $p = 0.02$), after controlling for baseline symptom controllability and sociodemographic factors.

In the socio-affective dimension, both the model for the total count of socio-affective classes ($F(6, 49) = 7.94$, $adjR^2 = 0.43$, $p < 0.01$) and the model for total word count ($F(6, 49) = 8.12$, $adjR^2 = 0.44$, $p < 0.01$) yielded significant results. Improved symptom control at the end of the intervention was associated with greater engagement activities ($B = 0.27$, $p = 0.01$) and higher word counts in participants' posts ($B = 0.28$, $p = 0.01$), controlling for covariates.

In the cognitive dimension, both the model for the total count of cognitive classes ($F(6, 49) = 7.7$, $adjR^2 = 0.42$, $p < 0.01$) and the model for average question completion percentage ($F(6, 49) = 9.61$, $adjR^2 = 0.48$, $p < 0.01$) yielded significant results. After adjusting for covariates, improved symptom control at the end of the intervention was associated with greater engagement activities ($B = 0.28$, $p = 0.02$) and a higher percentage of questions addressed by participants ($B = 0.35$, $p < 0.01$).

In the behavioral dimension, only the model for symptom care plan count was significant ($F(6, 49) = 6.47$, $adjR^2 = 0.37$, $p < 0.01$). After adjusting for covariates, completing more symptom care plans was significantly associated with better symptom control at the end of the intervention ($B = 0.25$, $p = 0.04$).

Discussion

Principle results

Aim 1 Understanding engagement phenomena (dimensions, influencing factors, and challenges)

Our findings align with a prior review [12], emphasizing education level as a key predictor of engagement in DHIs. Participants with lower education levels may have struggled with the length and complexity of nurses' messages, finding it difficult to process extensive information and feeling uncomfortable with written communication—the primary mode in Nurse WRITE. The qualitative analysis revealed that 20-30% of less engaged participants, compared to high engagers, reported confusion about the intervention process, even though nurses had explained it at the outset. Although nurses were encouraged to tailor their responses to participants' capacities and needs, they faced challenges adhering to intervention protocols. For instance, while some participants preferred phone communication, nurses were restricted to asynchronous message boards. Additionally, nurses were required to follow structured intervention phases, even when some participants wanted to skip directly to solutions, bypassing representational assessments or discussions of concerns (e.g., opioid addiction). While the relationship between low education and low engagement warrants further investigation, identifying education level as a potential risk factor could help target participants who may need additional support.

Deteriorating health and ongoing treatments emerged as significant challenges, leading participants to prioritize their health over engaging in symptom management on message boards. Patients with higher symptom severity tended to create more symptom care plans, reflecting their motivation to explore management strategies. However, severe symptoms often required hospitalization or medical appointments, further limiting engagement. Comorbidities, such as hypertension and diabetes, posed additional challenges for patients with recurrent ovarian cancer, impacting their ability to participate. These findings align with previous research on engagement in DHIs [12]. Beyond health issues, competing responsibilities—such as demanding work schedules, family obligations, and other social commitments—further drained participants' time and energy, affecting their ability to focus on learning and managing symptoms. Future research with a larger sample size is needed to confirm the impact of these factors.

Over half of the low engagers stopped participating after the introduction and representational assessment (initial intervention element), suggesting potential issues with early disengagement in provider-guided DHIs of this nature. Establishing trust and rapport during the orientation phase is crucial [36]. Early video conferencing for introductions and orientation allows nurses to gather verbal and non-verbal cues related to symptomatology [37], facilitating a quick understanding of the participant's condition and the development of effective rapport.

Aim 2 Relationship between patient engagement levels and symptom controllability

Our study highlighted the importance of socio-affective engagement in improving symptom control. This type of engagement involves expressing positive emotions, valuing nurse input, using the nurse's name, sharing personal experiences, showing vulnerability, and seeking ongoing interactions. These actions help build trust and foster a strong nurse-patient relationship, which is essential for effective online communication, learning, coordination, and symptom management.

The Nurse WRITE program supported this engagement through features like nurse bios, photos, personalized webpage, and empathetic communication training. Future provider-guided digital health interventions could further enhance these efforts by accommodating participants' communication preferences, such as voice-to-text conversion, and synchronous options like chat rooms, phone calls, text messages, and emails, to facilitate continuous interactions.

