

Is there an app for that? A Systematic Search and Analysis of mHealth apps in the digital marketplace for pediatric cancer patients

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Abstract

Background: The significant increase in smart phone ownership has led to a rise in mobile health (mHealth) app use. This type of app aims to improve patient outcomes by reducing barriers to recovery through various features. Developing tailored features through mHealth apps creates a pathway to address healthcare needs of pediatric cancer patients and their families who have complex care needs. However, few apps are designed specifically to integrate with pediatric cancer care.

Objective: This study reports a systematic search and analysis findings of mHealth apps available on the Apple App and Google Play Store, designed for managing pediatric cancer through a list of features that serve patients, caregivers, or both audiences.

Methods: Following the PRISMA guidelines, we reviewed apps for pediatric cancer patients and caregivers that were available as of January 2024. We searched the Apple App and Google Play Stores with a list of keyword combinations focusing on pediatric cancer care. Inclusion criteria were (a) specifically targeted apps on pediatric oncology patients, their families, or both; (b) available in either app store, and (c) available in English (not exclusively). Once identified, apps were assessed by reviewing their features, user ratings, and app store information with descriptive analysis.

Results: In total, 22 apps were identified, and 17 of those apps were available on both platforms. The most popular features (n=12) amongst the selection in order were resource sharing, symptom tracking, reminders, care team connections, journaling, community support, medication tracking, data visualizations, appointment tracking, health activity data, data sharing, and integration with other health apps. These platforms designed their features and interface for caregivers (n=9) more frequently than the patients (n=7) while a subset of apps created options for both users (n=6). Out of 18 apps with publicly available reviews, 16 of them were rated highly (M=4.4, Min=3.1, Max=5.0, SD=0.59). A small subset (n=3) achieved over 5000 downloads while the remaining 19 apps had fewer than 500. Despite the growing inclusivity of multilingual platforms, more than half of the apps (n=12) were not publicly available in languages other than English. Apps that required extra hardware or software requested access to a range of device functionalities (M=2.72, Min=0, Max=10, SD=3.13).

Conclusions: Our review highlights the promising yet underdeveloped potential of mHealth apps in pediatric oncology care, underscoring the urgent need for more inclusive, comprehensive, and integrative digital health solutions. Future developments should actively involve key stakeholders from the pediatric oncology community, including patients, families, and healthcare professionals, to ensure the apps meet specific needs while addressing linguistic and cultural barriers. Our findings could guide developers, patients and caregivers, and healthcare providers towards understanding the state of pediatric oncology mHealth and approaches to enhancing existing platforms.

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Original Manuscript

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Abstract

Background: The significant increase in smart phone ownership has led to a rise in mobile health (mHealth) app use. This type of app aims to improve patient outcomes by reducing barriers to recovery through various features. Developing tailored features through mHealth apps creates a pathway to address healthcare needs of pediatric cancer patients and their families who have complex care needs. However, few apps are designed specifically to integrate with pediatric cancer care.

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Conclusion: Our review highlights the promising yet underdeveloped potential of mHealth apps in

pediatric oncology care, underscoring the urgent need for more inclusive, comprehensive, and integrative digital health solutions. Future developments should actively involve key stakeholders from the pediatric oncology community, including patients, families, and healthcare professionals, to ensure the apps meet specific needs while addressing linguistic and cultural barriers. Our findings could guide developers, patients and caregivers, and healthcare providers towards understanding the state of pediatric oncology mHealth and approaches to enhancing existing platforms.

Keywords: mHealth, mobile app, pediatric cancer, systematic analysis, oncology



Introduction

Approximately 400,000 children are diagnosed with cancer each year, and the incidence continues to rise annually [1]. Fortunately, treatment advances have also resulted in significant improvements in survival rates [2,3]. Despite these significant advances, pediatric cancer remains a leading cause of death among children [4]. The management of pediatric cancer is complex and requires multidisciplinary care that involves ongoing monitoring, management of physical/psychological symptoms, and social supports for families. This includes community resources, symptom management, rehabilitation, and access to educational content for patients and their families. Digital interventions, such as mobile health apps, have the potential to meet these needs in real-time while eliminating barriers like the distance from a medical center, lifestyle demands (e.g. work, school), and mental health stigma [5].

