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ORIGINAL ARTICLE

Feasibility of a randomized controlled trial of symptom screening and feedback to healthcare providers compared with standard of care using the SPARK platform

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Abstract

Purpose Supportive care Prioritization, Assessment and Recommendations for Kids (SPARK) is a web-based application that enables symptom screening and access to clinical practice guidelines for symptom management. Objective was to determine the feasibility of a randomized trial of daily symptom screening for 5 days among children receiving cancer treatments.

Methods We included English-speaking pediatric cancer and hematopoietic stem cell transplantation (HSCT) patients who were 8–18 years of age at enrollment and who were expected to be in the hospital or in clinic daily for five consecutive days. We randomized children to either undergo daily symptom screening with symptom reports provided to the healthcare team using the SPARK vs. standard of care. The primary endpoint was feasibility, defined as being able to enroll at least 30 participants within 1 year, and among those randomized to intervention, at least 75% completing symptom screening on at least 60% of on-study days.

Results From July 2018 to November 2018, we enrolled and randomized 30 participants. The median age at enrollment was 12.5 (range 8–18) years. Among the intervention group, the median number of days Symptom Screening in Pediatrics Tool (SSPedi) was completed at least once was 5 (range 4 to 5), with one participant missing 1 day of symptom screening. Among all participants, baseline and day 5 SSPedi scores were obtained in 29/30 participants.

Conclusion A randomized trial of the SPARK with daily symptom screening for 5 days was feasible. It is now appropriate to proceed toward a definitive multi-center trial to test the efficacy of SPARK to improve symptom control.

Keywords Children · Feasibility · Supportive care · Symptom screening

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Background

Children with cancer and pediatric hematopoietic stem cell transplant (HSCT) recipients frequently experience severe and bothersome symptoms because treatments are intensive [1, 2]. In one study of pediatric inpatients admitted for at least 4 days, 99% reported at least one bothersome symptom and 60% reported at least one severely bothersome symptom [1]. A follow-up study identified that, in most circumstances, symptoms reported as severely bothersome by patients were not documented by healthcare professionals and interventions were not administered [3].

In order to improve symptom control and communication of bothersome symptoms to healthcare professionals, we developed SSPedi (Symptom Screening in Pediatrics Tool) [4], a symptom screening tool targeted for children receiving cancer treatments [4, 5]. Building upon the SSPedi, we then developed SPARK (Supportive care Prioritization, Assessment and

Recommendations for Kids), a web-based application consisting of a symptom-screening component centered on the SSPedi and a supportive care clinical practice guideline (CPG) component [6]. The SPARK was designed to allow children to report and track their symptoms, to facilitate communication of symptoms to healthcare professionals, and to enable provider access to CPGs for symptom management.

We have previously described the initial development of the patient-facing portal of the SPARK. Iterative refinements were based on cognitive interviews with 90 children between 8 and 18 years of age receiving cancer treatments and pediatric HSCT recipients [6]. We next completed a single-armed feasibility study in which we tested the longitudinal utilization of the SPARK among children 8–18 years of age admitted to hospital or seen in clinic daily for 5 days. Among the 30 enrolled participants, we found that daily completion of the SSPedi via the SPARK was feasible. However, we ultimately will require a randomized controlled trial to identify if the SPARK improves the lives of children receiving cancer treatments. Prior to embarking on a definitive randomized controlled trial, it is important to first determine trial feasibility including enrollment rates and completion rates and whether outcome assessments can be obtained [7].

Consequently, the objective of this study was to determine the feasibility of a future randomized controlled trial of daily symptom screening for 5 days among pediatric inpatients and outpatients with cancer or HSCT recipients.

Methods

This randomized controlled feasibility trial conducted at The Hospital for Sick Children (SickKids) in Toronto, Canada, was approved by the Research Ethics Board at SickKids.

Eligibility We included English-speaking pediatric cancer and HSCT patients who were 8–18 years of age at enrollment and who were expected to be in the hospital or in clinic daily for five consecutive days. Participants actively receiving cancer treatment and those who had completed cancer treatment were eligible. Exclusion criteria were illness severity, cognitive disability, or visual impairment that precluded utilization of the SPARK according to the patient's primary healthcare team.

Procedures We randomized children to either undergo daily symptom screening for 5 days with symptom reports provided to the healthcare team or standard of care, with no systematic approach to symptom screening or reporting. Potential participants were recruited from the inpatient ward and outpatient clinics. Five days was chosen to allow longitudinal daily evaluation but preserve feasibility as few children are admitted or seen daily in clinic for longer than 5 days.

