



Co-designing an e-resource to support' search for mobile apps

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Contributions: (I) Conception and design: All authors; (II) Administrative support: All authors; (III) Provision of study materials or patients: All authors; (IV) Collection and assembly of data: A Virani; (V) Data analysis and interpretation: A Virani, L Duffett-Leger; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

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Background: Contemporary parents use mobile applications or “apps” to resolve their day-to-day parenting concerns. However, research suggests an abundance of low-quality apps makes the app searching process arduous for parents, therefore, there is a need to develop a resource that supports parents’ search for apps.

Methods: The study aimed at engaging parents in co-developing a parenting app directory and co-designing Webpages to feature the directory. Four focus group discussions were conducted with 18 first-time Canadian parents to develop the parenting app directory. Participatory design was used to co-create Webpage prototypes (landing or main Webpage and the app description page) with 3 first-time Canadian parents.

Results: Twelve apps that met the eligibility criteria were included in the parenting app directory. Parents supported the idea of creating an app directory and recommended sharing the link in perinatal classes. During design sessions, parents stressed the importance of an organized user interface, providing less but the best choices to ease the search process for apps, reducing the number of clicks to save time, and mobile optimization of the Website to accommodate different screen sizes.

Conclusions: Contemporary parents’ use of apps is growing significantly; therefore, clinicians should support parents’ search for quality apps and guide them accordingly. Parents can provide insight into design principles that can be used in developing appealing parenting app resources. Parents should be involved in designing future resources as they can significantly contribute to ensuring a resource is useful.

Keywords: Mobile applications; parenting apps; participatory design; webpage prototypes; user interface design

Received: 29 October 2020. Accepted: 19 April 2021; Published: 21 May 2021.

doi: 10.21037/ht-20-29

View this article at: <http://dx.doi.org/10.21037/ht-20-29>

Introduction

Infants grow significantly in the first year of their lives requiring parents to keep up with their constantly changing needs (1). The literature on parents’ use of online resources suggests mobile applications or “apps” are commonly used by parents to resolve their everyday parenting concerns (2-4). Parents use apps for things like retrieving information on parenting topics, getting support from friends, family, and other parents, and tracking their babies’ growth on a

daily basis (5-7).

The proliferation of low-quality and irrelevant apps creates barriers for parents in effectively accessing parenting material. Taki and colleagues (8) performed a systematic analysis of infant feeding apps and reported 91% were of poor quality due to issues with user interface design (e.g., navigation) and content (e.g., readability). Many evidence-based apps are invisible to users because they are lumped in with poor quality apps. By 2018, 84,000 publishers had

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released 325,000 apps on the marketplace which indicates the increased number of choices available to users thus worsening the search for evidence-based apps which are comparatively very few and require more time and resources to develop (9,10). Some researchers have reported content credibility and security concerns as barriers to app utilization (3,11,12). Many parents, however, overlook the credibility of the content and security of the personal data concerns due to the benefits gained from using certain app features such as customization of data (13-15).

The importance of an organized and functional user interface cannot be denied in the effective utilization of apps. Users generally evaluate apps on utility, functionality, and security standards and if these requirements are not met, they move on to the next app. Apps with poor first impressions, poor design, lack of interactive features, glitches, unnecessary personal information requests, and malware alerts lose users quickly, receive low star ratings, and poor user reviews, negatively affecting their search ranking in the app store (16). Evidence-based apps are scientifically robust; however, many lack parents-preferred user interface elements and therefore, receive less attention and low star ratings on the app store. For example, Virani *et al.* (17) reported an evidence-based app had the lowest number of downloads, overall lowest MARS (Mobile App Rating Scale) score, and the lowest score on the MARS engagement subscale compared to other 15 apps that were included in the review. Hingle *et al.* (18) also found that evidence-based apps frequently lacked visual appeal, interactive features, and intuitive user interfaces.

