Contemporary Clinical Trials 85 (2019) 105819

Contents lists available at ScienceDirect

Contemporary Clinical Trials

journal homepage: www.elsevier.com/locate/conclintrial

Scalability of cancer SurvivorLink™: A cluster randomized trial among pediatric cancer clinics

Cam Escoffery[a,*], Jordan Gilleland Marchak[b], Regine Haardörfer[a], Lillian Meacham[b], Rebecca Williamson Lewis[c], Hallie Udelson[a], Paula Edwards[d], Ann C. Mertens[b]

[a] Rollins School of Public Health, Emory, 1518 Clifton Road, Atlanta, GA 30322, USA
[b] Department of Pediatrics, Emory University; Aflac Cancer and Blood Disorder Center, Children's Healthcare of Atlanta, 1405 Clifton Rd, Atlanta, GA 30322, USA
[c] Aflac Cancer and Blood Disorder Center, Children's Healthcare of Atlanta, 1405 Clifton Rd, Atlanta, GA 30322, USA
[d] Himformatics, 1579 Monroe Drive NE, Suite 410, Atlanta, GA 30324, USA

ARTICLE INFO

Keywords:
Cancer survivor
Child
Medical records
Health behavior
Health education
Surveys and questionnaire

ABSTRACT

Background: Children diagnosed with cancer are living longer and the survivor population is growing. However, most survivors develop late effects of radiation and chemotherapy shortly to years after completion of therapy, and the receipt of follow-up visits that are recommended by the Children's Oncology Group (COG) is suboptimal nationally.

Aims: The aims of this study are to: 1) evaluate the impact of a patient-controlled electronic personal health record (ePHR) and system (SurvivorLink) on care visit attendance, risk-based surveillance, and other secondary outcomes (i.e., patient activation, quality of life (QOL)); 2) measure the use, acceptability, and perceived usefulness of, and satisfaction with SurvivorLink; and 3) assess facilitators and barriers to implementation.

Methods: This hybrid effectiveness–implementation, clustered randomized control trial (RCT) evaluates the effect of SurvivorLink among pediatric cancer survivors and their parents on receipt of follow-up cancer care. We will recruit 20 pediatric survivor clinics with half receiving the intervention and half acting as a waitlist control. Parents of survivors and survivors will complete baseline, 3 and 12 month surveys that assess SurvivorLink use, patient self-efficacy, and intentions to return for follow-up. We will use mixed methods and multi-informant assessment to assess implementation outcomes (i.e., acceptability, feasibility, appropriateness).

Discussion: New approaches are needed to facilitate the receipt of long-term follow-up care among pediatric cancer survivors. This study will assess whether SurvivorLink is effective in increasing receipt of follow-up cancer care. Moreover, it will explore the influences of context and other moderators of clinical practice change in pediatric cancer survivorship.

1. Introduction

Due to improvements in cancer therapy over the past three decades, children diagnosed with cancer are living longer and the survivor population is growing. Data from the National Cancer Institute show that the overall 5-year survival rate for childhood cancer has increased from 45% in 1970 to over 84% in 2014 [1]. However, childhood cancer and its subsequent treatment predispose survivors to a higher risk of certain life-threatening and debilitating diseases called late effects [2]. Numerous reports and reviews of late effects of chemotherapy and

Abbreviations: CAI, Context Assessment Index; CFIR, Consolidated Framework for Intervention Research; COG, Cancer Oncology Group; COG LTFU, Guidelines Cancer Oncology Group Long-term Follow-up Guidelines; EBIs, Evidence-based interventions; EBPAS-36, Evidence-Based Practice Attitude Scale-36; EMR, electronic medical record; ePHR, electronic personal health record; IOM, Institute of Medicine; LTFU, long-term follow-up; MSEM, multilevel structural equation modeling; NCI, National Cancer Institute; PAM, Patient Activation Measure; PedsQL, Pediatric Quality of Life Inventory; PROMIS, Patient-Reported Outcome Measurement Information System; PSAT, Program Sustainability Assessment Tool; QOL, quality of life; RE-AIM, Reach Effectiveness Adoption Implementation and Maintenance Framework; RTQ-Provider, Readiness for Transition Questionnaire-provider version; REP, Replicating Effective Programs model; RTIPs, Research-Tested Intervention Programs; SCP, survivorship care plan; TAM, Technology Acceptance Model

* Corresponding author at: Rollins School of Public Health, Emory University, 1518 Clifton Road, NE, Atlanta, GA 30322, USA.
E-mail addresses: cescoff@emory.edu (C. Escoffery), jgillel@emory.edu (J. Gilleland Marchak), regine.haardoerfer@emory.edu (R. Haardörfer), lillian.meacham@emory.edu (L. Meacham), rebecca.lewis@choa.org (R. Williamson Lewis), hallie.udelson@emory.edu (H. Udelson), pedwards@himformatics.com (P. Edwards), amerten@emory.edu (A.C. Mertens).

https://doi.org/10.1016/j.cct.2019.105819
Received 11 April 2019; Received in revised form 31 July 2019; Accepted 5 August 2019
Available online 07 August 2019

radiation describe the sequelae that may present after cancer shortly following the end of active treatment until years after the completion of treatment [3–6]. These publications show that type and intensity of therapy, as well as age at therapy, are important factors in determining both overall survival and risk for developing late effects [7–11]. Long-term follow-up of pediatric cancer survivors has found that the cumulative incidence of chronic health conditions by age 45 years is 95.5%. Moreover, 80.5% of survivors have conditions graded as serious, life threatening, or disabling [12]. Pediatric cancer survivors often have more than one chronic condition; 38% reported having at least two conditions and 24% reported having three or more conditions [13]. In addition, survivors experience increased cause-specific mortality from subsequent malignancy (Standardized Mortality Ratio [SMR] = 15.2), cardiac (SMR = 7.0), and pulmonary (SMR = 8.8) causes relative to the general US population [14].

