Technology Usage, eHealth Literacy and Attitude Towards Connected Health in Caregivers of Paediatric Cancer

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Abstract— While Connected Health (CH) presents an attractive solution to supporting those with paediatric cancer within a burdened healthcare system, uptake has been limited in practice. This study explored the extent to which attitudes towards CH and the ability to identify evidence-based CH interventions could be predicted by technology usage and eHealth literacy for parents of children with cancer and their Health Care Providers (HCPs). A survey of 85 parents and HCPs was conducted consisting of measures of eHealth literacy, attitude towards online sources, electronic device/internet usage and evaluations of existing CH technologies. While respondents frequently interacted with online supports, CH use was limited (30.8%). Multiple regression and t-test analyses were conducted to determine the relationship between technology usage and eHealth literacy on CH use, attitude and perceived quality. Positive attitudes towards CH and strong eHealth literacy skills were found, however, those who had not used CH had significantly lower eHealth literacy than those who had (t(74)=2.08, p=.04 (two-tailed). Further, eHealth Literacy and device use significantly impacted attitude (F(3,75)=12.01, p<.001) and trust in higher quality CH applications (F (2,58)=3.87, p=.03). This suggests that eHealth literacy and device access play a crucial role in facilitating CH use for stakeholders in paediatric cancer. Consideration of how best to support those with differing eHealth literacy when developing CH technologies is needed to support effective employment in practice.

Keywords— Connected Health, Paediatric Cancer, eHealth Literacy, Attitude, Accessibility.

I. INTRODUCTION

Social distancing measures implemented in response to the Covid-19 pandemic have given rise to a digital revolution in healthcare [1]. Specifically, restrictions to in-person service delivery have led to a greater reliance on digital technologies to support patients [2]. One such area of digitalisation is connected health (CH), an umbrella term referring to the concepts of eHealth and mHealth, amongst other technologies [3]. CH differs from other technologies in that it involves a two-way flow of information, where user data is gathered, analysed and returned in a manner that provides insight. CH may be of particular benefit to families impacted by paediatric cancer by providing support while reducing barriers to care [4]. However, research suggests low adherence and high attrition rates for CH use in practice generally [5], [6]

suggesting a clear need to increase engagement with these technologies [7].

Poor understanding [8] and lack of desire to use CH [9] has been noted among patients, however limited research has examined the reasons for this reluctance to engage with CH. From a theoretical perspective, CH acceptance can be considered a form of behavioural intention, and as such a predictor of use [10]. While acceptance has been linked with experience and proficiency in technology [11], there is a need to examine further its role in facilitating CH use. An additional factor that may impact CH acceptance is eHealth literacy. eHealth literacy is the ability to locate, evaluate and apply health-based information pertaining to a specific concern from internet-based sources [12]. Positive associations between eHealth literacy and acceptance have been noted [10], [13], [14] with those with lower expectations of CH also having lower intentions to use [15]. eHealth literacy also impacts attitude towards CH for Health Care Providers (HCPs), with technological skills and comfort associated with greater digital usage [16]. While broad analysis of the impacts of attitude and eHealth Literacy have been conducted, no analysis of the effects of these factors within paediatric cancer has occurred to date.

HCPs play an essential role in CH implementation [17] and have been shown to mediate attitude development in patients [18]. However, HCPs are unlikely to fully utilise these technologies in practice [10], [19]. Techno-centrist design may exacerbate this research-practice gap by removing stakeholders from the design process [20], [21]. To mitigate this, research efforts have shifted to a bottom-up approach in which CH use for individual stakeholders is the primary subject of analysis [19]. Further analysis of stakeholder needs pertaining to CH in paediatric cancer is required to ensure its effective implementation for this cohort.