Users learn to locate apps through trial and error methods. Today's parents have limited time to scroll through hundreds of pages or apps, rather, they typically select from the initial few search options. Poor searching skills (e.g., inappropriate search terms, unfamiliarity with advanced search functions) often lead to irrelevant results that fail to meet parents' needs and quality expectations. Many parents feel trapped in cycles of app searching, installing, trialing, uninstalling, and starting over (19-21). Thus, there is a need for a solution that provides parents easy and efficient access to quality apps in a way that is preferred by parents.

While evidence-based apps have been developed to better meet the needs of parents, these apps are difficult for parents to locate due to their low visibility among the plethora of parenting apps. Further, evidence suggests that co-designing with the target population leads to more relevant and useable technologies compared to products developed on their behalf (22,23). Therefore, the purpose of

this study was twofold: (I) to engage parents in developing a parenting app directory that contains the list and brief information about quality parenting apps to support their search for apps; and (II) to involve parents in designing a user interface of Webpages featuring a parenting app directory.

The rapid rate at which apps develop, update, and disseminate requires constant maintenance of the existing apps, and the addition of new apps to the directory. It is difficult for the student investigator (primary author) to keep up with this challenge and sustain the intervention; therefore, the researchers partnered with an existing parenting Website that provides resources to parents/caregivers of children from birth to 8 years. The Website hereafter refers to as the host Website. The participants were asked to design only two Webpages; a landing page and an app description page using the basic layout, color, and design of the host Website. Participants were also engaged in developing links supporting feedback on existing apps and the addition of new apps in the future. The final prototypes were supposed to be part of the hosting Website but, due to unforeseen circumstances, this plan was not implemented.

Methods

Derived from participatory action research, participatory design approaches to software design involve users throughout the design process from identifying needs to developing and testing the design product. The democracy and empowerment of users of technology are the core principles of participatory design (22,24). Appropriate democratic participation empowers users by involving them in technology-related decisions that affect their lives in some way. Final design decisions are based on consensual agreements between researchers and users. The participatory design creates a sense of ownership among users and empowers them as key stakeholders (23,25). To involve participants throughout the process the project was divided into three phases: app review, focus group discussions, and Webpages prototyping. To address this aim, the study had the following objectives: (I) to gain an insight into available parenting apps and their quality by performing an app review on the Google Play Store; (II) to explore parents' perceptions of available parenting apps and involve them in the development of a parenting app directory through focus group discussions; (III) to engage parents in designing Webpages prototypes to feature the

parenting app directory.

Sample and setting

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Conjoint Health Research Ethics Board (CHREB ID: REB17-2077) and informed consent was taken from all the participants.

App review

The authors conducted an app review to gain insight into current trends of parenting apps and their quality. The authors found 4,300 apps on their initial search using 18 search terms: mum, mom, mommy, mama, mother, father, dad, daddy, papa, newborn, baby, infant, kid, child, children, family, parent, and parenting. Most apps were of poor quality due to inadequate information/features, lack of credible information/sources, navigation issues, and excessive advertisements. Detailed findings of the app review have previously been published (17). Some of the apps from the review were used in the next phase to explore participants' perceptions of available parenting apps.

Focus group discussions

The parenting app directory was developed in four focus group discussions with a total of 18 first-time Canadian parents of infants (birth-12 months) who owned a smartphone and have used at least one parenting apps in the past 6 months. The majority of the participants were female (n=15) and between 31–40 years of age (n=14). Most parents were married (n=17), born in Canada (n=12), and on maternity leave (n=14) at the time of focus group discussions. Parents were recruited via placing posters and distributing study cards in community health centers, public libraries, and in perinatal classes. A Facebook page was also created to recruit parents. The focus groups were conducted in public library meeting rooms in Calgary, Canada. Each focus group lasted approximately 2 hours and explored parents' search for apps, their preferences, their desired features in apps. While the detailed findings of focus group discussions are shared somewhere else (21), findings that are pertinent to the development of the parenting app directory are described in this paper.