Mobile health apps, also known as mHealth apps, are software applications designed to run on mobile devices, such as smartphones and tablets [6]. The significant increase in mobile or smartphone ownership has simultaneously led to a rise in the use of mHealth apps. Furthermore, the global proliferation of mobile devices among the younger demographic underscores the feasibility of mHealth apps for pediatric cancer patients. Recent statistics indicate that technological access is substantial among the adolescent cohort [7]. Approximately 95% of adolescents possess or at least have access to smartphones, and 90% have access to a desktop or laptop computer. Notably, almost half of this demographic (46%) reported to be online almost constantly [7].

mHealth apps offer a range of health-related services and resources, such as tracking symptoms, providing medication reminders, and connecting patients with healthcare professionals [5,8]. The use of mHealth apps in the context of pediatric cancer is an emerging field that holds great potential for improving the management and outcomes of this disease [5,9]. mHealth can provide valuable support for families dealing with pediatric cancer, including access to emergency contact information, educational resources, and social support networks [10]. Some apps also provide pediatric cancer families with tools to improve psychosocial well-being and health outcomes [11]. Additionally, these apps can help healthcare professionals to monitor and track patient progress more efficiently while providing more personalized care [12].

Despite the increasing numbers of mHealth apps developed for cancer patients, there is a lack of literature in pediatric cancer regarding the collective analysis of mHealth apps available on the market, even more specifically, apps designed for use by the children and adolescents themselves. Limited literature has focused on mHealth apps for caregivers of pediatric cancer patients [5,9]. One of the early investigations highlighted cancer apps for adolescent and young adult cancer patients with their functionalities for symptom tracking, pain management, monitoring, and medication management [13]. In recent literature, studies focus on electronic medical diaries for mood, symptom and treatment tracking [14], care after cancer treatment [15], pre-rehabilitation support [16], and post-treatment medical adherence [17]. In addition, newer mHealth technologies have leveraged wearable technologies for tracking physical activity [18,19], social media behaviors [19,20], web-text messaging for weight management [21], and gamification of monitoring symptoms to address cancer-associated pain through self-guidance [22,23].

Technology is rapidly evolving to serve lifestyles globally, therefore, mHealth apps for pediatric patients require further investigation to explore the potential benefit beyond their direct clinical outcomes. A broader perspective should encompass the current state of needs as well as opportunities and challenges for patients and their families. The aim of this systematic search is (a)

to investigate currently available mHealth apps designed specifically for pediatric oncology in mobile app repositories (Google Play Store, Apple App Store), (b) analyze the features and cost of services provided, (c) to conduct a descriptive analysis to inform developers, designers, and clinician scientists. Our study aims to evaluate pediatric cancer-specific mHealth apps that ultimately improve psychosocial and health outcomes in vulnerable populations.

Methods

We performed an observational, cross-sectional, descriptive study of all smartphone apps associated with pediatric cancer available on the iOS and Android platforms.

Mobile app search

The methodology used was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) system (see Appendix 1) [24]. The search was conducted in January 2024. The review used a series of keyword combinations (n=116) through the Apple App Store and Google Play Store. The search terms included; "pediatric", "kid", "teen", "youth", "adolescent", "child", "infant", "little", "minor", "onco-", "teenager", "young", "blood", "bone", "leukemia", "lymphoma", "oncology", "tumor", and "cancer".

Inclusion criteria

Co-authors (MSF, MS, ES, DIJ) reviewed apps for eligibility. For inclusion in the review, apps met the following criteria: (a) specifically related to supporting pediatric cancer patients/families, (b) available in the Apple App Store or Google Play Store as of January 2024, and (c) available in English (not exclusively). Apps that functioned as multi-institutional patient portals were excluded for being too broad to be considered a service for pediatric oncology care. Free apps (no cost), apps for a fee and free trial apps (freemium), and subscription service apps were included. After identification, the information available on each platform was recorded and analyzed. A total of 196 apps were identified in both app stores. A total of 174 apps were excluded, the majority were not related to the search terms or eligibility criteria. Eligible apps (n=37) were assessed for full inclusion. Figure 1 illustrates the PRISMA flow diagram of the review.

