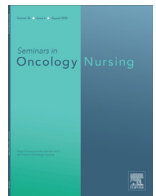




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## Relationship and Attachment to Digital Health Technology During Cancer Treatment

Andrew Darley<sup>a,\*</sup>, Eileen Furlong<sup>b</sup>, Roma Maguire<sup>c</sup>, Lisa McCann<sup>d</sup>, Barbara Coughlan<sup>b</sup>

<sup>a</sup> Assistant Professor, School of Nursing, Midwifery and Health Systems, University College Dublin, Ireland

<sup>b</sup> Associate Professor, School of Nursing, Midwifery and Health Systems, University College Dublin, Ireland

<sup>c</sup> Professor, Department of Computing and Information Sciences, University of Strathclyde, Glasgow, United Kingdom

<sup>d</sup> Senior Lecturer, Department of Computing and Information Sciences, University of Strathclyde, Glasgow, United Kingdom

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## ABSTRACT

**Objective:** The aim of this study is to explore the relationship that people with cancer and their family caregivers develop with symptom management technology during chemotherapy.

**Data Sources:** A longitudinal and multi-perspective interpretative phenomenological approach was adopted. Data were collected using one-to-one in-depth interviews with people with colorectal cancer using supportive digital health symptom management technology (n=3) and their family caregivers (n=4) at two time points during chemotherapy treatment. Data were analyzed using interpretative phenomenological analysis and followed COREQ guidelines.

**Conclusion:** People with cancer and their family caregivers can develop emotional bonds with supportive symptom management technology during cancer treatment. Digital health technology can be experienced as a person guiding them during their cancer treatment. Participants felt vulnerable after the technology was returned to the research team. Participants recognized that it was not the technology that successfully facilitated them through their initial chemotherapy cycles; rather, the technology helped them learn to manage their symptoms and promoted their self-efficacy, as well as how to emotionally respond.

**Implications for Nursing Practice:** The relationship and psychological bonds people with cancer and their family caregivers develop with technology during treatment may be critically important for oncology nurses to be aware of should digital health be prescribed within the outpatient model of cancer care. This study indicates that technology may not be needed for a full treatment experience, as digital health can promote confidence and self-efficacy regarding symptom management and prepare people with cancer to be independent after the digital health technology is returned to the research team. However, further research is needed regarding individual preferences for digital health provision.

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As technology has transformed how people relate and communicate with others in personal and professional environments, recent digital innovations have influenced how we engage with our health. Digital health maintains the core goals of empowering people with health conditions to become active decision-makers at the center of their care and facilitate effective communication with their care team.<sup>1</sup> Digital health technology (DHT) is particularly important for people living with chronic health conditions, including cancer, as individuals diagnosed with such conditions are commonly expected to engage in symptom management and self-care practices in their

home environment. Supportive cancer care interventions using DHTs include real-time symptom monitoring systems and physical activity programs,<sup>2</sup> which align with the current outpatient model of cancer care, i.e., people with cancer receive treatment in a clinical environment and return to their home setting before the next treatment. Although the outpatient model of care facilitates people receiving treatment to maintain a level of normality in everyday life and reduces long in-patient stays, an important responsibility is expected from these individuals and their support network, that is, for them to be informed about the condition and symptom management processes, should they arise.

DHTs in cancer care are increasingly being developed and studied for their acceptability, usability, and effectiveness in improving health outcomes.<sup>3-5</sup> A recent review highlighted how DHTs can garner benefits beyond their intended improvement in health outcomes

\* Address correspondence to: Dr Andrew Darley, University College Dublin, School of Nursing, Midwifery and Health Systems, Health Science Centre, Belfield, Dublin 4, Ireland.

E-mail address: [andrew.darley@ucd.ie](mailto:andrew.darley@ucd.ie) (A. Darley).

**TABLE 1**  
Demographic and Clinical Details of People With Colorectal Cancer.

Name	Age	Diagnosed (Time since diagnosis when first interviewed)	Employment Status	Treatment Regimen	Colorectal Cancer Staging	Timepoint of Initial Interview	Timepoint of Follow-Up Interview
Stuart	71	November 2017 (5 months)	Retired	Surgery and Chemotherapy	Stage III	Cycle 4	Cycle 11
Evelyn	78	January 2018 (4 months)	Retired	Surgery and Chemotherapy	Stage III	Cycle 4	Cycle 11
Carl	70	January 2018 (5 months)	Retired	Surgery and Chemotherapy	Stage II	Cycle 4	Cycle 11

such as a sense of connection to their cancer care team and reassurance.<sup>6</sup> However, a gap in the evidence base remains regarding an in-depth understanding of the personal relationships people with cancer and their family caregivers develop with DHTs. Comparatively, relationships and attachment to digital technologies have been extensively studied within organizational and social contexts.<sup>7-9</sup> These studies have indicated how technology can be used for emotional gratification and, in many instances, can lead to behavioral dependence or addiction to the relevant device or online platform.<sup>7</sup> Additionally, Mamun and colleagues<sup>10</sup> observed how emotional attachment influences the adoption and adherence to technology such as digital personal assistants.