Participants were randomly allocated 1:1 to the intervention group or to the control group. The randomization sequence was computer-generated and stratified by treatment (HSCT yes vs. no) and age (8–10, 11–14, and 15–18 years) as our previous data suggested that these factors were strongly associated with higher total SSPedi scores [1]. Block size was not disclosed, and the allocation sequence was concealed.

Patients randomized to the intervention group completed symptom screening using the SPARK once daily for 5 days on a study-supplied iPad. Inpatients received daily reminders on the iPad to complete the SSPedi, and symptom reports were available to the child at any time. For outpatients, a research associate provided the iPad in person daily and reports could be viewed at those encounters. Communication of the SSPedi results to the healthcare team was as follows. Daily SSPedi reports on days 1, 2, 3, and 4 were printed and were (1) given to the patient's bedside nurse; (2) given to the patient's treating provider (typically fellow, resident, or nurse practitioner); and (3) placed in the patient's health record. On days 1 and 3, a report describing severely bothersome symptoms ("a lot" or "extremely") was emailed to the patient's most responsible physician (Fig. 1 shows an example report). Emails were not sent daily to reduce the burden on responsible physicians. We did not print or distribute reports on day 5 as the outcomes were obtained on day 5, and thus, report dissemination on this day could not influence outcomes. An in-person training session on how to interpret reports was held for healthcare professionals prior to study activation.

For those randomized to the control group, a research associate visited the patient on days 1 and 5 to obtain the baseline and the final SSPedi score, which was completed on an iPad. Symptom reports were not printed, shared with the participant or their family, shared with the clinical team, or emailed to the primary physician. The child was not encouraged or discouraged from discussing their SSPedi scores with their physician or healthcare team.

Outcomes and analysis The primary endpoint was feasibility, defined as being able to enroll at least 30 participants within 1 year, and at least 75% of those randomized to the intervention group completing symptom screening on at least 60% of on-study days.

Secondary endpoints included efficacy measures that would be used as outcomes in the future definitive randomized trial and were the SSPedi, pain, and quality of life (QoL). These were administered by the research associate on study day 5 for both groups. The day 5 self-reported total SSPedi score would be the primary endpoint of a future trial, and thus, we described the proportion of children from whom this score was obtained. The total SSPedi score is a validated measure that reflects the total burden of bothersome symptoms experienced [2]. The total score is the sum of each of the 15-item Likert scores that range from 0 (not at all bothered) to 4 (extremely bothered) to yield a total score that ranges from 0 (no bothersome symptoms) to 60 (worst bothersome symptoms).