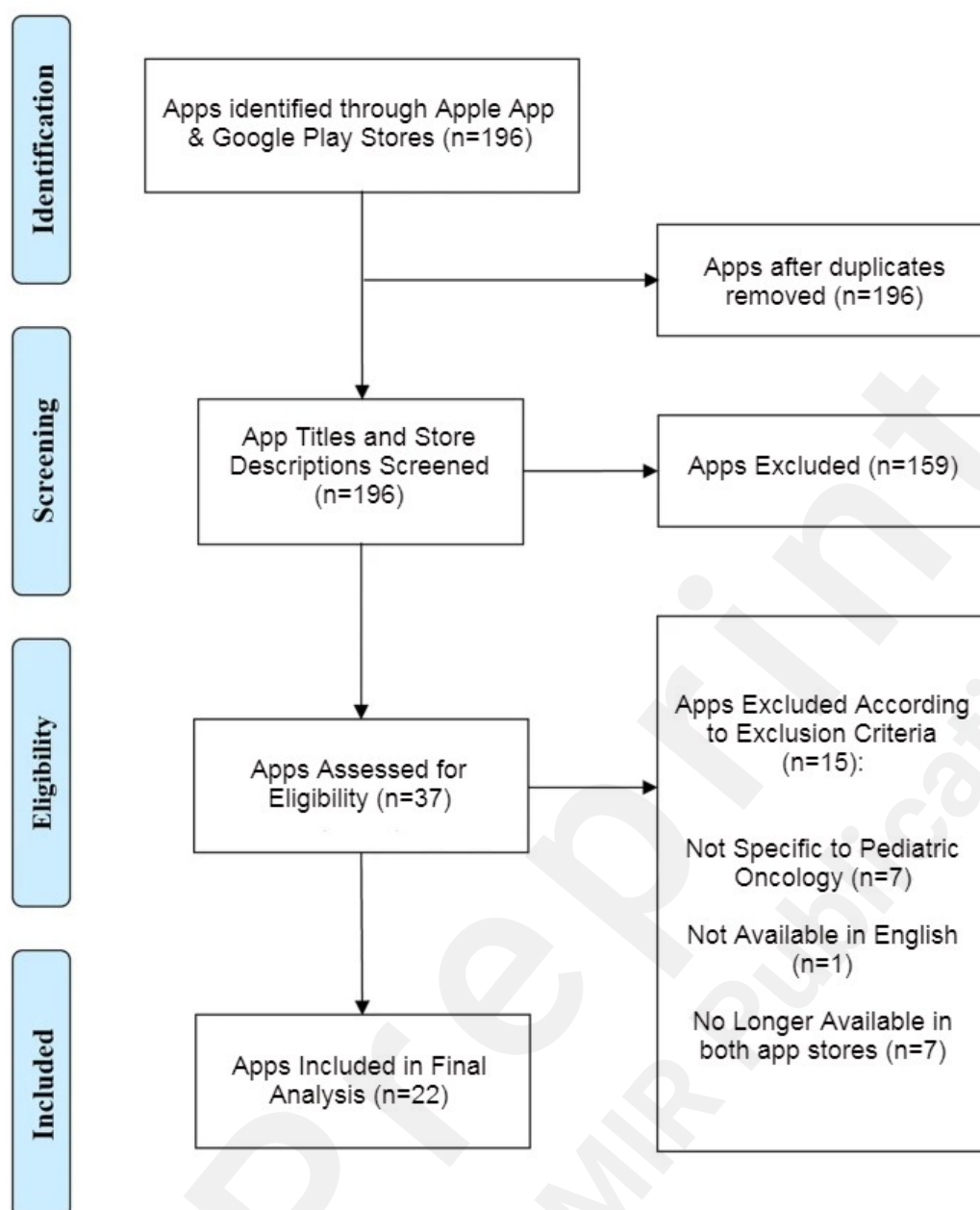


Figure 1. PRISMA Flow Diagram

Data collection and analysis

Data was collected on the following variables from the app stores: descriptions, app rating (out of 5), number of reviews, total cost of services, intended user demographic, file size, supported languages, app privacy and data access requests, latest update, and the app features. App features were determined through reading the app description, reviewing snapshot images provided in the store, downloading the apps from each store, and reviewing the original publisher's website post or press release. Data was recorded on a Microsoft Excel sheet for analysis.