The use of mHealth, a form of CH, is growing rapidly within paediatric cancer, with high availability and varied quality [22]. Covid-19 responses by the United States Food and Drug Administration (FDA) further exacerbated this quality discrepancy through easing mHealth restrictions to expand access [23]. Additionally, mHealth tools developed by researchers and based in scientific evidence are rarely shared with the public [24]. As such patients and HCPs have difficulties accessing appropriate, high quality and relevant health content [25], [26]. Analysis of safety concerns in

consumer-facing health apps found eighty individual safety concerns across the literature, from inaccurate or insufficient information to failure to respond to high-risk information [27]. Gaps highlighted included a lack of stakeholder involvement and poor evidentiary support. This suggests a need for additional analysis of mHealth supports in this space to ensure their efficacy.

As healthcare systems are increasingly burdened, CH's efficiencies and cost savings present an attractive solution. While positive impacts of CH have been noted, barriers such as attitude, eHealth literacy and comfort with technology may impact uptake. Further, stakeholders demonstrate skills deficits in identifying effective, relevant, and evidence-based CH technologies. This presents risks both for impact and future uptake. An analysis of the barriers or facilitators to use is needed to support greater uptake of CH within paediatric cancer. As such, examination of the role of eHealth literacy and technology usage on the ability to identify evidence-based CH interventions is required. This study seeks to analyse the relationship between technology usage, eHealth literacy and attitude towards CH for parents of children with cancer and their HCPs. Secondly, we aim to examine the relationship between eHealth literacy, technology use and the ability to identify evidence-based CH interventions for parents and healthcare providers.

II. METHOD

A. Participants

A sample of parents/caregivers of paediatric cancer and HCPs were recruited to take part in the study between October 2020 and March 2021. For HCPs, eligibility criteria included being qualified as an HCP with at least one year's experience working with children. For parents/caregivers, eligibility criteria consisted of having a child (aged 0-18) with cancer who was at least six months post-diagnosis but less than five years from active treatment. Recruitment was conducted through sharing invitations to participate on social media and circulating among support services and non-governmental associations in the paediatric cancer space. Full ethical approval for this study was obtained through the Maynooth University ethics board (reference number: 2408299). In addition, full informed consent was obtained from all participants.

B. Measures

The following information was collected from participants using an online survey:

1) Demographic Information: Brief demographic information was obtained, including age, gender, marital status and ethnicity. For parents, the child age, diagnosis and stage in the treatment/survivorship trajectory was collected.

2) Electronic Device/Internet Usage. Electronic device and internet usage for health was measured using an adapted version of the Health Information National Trends Survey (HINTS) [14]. Three questions were asked pertaining to internet use through different technologies, devices used, and online health behaviours completed in the past year.

3) eHealth Literacy: The eHealth literacy eScale (eHEALS) [12], was used to measure participants' eHealth Literacy. The eHEALS is an 8-item measure of knowledge, skills and comfort at finding, evaluating and applying eHealth

information to health concerns. Cronbach's alpha was .92 suggesting strong reliability.

4) eHealth Attitude: The 5-item computer interest subscale of the adapted Attitudes Toward Computer/Internet Questionnaire (ATC/IQ) [28] [29] was utilised to measure attitudes towards eHealth. Cronbach's alpha was 0.65 suggesting an acceptable level of reliability within the scale.

5) Application (App) evaluation: A simple Likert scale from 1 (Strongly disagree) to 5 (Strongly agree) was developed to measure participants' self-reported trust in a number of CH smartphone apps. These apps were selected based on systematic searches of the Google Play and the Apple App Store in September 2020. To be included in the analysis, apps were required to provide a CH intervention for parents or children affected by paediatric cancer. Extending on a previous content analysis where a total of 1316 apps were found to meet inclusion criteria, those apps with the greatest and least number of behaviour change techniques (BCTs) were selected for use in this study. BCTs are observable and replicable components of interventions that effectively change behaviour, with interventions including BCTs more likely to be effective [30]. BCTs Taxonomy, Version 1 (BCTv1) was used for content analysis [31]. The BCTTv1 consists of 93 individual BCTs across 16 domains. The presence or absence of each BCT for each app was examined and a one scored if the technique was present. Scores were then summed to determine an apps total volume of BCTs. The three applications with the greatest and least number of BCTs were selected for inclusion. Apps included in the present analysis targeted symptom tracking and management (n=4) and communication with HCPs (n=2). Low BCT apps included on average 1.7 BCTs compared to high BCT apps, which had 16.7 BCTs on average.