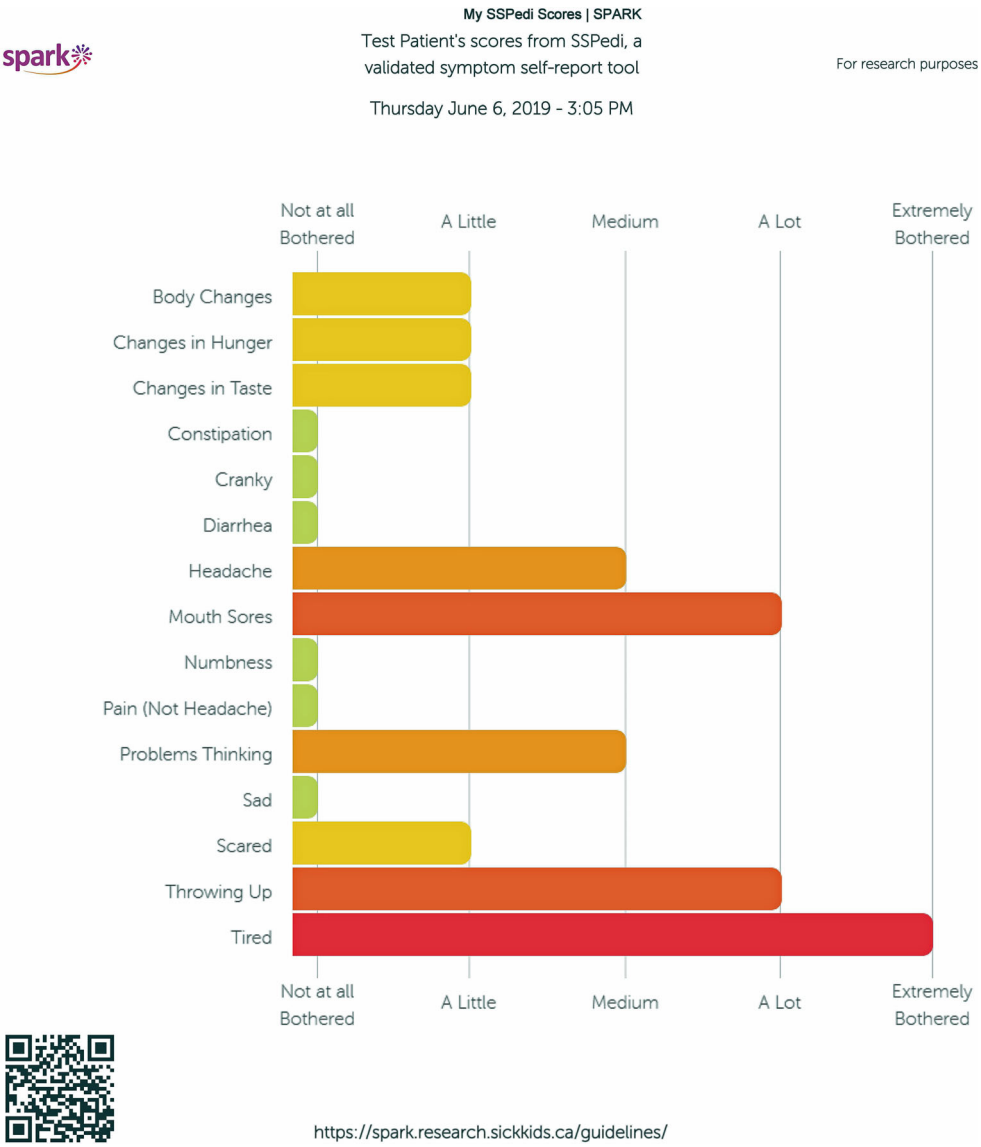

Fig. 1 Example of a SPARK symptom report

Other efficacy endpoints were pain and QoL. Self-reported pain was assessed using the Faces Pain Scale-Revised, which consists of a series of horizontal faces that depict a neutral facial expression of no pain on the left and worst pain on the right. It has six faces and may be scored on a 0 to 10 scale in which higher numbers denote more pain [8]. The Faces Pain Scale-Revised is psychometrically sound and feasible for children 4 to 18 years of age [9]. Self-reported QoL was measured using the PedsQL 3.0 Acute Cancer Module. This measure is a multidimensional instrument that is reliable and valid in children with cancer [10–13]. It assesses pain and hurt, nausea, procedural anxiety, treatment anxiety, worry, cognitive problems, perceived physical appearance, and communication. The self-report 7-day recall version was used.

To obtain further quantitative and qualitative data, participants in the intervention group were interviewed on day 5 using a semi-structured format. We asked whether completing the SSPedi daily was too much, too little, or about right. We also asked about ease of use of the SPARK website to report symptoms and ease of understanding of SPARK reports on a 5-point Likert scale ranging from "very easy" to "very hard." We asked whether participants viewed their SPARK reports. We also asked participants what they liked and disliked about the SPARK, barriers to completing the SSPedi and what helped them remember to complete the SSPedi daily. Analyses were descriptive.

Results

From July 4, 2018 to November 16, 2018, 52 patients were assessed for study eligibility. Of those screened, nine were not eligible due to illness severity ($n = 3$), cognitive disability ($n = 3$), or inability to understand English ($n = 3$).

Among eligible patients, 13 refused to participate, resulting in 30 patients being enrolled to the study. (Figure 2 shows flow diagram of study participation). Therefore, the feasibility criterion related to enrollment rate was met as we enrolled 30 participants within 1 year (achieved in approximately 4 months).

Demographic characteristics of participants are illustrated in Table 1. The median age at enrollment was 12.5 (range 8–18) years. There were 15 participants randomized to the intervention group and 15 participants randomized to the control group. All participants in the intervention group completed the day 5 SSPedi assessments and questionnaires and participated in the interview. Among the intervention group, the median number of days the SSPedi was completed at least once was 5 (range 4 to 5), with one participant missing 1 day of symptom screening. Therefore, the feasibility criterion related to frequency of symptom screening was met since all 15 participants completed symptom screening on at least 60% of on-study days. In terms of communication of SSPedi results to the healthcare team, there were no difficulties in distributing the printed symptom reports for the 59 completed SSPedi assessments on days 1 to 4. Four patients on day 1 and four patients on day 3 did not report severely bothersome symptoms, and thus, emails to the most responsible physician were sent for 11/15 participants on both days.