The apps for the directory were selected via two strategies: First, during focus group discussions, parents mentioned a few apps that they liked to use. The authors evaluated those apps on MARS (Mobile App Rating Scale),

developed by a multidisciplinary team to appraise app quality (26). Apps that scored 3 and above were added to the directory. Second, during focus group discussions in one of the activities, the moderator provided app cards (cards with the name and icon of the app, and its purpose) and asked parents to review one or two apps based on their interest. After reviewing apps for 10–15 minutes, each participant individually shared their feedback to the group and further discussed each app with other participants including likes/dislikes, pros/cons, and reason for inclusion or exclusion of the particular app in the directory. The discussion ended with the mutually agreed decision that whether the app should be part of the directory or not. Apps that received participants' agreement for inclusion were further evaluated on the MARS scale by researchers and only included in the directory if they received a 3/5 or above score on the MARS.

Design sessions

The primary author and 3 parents (2 fathers and 1 mother) co-created the user interfaces for two Webpages in a series of three sessions. The prototype designing sessions were conducted online using SMART kapp™ technology. The SMART kapp™ technology consists of a SMART kapp™ digital whiteboard and a SMART kapp™ app, that allows real-time sharing and editing of the drafts created by the moderator on the whiteboard. For details about this technology please visit <https://www.smarttech.com/>. Prior to the designing session, the moderator sent a link to download The SMART kapp™ app, a link for the designing space (*Figure 1*), and examples of a few app directories. On the day of the designing session, participants were connected using the SMART kapp™ technology. The moderator incorporated participants' feedback on the SMART kapp™ digital whiteboard which participants could see on their SMART kapp™ app in real-time.

The design sessions were video recorded and analyzed using agile development methodology after each session by the researchers to incorporate parents' suggestions. Agile development methodology is a pragmatic approach to design that is rapid, flexible, iterative, and heavily relies on integrating users' feedback (27). After finalizing the whiteboard prototyping drafts, the moderator developed the interactive prototype in Wix, a free Website builder, and sent the link via email to participants for review. The prototypes were further modified based on participants' feedback.

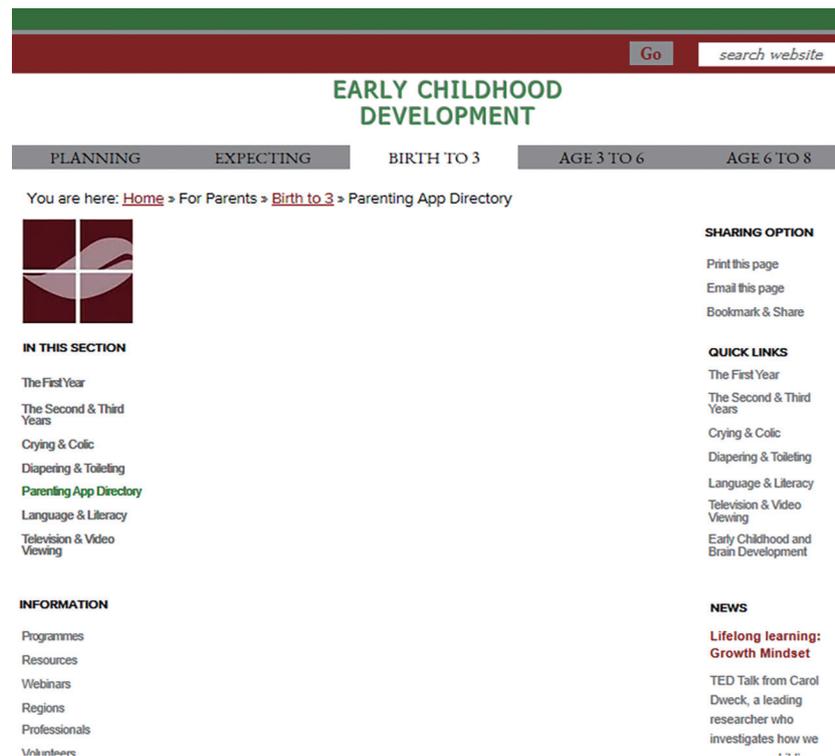


Figure 1 Designing space.

