

# The mobile health application can add our insight into caring for children: The benefit and future usage of the Chemo Assist for Children

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## Abstract

**Background:** The ease of use of mobile health applications felt by users is essential to ensure the sustainability of digital-based intervention programs. The mHealth Chemo Assist for Children (CAC) application has been used by parents with children with acute lymphoblastic leukemia (ALL) who are undergoing chemotherapy in usability tests and positive benefits felt by users have been reported. A deeper understanding of the barriers and factors supporting implementing the CAC mHealth application can help guide strategies to overcome these challenges.

**Purpose:** This study aims to evaluate the obstacles and factors supporting implementing mHealth CAC application in a natural setting.

**Methods:** Qualitative research was conducted at two government hospitals in Indonesia. Focus group discussions were conducted with nine parents of children with ALL following chemotherapy. The interview was transcribed verbatim and analyzed using qualitative content analysis.

**Results:** This research produced three main themes, namely the use of CAC and additional usage expectations, application quality, and current and future application usage.

**Conclusion:** It is necessary to improve the benefit, ease of use of application features and overcome the obstacles experienced in using the CAC application.

**Keywords:** acute lymphoblastic leukemia; expectations; natural setting; parents; quality

## Introduction

The industrial revolution 4.0 has affected the development of technological advances in the health sector, including the emergence of web and mobile-based health applications. Mobile health (mHealth) is a broad concept that describes various smartphone technologies and, most frequently, consumer healthcare technologies, such as web-based information resources, remote monitoring, and telehealth (Moumtzoglu, 2019). The mobile health application is a form of digital health intervention (Labrique et al., 2020). It is estimated that there are almost 3 million Android applications worldwide in the Google Play Store and more than 3 million in the Apple App Store (Cannon, 2018). Meanwhile, more than 400 health applications in Indonesia have been developed by local and central governments (Ministry of Health, 2021).

In the area of cancer, past studies have revealed that patients value the importance of using apps for healthcare management and feel comfortable using them (Girault et al., 2015), they overcome barriers to care and improve the delivery of resources to hard-to-reach populations, and provide opportunities for behavior change interventions (Phillips et al., 2019). A systematic review explained that around 54 articles were found to analyze application development in cancer. Approximately 28 of these articles are applications for early cancer detection, especially melanoma,

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with nine articles (Ana et al., 2020). Furthermore, a systematic review reported 12 studies that assessed interventions for the early detection of cancer in children in developing countries in the form of training of health professionals in early detection of childhood cancer, public awareness campaigns, and the “Teman Kanker” application (Zabih et al., 2020).

Children diagnosed with cancer have been on treatment for a long time, requiring secondary preventive measures to routinely monitor symptoms that appear as side effects or are related to treatment. A scoping review of 14 articles obtained nine health technologies in the area of pediatric oncology that have been developed in various developed countries to monitor symptoms and manage symptoms due to chemotherapy alone or multiple, namely Supportive Care Prioritization, Assessment, and Recommendation for Kids (SPARK), Empower Stars!, Pain Squad+, Kræftværket app, Sisom, Care Assistant, Cancer-Tailored Intervention for Pain and Symptoms (C-TIPS), THRIVE, and Facebook-based “Healthy Teens for Soaam” (Novrianda et al., 2022). Chemo Assists for Children (CAC) is an mHealth application developed to monitor and manage symptoms due to chemotherapy in children with acute lymphoblastic leukemia (ALL) in Indonesia (Novrianda et al., 2023).

The mHealth CAC application has been used by parents with children with ALL who are undergoing chemotherapy at two government hospitals in Indonesia and reported positive benefits felt by users. However, this is not in line with adherence to the mHealth CAC application (Novrianda et al., 2022). There are several reasons for the discrepancy in implementing this mHealth application, where users experience certain obstacles and challenges in using the mHealth CAC application. A deeper understanding of the barriers and factors supporting implementing the CAC mHealth application can help guide strategies to address these challenges. A consolidated framework for implementation research (CFIR) was used to describe factors associated with the successful adoption of evidence-based practice across five domains: internal settings, individual characteristics, external settings, characteristics of interventions, and implementation processes with evidence that supports its use in resource-limited environments. This study uses the CFIR framework to evaluate the barriers and factors preventing implementing mHealth CAC applications in hospitals with limited resources and explores strategies that support implementation in this environment.

This study aims to evaluate the application of the Chemot Assists for Children (CAC) mobile health application to parents with children with acute lymphoblastic leukemia.