These data summarized above clearly indicate that cancer survivor care should be lifelong and include monitoring for early detection and treatment of late effects. A panel of experts and medical specialists working with the Children's Oncology Group (COG) developed the Long-Term Follow-Up Guidelines for Survivors of Childhood, Adolescent and Young Adult Cancers (LTFU Guidelines) to improve individual monitoring for specific late effects [15,16]. These evidence-based guidelines, organized by therapeutic exposure, include a list of all late effects associated with that treatment and screening tests that are recommended for each late effect. Aligned with the Institute of Medicine (IOM)'s call for survivorship care plans for all cancer survivors [17], the COG LTFU Guidelines can be used to develop survivorship care plans for pediatric cancer survivors that include survivors' cancer treatment summary and individualized late effects risk profile and surveillance plan. The personalized survivorship care plan serves as a guide to long-term follow-up care for the patient and their healthcare providers.

1.1. Challenges of follow-up cancer survivor care

Currently, the COG recommends that pediatric cancer patients be referred to a cancer survivor program for evaluation at two years after the completion of cancer therapy, with regular follow-up visits thereafter. In addition to follow up in a survivor program, survivors often require medical care from a number of other healthcare providers in both primary and subspecialty fields. Many of these healthcare providers are unaware of the complex medical needs of pediatric cancer survivors [18]; consequently, cancer survivors or their parents are often left to ensure these providers are aware of their pediatric cancer history and recommended surveillance tests. Communication with and between a survivor's various healthcare providers can be challenging but crucial, particularly during times of a health crisis, move to a new city, or acquisition of a new provider(s) during the transition from the pediatric care system to the adult care system, for example.

1.2. Evidence-based pediatric cancer survivorship interventions

Promotion of evidence-based, cancer survivorship interventions to improve lifelong survivor care and quality of life is in its infancy. A review of the National Cancer Institute's Research-Tested Intervention Programs (RTIPs) website yielded only 19 interventions for survivorship/supportive care, a majority of which were supportive care interventions for adults diagnosed with cancer [20]. Only one intervention (Surviving Cancer Competently Intervention Program (SCCIP) centered on pediatric cancer survivors. Further, a recent review examined the application of implementation science across the cancer control continuum and found only 6% of NCI-funded implementation science grants (n = 4) were focused on survivorship [21].

Cancer SurvivorLink™, www.cancersurvivorlink.org, was created to improve patient-provider communication and increase adherence to survivor care recommendations. SurvivorLink is a patient-controlled electronic personal health record (ePHR) where users can upload and store their important health documents and electronically share their health record with all of their healthcare providers who are registered on SurvivorLink. If the clinic where they receive survivor care has an affiliation with SurvivorLink, registrants have the opportunity to affiliate with their survivor clinic, allowing the clinic to upload health documents on their behalf [19]. The SurvivorLink functionality allows survivor clinic users to manage patients who select them as their clinic, the medical record release requirements of their institution, and the relationship with their own survivors. Educational materials about survivor care and late effects of cancer therapy are also available for patients/parents and providers.

1.3. Aims and objectives

To address this gap of effective pediatric survivorship interventions in the literature, this is the first study to conduct a hybrid I effectiveness-implementation trial of a survivorship intervention in the pediatric survivor clinic setting. The overarching goal is to implement SurvivorLink in pediatric survivor clinics to improve a survivor's adherence to late effects surveillance. The overall aims of this study are to examine how context influences the implementation and sustainability of SurvivorLink and to assess its impact on survivor's adherence to cancer survivor care and late effects screening. Key objectives are:

1. Develop a standardized process to implement SurvivorLink within pediatric cancer clinics.
2. Determine the impact of SurvivorLink on patient outcomes, including survivor clinic attendance and engagement in risk-based surveillance, as well as patient reported outcomes including quality of life (QOL) and health self-efficacy.
3. Evaluate the uptake, acceptability, and utilization of SurvivorLink among childhood survivors/parents and at the clinic level.
4. Assess the integration of SurvivorLink into pediatric survivor clinics' workflows and identify contextual facilitators and barriers to implementation.

2. Methods

2.1. Trial design

Using the Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) framework and the Consolidated Framework for Intervention Research (CFIR) [22,23] the study design is a hybrid 1 effectiveness-implementation, clustered randomized waitlist control trial, considering pediatric survivor clinics as units of clustering. The intervention will be packaged for delivery and training materials will be developed in Year 1 of the study. We will recruit pediatric clinics in Year 2 and implement the program in Years 2 (intervention) and 3 (waitlist). The Emory IRB has approved the study protocol.

2.2. Study population

2.2.1. Pediatric survivor clinics

The COG, a National Cancer Institute supported clinical trials group, is the world's largest organization devoted exclusively to childhood cancer research [15]. Of 14,000 children and adolescents diagnosed with cancer each year in the United States > 90% are cared for at COG member institutions.

For this trial, 20 pediatric survivor clinics will be recruited from COG centers. According to the most recent data, 130 of the 220 COG centers (59%) reported having a designated pediatric cancer survivor clinic (i.e., presence of late effect clinics/services) with a specialized late effects provider(s) that followed recommended clinical practice as described in the COG LTFU Guidelines [24]. Additionally, clinics must meet the following eligibility requirements: 1) provide a survivorship

care plan to survivors seen in clinic, 2) see > 100 pediatric cancer survivors annually, 3) be willing to become a SurvivorLink partner clinic and complete a Business Associates Agreement with Emory University, and 4) be able to enroll a minimum of 75 patients in one year.

2.2.2. Patients

Eligibility criteria for this study include that survivors be at least two years off therapy and attendance at a pediatric cancer survivor clinic. Each survivor clinic will document number of eligible patients approached and if they choose to register on SurvivorLink. Clinic staff will approach caregivers/parents of survivors < 18 years old and survivors 18–22 years of age who are either English or Spanish speaking during their clinic visit to assess their interest in participation in this study. The only exclusion criterion is having a terminal diagnosis.

2.2.3. Randomization

Pediatric cancer survivor clinics will be randomized to either the SurvivorLink arm or the waitlist control arm in Year 2 of the study. Clinics will be matched in pairs based on patient population size, level of current survivorship care, and location (urban/rural) using the urban/rural continuum codes [25]. The clinics will be block randomized in groups of 2 or 4 and one member of each pair will be randomly assigned to the SurvivorLink arm and the other to the waitlist arm. See Fig. 1 for the CONSORT diagram for our clustered randomized trial.