Despite the international strategies developed to enable societies to provide digital health,<sup>11,12</sup> a similar focus on personal relationships to technology has been overlooked within a cancer care context. Therefore, little is known regarding the type of relationships that people with cancer can have when using DHT in the home setting and how this relationship may change over time. Similarly, there is a dearth of literature regarding how family caregivers relate to DHT in the context of the family and its impact on their supportive role. Gaining this in-depth understanding of these relationships may support researchers, clinicians, and technology developers to identify ways how to further personalize digital health and increase its meaningfulness in their lives in the mission of providing support during cancer treatment.

The aim of this study is to explore the relationship that people with cancer and their family caregivers develop with symptom management technology during chemotherapy. While our previous article highlighted the psychosocial meaning of DHT in the family setting,<sup>13</sup> the current article seeks to expand on this evidence with an exploration of the distinct experience of people with cancer and their family caregivers' relationship to the technology during treatment and how they responded after it was returned while still receiving treatment.

## Methods

The methodology for this study is fully detailed in the previous article<sup>13</sup> and briefly described in this section. The current study was conducted in the context of a nurse-led European, multicentre randomized controlled trial (RCT) examining the effectiveness of electronic symptom management using the advanced symptom management system remote technology for patients with cancer.<sup>14</sup> Participants in the trial assigned to the intervention group were required to report their chemotherapy symptoms daily using

smartphone-based DHT. Their information was sent to their cancer care nursing team whose role was to respond by phone or text, depending on the severity of the symptoms and subsequently received tailored self-care advice specific to the reported symptoms, as well as access to a library of self-care information.

A longitudinal, multiperspective qualitative design using the lens of interpretative phenomenology was employed. Data were collected using one-to-one, in-depth interviews with people with colorectal cancer and their family caregivers and analyzed using interpretative phenomenological analysis.<sup>15</sup> The research was conducted in accordance with the Consolidated Criteria for Reporting Qualitative Research (COREQ).<sup>16</sup> Ethical approval was obtained from University College Dublin and two cancer care centres in Ireland (St James's Hospital and St Vincent's Hospital Group).

## Participants

People with colorectal cancer were recruited from two cancer care centers participating in the eSMART clinical trial. The researcher provided interested participants with an information leaflet and consent form. Each participant was asked if they would like to nominate a family or informal caregiver to be contacted about the research. This process was not a requirement for their own participation. The recruitment strategy is detailed in full in our previously published article.<sup>13</sup> A small homogeneous sample was recruited in line with IPA guidance<sup>15</sup> and addressed the need for cancer-specific digital health research.<sup>17</sup> Participants included adults (aged 18+) with newly diagnosed (i.e., 4-5 months previously) Stages I-III colorectal cancer undergoing active chemotherapy using (removed for peer-review) and nominated adult (18+) family caregivers. [Tables 1](#) and [2](#) describe their demographic and clinical characteristics.

## Data Collection and Analysis

All participants were interviewed at two timepoints by the lead author (i.e., during chemotherapy while using the DHT and after they returned the technology to the research team while still receiving chemotherapy), as described in [Tables 1](#) and [2](#). Interviews were conducted using interview guides (online [Supplemental Material A](#) and [B](#)) which featured open-ended questions designed to offer participants the opportunity to share their detailed first-person accounts of using DHT during their cancer experience. The initial interview guides asked participants to describe their experience of DHT and its impact (if any) on their symptom management activity and psychosocial response to their cancer diagnosis and treatment. The follow-

**TABLE 2**  
Demographic and Relationship Details of Family Caregivers.

Name	Relative with Colorectal Cancer	Age	Relationship to Relative with Colorectal Cancer	Time of Initial Interview (i.e., Relative's Chemotherapy Cycle)	Time of Follow-Up Interview (i.e., Relative's Chemotherapy Cycle)
Faye	Carl	71	Wife	Cycle 6	Cycle 11
Jane	Evelyn	52	Daughter	Cycle 3	Cycle 11
Caroline	Evelyn	54	Daughter	Cycle 4	Cycle 11
Nadine	Evelyn	49	Daughter	Cycle 5	Cycle 11

up interview guides asked participants to describe their experience since returning the device to the research team. Field notes were taken during both interviews, which enabled the researcher to further explore and ask questions regarding specific experiences, thoughts or feelings raised by participants in their initial interview during the follow-up interview, as well as informing later data analysis. Interviews lasted between 23 and 95 minutes and were digitally recorded and transcribed verbatim by the lead author.

Interviews were analyzed, concurrently with data collection, by the lead author according to interpretative phenomenological analysis (IPA),<sup>15</sup> an interpretative method of analysis that enables researchers to access participants' inner cognitive worlds and give voice to participants' sense-making of their experiences. Each interview was coded individually before cross-case analysis of each interview was used to code themes, to identify patterns, and to develop the final superordinate themes and their related subthemes emerging from the data and interpretation. All coding and interpretations were reviewed and validated by co-authors to ensure credibility. To further ensure rigor and transparency, the research team were guided by Yardley's (2000) guidelines<sup>18</sup> for qualitative psychological research and met the specific quality criteria for achieving excellence when using interpretative phenomenological analysis.<sup>19</sup>

### *Reflexivity and Positionality*

Reflexivity is pivotal when conducting IPA to ensure researchers are aware of their own impact on the research process and that analysis can be shaped by experiences in their own life experiences and worldview.<sup>15</sup> The lead researcher of the current study held an educational background in psychology and applied social research and was a member of the RCT research team, in which they contributed to the design of the DHT (particularly the evidenced-based algorithm and self-care advice). Additionally, the lead researcher was involved in the pilot and main trial, which meant they had experience in recruiting and training people with cancer to use the DHT before conducting the current interviews. It must be noted that the lead researcher's father was diagnosed with cancer while undertaking the study, i.e., during the analysis process. The researcher gained a rich understanding of the complexities of cancer care and the experience of being a family caregiver that he may not have had otherwise, which informed the lens in which the data was analyzed. Co-authors were university-based lecturers who specialized in diverse and relevant fields to the study including oncology nursing, psychology, and qualitative research. Three co-authors were project leads in the randomized controlled trial.