In the cognitive dimension, higher participant engagement significantly improved symptom control

through effective coordination with nurses. Engagement included actions like responding to questions, fulfilling requests, expressing agreement or disagreement, seeking information, and asking clarifying questions. This collaboration fostered knowledge-sharing and the personalization of care plans, ultimately boosting patient confidence in managing symptoms post-intervention.
Although nurses worked to tailor communication to patient needs, strict protocol adherence posed challenges. Future DHIs should address these limitations by introducing greater flexibility, simplifying content, and utilizing diverse formats and technologies, such as visual aids, serious games, AI chatbots, or self-learning materials, to enhance comprehension and sustain engagement.
High completion rates of intervention questions and requests in participant posts indicated effective collaboration with nurses, with comprehensive responses addressing multiple questions. On the other hand, low completion rates led to recurring queries and extended communication, causing participant frustration and delaying symptom management. In Nurse WRITE, some nurses enhanced interactions by numbering questions and providing personalized feedback tailored to participants' progress, goals, and challenges. Future DHIs could enhance participant attention and efficiency by incorporating formatting elements like color or italics to highlight key questions. Additionally, AI tools could prompt participants to address unanswered questions or requests before submitting their posts, fostering more efficient and continuous interactions.

Limitations

While exploratory and limited by a small sample size of 68 participants, this study provides valuable insights into factors influencing patient engagement and their effects on intervention outcomes. Given the scarcity of socio-affective and cognitive engagement datasets in provider-guided DHIs, this series of studies—creating a fine-grained socio-affective and cognitive dataset [26], developing a comprehensive engagement framework and tool [27], and evaluating patient factors, engagement, and outcomes—represents a significant step forward.
Another limitation of the study is that not all low engagers mentioned challenges or barriers before discontinuing communication on the message boards. However, as discussed in the Introduction, this situation is anticipated. To gain insights into their experiences and inform future provider-guided DHIs, we analyzed their intervention activities on the message boards before disengagement.
To address methodological limitations, this study utilized a combination of methods to provide a more comprehensive understanding of engagement phenomena. Two examples illustrate why relying on a single method would have been inadequate:

1. Quantitative analysis identified education as a key factor influencing engagement but lacked the context to explain why. Qualitative analysis filled this gap, uncovering challenges such as confusion about the intervention process and timeline, as well as issues with computer literacy, which shed light on the link between education and engagement.
2. Quantitative analysis revealed a trend where comorbidities negatively impacted engagement, while higher symptom severity prompted participants to adopt more symptom management strategies. Qualitative analysis added nuance, showing that when symptoms became severe enough to require hospitalization, significantly hindered engagement.

These examples demonstrate that a single method would have provided only a partial understanding of patient engagement phenomena.

Comparison with Prior Work

Compared to SD WRITE, where participants interacted with self-directed modules without nurse involvement, the presence of nurses in Nurse WRITE may have influenced how less well-educated patients engaged with intervention. Participants might have felt self-conscious about their writing when communicating with nurses and faced challenges like website navigation and confusion

regarding the intervention process. Previous studies link computer literacy and DHI engagement positively [38-40], but none, including ours, adequately measured baseline computer literacy. Therefore, future provider-guided DHIs should incorporate this measure into their designs to confirm its impact.

Our study revealed that participants completing more care plans managed their symptoms better. This process, involving six out of seven intervention elements, enhanced patients' symptom understanding, corrected misconceptions, and built knowledge and confidence in effective symptom management. While such step-by-step processes may yield greater control and engagement [41], this method requires patience and effort, and failing to find a solution can lead to frustration and disengagement. Our qualitative analysis showed that the majority of low-engagement participants disengaged after the introduction phase but before completing a care plan. Previous studies have also suggested a connection between DHIs that allow participants to choose their interaction style and increased engagement [42-44]. Therefore, future provider-guided DHIs should aim for a harmonious blend of protocol adherence and flexibility, such as allowing early care plans, collaborative adjustments, and visual progress tracking on the homepage to enhance meaningful behavioral engagement and prevent frustration.