Results

In total, 22 apps were included in this review of pediatric cancer apps within the digital marketplace. Most applications were available in both the Google Play and Apple App Stores while sharing the same features for both Android and iOS users (See Appendix 2). Therefore, our report is based on consolidated data (Google Play and Apple App Store) for each app. More specifically out of 22 apps,

17 of them are available on both marketplaces. The remaining 5 apps were exclusively present on the Apple App Store either because the Google Play Store version was taken down or was never created as a complementary platform of access.

App Features

We grouped and summarized the features of the apps by frequency (see Table 1). The Resource and Information feature was the most frequent property (77%, n=17). This feature allows users to access peer-reviewed guidebooks and video course material related to pediatric cancer. Following that, the Symptom Tracking feature (55%, n=12) allowed users to log journal entries or short reports on their immediate symptoms. Reminders (45%, n=10) let users customize push notifications for important treatment-related events. Connections to Care Teams, Journaling, and Community Support (41%, n=9) provided speed-dial options to oncological healthcare, a logging feature for clinical guidance, and a social component to connect with other pediatric oncology patients or caregivers directly. Medication Tracking and Data Visualization/Graphs (36%, n=8) saved or described dosage instructions and created pictures to describe variables over time such as medication adherence. The Ability to Share Data, Appointment Tracking, and Health Activity Data (27%, n=6) present a repository for users to save important documents to send pictures to a healthcare team, schedule upcoming medical appointments on the app calendar, and record basic aerobics, mindfulness activities, and nutritional habits. Integration with Other Health Apps (9%, n=2) allowed the platform to access other downloaded health and fitness data tracking apps in the patient or caregiver's phone, such as Apple Health or the Fitbit App.

Table 1. Apps and feature distribution

App names	Platform		App features											
	Apple App Store	Google Play Store	Symptom Tracking	Medication Tracking	Appointment Tracking	Information / resources	Push notification reminders	Data visualization / graphs	Ability to share data	Journaling	Connection to care team	Health activity data tracking	Integration with other health apps	Community support
COG KidsCare	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			
Cancer.Net Mobile	✓	✓	✓	✓		✓		✓			✓			
My Cancer Tracker	✓	✓	✓	✓	✓			✓	✓	✓				
CancerAid	✓	✓	✓	✓	✓	✓				✓	✓			✓
NET Cancer Health Storylines	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	
Pain Squad	✓		✓				✓							
iThrive Beyond Peds Cancer	✓		✓			✓	✓							
HomeTown Cancer Predisposition	✓	✓	✓		✓	✓	✓	✓				✓		
Heroes Circle	✓													✓
The Breath Brake App	✓													✓
Kids' Guide to Cancer	✓	✓				✓								✓
The Lounge at MSK	✓	✓				✓			✓		✓			✓
BELONG beating Cancer Together	✓	✓				✓	✓		✓		✓			✓
Medication and Symptom Tracker [Tracker, Reminder - CareClinic]	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Outcomes4Me Cancer Care	✓	✓	✓	✓	✓	✓	✓	✓			✓			✓
iaya	✓	✓				✓				✓				✓
I'll explain it to you	✓					✓								
FORTEe Get Strong	✓	✓				✓						✓		
AYABytes	✓	✓	✓			✓	✓	✓		✓		✓		
Our Journey with Cancer	✓	✓				✓				✓	✓			
LLS Coloring with Kids	✓	✓				✓								
OncoPower	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓
Frequency n (%)	22 (100%)	17 (77%)	12 (55%)	8 (36%)	6 (27%)	17 (77%)	10 (45%)	8 (36%)	6 (27%)	9 (41%)	9 (41%)	6 (27%)	2 (9%)	9 (41%)

Most apps were free-to-use and publicly available. "Medication and Symptom Tracker" had additional in-app purchases (up to \$60 total) that expanded on the existing features of the software.