Acknowledging the researcher's involvement and perspective, it was important to ensure that participants did not feel obliged to participate after engaging with the lead researcher in the main randomized controlled trial. To avoid this sense of obligation, a research nurse introduced the current study to eligible participants and asked if they agreed to discuss it further with the lead researcher. Once agreed to be approached, the researcher explicitly that the current study was a related, yet separate, research study. All participants were informed that their choice to participate in the current study would not affect their participation in the main trial. Additionally, the lead researcher maintained a reflexive journal to support interpretation and analytical transparency and reflect on researcher's influence in the research process.

### **Results**

Two superordinate themes and related subthemes were identified: "People with cancer's relationship to DHT" and "Family Caregivers' Relationship to DHT." Both superordinate themes describe the trajectory from when participants were introduced to the technology, the relationship they formed with it during cancer treatment and

how they responded after it was returned while still receiving cancer treatment. Participant extracts, using pseudonyms, were selected for their strength in capturing the essence of each theme.

### *People With Cancer's Relationship to DHT*

#### *Attachment*

All participants reported a sense of attachment and how the technology became a part of their daily life: "a focal point of the morning when I get up" (Carl). Participants discussed completing the questionnaire as part of their daily routine and how it was a task that they felt needed to be done in order to commence their day. Participants similarly shared how they rarely missed reporting their symptoms, regardless of their life events, inferring their level of commitment: "wouldn't miss a morning, I wouldn't miss one" (Stuart). Evelyn described how she "got in on it very quick" emphasizing her belief of its inaccessibility but became accustomed to it: "I don't worry about it now. It's just my thing to do every day." The integration of the technology into daily life was facilitated by its simple language regarding cancer that avoided the use of impenetrable "doctor language," making the health information more accessible and relatable for participants.

Participants' sense of attachment is captured by how Stuart joked "If they tried to take the phone off me, I wouldn't give it back to them." Stuart recognized in himself the level of support and personal guidance the device has given him during his treatment, as he stated, "I'm so used to being, I suppose, taken by the hand by this [device] it's like a security blanket." The image of being "taken by the hand" implies that Stuart felt like he had been guided by someone whom he feels has provided guidance and reassurance. Whereas a "security blanket" is an item used to provide psychological comfort, particularly in unusual or unique situations. Similarly, Carl referred to the technology as a "comfort blanket" and "safety net." Comfort objects are viewed as transitional objects as they help children and adults make the emotional transition from dependence to independence, providing familiarity, continuity, comfort, and stability to their owners. Therefore, when Stuart commented that he would be resistant to giving back the device to the research team, this indicates his feelings of separation anxiety. In his initial interview, Stuart spoke of his belief of how he would not feel safe without the device as it has supported his well-being during the unfamiliar and often challenging experience of cancer treatment. Alternatively, participants referred to the technology as a person such "Mr. Reliable" or "someone that's looking after you," which indicates how they felt like there was a person guiding them during their chemotherapy. Participants' dependency on being monitored by their oncology team daily cultivated a sense of well-being and safety, meaning that without the technology they feared becoming unwell or unprepared to cope.

#### *Abandonment*

Participants expressed their anticipatory anxiety about returning the technology to the research team and ruminated what the chemotherapy experience would be like without its support:

I will probably would be up the walls because I'd be thinking "Was this right? Was this wrong? (Evelyn, Int. 1)"

When the sixth session is over and my mobile is gone, I'll feel like a fish out of water. It's one thing to be given questions on a mobile to answer but when you're given no questions to answer (pauses) and you don't have your mobile, do I...? I'll have to, I'll have to buy a thermometer myself to take my own temperature. (Stuart, Int. 1)

Participants feared potential symptoms without access to clarification using the technology and would doubt their well-being and

whether symptoms were normal or expected. Participants perceived how they would be abandoned (“left on my own”) and would not have the option to ask questions on a daily basis, instead, the onus will be on them to monitor themselves. Stuart repeatedly used the word “gone” when referring to returning the technology, believing that the nursing team who have supported him will no longer be accessible and reassurance will dissipate:

I would imagine that I would be, to a very certain extent, left on my own... and certainly if I didn't have this option or facility opened to me I would not be as relaxed or as, or as, or as happy as I am, you know? (Stuart, Int. 1)

Carl described his concern of not having the technology and believed he would be vulnerable without the “additional care” that he had been receiving. Carl described being “unsettled” without the technology and anxious which manifested in him recording his temperature readings five times a day “just to make sure that I was actually OK,” which signified the level of uncertainty that Carl felt in this period.