C. Data Analysis

Data were analysed using the Statistical Package for Social Sciences (SPSS). Multiple regression analyses were conducted to assess the influence of eHealth literacy and Internet/Device usage on ATC/IQ. To determine the relationship between technology usage, eHealth literacy and attitude toward CH and participants self-reported trust, likelihood to use and perceived quality of CH apps, multiple regression analyses were conducted. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Two blocks of predictor variables were employed for each multiple regression model, internet/device usage and eHealth Literacy. The Pearson product-moment correlation coefficient was used to examine the relationship between eHealth literacy and scientific evidence and trust in high and low BCT apps. To determine the impact of eHealth Literacy on past use of CH for HCPs and parents, an independent samples t-test was conducted.

III. RESULTS

A. Participant Characteristics

Participants were primarily aged 35-44 (44.6%, n=25), resided in Ireland (64.6%, n=53), female (89.4%, n=76), married (70.6%, n=60) and lived in a large town or city (44.7%, n=38). For parents of children with cancer, diagnoses included Acute

Lymphoblastic Lymphoma (ALL, 40.8%), brain or spinal cord cancer (10.2%) or another cancer (12.2%). Children were primarily aged under five (36.4%) or between six and ten (34.5%) and had finished active treatment for over one year (27.1%), though a variety of treatment/survivorship stages were noted.

TABLE 1: Demographic Information

		Participant Type					
		Parents (n=57)		*HCPs (n=28)*		*Total (n=85)*	
		n	%	n	%	n	%
Age	18-24	2	4.9	0	0	2	3.6
	25-34	6	14.6	7	46.7	13	23.2
	35-44	22	53.7	3	20.0	25	44.6
	45-54	9	22.0	3	20.0	12	21.4
	55-64	1	2.4	2	13.3	3	5.4
	65+	1	2.4	0	0.0	1	1.8
Gender	Male	3	5.3	6	21.4	9	10.6
	Female	54	94.7	22	78.6	76	89.4
Habituation	Rural (<5,000 inhabitants)	19	33.3	5	17.9	24	28.2
	Small Town (<10,000 inhabitants)	21	36.8	2	7.1	23	27.1
	Large town/City (>10,000 inhabitants)	17	29.8	21	75.0	38	44.7
Marital status	Married	41	71.9	19	67.9	60	70.6
	Widowed	1	1.8	1	3.6	2	2.4
	Divorced/ Separated	2	3.5	1	3.6	3	3.5
	Cohabitating	9	15.8	5	17.9	14	16.5
	Never married	4	7.0	2	7.1	6	7.1

B. Electronic Device/Internet Usage

Most respondents accessed the internet daily using computers (61.5%), a mobile device (92.3%) or CH (30.8%). However, 5.6% of parents only accessed the internet weekly. Smartphones were the most common device used within the past year by both groups (91.8%). Tablet computers (63.5%), wellness apps (48.2%) and smart devices were also common (47.1%). Participants engaged with an average of 3 different technologies within the past year, with both group means relatively equal. Mean online health behaviours for HCPs were slightly higher (m=6.12) than parents (m=5.55). HCPs also completed more CH activities across the past year (mean =2.32) in comparison to parents (mean=1.92).

To determine the impact of eHealth Literacy on past use of CH for HCPs and parents, an independent samples t-test was conducted. Past CH use was determined based on answers to the technology/device use questions pertaining specifically to CH use. There was a significant difference in scores for those who had used CH (M=32.6, SD=6.9) and those who had not (M=29.1, SD=7.4; t(74)=2.08, p=.04, two-tailed). The magnitude in differences in the means (mean difference=3.47, 95% CI:.145-6.81) was moderate (eta squared =.06). An

independent samples t-test was also conducted to compare eHealth Literacy scores across the two participant groups. No significant difference was found in scores between parents (M=29.98, SD=6.37) and HCPs (M=32.6, SD=8.7); t(74)=-1.4, p=.16 (two-tailed).