2.3. SurvivorLink implementation

The core elements of SurvivorLink implementation are: 1) training of clinic staff; 2) education and registration of childhood cancer survivors and/or their parents; 3) distribution of the survivorship care plans to survivors via SurvivorLink; and 4) management and tracking of survivor and parent use of SurvivorLink. To increase the fit of the program, some adaptations of core elements (Elements 2 and 3) in the format of content and delivery will be allowed given the different infrastructure of the clinics.

Applying principles of the Replicating Effective Programs (REP) model [26], all training materials for SurvivorLink will be standardized and packaged in a toolkit with supporting materials. Stakeholders serving on the SurvivorLink Advisory Board will review the toolkit for user-friendliness of the protocol, training, and tools, and any missing information. This Board currently includes a pediatric cancer nurse practitioner and oncologist, family physician, representatives from patient advocacy groups, and parent and patient members. The Board will be expanded to include representatives from the COG's Survivor and Outcomes Committee beginning in Year 1 and patient/parent and provider stakeholders from participating institutions in subsequent years.

Training of clinic directors and staff at randomized clinics will be conducted through webinars, PowerPoint presentations and use of the toolkit. During the training, the SurvivorLink team will provide an

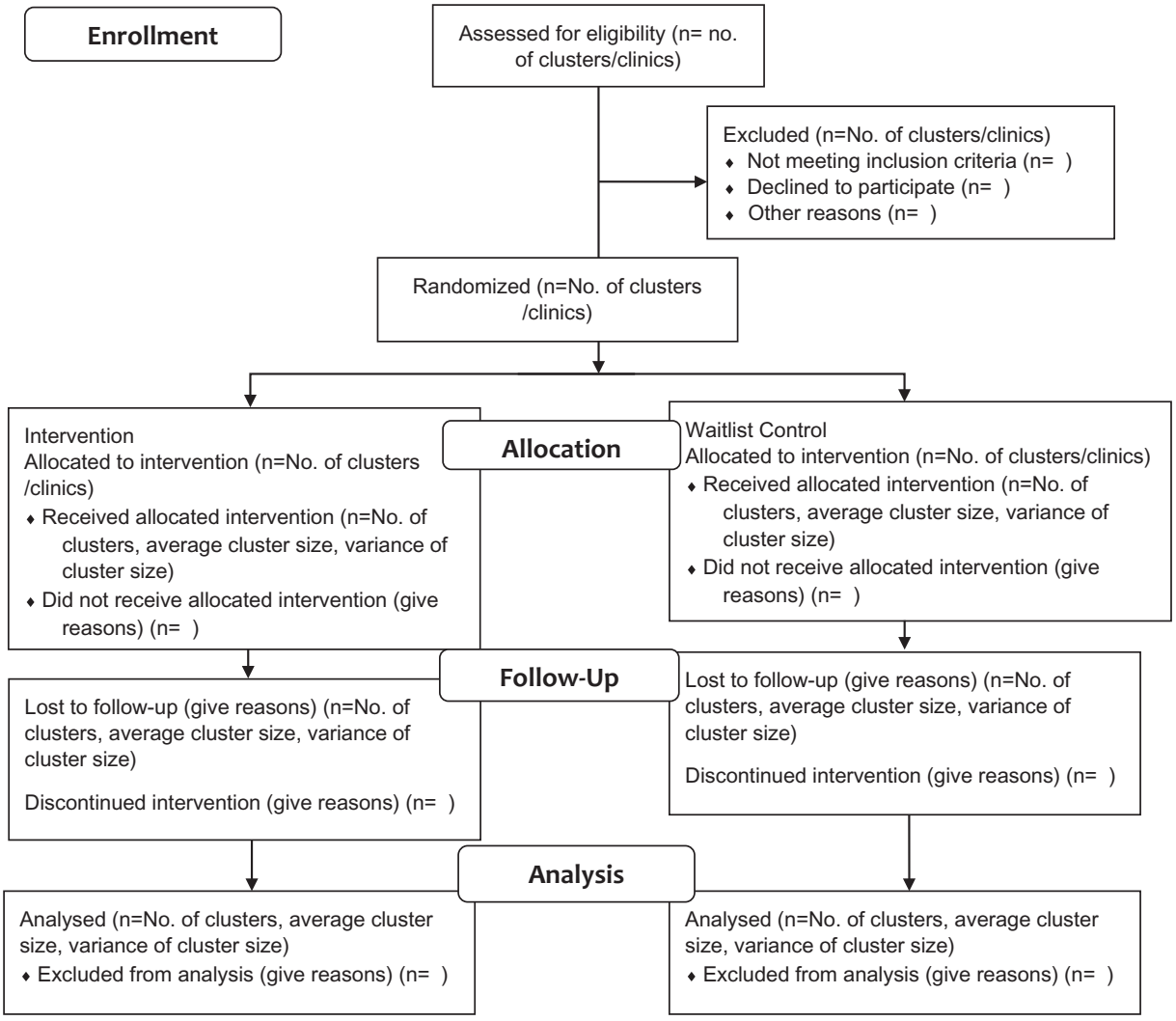

Fig. 1. Clustered RCT CONSORT flow diagram.

overview of the intervention, a logic model of program elements leading to key healthcare outcomes, key intervention components, and the system itself. They will demonstrate the functionality of SurvivorLink from all user perspectives (patient, parent, and clinic). In addition, discussions will apply principles of workflow design to 1) ensure fit of the core elements into their clinic workflow, and 2) map clinic flow to determine possible places to integrate the introduction, registration and follow-up reinforcement of SurvivorLink. Finally, a readiness for implementation tool and a fidelity checklist will be discussed and shared. Clinic staff will be allowed to ask questions during the training or submit questions at any time for technical assistance via email or phone calls. Clinic staff will also be trained on education and registration of users, distribution of the survivorship care plan (SCP) and uploading of each patient's SCP into their SurvivorLink account, and user management and tracking of registration by their patients.

2.3.1. Intervention - SurvivorLink arm

Once randomized to the SurvivorLink arm, clinic directors will be contacted to schedule the initial training and will be sent the SurvivorLink toolkit. Each site will be individually trained to allow for tailoring for their current workflow.

To enroll survivors in SurvivorLink, clinic staff will verbally assess participants' health literacy, and if they have access to the Internet (either computer or smartphone) [27]. After obtaining consent and assent as appropriate, clinic staff will use a script explaining the purpose of SurvivorLink and how to register for the website. Adolescent survivors (ages 15–17) who provide assent, will create a SurvivorLink account and their parent will then share their health record with them.