Once the device was returned to the research team, a sense of loss and abandonment pervaded participants' follow-up interviews:

There was a void there (laughs). This little thing in the morning. It got I suppose in the beginning it was like a chore; OK I've committed to this; I'm going to do it. But after a month or so or a few weeks, you got to enjoy it in the morning you know? (Carl, Int. 2)

If I did feel unwell, I would have the reassurance of the phone because any time I rang in here and that I said I wasn't eating or sleeping well but any little problem they'd be on to me straight away (clicks fingers) (Stuart, Int. 2)

In her follow-up interview, Evelyn described the sense of loss she experienced after returning the device and became aware of the extent of the support she felt from it: “I didn't think it would be as bad. . . I just thought it was like the stand-by for me.” Although Evelyn recognized the technology as practical support when the device was returned, she missed it and realized the personal connection she had to it and the positive emotional benefits she experienced in return. Evelyn noted how she regularly reminded herself that she was no longer required to complete the questionnaire in the initial two weeks after returning the device, highlighting how accustomed she had become to it in her daily routine.

#### *Adjusting Without the Technology*

Despite the sense of anticipatory loss and abandonment, follow-up interviews showed how participants had adjusted to the experience of chemotherapy without the technology during their subsequent chemotherapy cycles. Several factors assisted them in adapting without the support of technology. Firstly, participants explained how they had become accustomed to chemotherapy treatment from the previous chemotherapy cycles with the support of the device and knew what symptoms to expect: “by then you're kind of in on all the side effects and all” (Evelyn, Int. 2). Evelyn felt more comfortable with the treatment as she began to understand how it occurs and what to expect, as she termed it “the pattern of what's happening” which allowed her to feel “steady” in herself and able to undertake the remaining treatment. Stuart shared a similar experience of being aware of his symptom pattern and how to respond practically and psychologically:

I knew after the first six sessions, I knew what the story was. I knew I wouldn't have my appetite, I knew that I would probably have a bit of diarrhea and I felt that when the phone was taken away. . . I knew what was happening from the previous six

sessions, so when the phone was taken away and the same was happening again, I wasn't worried about it (Stuart, Int. 2)

Second, participants described how they had become more independent after giving back the technology, which was largely due to the experience and knowledge gained and the recognition they could manage without it:

I gave it back on the Monday and it really was the following weekend before I said to myself you know don't be stupid because the phone is the tool. It does build up a dependency you know because of the comfort blanket. (Carl, Int. 2)

Acknowledging the adjustment period, Carl and Evelyn stated that they realized that they must “persevere” without the technology: “Got then to pick myself up again that I'm on my own now.” (Evelyn). Carl described how the turning point in his confidence in moving forward without the device was realizing that “after the first couple of times when you read it [self-care advice], you know what to do.” Similarly, Stuart described how “the longer the phone wasn't with me, the easier it was for me” and his growing emotional resilience regarding his cancer experience:

There's an old expression, “You never miss the bush until the shelter is gone” and I was being sheltered by the fact I had the phone at my disposal 24 hours a day for the first six sessions. . . The shelter was gone then after six sessions and maybe for the first couple of weeks I was a bit anxious, but I didn't miss it. Eventually I didn't miss the shelter because, I was, I felt okay. (Stuart, Int. 2)

The “shelter” of the technology gave Stuart an opportunity to control his environment and confidence in facing the unknown, external threats of cancer and its treatment he faced. Stuart discussed how he was initially anxious once the shelter of the technology was gone, but these anxieties lessened as he found that his symptoms were not significant or concerning to him. It must be noted that Stuart described how his adjustment period was shaped by how he was not “sick enough” to miss the device. Stuart recognized that if he were to have new or severe symptoms, he believed he would require the support of technology to help him cope and “ease” his mind.

Evelyn explained how she felt “stronger” and more knowledgeable in managing her symptoms as a result of using the technology in her later chemotherapy cycles. Evelyn's self-efficacy and emotional resilience is reflected in her confidence to report her symptoms directly to her cancer care team, which she described being reluctant to do in her first interview:

Now you're gone to the stage, you're kind of independent, you know what's going to happen and if you have side-effects you just tell them [oncology nursing team]. . . I had more power inside myself. (Evelyn, Int. 2)

#### *Family Caregivers' Relationship to DHT*

##### *Facilitating DHT within the family*

Once their relatives with cancer had been provided with the technology, family caregivers played a role in helping them integrate it into their family life. Firstly, each family caregiver described how they encouraged their relative to consider taking part in the DHT clinical trial. Despite previous challenges in supporting her mother to use technology, Jane explained how she encouraged her mother to “Take it and try it. See how you get on.” Jane gave her mother support in making the decision and highlighted that Evelyn may have a potentially more positive experience. This support may have been particularly important if

Evelyn's lack of digital literacy or confidence with technology was a consideration in her decision to take part.

Faye described how Carl initially did not want to participate as he felt that he had "enough to be doing" and that it would be inconvenient to complete the symptom questionnaire on a daily basis. Faye urged him to consider taking part because she valued how "it will, at least, be a point of contact" and persuaded her husband to take part in the study, as she notes his lack of communication and ability to ask for help when needed. Faye, who worked previously as a nurse, highlighted her awareness that when people are unwell, they are more likely to feel helpless and less inclined to articulate their concerns regarding their physical and emotional well-being:

But I know, myself, that people can, but, feel very vulnerable, you know, when they... When they're, um, they don't always voice it, like Carl would be one who wouldn't voice it. So, we persuaded him to take the phone. (Faye, Int. 1)

Faye viewed the technology as a medium to "voice" these potential concerns that she believes he may not do so otherwise. Faye attempted to motivate Carl to participate in the study by reasoning that "it involves you in your own treatment, and you have a little bit of power." This rationale implies how Faye understood that cancer and illness can demoralize a person and make them feel powerless and defenceless.