## Materials and Methods

### Design

This type of research is qualitative, using the focus group discussion method, which aims to evaluate

the use of the mHealth CAC application in parents of children with ALL in natural or real-world settings through exploring an in-depth understanding of user experiences, perceptions, and satisfaction with the mHealth CAC application. The mHealth CAC application includes a collection of symptoms, symptom management strategies (14 strategies and 120 sub-strategies for 17 chemotherapy-related symptoms), online consultations, arrangements for nutritional and fluid needs, and information in the form of animated videos. When the user logs in to the CAC application, several demographic, physical, and chemotherapy data will appear for the child, calculating the child's calorie and fluid needs. Based on the severity score of the child's symptoms entered into the application, a symptom management strategy is obtained that is recommended for parents to apply to children with ALL.

### Sample and setting

In qualitative research, participants who are part of the target population are required to share experiences following the research objectives to explore the constraints and supporting factors for the application of mHealth CAC. The population in this study was parents of children with acute lymphoblastic leukemia who were undergoing chemotherapy at Dr. M. Djamil Hospital Padang and Arifin Achmad Hospital Pekanbaru.

Participants were taken by purposive sampling and selected based on the inclusion criteria: Fathers or mothers who have children with ALL who are undergoing chemotherapy for induction, consolidation, and recovery; Fathers or mothers who have ALL children aged 1-18 years; Father or mother who has used the mHealth CAC application; Able to communicate and cooperate reasonably.

### Ethical consideration

This research has obtained ethical approval from the Health Research Ethics Commission Dr. M. Djamil Hospital Padang (LB.02.02/5.7/461/2022). Permission and authorization to conduct the study were received from the Director of Dr. M Djamil Hospital Padang and Arifin Achmad Hospital Pekanbaru.

The researcher provided brief information to the respondents regarding the implementation of the study, the confidentiality of information, and the participants' right to withdraw at any time. All participants in this study were parents of children with acute lymphoblastic leukemia undergoing chemotherapy, and no children under 16 years old were involved. All parents or guardians obtained an informed consent form for audio recording and using excerpts in publications and reports.

### Data collection

Data collection procedures include data collection methods and data collection procedures. The data collection strategy used focus group discussion (FGD) online using the Google Meet

**Table 1. Characteristics of Respondents who used the mHealth CAC application (n=16)**

Characteristics	Frequency	Percentage
<b>Parents</b>		
Age		
20-30 years	9	56.3
31-40 years	4	25.0
41-50 years	2	12.5
51-60 years	1	6.3
Sex		
Male	1	6.3
Female	15	93.8
Education		
High education	1	6.3
Senior high school	5	31.3
Junior high school	6	37.5
Elementary school	4	25.0
Occupation		
Entrepreneur	1	6.3
Private staff	2	12.5
Not working (housewife)	13	81.3
Province		
West Sumatera	6	37.5
Riau	6	37.5
Jambi	4	25.0
Ethnic		
Minang	5	31.3
Melayu	3	18.8
Aceh	1	6.3
Batak	2	12.5
Sunda	1	6.3
Jawa	2	12.5
N.A	2	12.5
<b>Child</b>		
Age		
Toddler (1-3 years)	4	25.0
Preschool (4-6 years)	8	50.0
Age school (7-12 years)	1	6.3
Adolescent (13-18 years)	3	18.8
Sex		
Male	10	62.5
Female	6	37.5
Protocol		
High-risk	8	50.0
Standard-risk	7	43.8
AML	1	6.2

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**Cont. Table 1. Characteristics of Respondents who used the mHealth CAC application (n=16)**

Characteristics	Frequency	Percentage
Phase		
Induction	7	43.8
Consolidation	6	37.5
Maintenance	3	18.8