Results

The results section is divided into 2 parts: parenting app directory and user interface designing.

Parenting app directory

The focus group discussions revealed 34 apps and 18 parents reviewed a total of 20 apps during focus group discussions. After removing duplicates (n=14), 12 apps were selected for the app directory by using the following criteria. Apps were considered ineligible if they were paid (n=4); mostly used in pregnancy (n=4); needed a device to operate (n=2); targeting sick kids (n=1); non-parenting apps (n=5); voted out by participants (n=10) and; scored less than 3 on MARS (n=7). Apps were divided into categories as suggested by participants to ease the searching process. The list of eligible apps, their categories, MARS scores, and purposes are presented in *Table 1*.

To explore the viability of creating a parenting app directory to support parents' search for apps, at the end of the focus group discussions, participants were asked to share their feedback. All participants agreed that the parenting

app directory will support parents in finding quality apps. One mother (age 39 years) said: *"I like the idea because I usually Google top apps for whatever and I get the list of 10 things and go through it... It's basically just centralizing it... and I think one thing for me is that it will give you the things to search for, so it might actually help to look up things."*

While reviewing apps during the focus group discussions many parents were excited and surprised to learn about the different types of apps to assist them with their day-to-day parenting concerns, such as sign language app. They felt the Website would be a good resource for parents to learn about new apps. One mother (age 29 years) shared her feeling while reviewing a breastfeeding information app, *"I wish I had that [info for nursing mum app] when I first started doing breastfeeding. Most of the information is for the first life months when you need it the most."* One father (age 35 years) shared his thoughts about a tracking app, *"That (tracking app) looks useful, and if we did know about that we would have probably used it."* Another mother (age 29 years) commented while presenting an app review to the group on a sign language app, *"I had never thought (about a sign language app) and I'm happy that I did try one."*

Parents suggested that the parenting app directory link

Table 1 List of parenting apps included in the directory

Apps	Category	MARS score	Purpose
BabyTime	Tracker	4.5	It tracks infants' activities and also provides lullabies and white noises.
Baby + – Your Baby Tracker	Tracker	4.4	It tracks infants' activities and also offers lullabies, white noises, and a baby book.
CANImmunize	Tracker	3.8	It records, tracks and provides information on immunizations.
Baby and Child First Aid	Information	4.5	It provides information on emergency and first-aid and also records medications, allergies, emergency, and doctors' contacts.
Info for Nursing Mum	Information	4.4	It mostly provides information on breastfeeding.
BabyCenter	Information	4.4	It provides information on a wide range of parenting topics and also offers a baby book and parenting forums.
WebMD Baby	Information	4.4	It provides information on health-related matters and also offers a baby book and a basic tracker.
Babybrains	Information	4.0	It provides information on brain development activities.
Don't Cry My Baby (lullaby)	Sleeping-aid	4.5	It provides white noises and lullabies.
Baby Sleep - White Noise App	Sleeping-aid	4.3	It provides white noises and lullabies.
ASL Dictionary for Baby Lite	Miscellaneous	4.4	It supports teaching and learning of sign language.
Baby Weaning and Recipes	Miscellaneous	4.3	It provides recipes and information on baby weaning.

MARS, mobile app rating scale.

should be promoted in prenatal classes to make parents aware of these online resources in advance. As one mother (age 29 years) said, *“If the Website link is given in the... parenting prep classes, then they (to be parents) will have time to look through those before the baby is born.”*

User interface designing

During focus group discussions and design sessions, parents provided several suggestions to design a usable user interface for the Webpages. See *Table 2* for the suggestions and supporting quotations from participants. Participants co-created two Webpages prototypes: a landing page for the list of apps included in the directory and the app description page for each app.