Second, family caregivers had a key role in helping them adjust to using the technology and ensure they were using it correctly and daily. Faye's concern and need for reassurance is exemplified in how she approached Carl about the questionnaire: "I'll actually say to him, 'you've done your phone? Have you done your phone?'" (Faye, Int. 1). Family caregivers expressed an awareness that their relative may not be interested in completing the questionnaire when they felt unwell or experienced low moods:

When she's down in the dumps a bit she's kind've like "Oh I have to do that phone!" you know so her instinct is to give out about it. We try to keep telling her to use it as a positive thing – not that it's a burden to do it but it's the days she's feeling like that it's on top of her that she would be kind've giving out about doing it, you know? But as I said, it's for her own benefit. (Caroline, Int. 1)

Thirdly, family caregivers also had a role in ensuring that their relatives reported their symptom information accurately in the daily symptom questionnaire. Family caregivers noted that they were aware how their relative could potentially minimize or under-report their symptoms when completing the questionnaire, so they did not receive a call from the oncology team.

I just think some days, when she was feeling sick, she just wanted it over and done with, I think with she just going "Yeah, No, Yeah, No." I said, "Sure that's no use to them [nursing team] because that's not the study – they don't know how you're feeling and that's not the way you're feeling so you can't do that." (Nadine, Int.1)

Nadine understood how there was a greater responsibility on her to monitor Evelyn which brings greater uncertainty for Nadine as she is unfamiliar with the symptoms and knowing when her mother may need medical attention. Additionally, family caregivers played a role in supporting technical issues when they arose and reassuring their relatives if they became frustrated with the device.

#### *Relationship to their relatives' technology*

Each family caregiver described their unique relationship to the technology. Faye discussed how she did not get involved with Carl's use of the technology: "I don't interfere that way." Nevertheless, Faye likened it to "somebody looking after you" and that it would have

benefits for both her and Carl, in terms of managing his chemotherapy symptoms and psychological well-being. Faye expressed how Carl likes to have control and routine in his life and becomes annoyed when it is altered or uncertain. Faye did not want to get involved because Carl asserted ownership over the technology, or she understood that it would be easier for both of them if she did not involve herself with the device. Faye referred to it as "his thing" which she does not see herself as part of and did not want to "babify" him. Acknowledging Faye's previous career as a nurse, it may be possible that Faye did not want to approach or treat Carl as she would have as a nurse; instead, Faye wanted to view him from the perspective of being his wife. As such, the technology enabled Faye to remain in the role of his wife, rather than assuming the role of a nurse or carer during his treatment.

Likewise, Nadine referred to Evelyn's technology as "her thing." Despite her initial ambivalence towards the technology, Nadine noted that there was a change in her own relationship with the technology, as she observed its value as time passed:

I think maybe I came bit dependent on in it. . . Because if I was there making sure like if she wasn't feeling well then, I'd make sure she'd put in the right things, so I'd get tips you know that kind of way? (Nadine, Int. 2)

Nadine referred to the technology as a "crutch" that was specific to the family "to make right decision" regarding their mother's care. Jane recognized that behind the technology that "there's somebody there at the back of this machine." This indicates how Jane perceived it to be a personable device, supported by a nursing team, and not just a piece of technology. Jane understood that a dedicated oncology nurses were using the device who could help them "get through" any adversity or issues with symptoms that they may face. Likewise, Faye described how the technology reassured her regarding Carl's health and well-being as she understood it was "in the background" and "gave me the freedom" to maintain aspects of her daily life. This image described her feeling of how the technology was a constant presence and support in their lives. Faye knew that he had that 'fall back' should anything go wrong or if he experienced symptoms that needed to be attended to. Jane repeatedly commented in both interviews how the device gave her "peace of mind" knowing that her mother was being actively monitored by her oncology team. Jane also described personable aspect of the device and connection to their oncology nursing team:

If you think that there's just something not right, you can put the information in, that you know there's somebody there at the back of this machine that going to. . . help you through to get through" (Jane, Int. 2)

#### *Provision of care without the technology*

After the technology was returned, family caregivers discussed how they felt more vulnerable in providing care to their relatives and questioned their knowledge levels:

Well, I suppose we were questioning ourselves more – is that right? Is that wrong? Should we do this? That's part of it now because you know she's been on it for so long and you know that sort of thing. She was getting a bit shaky in herself, so we were questioning was that part of it, if not or because she's shaken up from the fall or you know? (Caroline, Int. 2)

Jane discussed how she would be "thinking to myself you need to be doing this, you need to be doing that" and felt the need to "monitor everything." Jane began to fixate on the responsibilities and tasks involved in providing care as they realized the protection of the technology was no longer available:

I think we had to become more aware ourselves of what was happening with mammy, changes and stuff like that. We had to be more on the ball about different things rather than using the app to be putting in and getting your information and being told. We had to be more aware of the changes in her.” (Jane, Int. 2)