Age range

Apps were split into 3 groups based on their intended audience. Apps that focused on a pediatric population, between the ages of 0 to 17 years-old, (n=7) used activities designed to interest the younger demographic to convey valuable information or make certain features more accessible from a medical literacy perspective. Apps that focused on caregivers, 18 years and older, (n=9) were more likely to create direct connections to healthcare and generate data visualizations to translate numbers

into meaningful interpretations. The rest of the apps targeted both pediatric patients and caregivers (n=6) such as using different parent/child accounts to separate features among different groups.

User ratings and reviews

The majority of apps (n=18) had user ratings publicly available for review and analysis. Four apps did not receive any user reviews or ratings (Hometown Cancer Disposition, Kid's Cancer Guide, AYABytes, and FORTe Get Strong). Most of the apps had between 1 and 100 posted reviews per app, whereas there were apps that received a high number of user ratings, such as "Medication and Symptom Tracker" (n=3100) and "BELONG Beating Cancer Together" (n=5770). 16 apps received high ratings (M=4.4, Min=3.1, Max=5.0, SD=0.59).

Downloads and storage

CancerAid, Cancer.Net Mobile, BELONG Beating Cancer Together, and My Cancer Tracker were downloaded by greater than 5000 users. The rest of the apps were downloaded by less than 500 users. On average, apps required a relatively small size for storage and saving health-related information (M=67.03 MB, Min=1.70, Max= 235.3, SD= 58.38).

Language availability

To be included, apps were required to have an English option. The majority of the apps provided English exclusively (n=12). However, 10 apps provided multi-language options including Spanish (n=4), French (n=4), Arabic (n=2), German (n=2), Chinese (n=2), Hebrew (n=1), Dutch (n=1), Italian (n=2), Hindi (n=1), Romanian (n=1), and Portuguese (n=1).

Data and Health Information Privacy

Apps typically request access to key hardware or software features built into the device to exercise the full length of capabilities designed into the mHealth app. These requests appear as pop-up notifications the require an input before continuing using the app (M=2.72, Min=0, Max=10, SD=3.13). The types of requests across both app stores included approved access to calendar, files, camera, microphone, location, user ID, device ID, Wi-Fi networks, contacts, and phone status.

Discussion

Principal findings

The principal findings of our systematic search and analysis reveal a noticeable scarcity of pediatric oncology-specific mHealth apps in the digital marketplace, highlighting a critical gap in resources aimed at supporting pediatric cancer patients and their families. Despite the growing prevalence of mHealth solutions in the broader healthcare landscape,[25] our analysis underscores the underrepresentation of pediatric cancer patients in this technological advancement [26]. Similarly Jupp et al.'s earlier review identified only 1 out of 28 qualifying oncology apps that specifically served pediatric patients [27].

The existing apps predominantly focus on educational resources, symptom tracking, and medication reminders. While these features align with general needs within chronic illness management, they often lack the specificity and depth required for the complex care trajectories typical in pediatric oncology, such as a focus on cancers more likely in children than adults, a risk-based medical follow-up, a systematic plan for lifelong surveillance, symptom management, developmental delays or educational disruption, fertility concerns, and prevention measures for long term effects of treatment [28].

Target population

Of the few apps currently available for pediatric cancer, apps were designed to target children and adolescent patients, caregivers, or both user populations. Apps designed for adolescents and young adults (AYA) with cancer are of interest since nearly two-thirds of AYAs within in the US report using an app for health behaviors, including medication reminders [29]. Several studies have reported the informational needs of AYAs in a cancer care app by highlighting features such as free-text diaries. The overarching goal of a cancer care app is expected to help monitor the impact of the disease and treatment in their day-to-day life and emotions [14]. Additionally, there is a need for personalized data to be adapted to a patient's specific condition, considering factors such as the type, history, and severity of cancer,[30] as well as age-appropriate content that addresses topics like diagnosis, treatment options, sustaining social ties, and strategies to manage the illness [31]. These abilities help AYAs to be more independent with self-care, thus easing the transition to adulthood and long-term survivorship [32]. Additionally, more recent pediatric oncology literature has called out the gap in the child's voice, particularly in symptom assessment [33–35]. mHealth apps designed specifically for children could provide that opportunity to improve reporting standards.