Among all participants, both baseline and day 5 SSPedi scores were obtained from 29 of 30 participants. One participant in the control group missed all of the day 5 assessments due to unanticipated early hospital discharge. A further two participants in the control group were able to complete the day 5 SSPedi assessment but did not complete the other questionnaires because of illness severity.

Table 2 describes the experience with daily completion of the SSPedi via the SPARK for 5 days among those randomized to the intervention group. Of these 15 participants, 14 (93%) thought a frequency of once daily symptom screening was "about right." All participants thought using the SPARK to report symptoms was easy or very easy and 14 (93%) thought SPARK symptom reports were easy or very easy to understand.

When participants were asked about what they liked and disliked about using the SPARK, the most common responses related to likes were ease of use ($n = 8$), ability to complete the SSPedi quickly and to change answers ($n = 2$), and website esthetics ($n = 2$). In terms of dislikes, one participant did not like having to log into the system each time and one did not like the SPARK page entitled "How SSPedi Helps," which includes testimonials from children speaking about the benefits of the SSPedi completion. The two barriers to completing the SSPedi noted were severe symptoms making it difficult to complete SSPedi ($n = 3$) and forgetting ($n = 1$). The things that

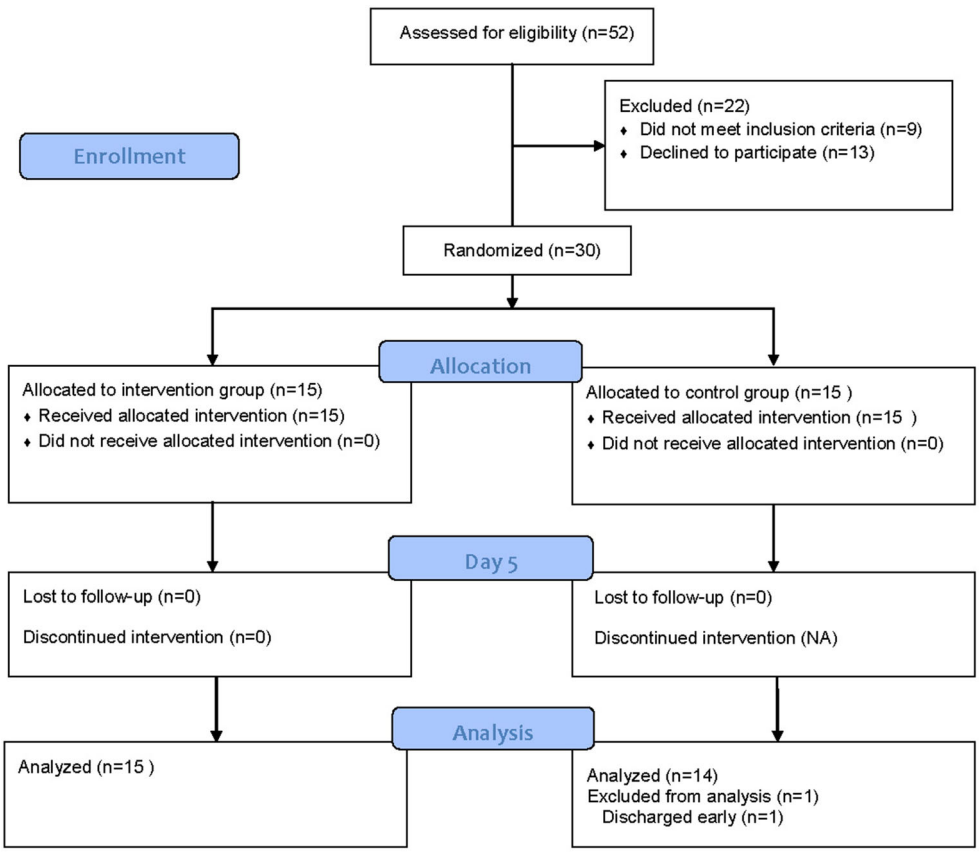

Fig. 2 Flow diagram of study participation and flow through the trial

Table 1 Demographics of the study cohort ($N = 30$)