Landing webpage prototype

The landing page features the app directory and provides a list of apps. See *Figure 2* for the landing Webpage prototype. Parents suggested categorizing apps and placing three apps in one row to permit a glance of the available apps in a specific category. The directory has two active links. The first link takes users to an app comparison chart

for each category. The comparison chart allows parents to compare app features in a category and select an app based on their preferences. As one mother (age 32 years) said: *“I really like the comparison idea. It is definitely handy to see everything in comparison like that.”* See *Figure 3* for a comparison chart. The second link is labeled as “read more” which takes parents to the app description page and allows parents to learn more about the app. One mother (age 32 years) commented on the importance of having a short app description accompanied by a ‘read more’ link, said: *“The number of apps I have seen I kinda guess what this app is, but I am not sure exactly what it is for? So, a shorter description with a link to read more will help.”*

As mentioned earlier the resource will also involve parents in commenting on existing apps and the addition of new apps. To engage parents, two links, ‘comment board’ and ‘recommend an app’ can be added to the host Website’s Quick Links section. The comment board allows parents to comment on the app’s current status and view other parents’ feedback on apps. The ‘recommend an app’ link permits parents to suggest apps that they would like to share with other parents. However, when parents suggest an app, they will receive a message *“Thank you for recommending an*

Table 2 Parents' suggestions for designing a usable user interface and supporting quotations

Suggestions	Participant's words
Apps should be presented in categories to ease the search process.	"I think the categories would work well that would be the best (mother, age 32 years).
There should be a maximum of three best apps in one category; too many apps with similar features in one category were deemed overwhelming.	"I would recommend you to include two to three apps that have the best ratings (mother, age 36 years). "They gonna be lost if you put 50 or 60 apps on that main page (mother, age 37 years).
Use of an organized interface; busy and chaotic Webpages were considered "annoying and took longer to find desired parenting material.	"I just find if there is too much on there and I have to search through a bunch of things to find what I'm looking for then I just get frustrated (mother, age 33 years).
Mobile optimization of the Website as parents used smartphones more than any other device due to its smaller size.	"If the website is mobile optimized then three [apps] in a row is fine. If not, then it will be very difficult and a long row to see on a small screen You know 80% of your traffic comes from mobile so make sure it is mobile optimized (father, age 35 years).
Avoid repetition of the content on the Webpages; fewer words and use of images were recommended to convey the message.	"You can check app-specific comments on the app store. No need to duplicate that here (father, age 33 years). "I just don't want you to duplicate what's on the app store (father, age 35 years).
Reduce the number of clicks; more clicks waste time and deters parents from using the resource effectively.	One father commented on other fathers' disagreement on adding another click: "I agree, there will too many clicks and it will be confusing (father, age 35 years). "If I am on the computer, I don't mind the clicks but if I am on the phone, I definitely want less clicks (mother, age 32 years).

app. Our team will evaluate the app and it will be posted on the directory if it meets the quality standards." This additional step will ensure that only quality apps are added to the directory. As one father (age 33 years) stated: "People can submit all kinds of app... and every time someone sends an app, you have to make sure that it is relevant, reviewed and placed in the right category. It has information that is reputable."

Participants also suggested that it would be nice to have a link for interested parents who would like to know the process of app selection. To accommodate this request 'how we assess apps' can be added to the 'Quick Link' section to let interested parents learn about the app selection process for the directory.

App description webpage prototype

The app description page is specific to each app and describes the app briefly to assist parents in selecting apps based on their preferences. See Figure 4 for the app description page. Participants suggested an organized interface with less repetition from the app store description page. Parents felt that the availability of the app in multiple languages was important information that is often not showcased and should be available next to the app icon on the app description page. As one father (age 35 years)

stated: "English is her (my wife's) second language, or for people who have recently moved here, their English might not be as good. Everything in the app store is in English, and it would be nice to know if it is available in additional languages like French or German."