C. eHealth Literacy & Attitudes

Participants reported positive attitudes towards online sources with mean scores of 20.67. Parents (m=21.05) were slightly more positive than HCPs (m=19.92). The reverse was the case for eHealth Literacy with HCPs (m=32.48) scoring higher than parents (m=29.98), though both groups had good eHealth Literacy skills (see Table 2).

TABLE 2: Mean Device, Attitude and eHealth literacy

			Participant Type		
			Parent (n=51)	*HCP (n=25)*	*All (n=76)*
Electronic Device/ Internet Usage	Mean actions in past year	Mean	5.55	6.12	5.73
		SD	2.11	2.72	3.32
	Mean CH actions in the past year	Mean	1.98	2.32	2.10
		SD	0.77	0.98	0.86
Attitude	ATC/IQ	Mean	21.05	19.92	20.67
		SD	3.22	3.30	3.27
eHealth Literacy	eHEALS	Mean	29.98	32.48	30.80
		SD	6.37	8.68	7.25

Standard multiple regression was used to assess the impact of eHealth Literacy, device use and group on CH attitude as measured by the ACT/IQ. The total variance explained by the model as a whole was 30.6%, F (3,75)=12.01, p<.001. Significant unique contributions for both eHealth Literacy (beta=-.377;p<.001) and device use (beta=.356; p<.001) were found, with the largest single contribution to attitude from eLiteracy which explained 13% of the variance in the ACT/IQ scores, followed closely by device use at 11.3%.

D. Evaluation of CH applications with high and low BCTs

Participants responded similarly to both high and low BCT CH apps regarding their scientific evidence and trust. Participant mean responses suggest both groups did not highly trust the quality of the apps for those with high or low BCTs.

TABLE 3: Evaluation of CH applications

		BCT Measure			
		Scientific Evidence		Trust	
Participant group	BCTs	High	Low	High	Low
Parent (n=43)	Mean	8.16	8.05	8.79	8.47
	SD	3.12	2.81	2.86	2.86
HCP (n=16)	Mean	9.00	8.63	9.94	9.25
	SD	3.246	2.029	3.043	1.81
Total (n=59)	Mean	8.39	8.20	9.10	8.68
	SD	3.146	2.618	2.928	2.622

The relationship between eHealth literacy and scientific evidence, and trust in high and low BCT apps was examined using Pearson product-moment correlation coefficient. There was a medium positive correlation between trust in High BCT apps and eHealth literacy (r=.41, n=59, p=.001) with high eHealth literacy associated with greater trust in High BCT apps. There was a small negative correlation between trust in

low BCTs and device use (r=.27, n=59, p=.04), with technology use associated with less trust in low BCT apps.

Several standard multiple regression analyses were conducted to assess the ability of eHealth Literacy and device use to predict trust and perceived degree of scientific evidence for CH applications with low or high volumes of BCTs. No significant effects for scientific evidence for low (F (2,58)=2.81, p=.07) or high BCTs (F (2,58)=1.17, p=.321) or trust for apps with low BCTs (F (2,58)=1.9, p=.15) was found. For trust in high BCT applications, the total variance explained by the model as a whole was 9%, F (2,58)=3.87, p=.03. Significant unique contributions for eHealth Literacy (beta=-.348; p=.008) was found, explaining 11.8% of the variance in trust scores.

IV. DISCUSSION

The present study sought to examine the impact of eHealth literacy, technology usage, and attitude towards CH and its use. Results suggest that while HCPs and parents frequently interact with technology and online supports for health, overall CH use was limited. Encouragingly, positive attitudes and strong eHealth Literacy skills were found in both groups, with HCPs demonstrating slightly higher eHealth literacy and past CH use, while parents expressed more positive attitudes. Results suggest both eHealth literacy and past device usage play important roles in CH evaluation and use, with both contributing significantly to respondents' attitudes towards online sources and trust in high BCT apps. This suggests a key role for eHealth literacy and device access in supporting accurate evaluations of CH technologies and may facilitate effective use for stakeholders in paediatric cancer.