Characteristic	*n* (%)
Male	13 (43.3)
Age in years	
8–10	10 (33.3)
11–14	10 (33.3)
15–18	10 (33.3)
Diagnosis	
Leukemia or lymphoma	17 (56.7)
Solid tumor	8 (26.7)
Brain tumor	0 (0.0)
Other[a]	5 (16.7)
Relapse	9 (30.0)
Treatment group	
Cancer	20 (66.7)
Stem cell transplantation	10 (33.3)
Inpatient	18 (60.0)
Receiving active cancer therapy	27 (90.0)
Language spoken at home	
English	25 (83.3)
Other[b]	5 (16.7)

[a] Other diagnoses were aplastic anemia ($n = 1$), immunodeficiency ($n = 1$), myelodysplastic syndrome ($n = 2$), and hemophagocytic lymphohistiocytosis ($n = 1$). (These were stem cell transplantation patients.)

[b] Other languages were Gujarati ($n = 1$), French ($n = 1$), Dari ($n = 1$), and Arabic ($n = 2$)

helped participants remember to complete the SSPedi were a parent reminding them ($n = 5$), daily reminders on the iPad ($n = 4$), and the research associate ($n = 2$).

Discussion

In this feasibility study, we found that a future randomized controlled trial comparing daily symptom screening with provision of symptom reports to the healthcare team vs. standard of care was feasible in children receiving cancer treatments. We also found that among those randomized to the intervention group, the SPARK was easy to use and SPARK reports were easy to understand. These findings are important as they will allow us to proceed to a definitive randomized trial without a change in design and thus to include these participants in the definitive trial.

Within the adult oncology setting, randomized trials evaluating routine symptom screening [14–16] and incorporation of routine screening into clinical practice [17, 18] have both been demonstrated to be feasible. However, within pediatric oncology, these observations have not been made in general. In two previous systematic reviews focused on pediatric cancer patients, we identified that self-reported symptom screening or assessment tools had not yet been used to change patient management on the basis of identified symptoms [19, 20]. While some studies did measure symptoms more than once, they did not specifically determine the feasibility of either longitudinal symptom screening or the ability to study this approach in randomized trials. Consequently, our pilot study is important as it is one of the first in pediatric cancer to test the feasibility of repeated self-reported assessment of symptoms intended to change patient management because of symptom identification.

Another important feasibility study focusing on early identification of symptoms in pediatric patients has been published. This study tested the feasibility of conducting a randomized trial that utilized an electronic patient-reported outcome system in pediatric palliative care patients [21]. The study included children at least 2 years of age and obtained subjective outcomes from patients or parents between once per week and once per month. Completed surveys were printed and handed to providers and families. If scores reached predetermined thresholds, emails were also sent to healthcare providers. That study identified that enrolling these patients was feasible. It differed from our study in that ours exclusively assessed symptoms using self-report.

A strength of our study is the assessment of both randomization and other study processes to determine if a future definitive trial is feasible. Assessment of only study processes in a longitudinal fashion may suggest that the procedures are feasible, but the randomized trial could still fail if patients or healthcare providers refuse randomization. The major limitation of our study is its conduct at a single center, which will be

Table 2 Experience with SPARK and SPARK reports among those randomized to daily symptom screening for 5 days ($N = 15$)

	n (%)
Experience with daily SSPedi completion for 5 days	
Daily SSPedi completion frequency	
Too much	1 (6.7)
About right	14 (93.3)
Too little	0 (0.0)
Ease of using SPARK website to report symptoms	
Very easy	14 (93.3)
Easy	1 (6.7)
Neither hard nor easy	0 (0.0)
Hard	0 (0.0)
Very hard	0 (0.0)
SPARK reports	
Participant viewed SPARK symptom report	8 (53.3)
Ease of SPARK reports to understand	
Very easy	12 (80.0)
Easy	2 (13.3)
Neither hard nor easy	1 (6.7)
Hard	0 (0.0)
Very hard	0 (0.0)

the lead site of the future trial. Thus, feasibility at different sites is not assured.

In conclusion, a randomized controlled trial of the SPARK with daily symptom screening for 5 days vs. standard of care was feasible. It is now appropriate to proceed toward a definitive multi-center trial to test the efficacy of the SPARK to reduce bothersome symptoms and to improve quality of life.

Author contributions All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by Sadie Cook, Emily Vettese, and Lillian Sung. The first draft of the manuscript was written by Sadie Cook, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Compliance with ethical standards

Informed consent was obtained from all individual participants included in the study. The authors have declared no conflicts of interest.

Ethics approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the Research Ethics Board at SickKids, and are registered with clinicaltrial.gov (NCT03495518), and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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