2.3.2. Control - waitlist intervention arm

Clinics randomized to the waitlist arm will receive the intervention in Year 3 of the study. After the year of data collection from waitlist clinics, the waitlist control cancer clinics will then be individually trained and will implement the SurvivorLink program at their sites. In the waitlist clinics, survivors will be enrolled via a method that is similar to the one described above for the intervention clinics.

2.4. Data collection procedures

The sources of data for this study include: usage data automatically captured by SurvivorLink, patient- and parent-reported outcomes collected via surveys, and medical records abstraction. All patient and parent level data will be collected and managed via REDCap [28]. All consented parents and survivors in both the intervention and waitlist clinics will complete 3 surveys – at baseline (T1), 3-months (T2), and 12-months (T3) (Fig. 2). In Year 2, data will be collected from those who receive survivor care from a waitlist clinic. Data collection will include baseline, 3-month and 12-month follow-up surveys similar to the intervention group. The full set of surveys (with SurvivorLink questions) will be distributed in Year 3, during their intervention year. A subset of adolescents will also complete a 3- and 12-month survey regarding their use, feedback about SurvivorLink, and other self-management scales (e.g., readiness to transition to adult healthcare). Table 1 shows the primary and secondary measures for the effectiveness study.

2.4.1. Objective 1. Measures of impact on survivor care and quality of life

The effectiveness outcomes of interest for this study consist of two broad categories: 1) one year follow-up cancer care visit and other utilizations (risk based tests/visits, general medical care) or recommended services to other sub-specialists (cardiology, nephrology, neurology, psychology) abstracted from medical records, constituting our primary endpoints, and 2) diverse domains of parents' and survivors' patient activation, quality of life, intentions to seek follow-up care, as well as perceived attitudes about the intervention. Institutional medical records will be reviewed to assess whether survivors attended recommended cancer survivor clinic one-year follow-up visit and completed other screening. Parent's patient activation, QOL, and self-efficacy will be collected through the online patient self-report surveys. Covariates are the patients' cancer and treatment history, demographics and technology use assessments.

2.4.2. Objective 2. Process measures of parents and adolescents

A process evaluation of the uptake of SurvivorLink will be conducted to measure use, participation, acceptability, perceived usefulness and satisfaction among childhood survivors and their parents. SurvivorLink automatically captures when a user registers, verifies their account, creates their health record, stores and/or access a health document and the total number of times a user logs in, these data analytics will be used to describe the reach of SurvivorLink (% of approached parents/patients who register). Participants will provide permission for study staff to monitor SurvivorLink site utilization during the study period through the dashboard and Google Analytics. Parents and adolescents will also be surveyed about SurvivorLink to assess uptake, intervention use, frequency participation, acceptability, perceived usefulness and satisfaction of SurvivorLink.

2.4.3. Objective 3. Measures of survivor clinic reach, adoption and integration (implementation outcomes)

Our primary implementation outcomes for this aim are reach, adoption and level of implementation of SurvivorLink by clinics from the RE-AIM framework. For reach, clinic staff will collect information from both the intervention and control clinics on who was approached, who participated and reasons for non-participation, and steps taken for registration on SurvivorLink. Socio-demographic information on all survivors will be obtained from clinic medical record review.

Adoption is defined as the number of clinics that establish a clinic portal in SurvivorLink and measure level of adoption (e.g., phases - formative to full implementation). We will create a composite score of completion of its 4 core elements as an index of implementation. At baseline, clinics will complete an organizational profile (e.g., size, late effects clinic services, age of survivors, etc.) and other clinic adoption scales. These same measures will be assessed at follow-up with the addition of the Sustainability Model at 12 and 24 months post-implementation [29].

The clinic implementation phase of the hybrid study will involve mixed methods data collection through surveys and interviews. Online surveys will be completed by the designated clinic Project Manager at baseline and 12-month follow-up, who will be instructed to consult with clinic records or other staff as needed to provide full and accurate responses. At baseline and 12-month follow-up, there will also be 1-hour in-depth interviews to assess the level of implementation with the Project Manager, a survivorship clinic provider, and another staff member closely involved in using SurvivorLink (may be a provider, social worker, nurse, or other staff position) for each site.

In our in-depth interviews, the CFIR will be used to explore the implementation process as well as constructs influencing adoption, implementation, and maintenance [44]. We will also draw from the Technology Acceptance Model (TAM) to identify specific intervention characteristics that may be particularly relevant for adoption and implementation of technology interventions such as SurvivorLink [45]. Interview questions will be adapted from prior interview guides; see Table 2 below for questions that map to selected CFIR constructs.

Secondary implementation outcomes will also be explored and focused on maintenance and sustainability of SurvivorLink. The timeframe for this study does not allow us to assess early maintenance beyond 2 years; we will focus on capacity for sustainability and plans for maintenance in Year 1 and its continuation in Year 2. Capacity for sustainability (RE-AIM) will be measured at 12 and 24 months through clinic surveys using the Program Sustainability Assessment Tool (PSAT), and the Sustainability Model [29,46]. Additionally, our in-depth interviews will include questions about the clinic's plans to