Conclusions

Patient education level positively impacts their engagement with online provider-guided symptom management interventions. Further validation is also needed to explore factors like comorbidities and symptom severity. To address critical challenges like deteriorating health, website difficulties, and busy family lives, strategies should be implemented to re-engage low engagers, particularly those dropping out early or during critical intervention stages. Our findings also highlight Nurse WRITE intervention's mechanism of action, underscoring the significance of meaningful engagement across socio-affective, cognitive, and behavioral dimensions. These insights inform future DHIs, stressing the need to balance flexibility and protocol adherence. Strategies such as multi-platform synchronous delivery should be employed to accommodate participants’ needs to enhance continuous engagement and intervention outcomes.

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Conflicts of Interest

The authors have no conflict of interest to disclose.

Abbreviations

DHI: digital health intervention
RCT: randomized controlled trial
IQR: interquartile range
Mdn: median

SD: standard deviation
Nurse WRITE: nurse-directed arm of WRITE Symptoms
SD WRITE: self-directed arm of WRITE Symptoms

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Multimedia appendices

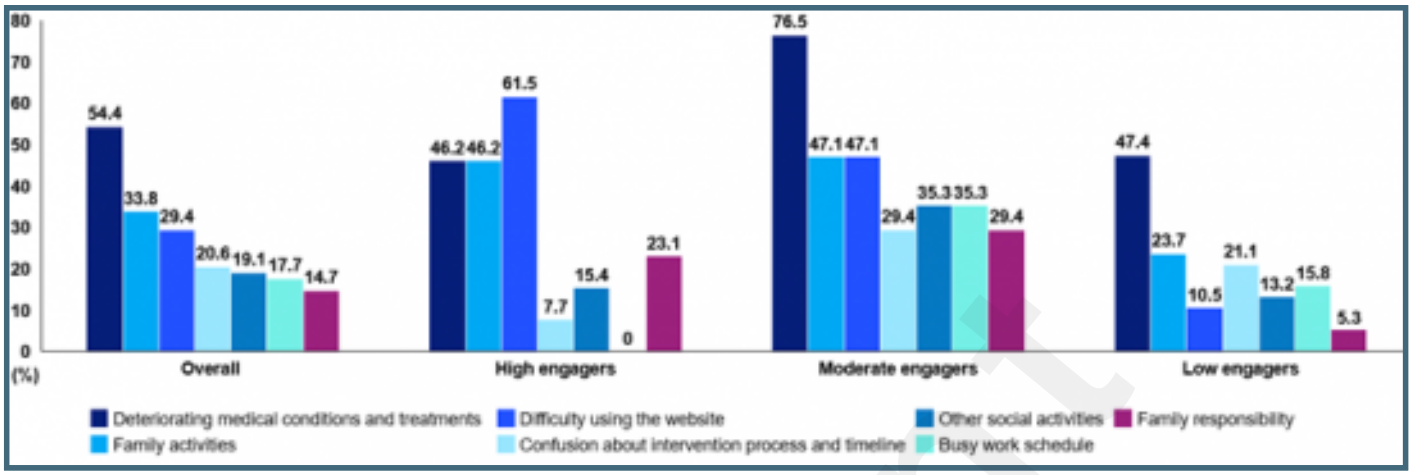
Appendix 1

Step	Intervention element	Description
1		The nurse initiates the message board by introducing herself and explaining how the intervention works on the message boards. The nurse then invited the patient to talk about herself and her experience with ovarian cancer and symptoms in general.
2	Representational assessment	The nurse proceeds to ask protocolized questions in the first few messages. This is for both the patient and the nurse to understand the patient's experience with each symptom fully. As the patient thinks about the questions and writes responses, she may see some things more clearly or differently. A few examples of the protocolized questions include: • What does your fatigue feel like, and how severe is it? • How has this symptom affected your life? Are you unable to do anything because of it? • How does your fatigue affect you emotionally?