Likewise, Faye had a heightened awareness how would engage with his symptom management practices and felt she had to be “vigilant” in order to avoid potential threat to his health. Similar to Jane, Faye also began to ruminate on the well-being of her husband without the technology. However, Faye also recognized that she would worry about his well-being even if he had it for the full duration of his treatment:

That it was to see how it was without the phone... I would have liked it for the whole time and then I thought “Well let’s say it came to the end of his chemo and the phone was gone and then you’d be imagining ‘Is everything OK?’,” that would be me. (Faye, Int. 2)

There was a prevalent sense in the family caregivers’ accounts of being exposed and that they found it harder to adjust afterwards than their relative with cancer. While family caregivers discussed being more knowledgeable from using the technology, Caroline depicted how “it’s like a comfort blanket and it’s taken away.” Family caregivers were able to manage their relatives’ symptoms, even if they had experienced distress without the technology, due to the knowledge gained during the initial chemotherapy cycles while using it. Family caregivers adjusted over time without the device, despite the new challenges of navigating and accessing standard care. However, there was an evident preference to keep the technology for the full duration to maintain the support for them and their relative:

Comparing the two periods, I would have preferred if the phone had kept on... It was a reassurance... I know that sometimes a patient might pass casually and actually that’s how some things are picked up because they pass a comment casually (Faye, Int. 2)

## Discussion

The current study sought to expand upon previous evidence regarding the personal meaning and psychosocial benefits of symptom management DHT for people with cancer and their family caregivers during chemotherapy<sup>13</sup> with a further exploration of the relationships to the technology. Given that a key focus in society is placed on the nature of and how people develop relationships with technology, the current research addresses a gap regarding how families can develop different bonds to supportive technology during cancer treatment.

### *Relating to DHT During Cancer Treatment*

While participants held mixed expectations regarding digital health and echoed previously known challenges, such as technology literacy and perceived burden,<sup>20–22</sup> people with cancer became accustomed to using the technology and developed a trusting relationship with it after an initial period of use. This relationship is akin to John Bowlby’s theory of attachment and the concept of “psychological connectedness.”<sup>23</sup> Emerging from Bowlby’s work is the concept of comfort or transitional objects traditionally used to help children and adults make the emotional transition from dependence to independence. Transitional objects are supportive to individuals as they can provide familiarity, continuity, comfort and stability to their owners during a time of great change.

The current findings suggest how DHTs can assume the role of a transitional object for people with cancer and family caregivers

undergoing treatment as participants regularly referred to the technology as a “comfort blanket,” “crutch” or a “safety net.” Kahne<sup>24</sup> wrote of how transitional objects can help people navigate the difficulties associated with the distinction between their inner mental life and the external world, which in the current context refers to individuals mentally adjusting to a cancer diagnosis and its related treatment. Therefore, by having a transitional object when commencing chemotherapy, participants had an item they could use to orientate themselves in their new circumstances, as well as nurturing a sense of psychological safety. As Hertlein and Twist<sup>8</sup> suggested that similar to our partners in personal relationships, we can also develop attachments to technologies.

The strength of the personal connection participants had with the technology is reflected in how they likened it to having a person or cancer care professional (“there’s someone looking after you”) guiding them through their chemotherapy experience, as observed in previous research.<sup>25,26</sup> The concept of anthropomorphism, i.e., the attribution of human-like attributes to nonhuman entities,<sup>27</sup> lies at the heart of the reassurance that participants felt from the technology. Terms such as ‘Mr Reliable’ revealed how the technology can embody a sense of personhood to its users and become like another member of the family or confidante during the treatment process. Family caregivers specifically observed how the technology was like another person checking on their relative alongside them.

Acknowledging the uncertainty that people can experience following a cancer diagnosis, current findings support Epley and colleagues<sup>28</sup> belief that anthropomorphism occurs when people strive to make sense of a new environment and attempt to predict or control it in the future. Duggan and colleagues<sup>29</sup> observed that symptom management is best suited for this behavior as researchers seek to enable people to understand their current difficulties and then manage them independently in the future, which was achieved in this study. Additionally, the findings support Epley and colleagues<sup>28</sup> explanation of how self-management technology is made interactive using clearly understood language and how people seek social connection when they experience illness which can be a time of loneliness or isolation. It must be acknowledged that both participant groups referred to the technology as both a practical tool and a supportive person interchangeably in their interviews. While Duggan and colleagues<sup>29</sup> argue that there is much work to be done in understanding why people treat objects as people, the current findings highlight how individuals can project human-like characteristics onto DHT because they have meaning and purpose in their lives, much like human relationships.

Moreover, the cognitive process of attributing human characteristics to DHT offers an understanding of people’s preferences regarding the style of care. Though previous evidence has shown a preference for in-person interaction with their oncology team rather than through technology,<sup>22,30,31</sup> participants in this study did not indicate an explicit desire to have more face-to-face contact with their oncology team. The argument that technology cannot replace human interaction with healthcare professionals<sup>4</sup> can also be demonstrated in the current study. While participants experienced psychological safety using the device, this effect was grounded in their awareness that their cancer care team were regularly checking and responding to their symptoms, which cannot be overlooked. While creators of digital health may have the best intentions of presenting a faster and more effective way of accessing care, it does not negate the role of healthcare professionals. Ultimately, digital health should be a complementary tool rather than a replacement for healthcare involving in-person human interaction and relationship development. The current findings reinforce Mooney and colleagues<sup>32</sup> suggestion that people with cancer reported better outcomes when combining electronic symptom monitoring with nurse practitioner interventions.