The app rating was another important piece of information that parents used to decide whether an app is worth trying before going through the details. One mother (age 32 years) said: "I would like to see, app rating without having to click on the app store." Participants felt that a link from the app store description page to download would be sufficient for interested parents to get detailed information about the app from the app store. Participants recommended a pros and cons chart for each app that would permit parents to have a quick glance at apps' potentials and facilitate their decision to download. One father (age 33 years) commented: "If you have 20 apps and you don't want to download all of them to try and see which one is good. These pros and cons can help you decide whether to download it or not." Participants also suggested adding the review details at the bottom including app ratings, date of review, and link to any research studies or expert review if available. For example, one father (age 33 years) said: "I like the review details in the end, it tells me that the app is updated and someone is responsible

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PARENTING APP DIRECTORY

Tracking Apps

[Click here to see tracking app comparison chart](#)

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Baby + - your baby tracker
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Information/Milestones Apps
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Babybrains
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Baby and Child First Aid
Provides first aid and emergency information through animations, videos...[Read more](#)

WebMD Baby
Provides information, tracks baby's growth, creates a baby book...[Read more](#)

Figure 2 Main or landing webpage.

for the update.”

Discussion

This study engaged Canadian parents of infants in developing a parenting app directory and in designing Webpages that featured the directory to ease their search for apps. It is well established that there is an abundance of online parenting material and it is difficult for parents to find quality resources (8,17,28). The developed app directory centralizes the apps on one Webpage thus creating a one-stop-shop for parents looking for quality parenting apps. Slomian *et al.* (29) utilized a similar idea and centralized Websites in the French language for mothers of children under 1 year of age. They found that the Website was a useful solution in addressing mothers' information needs, especially during the postpartum period.

Changes in current trends of dual-parent working families have affected parents' time availability. Time constraints force parents to make quick decisions in selecting

and using an online resource. Ryan *et al.* (30) found 42% of the parents never accessed a Website developed to support them with ADHD, reporting lack of time as a major barrier. Similarly, in this study parents frequently mentioned time constraints in accessing and evaluating online material and recommended time-saving interface elements such as an organized homepage, categorization of the content, less text, synopsis accompanied with 'read more' link for interested users, and mobile-optimized Website. Andrew *et al.* (31) indicated time-saving design is on the rise due to a gradual shortening attention span in humans. One of the most important features of the time-saving design is a homepage that is content-oriented, context-specific and highlights only the most relevant information thus minimizing users' time spent on other distracting features and guide users to subsequent Webpages based on their preferences.

First-time parents who are already overwhelmed with the responsibilities of an infant find it further overwhelming to select a quality resource from the infinite app choices available to them. Laja (32) stated in this world of

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Tracking Apps Comparison Chart

App Features	BabyTime (Parenting, Track & Analysis)	Baby + - Your Baby Tracker	CANImmunize
Available on iOS	x	✓	✓
Has a syn function	x	✓	x
Tracks feeding, voiding & bowel movements	✓	✓	✓
Tracks solids	x	✓	x
Tracks sleep	x	✓	✓
Tracks growth	✓	✓	✓
Records vaccinations	x	✓	x
Records doctor's visits/medications	x	✓	x
Data editing	✓	✓	✓
Exports data	✓	✓	✓
Reminders/ notifications	x	✓	✓
Shows trends	✓	✓	✓
Supports multiple babies	✓	✓	✓

Figure 3 App comparison chart. The information presented here is not factual.

unlimited choices, designers need to eliminate options for users. A huge number of choices distract users and they end up choosing nothing. In this study parents also felt overwhelmed with the abundance of app choices in one category and recommended to include only three top apps in a category.

The participatory design provides the opportunity to engage users in designing a resource that works for them. Technology products that are designed in partnership with end-users meet their expectations and increase the uptake of the developed resource. Abbass-Dick *et al.* (33) designed and evaluated an eHealth breastfeeding resource with Canadian Indigenous mothers using participatory design. They found that involving mothers in co-creating the resource resulted in a culturally relevant Website that met their needs and was appreciated by the participants. Similarly, in this study using a participatory design approach, parents participated in selecting the apps for the directory and suggested the user interface elements that are relevant to busy and overwhelmed parents and can simplify their search for apps.

Implication for practice

The growing trend of parents' use of apps and the proliferation of poor quality and irrelevant apps presented a timely opportunity to design an online resource for parents

supporting their search for apps. Clinicians need to support technologically savvy parents in a way that they like to receive information rather than the way health professionals used to deliver information.