3	Identifying and exploring Gaps, Errors, and Confusions	Throughout interactions with the participant, the nurse keeps attending to evidence of any confusion, concerns, or misconceptions about symptom management that the patient states or suggests during her message board posts. Any of these constitutes a barrier to effective symptom management for participants.
4	Creating conditions for conceptual change	Suppose any concerns/ misconceptions/gaps are identified. In that case, the nurse will (1) discuss the relationship between identified concerns/confusion/misconceptions and consequences of poor symptoms that the patient discussed during representational assessment and (2) provide information to address/counter the patient's concerns, gaps, or misconceptions.
5	Introducing replacement information	The nurse will then guide the patient to read the relevant clinical practice guidelines and provide relevant information to choose and use strategies that fit well into their life and needs for managing symptoms.
6	Summary	The nurse will summarize information and how she believes it can benefit the patient. For example, it increases comfort and lessens interference with life.
7	Goal Setting and Planning	The nurse will encourage the patient to work together on developing symptom goals and specific strategies to reach those goals.
8	Goal and Strategy Review	After two weeks, the nurse will ask protocolized questions to work with the patient to evaluate strategies, reinforce success, and outline modifications as needed. The nurse will also discuss any barriers to implementing strategies and work with the patient to identify new or different strategies that could be integrated into her life. A few examples of the protocolized questions include: • Were you able to use the above strategies? • If not, what things prevented you from doing so? • If yes, how well did the strategies (name/list strategies) help you reach your goal?
The back-and-forth discussion introduces the patient to a problem-solving approach to symptom management that could be applied to any symptom, not just the three they were working on.		

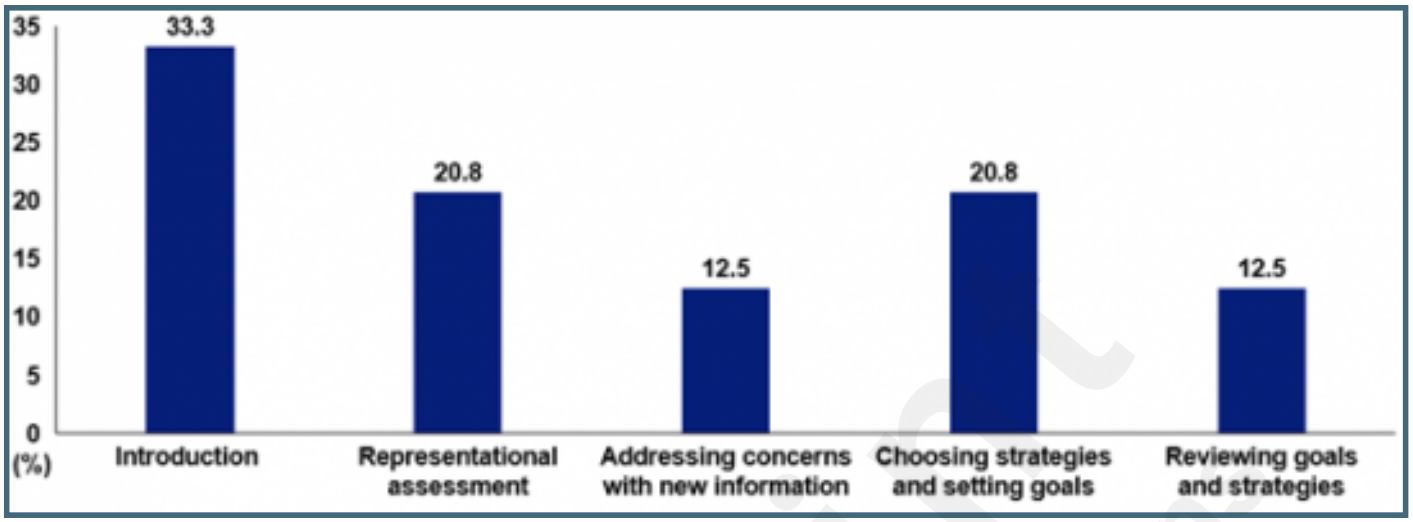
Supplementary Files

Figures

Most frequent challenges faced by engagers (n=68).



The percentage of pre-disengagement intervention activities of low engagers in the order of Nurse WRITE intervention elements (n=38).



Multimedia Appendixes

Nurse WRITE intervention phases.
URL: http://asset.jmir.pub/assets/237e2d2f804585b75a32b555bdb01709.docx