Participants’ attachment to the technology was evident in their anticipatory anxiety about returning to it after the initial six

chemotherapy cycles, which supports Duggan et al's<sup>29</sup> observation that children and adults can form strong attachment to simple and noninteractive objects. While all participants understood that they could access cancer care triage phone lines, they were anxious about using this care method. Participants ruminated about their inability to manage symptoms, barriers in contacting or receiving advice from their cancer care team, loss of routine and a lack of reassurance without the technology. Essentially, participants believed that they would not cope and felt exposed to potential threats without using the technology. In particular, people with cancer become reliant on technology to assure them that they were physically well even when they did not experience symptoms, which, in turn, offers an insight into the emotional bond that can form while using technology. Brenk-Franz and colleagues<sup>33</sup> recent research examining how attachment can be a predictor of digital health adoption adds further support to this discussion.

### *Navigating Cancer Treatment Without DHT*

The study's longitudinal approach highlighted how an adjustment period ensued for participants after the technology was returned whereby they felt abandoned and vulnerable in the initial weeks after its return. Echoing Duggan and colleagues' study<sup>34</sup> of the use of DHT among people living with chronic pain, the current findings underline how participants attributed human-like characteristics to the technology and described how it felt as though someone was with them helping and checking on their progress. Therefore, the abandonment felt by participants may not simply be the result of losing the technology, but it is also due to the loss of a supportive, human-like presence in their lives that they will not get back.

This sense of abandonment may have been further compounded by their awareness of completing their initial chemotherapy cycles supported by the technology. People with cancer who complete cancer treatment are known to experience heightened levels of anxiety, yearn for the involvement of their cancer care team and feel unprepared or uninformed regarding self-management without their accustomed resources.<sup>35</sup> Ultimately, people who have completed cancer treatment desire a relationship with their cancer care team and the security experienced within their cancer care center.<sup>36</sup> Similarly, in this study participants craved the connection of the DHT, even with standard triage care being available to them.

Despite participants' initial sense of abandonment, as time moved passed, people with cancer became aware of their increased knowledge and experience of managing their symptoms as a result from using the technology. This meant that participants' uncertainty and anxiety lessened with time as they understood they were equipped to deal with symptom management practices, independent of the DHT. Participants had a strengthened sense of self-efficacy regarding their symptom management. This finding concurs with White et al's<sup>37</sup> integrative review which concluded that people with high self-efficacy for cancer symptoms were associated with low symptom occurrence and distress and higher levels of quality of life and emotional well-being compared to individuals with lower levels of self-efficacy. Thus, using the DHT strengthened participants with cancer self-efficacy regarding caring for themselves which enabled them to engage in learned behaviors regarding their symptoms that maintained their quality of life.

A key finding of the RCT<sup>14</sup> is how the technology improved people's self-efficacy rates and empowered people to care for themselves. However, the close interpretative reading of participants' lived experiences facilitated an understanding of the process of developing self-efficacy using DHT on a human level, beyond their cancer experience. Current findings indicate that people with cancer do not require DHT for the full duration of their chemotherapy for symptom management. This research reinforces how as human beings we can adjust, endure and cope with stressful

circumstances.<sup>38-40</sup> While participants believed they were managing their symptoms due to the DHT usage, what they were doing was managing their symptoms because they were learning how to be self-aware about their bodies, respond to symptoms and manage their well-being. Though existing literature shows how people with cancer and their family caregivers commend DHT in its management of physical and psychosocial well-being,<sup>41-43</sup> this study argues that the use of DHT helps build confidence and prepares people with cancer to be independent.

While this is a very positive step forward for people with cancer, a word of caution is also required. In this study, participants' confidence and self-efficacy regarding their symptom management may have also erred into unsafe behavior as one participant stopped taking their temperature on a regular basis, as required in standard cancer care, after returning the device. Echoing Mayer et al's findings<sup>44</sup> regarding how people with cancer can cease to engage in increased levels of physical activity following the use of a DHT, however, their study did not investigate contextual factors and personal reasons for non-adherence. Current findings illustrate how people with cancer have the potential to stop engaging in self-care activities once the technology is returned due to their adjustment to treatment and established confidence. Additionally, it must be noted that participants may have adjusted successfully as they had become accustomed to the symptoms, whereas they may have had different experience without the device if their symptom profile became more severe or bothersome, as one participant remarked they would have wanted it back in this case.

Despite family caregivers having increased knowledge and self-efficacy in their cancer caregiving role following the use of the DHT, our findings show that family caregivers felt an increased anxiety and greater responsibility in caring for their relative after it was returned. Family caregivers' experience without the technology was marked with anxiety to be physically present with their relatives to monitor their well-being and, in some cases, difficulty in engaging and accessing the oncology team to obtain support and information. Although family caregivers discussed how they learned about effective symptom management and were reassured while their relative used DHT, some experienced a sense of burden and unmet needs<sup>45,46</sup> after it was returned. This feeling of burden may have been due to how relatives often experience poorer quality of life than the person diagnosed with cancer as they attempt to manage their relative's physical and psychosocial needs and their own.<sup>47</sup>