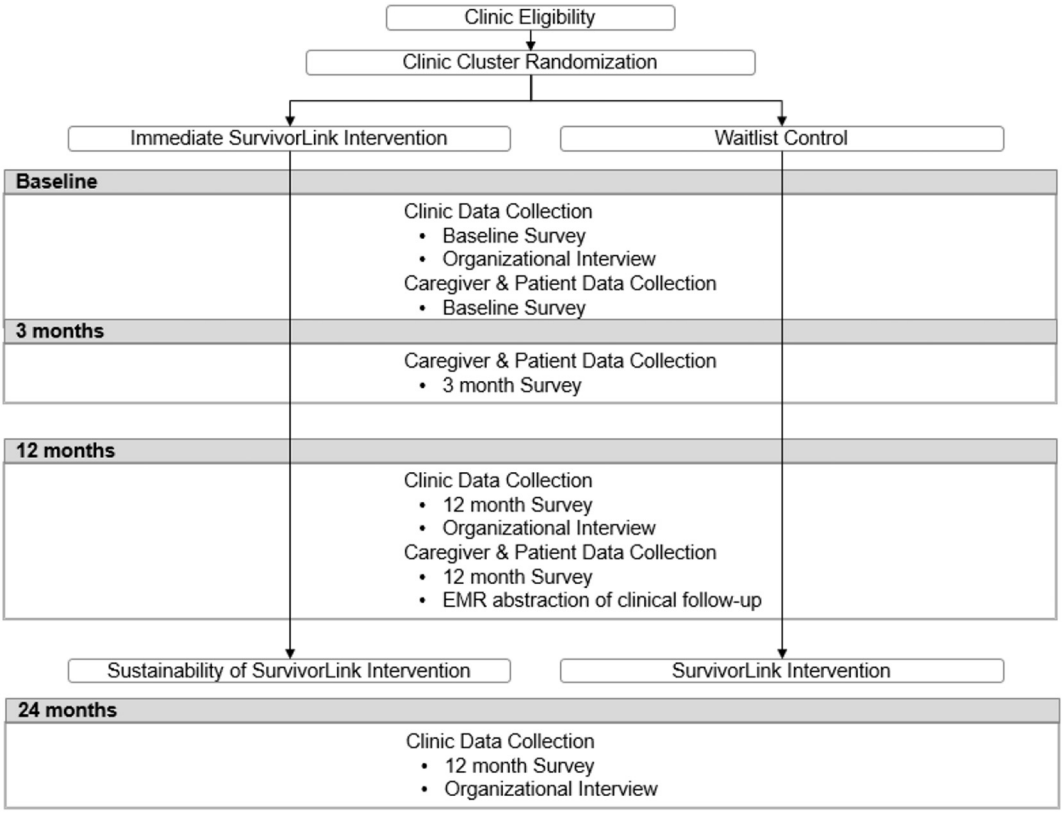

Fig. 2. Hybrid I effectiveness-implementation trial flowchart.

Table 1
Primary and secondary intervention effectiveness outcomes.

Primary Outcomes
Validated 1-year follow-up survivor care visit from electronic medical record (EMR)
Other follow-up tests and surveillance screenings from EMR
Secondary Outcomes and Measures
Parent/Survivor's patient activation
Patient Activation Measure (PAM) [30]
Changes in Parent/Survivor's quality of life
Patient-Reported Outcome Measurement Information System (PROMIS®) Global-10 [31–34]
PROMIS® Scale v1.2 – Global Health [35]
Changes in Parent/Survivor's self-efficacy to manage chronic disease: Adapted from Chronic Disease Self-efficacy Scale [36]
Changes in young adult survivors' readiness for transition to adult-oriented care
Readiness for Transition Questionnaire (RTQ) [37]
Overall satisfaction with oncology care
25-item Pediatric Quality of Life Inventory® Healthcare Satisfaction Hematology/Oncology Specific Module (PedsQL® Healthcare Satisfaction Hematology/Oncology Specific Module) [38]
Barriers to follow-up care
What are reasons for your/your child missing the annual follow-up appointment?
Creation of question with responses from literature [39]
Clinic Adoption scales
SurvivorLink readiness to implement scale [40]
Evidence-Based Practice Attitude Scale-36 (EBPAS-36) [41]
Context Assessment Index (CAI) (context, culture, leadership, evaluation [42])
Organizational Readiness to Change Assessment (ORCA) [43]

maintain Survivor Link.

2.5. Data analysis

2.5.1. Health outcomes

We will use PROC GLIMMIX to compare baseline demographics in the intervention and the control clusters for both baseline and follow-up samples to assess how well the randomization procedure worked and conditional attrition. Next, we will use multilevel modeling to assess the intervention impact. Multilevel modeling allows to model both individual-level and clinic-level variances, predictors, and cross-level interactions simultaneously [47–49]. This allows for unbiased estimates of effects. For the main outcome of one-year follow-up cancer visit, we will assess the impact of the intervention using hierarchical binary logistic regression adjusting for individual and cluster-level covariates while accounting for unmeasured differences between clusters. Models will be built sequentially, adding first individual level covariates, then clinic-level covariates, and finally the intervention assignment [47]. For secondary outcomes, multilevel models with the appropriate link function (i.e., linear for continuous outcomes, Poisson for count outcomes, binary for dichotomous outcomes) will be built similarly to those for the main outcome. Given the moderate number of clusters, Mplus will be used to calculate unbiased 95% confidence intervals [50].

2.5.2. Implementation outcomes

We will document the number of clinics that adopt SurvivorLink by establishing a clinic portal. Reach will be calculated as the proportion of eligible patients that register for SurvivorLink and effectiveness will be measured by the proportion of eligible patients that meaningfully use SurvivorLink (upload/store a document to their health record, download a stored document, and/or share their record with a registered provider). We will also assess which types of patients are more likely to register for or use it considering demographic characteristics (i.e., race), therapeutic exposure, patients vs. parents, and proximity to transition out of pediatric cancer center care.

We will conduct weighted clinic-level analyses (using *t*-tests), adjusting adoption, reach, summary implementation and sustainability scores due to estimated variances [51]. We will also use multilevel structural equation modeling (MSEM) to assess mediators to implementation (i.e., attitudes toward evidence, organizational readiness). Additionally, we will assess moderators to reach, level of implementation, capacity for sustainability and sustainability index based

Table 2
Consolidated framework for implementation research (CFIR) selected constructs for interviews.

Domain and construct	Sample areas for questions
Intervention characteristics	Flexibility/Adaptability of program, Complexity of use, Cost of staff time to deliver, Relative Advantage to clinic's performance
Process	Engaging opinion leaders, Champions for process change, Executing for optimal workflow
Individuals involved	Knowledge, Beliefs, Efficacy and skills sufficient to implement SurvivorLink
Inner setting	Structures currently within clinic to deliver program, Climate-compatibility with current clinic practice, Leadership engagement in delivering program
Outer setting	Patient needs and resources, Barriers and facilitators to meet needs, Partnerships for survivorship care, External policies or incentives parent

on organizational characteristics and inner/outer context variables. These data will inform important facilitators and challenges to implementation (in addition to the qualitative data on process) to discuss in training materials, webinars and future technical assistance with cancer clinics. HLM7 and Mplus 8 will be used to estimate the general multilevel and MSEM models. We will run descriptive statistics on process evaluation questions and compile open-ended comments related to users' reactions, thoughts about the intervention and suggestions for improvements.