Value of apps in patient care

In our study, the majority of the apps focused on educational resources for different user audiences. This is an expected finding as pediatric cancer treatment requires complex treatment regimens, daily medications, intensive side effects, and symptom burden. A major challenge to the oncological treatment plan is managing medication non-adherence/non-compliance. Missed treatments during home care are major causes of increased adverse outcomes including infection, relapse, and death in this vulnerable population [36]. There is evidence to support the efficacy of digital interventions in improving medication adherence, psychosocial well-being, and health outcomes in children and adolescents with chronic health conditions [5]. Thus, digital health tools aimed at improving adherence and alleviating symptom burden could be crucial to improving overall health outcomes.

Inclusivity

Furthermore, our findings highlight a significant language barrier, with more than half of the reviewed apps available exclusively in English. The accessibility of these digital interventions in alternative languages is a step towards closing the gap in care [37,38]. However, this has been an improvement as a review in 2017 cited only 20% of all medication apps were offered alternative languages [32]. In addition, the digital divide between socioeconomic and ethnic groups reduces the availability of such resources to underserved populations including Limited English Proficiency (LEP) patients and families [39,40]. New approaches via mobile apps should be considered, as these platforms can help with medical literacy and build self-care routines among patients and families [41,42]. In addition, developers and decision makers should consider the device compatibility and dependency on cellular connectivity to reduce problems due to inconsistent service, limited storage, data plan requirements, or budget-friendly smartphones that are outside of the regularly maintained cycle of software updates [14,20,32]. Such an approach may support scalable, accessible, and affordable use.

Privacy and security

Finally, data security and privacy are important as patients and families are storing and sharing personal identifiable information and confidential health information via apps. Healthcare institutions create guidelines for handling sensitive data; however, the privacy and security of personal health apps remains the responsibility of end-users. Unfortunately, the Health Insurance Portability and Accountability Act (HIPAA) does not regulate 3rd party apps or their services [43].

Other regulations such as the Children's Online Privacy Protection Act (COPPA) has been a major piece of legislation for protecting child information from 3rd party organizations, yet it has limited protections with regard to healthcare information [44–46]. To ensure adequate protection, app stores hosting mHealth tools should have additional protocols to require justification for the necessity of accessing requested phone sensors and other sensitive health informatics (e.g., camera, location, microphone) [43].

Limitations

This review provided an overview of pediatric cancer specific apps limited to the currently available apps in the Google Play and Apple App Store. We included these two common app stores because they are available in two major smartphone operating systems (iOS and Android) and are accessible by majority of end users [47]. We have not included other stores, such as the Galaxy Store or Amazon Appstore, due their limited user base and specific to requirements for service (i.e., the Amazon Appstore requires additional app installations) which may not be applicable for broader audience of pediatric oncology patients and caregivers. We focused on the US market for available apps as both app stores are regionally locked due to our physical location. In addition, we focused on apps available in the English language with additional language options. That limited our access to other apps that do not include English language as an option, or alternative apps for different regions or languages. Further research is suggested to investigate apps following a standardized quality assessment [48]. We were not able to use content or sentiment analysis with user comments because not all apps had a sufficient volume of comments to be analyzed. Finally, the apps are dynamic and subject to change depending on developer updates and business, and some apps could be removed from these stores for any reason, which may reduce the ability to replicate this review with the same set of apps.

Conclusions

Our review examined the landscape of mHealth apps for pediatric cancer. While mHealth apps hold promise for enhancing care and support for pediatric cancer treatment, our findings underscore the need for more inclusive, comprehensive, and integrated digital health solutions. Future development efforts must prioritize the involvement of pediatric oncology stakeholders, including patients, families, and healthcare professionals, to ensure that the apps are not only technically sound but also deeply aligned with the specific needs, reducing linguistic and cultural barriers. In addition, they should focus on evidence-based implementations. The complexity of pediatric cancer is a multifaceted challenge, and mHealth apps can bridge the gaps to become a fundamental source of support for patients and caregivers from diagnosis to survivorship.

Conflict of interest

ES is editorial board member of JMIR as an associate editor.

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Supplementary Files