While previous research has looked at the family caregivers' experience with dyadic DHT<sup>48,49</sup> and DHT specifically designed for family caregivers,<sup>50,51</sup> this is the first study to examine family caregivers' experience of their relative's use of DHT and contributes to our existing knowledge base. Although family caregivers became confident in their abilities to provide care while their relatives used the DHT, the prospect of returning it prompted them to question these abilities. Even though family caregivers were able to provide care to their relative with cancer when the DHT was returned, they believed it would be easier if their relative used it for the full duration of their treatment or at least had an option of returning it. This finding implies that family caregivers can become reliant on the benefits of DHT – both what it does for their relatives with cancer and themselves. In the same way that people with cancer felt like they lost a supportive, human-like person in their lives, so too did their family caregivers in which they lost a supportive member of their imagined team which cared for their relative with cancer, but also them during the cancer experience. Some family caregivers expressed a desire to have the DHT for the full duration for the cancer treatment.

In light of the evidence that DHT can be perceived as initially burdensome to people with cancer,<sup>48,49,52</sup> family caregivers in this study played a pivotal role in supporting their relatives' decision to use it as part of their treatment by voicing their encouragement and having open discussions. Compliance with DHT among people with cancer is

a known challenge due to physical or mental symptom burden,<sup>52</sup> navigational and comprehensibility issues or information burden.<sup>31</sup> Our findings highlight how adherence can be influenced by the self-perceived need for care by people with cancer, their psychological well-being and the perceived burden of contacting their cancer care team. Family caregivers took an active role in helping their relatives answer the daily questionnaire, when necessary, monitor the accuracy of symptom reporting, check its completion and provide technical support related to the device. By embedding and embracing DHT in their family dynamic and daily lives, family caregivers took a proactive stance to ensure their relatives' engagement, which is known to help reduce their sense of potential helplessness in providing care,<sup>53</sup> as well as control over their caring responsibilities and their relatives' well-being.

#### *Implications for Nursing Practice*

This research demonstrates how self-management DHT has the potential to elicit strong attachments among adults and fulfil some functions of a transitional object. This finding is particularly important in light of the triadic relationship between people with cancer, family caregivers, and oncology professionals.<sup>54</sup> Nurses should be aware of this relationship and their feelings of loss and lack of security people with cancer may experience once returned if DHT is to be widely adopted in health systems to facilitate outpatient models of care. This understanding may help oncology nurses identify ways to best engage and support these cohorts. However, further in-depth research is needed on how DHT acts as transitional objects to people with cancer and their family caregivers during symptom management.

The findings also suggest a cost-effective way of providing DHT in clinical practice. As people with cancer and their family caregivers adapted to the symptom management process without the technology using the knowledge they had acquired, this understanding implies that these populations could be provided with supportive technology for a set period at the beginning of their treatment to help educate and adjust to their treatment rather than using it for the full duration of their treatment. This approach would mean that cancer care professionals could reach more people concurrently with the same number of available devices without incurring additional costs to the cancer center, which is important in light of the digital health is a pillar of the European Cancer Strategy,<sup>11</sup> as well as the ever-growing incidence rates. While the technology promoted educational levels and self-efficacy, our findings show that a one-size-fits-all approach may not be appropriate in this setting regarding its return, as some may have a preference to maintain the technology for the full duration of treatment. While participants associated their knowledge levels and increased self-efficacy as a result of using the technology, family caregivers found the caregiving role harder without it and people with cancer may have had a more challenging time without it if they experienced more severe symptoms, which needs to be investigated in future provision of DHT.

#### *Limitations*

Although this study offers an in-depth understanding of the relationship people with cancer and their family caregivers can develop with DHT, some limitations must be acknowledged when considering the current findings. While the recruitment strategy included adults with colorectal cancer over the age of 18, all participants with cancer were over the age of 70. The inclusion of participants from a younger age profile may have potentially resulted in further perspectives regarding the relationship to technology. Similarly, the findings are based on the relationship between spouses and a parent with her children. The findings do not encompass the relationship between a parent and an adult child with cancer using digital health which may have garnered a unique insight into the phenomenon.

#### **Conclusion**

This is the first study of its kind to in-depth explore the relationships people with cancer and their family caregivers develop with DHT during course of their cancer treatment. The findings bring awareness to how DHT is not simply an intervention to improve health outcomes, but people with cancer and their family caregivers develop personal connections to it. More specifically, this research demonstrates how symptom management technologies have a great potential to elicit strong attachments in adults and fulfil some of the functions of a transitional object following a recent cancer diagnosis and receiving treatment. DHT can educate and promote self-efficacy among people with cancer and their family caregivers which means they can successfully self-manage their symptoms without it. The insights underlined in this work merit further exploration of the lived experience and meaning of using DHT during cancer treatment. Continuation of research in this area of health care may help inform future DHT design, improve oncology practice and effectively promote physical and psychosocial outcomes for people with cancer and their family caregivers.

#### **Declaration of competing interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### **CRedit authorship contribution statement**

**Andrew Darley:** Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Resources, Validation, Writing – original draft, Writing – review & editing. **Eileen Furlong:** Conceptualization, Formal analysis, Supervision, Writing – original draft, Writing – review & editing. **Roma Maguire:** Conceptualization, Writing – review & editing. **Lisa McCann:** Conceptualization, Writing – review & editing. **Barbara Coughlan:** Conceptualization, Formal analysis, Supervision, Writing – original draft, Writing – review & editing.

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