We will assess RE-AIM and organizational-level outcomes focused on implementation and sustainability through the interview data that will be transcribed verbatim. NVivo 10.0 will be used for text coding of the transcripts and to facilitate the organization, retrieval, and systematic comparison of data across a range of dimensions (e.g., clinic size, geographic region, patient demographics). A codebook will be developed from the first set of transcripts, using CFIR. We will use standard content analysis methods to identify themes, as well as site-ordered matrices [52]. Qualitatively, we will use site-ordered matrices (ordered by overall reach) to identify patterns in level of implementation by selected CFIR constructs and how context affects level of implementation and sustainability (salient inner and outer setting variables). We will also “converge” data by creating tables with qualitative data side by side with quantitative findings [53,54]. Salient themes will inform future changes to intervention content, technical assistance and training, and delivery in discussions with Advisory Board.

2.5.3. Power calculation

We conducted power calculations based on the following assumptions: A meaningful effect size of 10 percentage point differences between the two arms and 20% attrition. We also pre-determined a cluster size of 75 patients per clinic as feasible. Furthermore, we assumed a conservatively high (especially for a matched-pair design) intra-class correlation of 3% [55,56]. Close-form solutions are available for our design by Moerbeek and Teerenstra [55] and indicate the need for 20 clinics for adequate power for a small effect for follow-up visit based on our preliminary study (to detect mean difference of 10%) [57]. Thus, we determined the need for 75 patients each from 20 clinics yielding a total baseline sample size of 1500. Parallel, we determined that this sample size will also allow us to detect a small to medium effect size of $d = 0.26$ or larger for continuous outcomes, such as quality of life. One review has found small effects on psychosocial variables for SCP interventions to date [50].

3. Discussion

The Institute of Medicine (IOM) recommends all cancer patients should receive a survivorship care plan; however, scant research has explored how interventions which provide summary care documents have impacted a survivor's utilization of health care, and adherence to surveillance guidelines [58]. Although web-based tools, including electronic personal health records (ePHRs) to facilitate long-term follow-up (LTFU) have been called for in the childhood cancer survivor literature [59,60], very little is currently understood about ePHR use in this survivor population [61]. SurvivorLink functions as a web-based, patient-controlled communication tool for shared care. This ePHR system transcends the inability of different electronic medical record systems to exchange information, and allows cancer survivors to store and share their SCP and other health documents to promote and support delivery of evidence-based survivor care.

The number of visitors to SurvivorLink has been steadily increasing, and in 2017 alone Survivor Link had 1526 unique visitors. While our recruitment efforts have been focused on the state of Georgia, we have had visitors from all 50 states and 116 countries. We currently have over 1600 registered users including 719 caregivers/parents of survivors < 18 years, 622 young adult patients, 303 healthcare providers. Our team's previous work has demonstrated that SurvivorLink™ can serve as an important bridge for young adult patients who transfer their care [57]. Young adult SurvivorLink registrants who transferred to adult care during an observational study of SurvivorLink usage were more likely to be meaningful users (uploaded or downloaded a document from their survivor health record and/or shared their record) (aOR: 2.6 (95% CI: 1.1, 6.1)) and used the ePHR twice as frequently as those who continued to receive care in our institution's pediatric survivor clinic.

Our proposed research has numerous strengths. Importantly, it will contribute to implementation science by exploring context and other mediators and moderators of clinical practice change and by developing a clearinghouse of outer setting measures. Second, it will advance the field of pediatric cancer and offer the first hybrid effectiveness-implementation study to evaluate the impact of a technology-based, survivor health record and education system for pediatric cancer survivors and their parents. The achievement of these aims will help to promote evidence-based cancer survivor care to improve health and quality of life (QOL) of pediatric cancer survivors nationally.

Funding

This research is supported by the National Cancer Institute of the U.S. National Institutes of Health (R01CA218389). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. The project funders had no role in the design of the study or in writing the manuscript. No financial disclosures were reported by the authors of this paper.

Authors' contributions

CE, AM, RH, JM, RL, PE, and LM were involved in various stages of the study design. CE and AM conceptualized the study, and all helped to design the study questions. CE, AM, RH, JM, RL, LM and HU wrote the first draft. All authors read and approved the final manuscript.

Ethics approval and consent to participate

This study was approved by the Institutional Review Board of Emory University.

Declaration of Competing Interest

The authors declare that they have no competing interests.

References

[1] N. Howlader, A. Noone, M. Krapcho, J. Garshell, N. Neyman, S. Altekruse, SEER Cancer Statistics Review, 1975–2014. Bethesda, MD, (2016).

[2] K.C. Oeffinger, M.M. Hudson, Long-term complications following childhood and adolescent cancer: foundations for providing risk-based health care for survivors, CA Cancer J. Clin. 54 (4) (2004) 208–236.

[3] M.M. Hudson, D.A. Mulrooney, D.C. Bowers, C.A. Sklar, D.M. Green, S.S. Donaldson, et al., High-risk populations identified in childhood cancer survivor study investigations: implications for risk-based surveillance, J. Clin. Oncol. 27 (14) (2009) 2405–2414.

[4] L.K. Zeltzer, C. Recklitis, D. Buchbinder, B. Zebrack, J. Casillas, J.C. Tsao, et al., Psychological status in childhood cancer survivors: a report from the childhood cancer survivor study, J. Clin. Oncol. 27 (14) (2009) 2396–2404.

[5] K.K. Ness, M.M. Hudson, J.P. Ginsberg, R. Nagarajan, S.C. Kaste, N. Marina, et al., Physical performance limitations in the childhood cancer survivor study cohort, J. Clin. Oncol. 27 (14) (2009) 2382–2389.

[6] C.L. Schwartz, W.L. Hobbie, L.S. Constine, K.S. Ruccione, Survivors of childhood and adolescent cancer. 2 ed. St. Louis, Missouri, USA, Springer-Verlag Berlin Heidelberg, 2005.

[7] N. Marina, Long-term survivors of childhood cancer. The medical consequences of cure, Pediatr. Clin. North Am. 44 (4) (1997) 1021–1042.

[8] M.M. Hudson, A.C. Mertens, Y. Yasui, W. Hobbie, H. Chen, J.G. Gurney, et al., Health status of adult long-term survivors of childhood cancer: a report from the childhood cancer survivor study, JAMA 290 (12) (2003) 1583–1592.