Our findings are broadly consistent with past literature. For example, the important role of technology familiarity on CH use is consistent with past findings suggesting technological comfort, self-efficacy and habit predict CH use [32]. Perhaps surprisingly, no associations between demographic factors were found in relation to CH use, attitudes, or eHealth literacy. This is somewhat contradictory to past findings [14] and may have been impacted by the smaller sample size and relative heterogeneity of the sample. Our results support past analyses that suggest a need to support and encourage patient and HCP comfort with technology to reduce negative CH attitudes [8]. We also highlight a lack of trust and perceived quality of CH apps for this population, suggesting a need for increased efforts to support the dissemination of such tools. Results highlight the important role of eHealth literacy in supporting effective CH evaluation and use. In the context of the high accessibility and mixed quality of CH tools [22], eHealth literacy appears to support parents and HCPs in identifying effective CH. As such, these results suggest a need for efforts to support eHealth literacy for parents and HCPs. While the present analysis highlights eHealth literacy and encouraging device use as possible avenues to support CH uptake, additional efforts are required. Specifically, a need for expert analysis and dissemination of paediatric health apps through reputable and accessible sources has been noted [24], along with a need to incorporate CH technologies into training for HCPs to support use within clinical pathways [24], [33].

While the present analysis highlights parent and HCP willingness to engage with CH, further exploration of the role CH may pose is needed. While the efficacy and acceptability of CH interventions for paediatric cancer has been found [34],

high attrition and poor adherence have been noted [35]. Further, variability in preferences towards digital service delivery has been noted [36], [37]. Within the present study low levels of trust in CH was noted for both HCPs and parents, though most had engaged in at least one CH activity. This may suggest a hesitancy towards technology-mediated interventions such as CH which requires additional analysis. For an intervention to be successfully deployed it must be acceptable to stakeholders. Additional analysis of stakeholder perspectives on CH and its role is needed to ensure its effective use and value for stakeholders. Further public and patient involvement and stakeholder co-design of CH is needed to support uptake. Future research should examine stakeholder perspectives on CH within the paediatric care pathway and include parents, HCPs and children themselves in the design of CH supports.

The present results highlight the need for additional decisional supports for parents and HCPs to support them in determining which CH tools may be of benefit. Many of the CH tools with empirical support are not publicly available [24] creating difficulties in accessing higher quality supports [25], [26]. This absence of high-quality CH is particularly concerning when considered in the context of the high volume of freely available non-evidence-based CH on the market. This environment presents significant challenges to stakeholders in determining whether a CH app may be effective for their family. While the present analysis lends support to the importance of eHealth literacy in determining CH quality, analysis of factors which may support stakeholder decision making in this context is required. Future research should consider how best to engage with parents, HCPs and other key stakeholder to determine how to support decision making around CH use.

There are several limitations to the present study. Notably, the difficulties with participant recruitment and retention, with some respondents electing not to complete the BCT section of the survey, meaning that the present analysis is somewhat underpowered. Additionally, due to the constraints of the Covid-19 pandemic, participant recruitment occurred online only. As a result, device use and internet access may be higher in this sample due to the sampling methods employed. Additional efforts to examine eHealth literacy for hard-to-reach populations is needed. A further limitation is the timing of the present study. As recruitment occurred during covid-19, the associated increased use of remote service delivery methods may have impacted attitudes and device use.

V. CONCLUSION

In conclusion, this study has highlighted the importance of eHealth Literacy and device use on CH for HCPs and parents of children with cancer. While high device use and online health behaviours were suggested, lower use of CH was found. Further, respondents did not rate CH apps shown as highly trustworthy or evidence-based, indicating a skepticism towards such tools. As such, there is a clear need for efforts to support eHealth Literacy and comfort in device use to aid CH adoption within paediatric cancer. The present analysis also suggests a need for technology developers to consider the eHealth Literacy or device familiarity required by users to successfully engage with CH tools. By considering those with lesser eHealth Literacy or device use in the development of CH through user input in design, increased accessibility and engagement may be attained. Increased cooperation between psychological sciences, technology developers and end-users

is needed to ensure alignment between technological advances and effective interventions for those seeking support [38]. Through this, a more significant societal impact may be attained through increased effective usage of CH.

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