Danbjørg *et al.* (34) designed an app for postnatal parents and indicated parents were comfortable with app use and found it easy to use compared to other methods such as consulting nurses over the phone. However, nurses reported feeling incompetent while interacting with parents using the app due to unfamiliarity with digital modes of delivering information. Researchers and clinicians' participation in evaluating and suggesting apps can support parents' use of quality resources.

Co-creating resources with end-users not only provide insight into issues that users are facing but also provides ideas of dealing with the issue in a way that is appealing to users. Research methods such as participatory design can be used in exploring the target population's specific concerns and developing an online resource that suits their needs and meets their expectations. Researchers should consider involving parents throughout the process from identifying their needs to evaluating the end-product. Davis *et al.* (28) also recommended that nurses should actively participate in involving parents and other multidisciplinary teams in developing evidence-based resources that are acceptable to parents.

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Features

- Tracks your baby's feeding (breast/bottle/solids), pee, poop, tummy time and growth
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- Exports data to email or printer

Pros

- ✓ Allows multiple babies
- ✓ Sends Reminders
- ✓ Provides several customization options such as adding/deleting required icons, choosing date/time style, picking a colour for each child, selecting unit of measurements, allowing day/night interface and adding widgets
- ✓ Works offline (no internet connection required to input data)
- ✓ Good customer service as per users' reviews

Cons

- ✗ Small icons
- ✗ Icons are not labelled
- ✗ Advertisements at the bottom
- ✗ Need pro version to remove advertisements, to sync with more than one person and to get more options for exporting data.

Review Details

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Figure 4 App description page.

Users may not be theoretically equipped with design knowledge but they can provide insight into design principles that may be used in developing an appealing resource for the target populations. For example, in this study parents indicated that infant care responsibilities account for a huge amount of their time and suggested using time-saving user interface design elements to ease the search process for parents. Researchers can use this as a guide in developing future online resources targeted to parents and incorporate design elements that are relevant to parents.

Limitations

The study has a few limitations that need to be considered while interpreting findings. The high representative sample of mothers may not have very well captured fathers'

perception in this study. However, involving fathers in research is a challenging task that has been mentioned by several researchers (35-37). In the future, a parenting app study that would involve a greater number of fathers may provide a different insight into the matter. As the directory was supposed to be part of the host Website to sustain the intervention, participants were given a designing space with predefined basic layout that restricted their feedback on certain design elements such as color, images, and so on. Future studies that incorporate parents' preferences of the basic layout will add significantly to the body of parenting user interface design literature.

Conclusions

Today's parents are driven by the need for time and access

to resources that are convenient, efficient, and freely available. In this study, parents co-created a user interface with researchers to feature the app directory to support their search for apps. Parents consistently advocated for time-saving design features, such as a less cluttered and easier to navigate user interface that provides less but the best choices in a particular parenting app category, to incorporate the resource in their busy lives. Current trends depicting a constant increase in accessing apps to resolve parenting concerns, demand clinicians' and researchers' participation in supporting parents' search for quality online resources. Involving parents in research and gaining their perspectives on developing online resources will result in well-targeted technology products and will increase uptake amongst parents. Technology that is developed with users has a more powerful impact than those developed on behalf of them. This study provided insight into parents' preferred user interface features that can be used in designing future online resources.

Acknowledgments

The authors would like to acknowledge Dr. Eleni Stroulia, Professor, Faculty of Science, University of Alberta, for her contribution to the conception and design of the project as one of the supervisory committee members.

Funding: None.

Footnote

Data Sharing Statement: Available at <http://dx.doi.org/10.21037/ht-20-29>

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/ht-20-29>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Conjoint Health Research Ethics Board (CHREB ID: REB17-2077) and informed consent was taken from all the participants.

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doi: 10.21037/ht-20-29

Cite this article as: Virani A, Duffett-Leger L, Letourneau N. Co-designing an e-resource to support search for mobile apps. Health Technol 2021;5:10.