[9] M.M. Hawkins, Long-term survivors of childhood cancers: what knowledge have we gained? Nat. Clin. Pract. Oncol. 1 (1) (2004) 26–31.

[10] J.D. Dickerman, The late effects of childhood cancer therapy, Pediatrics 119 (3) (2007) 554–568.

[11] L. Pogany, R.D. Barr, A. Shaw, K.N. Speechley, M. Barrera, E. Maunsell, Health status in survivors of cancer in childhood and adolescence, Qual. Life Res. 15 (1) (2006) 143–157.

[12] M.M. Hudson, K.K. Ness, J.G. Gurney, D.A. Mulrooney, W. Chemaitilly, K.R. Krull, et al., Clinical ascertainment of health outcomes among adults treated for childhood cancer, JAMA 309 (22) (2013) 2371–2381.

[13] K.C. Oeffinger, A.C. Mertens, C.A. Sklar, T. Kawashima, M.M. Hudson, A.T. Meadows, et al., Chronic health conditions in adult survivors of childhood cancer, N. Engl. J. Med. 355 (15) (2006) 1572–1582.

[14] A.C. Mertens, Q. Liu, J.P. Neglia, K. Wasilewski, W. Leisenring, G.T. Armstrong, et al., Cause-specific late mortality among 5-year survivors of childhood cancer: the childhood cancer survivor study, J. Natl. Cancer Inst. 100 (19) (2008) 1368–1379.

[15] Children's Oncology Group, Long-Term Follow-Up Guidelines for Survivors of Childhood, Adolescent and Young Adult Cancers, Version 5.0. Available on-line Children's Oncology Group, Monrovia, CA, Oct 2018www.survivorshipguidelines.org.

[16] W. Landier, S. Bhatia, D.A. Eshelman, K.J. Forte, T. Sweeney, A.L. Hester, et al., Development of risk-based guidelines for pediatric cancer survivors: the children's oncology group long-term follow-up guidelines from the children's oncology group late effects committee and nursing discipline, J. Clin. Oncol. 22 (24) (2004) 4979–4990.

[17] S.G. Maria Hewitt, Ellen Stovall, From Cancer Patient to Cancer Survivor: Lost in Transition, Institute of Medicine and National Research Council, Washington, DC, 2006.

[18] C. Signorelli, C.E. Wakefield, J.E. Fardell, T. Foreman, K.A. Johnston, J. Emery, et al., The role of primary care physicians in childhood cancer survivorship care: multiperspective interviews, Oncologist 24 (5) (2019).

[19] R. Williamson, L. Meacham, B. Cherven, L. Hassen-Schilling, P. Edwards, M. Palgon, et al., Predictors of successful use of a web-based healthcare document storage and sharing system for pediatric cancer survivors: cancer SurvivorLink, J. Cancer Surviv. 8 (3) (2014) 355–363.

[20] National Cancer Institute, Research-Tested Intervention Programs, Available from https://rtips.cancer.gov/rtips/index.do , Accessed date: 1 July 2018.

[21] G. Neta, M. Sanchez, D. Chambers, S. Phillips, B. Levya, L. Cynkin, et al., Implementation science in cancer prevention and control: a decade of grant funding by the National Cancer Institute and future directions, Implement. Sci. 10 (1) (2015) 4.

[22] R.E. Glasgow, L.W. Green, L.M. Klesges, D.B. Abrams, E.B. Fisher, M.G. Goldstein, et al., External validity: we need to do more, Ann. Behav. Med. 31 (2) (2006) 105–108.

[23] L.J. Damschroder, D.C. Aron, R.E. Keith, S.R. Kirsh, J.A. Alexander, J.C. Lowery, Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science, Implement. Sci. 4 (2009) 50.

[24] D. Eshelman-Kent, K.E. Kinahan, W. Hobbie, W. Landier, S. Teal, D. Friedman, et al., Cancer survivorship practices, services, and delivery: a report from the Children's oncology group (COG) nursing discipline, adolescent/young adult, and late effects committees, J. Cancer Surviv. 5 (4) (2011) 345–357.

[25] United States Department of Agriculture, USDA ERS - Rural-Urban Continuum Codes, Available from https://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx , Accessed date: 1 June 2018.

[26] A.M. Kilbourne, M.S. Neumann, H.A. Pincus, M.S. Bauer, R. Stall, Implementing evidence-based interventions in health care: application of the replicating effective programs framework, Implement. Sci. 2 (2007) 42.

[27] L.D. Chew, K.A. Bradley, E.J. Boyko, Brief questions to identify patients with inadequate health literacy, Fam. Med. 36 (8) (2004) 588–594.

[28] P.A. Harris, R. Taylor, R. Thielke, J. Payne, N. Gonzalez, J.G. Conde, Research electronic data capture (REDCap)–a metadata-driven methodology and workflow process for providing translational research informatics support, J. Biomed. Inform. 42 (2) (2009) 377–381.

[29] L. Maher, D. Gustafson, A. Evans, Sustainability Model and Guide, NHS Institute for innovation and Improvement, 2007.

[30] J.H. Hibbard, J. Stockard, E.R. Mahoney, M. Tusler, Development of the patient activation measure (PAM): conceptualizing and measuring activation in patients and consumers, Health Serv. Res. 39 (4) (2004) 1005–1026 Pt 1.

[31] D.R.W. Cella, A. Stone, N. Rothrock, B. Reeve, S. Yount, D. Amtmann, R. Bode, D. Buysse, S. Choi, Initial item banks and first wave testing of the patient–reported outcomes measurement information system (PROMIS) network: 2005–2008, J. Clin. Epidemiol. 63 (11) (2010) 1179–1194.

[32] P.A. Pilkonis, S.W. Choi, S.P. Reise, A.M. Stover, W.T. Riley, D. Cella, Item banks for measuring emotional distress from the patient-reported outcomes measurement information system (PROMIS(R)): depression, anxiety, and anger, Assessment 18 (3) (2011) 263–283.

[33] R.D. Hays, J.B. Bjorner, D.A. Revicki, K.L. Spritzer, D. Cella, Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items, Qual. Life Res. 18 (7) (2009) 873–880.