Note: AML = acute myeloblastic leukemia, N.A = not available

**Table 2. Frequency of using the Chemo Assist for Children (CAC) application and user characteristics (n=16)**

Re-spon-dent	Fre-quency	Age, year	Sex	Education	Occu-pation	Ethnic	Child's age, year	Proto-col	Phase
<b>Arifin Achmad Hospital Pekanbaru</b>									
1	6	27	Female	High edu-cation	Not working	Melayu	4	SR	Consolidation
2	4	35	Female	Se-nior-high	Not working	Melayu	7,5	SR	Maintenance
3	5	24	Female	Se-nior-high	Not working	Melayu	6	SR	Consolidation
4	8	41	Female	Se-nior-high	Private staff	Minang	5,9	HR	Maintenance
5	5	25	Female	High edu-cation	Not working	Batak	4	SR	Induction
6	5	30	Female	Se-nior-high	Not working	Aceh	6,8	SR	Induction
7	3	30	Female	High edu-cation	Not working	Jawa	4,5	SR	Induction
8	3	32	Male	High edu-cation	Emplee	Jawa	3,5	SR	Induction
<b>Dr. M. Djamil Hospital Padang</b>									
9	1	42	Male	Se-nior-high	Entre-preneur	Jawa	15,3	HR	Maintenance
10	1	21	Female	Se-nior-high	Not working	Batak	3,4	HR	Consolidation
11	1	24	Male	Se-nior-high	Farmer	Sunda	1,5	SR	Induction
12	2	24	Female	Se-nior-high	Private staff	Caniago	16	HR	Consolidation
13	1	37	Female	Junior-high	Not working	N.A	4,4	HR	Consolidation
14	1	33	Female	High edu-cation	Emplee	Minang	2,8	HR	Consolidation
15	2	20	Female	Junior-high	Not working	Tanjung	3,2	HR	Induction
16	1	23	Female	Elementary	Private staff	N.A	4,7	SR	Induction

Note: SR = Standard-Risk, HR = High-Risk

**Table 3. Characteristics of parents who attended FGD (n=9)**

Participant	Age, year	Sex	Education	Occupation	Origin	Ethnic
1	41	Female	Senior	Private	Kubang	Minang
2	30	Female	Senior	Not working	Tanjung balai karimun	Aceh
3	25	Female	High	Not working	Riau	Batak
4	27	Female	High	Not working	Riau	Melayu
5	32	Male	High	BUMD	Riau	Jawa
6	35	Female	Senior	Not working	Riau	Melayu
7	24	Female	Senior	Private	Padang	Caniago
8	24	Male	Senior	Farmer	Jambi	Sinda
9	38	Female	Junior	Not working	Pariaman	Piliang

**Table 4. Themes and quotes from the content analysis of the focus group discussions**

Themes	Quotes
Uses of CAC and additional usage expectations	Assess the child's condition "I feel this application helps me in assessing my child's condition." (P6)
	Solutions to overcome child complaints "... besides that, we are also given directions or suggestions on what I can do to deal with my child's complaints." (P6)
	Train mother's patience "Besides that, this application can train mother's patience too." (P5)
	Increase knowledge of caring for children "It's the best because we parents know what complaints children experience and what actions parents can take. This application can also add to our insight in caring for children." (P6)
	To increase recommendations, information, and education (e.g., genital hygiene) "In my opinion, there should be more information and education regarding children's health, for example, maintaining the cleanliness of the child's genital area. Parents sometimes miss that cleanliness is important so that children stay healthy and protected from disease." (P6)
	More detailed assessment of the child's condition "It is better to add questions for a more in-depth condition assessment." (P1)
	Ease of downloading apps for all types of apps "I hope this application can be downloaded easily regardless of the type of cellphone because some parents also want to get this application, ma'am, but cannot download it on their respective cell-phones." (P2)

application. Nine parents had used the mHealth CAC application for one month and were willing to participate in the FGD. The FGD lasted for two hours. In conducting the FGD, the researchers used semi-structured interview guidelines based on research objectives and CFIR. Observations of field conditions complement the data collected, including expressions and situations.

Focus group technique is a type of qualitative

research methodology, generally defined as a structured discussion with a small group of people, run by a facilitator or using a moderating team, to generate qualitative data on a precise topic of interest (Masadeh, 2012). FGDs are carefully planned discussions designed to elicit group members' perceptions of a defined area of interest (Kontio et al., 2004). In FGDs, several users are brought together to discuss their attitudes