[34] S. Magasi, G. Ryan, D. Revicki, W. Lenderking, R.D. Hays, M. Brod, et al., Content validity of patient-reported outcome measures: perspectives from a PROMIS meeting, Qual. Life Res. 21 (5) (2012) 739–746.

[35] M.G. Ory, S. Ahn, L. Jiang, K. Lorig, P. Ritter, D.D. Laurent, et al., National study of chronic disease self-management: six-month outcome findings, J. Aging Health 25 (7) (2013) 1258–1274.

[36] K.R. Lorig, P. Ritter, A.L. Stewart, D.S. Sobel, B.W. Brown Jr., A. Bandura, et al., Chronic disease self-management program: 2-year health status and health care utilization outcomes, Med. Care 39 (11) (2001) 1217–1223.

[37] J. Gilleland, S. Amaral, L. Mee, R. Blount, Getting ready to leave: Transition readiness in adolescent kidney transplant recipients, J. Pediatr. Psychol. 37 (1) (2011) 85–96, https://doi.org/10.1093/jpepsy/jsr049 PMID: 21878430.

[38] J.W. Varni, D.J.L. Quiggens, G.X. Ayala, Development of the pediatric hematology/oncology parent satisfaction survey, Child Health Care 29 (4) (2000) 243–255.

[39] J.L. Klosky, D.K. Cash, J. Buscemi, S. Lensing, D.M. Garces-Webb, W. Zhao, et al., Factors influencing long-term follow-up clinic attendance among survivors of childhood cancer, J. Cancer Surviv. 2 (4) (2008) 225–232.

[40] C.M. Shea, S.R. Jacobs, D.A. Esserman, K. Bruce, B.J. Weiner, Organizational readiness for implementing change: a psychometric assessment of a new measure, Implement. Sci. 9 (1) (2014) 7.

[41] G.A. Aarons, Mental health provider attitudes toward adoption of evidence-based practice: the evidence-based practice attitude scale (EBPAS), Ment. Health Serv. Res. 6 (2) (2004) 61–74.

[42] B. McCormack, G. McCarthy, J. Wright, P. Slater, A. Coffey, Development and testing of the context assessment index (CAI), Worldviews Evid.-Based Nurs. 6 (1) (2009) 27–35.

[43] C.D. Helfrich, Y.F. Li, N.D. Sharp, A.E. Sales, Organizational readiness to change assessment (ORCA): development of an instrument based on the promoting action on research in health services (PARIHS) framework, Implement. Sci. 4 (2009) 38.

[44] H.C. Kaplan, L.P. Provost, C.M. Froehle, P.A. Margolis, The model for understanding success in quality (MUSIQ): building a theory of context in healthcare quality improvement, BMJ Qual. Saf. 21 (1) (2012) 13–20.

[45] M.P. Gagnon, E. Orruno, J. Asua, A.B. Abdeljelil, J. Emparanza, Using a modified technology acceptance model to evaluate healthcare professionals' adoption of a new telemonitoring system, Telemed. J. E Health 18 (1) (2012) 54–59.

[46] D.A. Luke, A. Calhoun, C.B. Robichaux, M.B. Elliott, S. Moreland-Russell, The program sustainability assessment tool: a new instrument for public health programs, Prev. Chronic Dis. 11 (2014) 130184.

[47] R.Z. Omar, S.G. Thompson, Analysis of a cluster randomized trial with binary outcome data using a multi-level model, Stat. Med. 19 (19) (2000) 2675–2688.

[48] M.K. Campbell, J. Mollison, N. Steen, J.M. Grimshaw, M. Eccles, Analysis of cluster randomized trials in primary care: a practical approach, Fam. Pract. 17 (2) (2000) 192–196.

[49] T.D. Koepsell, D.C. Martin, P.H. Diehr, B.M. Psaty, E.H. Wagner, E.B. Perrin, et al., Data analysis and sample size issues in evaluations of community-based health promotion and disease prevention programs: a mixed-model analysis of variance approach, J. Clin. Epidemiol. 44 (7) (1991) 701–713.

[50] M.E. Brennan, J.F. Gormally, P. Butow, F.M. Boyle, A.J. Spillane, Survivorship care plans in cancer: a systematic review of care plan outcomes, Br. J. Cancer 111 (10) (2014) 1899–1908.

[51] A. Donner, N. Klar, Design and Analysis of Cluster Randomization Trials in Health Research, (2000).

[52] M. Patton, Qualitative Research Methods, 3rd ed., Sage Publications, Thousand Oaks, CA, 2002.

[53] J. Creswell, V.L. Plano Clark, Designing and Conducting Mixed Methods Research, Sage Publications, 2011.

[54] C. Teddlie, A. Tashakkori, Foundations of Mixed Methods Research: Integrating Quantatitatve and Qualitative Approaches in the Social and Behavioral Sciences, Sage Publications, 2009.

[55] M. Moerbeek, S. Teerenstra, Power Analysis of Trials With Multilevel Data, CRC Press, 2015.

[56] G. Adams, M.C. Gulliford, O.C. Ukoumunne, S. Eldridge, S. Chinn, M.J. Campbell, Patterns of intra-cluster correlation from primary care research to inform study design and analysis, J. Clin. Epidemiol. 57 (8) (2004) 785–794.

[57] R.S. Williamson, B.O. Cherven, J. Gilleland Marchak, P. Edwards, M. Palgon,

C. Escoffery, et al., Meaningful use of an electronic personal health record (ePHR) among pediatric cancer survivors, Appl. Clin. Inform. 8 (1) (2017) 250–264.
[58] Institute of Medicine, Council NR, M. Hewitt, S. Greenfield, E. Stovall (Eds.), From Cancer Patient to Cancer Survivor: Lost in Transition, The National Academies Press, Washington, DC, 2006(534 p).
[59] T.O. Henderson, D.L. Friedman, A.T. Meadows, Childhood cancer survivors: transition to adult-focused risk-based care, Pediatrics. 126 (1) (2010) 129–136.
[60] P.C. Nathan, B. Hayes-Lattin, J.J. Sisler, M.M. Hudson, Critical issues in transition and survivorship for adolescents and young adults with cancers, Cancer. 117 (10 Suppl) (2011) 2335–2341.
[61] Institute of Medicine, National Research Council National Cancer Policy Board. Childhood Cancer Survivorship: Improving Care and Quality of Life, National Academies Press, Washington (DC, 2003.