**Cont. Table 4. Themes and quotes from the content analysis of the focus group discussions**

Themes	Quotes
Application quality	<p><b>Favorite part of using the CAC app</b></p> <p>Features of nutritional needs  “... apart from that, there is a nutrition menu as well so I can also see my child’s nutritional needs, ma’am.” (P1)</p> <p><b>Music and murottal therapy</b>  “Usually, my child is often fussy, crying so when I assess his condition, there is a suggestion to give music therapy, so if my child is fussy, I usually turn murottal so he can calm down mom, and this is routine therapy that I do., and Alhamdulillah my child can sleep well, and I always follow and carry out the suggestions given from the application, ma’am.” (P2)</p> <p><b>Doctor consultation</b>  “Recently, my child has had a cold cough, ma’am, so this application suggests consulting a doctor to be given the medicine.” (P6)</p> <p><b>Very challenging part</b></p> <p><b>Setting caloric needs</b>  “Maybe the division fills the nutritional needs of children, ma’am because I don’t understand that part. For example, if I adjust the calories, the result is that the nutrition has not been fulfilled or is still lacking. So, I’m confused, ma’am.” (P5)</p> <p><b>Problems downloading the app for certain types of cellphones</b>  “If I ever recommend to other parents. But because the cellphone is insufficient, they cannot download this application. Many want it, but the problem is insufficient cell phone type, ma’am.” (P2)</p> <p><b>Barriers to logging in if you forget your password/ email</b>  “Apart from that, when I registered, I had quite a bit of trouble, ma’am, because we had to enter our email and password. Well, when parents log out to log in again, they must enter their email and password. OK, sometimes I forget that.” (P6)</p>

and feelings about the topic for about one to two hours, with the moderator facilitating the discussion using a pre-planned script (Nielsen, 1993, 1995). Focus group sizes often range between six and 12 individuals (Guest et al., 2017).

As such, FGDs are best suited for exploring and gaining an in-depth understanding of end users’ experiences, opinions, hopes, desires, and concerns, mainly after they have used the technology in real-world settings. The tools or instruments used in collecting data were questionnaire sheets for patient demographic data and interview guides designed by researchers.

### Data analysis

In qualitative research, the data analysis process is carried out simultaneously with the data collection process (Utarini, 2021). Data analysis in qualitative research is subjective because researchers are the main instrument for data collection and

research data analysis (Afiyanti & Rachmawati, 2014; Utarini, 2021). Each interview was audio recorded using a tape recorder. The audio data were transcribed verbatim after each interview by A.F. (a newly-graduated nursing student with experience in qualitative research). After that, another researcher (D.N) examined the transcripts using audio recordings. Furthermore, data analysis carried out by researchers was qualitative content analysis (Elo et al., 2014), one of the qualitative methods currently available for analyzing data and interpreting their meaning. This method is a systematic and objective way to describe and measure phenomena. The prerequisite for a good qualitative content analysis is that it can be reduced to concepts that describe research phenomena by creating categories, concepts, models, conceptual systems, or conceptual maps.

The resulting categories were obtained from data that have meaning related to the phenomenon



**Cont. Table 4. Themes and quotes from the content analysis of the focus group discussions**

Themes	Quotes
Current and future use of the app	<p>Use when there is a complaint            "But not all of our children experience the symptoms in the application, ma'am. Because of that, we didn't charge it on that day." (P2)</p> <p>Rarely used because a child uses the cell phone            "But I rarely use this application because my cell-phone is often held by children." (P3)</p> <p>Not optimal because it works            "I answered the questions according to what was in the application, then such as the symptoms experienced by children, weight, but for other menus, I could not open them because I was working." (P4)</p> <p>I didn't use it because I asked other people            "I have never used this application, just looking at it, ma'am, since it was introduced. Because my child and I live in a halfway house, ma'am, there are also consultants available regarding child problem measures, so if Aqil has a problem, I usually ask him right there, ma'am." (P8)</p> <p>I don't understand yet because of the new app            "This is the first time I know about this application, ma'am, so I don't understand how to use it." (P4)</p> <p>Willingness to use the app            "While this application can help us, why not, ma'am, for me, God willing, I will continue to use this application." (P2)</p> <p>Need to recommend to others            "Yes, ma'am, we can recommend this application, especially for those who are new to becoming parents. Sometimes they don't know what action to take when a child experiences complaints." (P6)</p>

under study. The resulting themes were not derived from theory and emerged from the data inductively. Decisions regarding data saturation were discussed with the research team.

### Trustworthiness

The trustworthiness in qualitative content analysis starts from the data collection phase to reporting results. Going through these phases should give the reader a clear indication of the trustworthiness of the research as a whole. In this study, we conducted member checking to reduce description and interpretation bias. We conveyed the verbatim transcript of the discussion to the participants to gain confidence and confirm that the data collected were consistent with what the participants expressed during the group discussion. The discussion findings were re-evaluated with other researchers to review and understand the data. In addition, peer debriefing was conducted between researchers and external reviewers, representatives of qualitative methodologists with relevant expertise.

### Results

Of the 18 parents invited to use mHealth Chemo

Assist for Children (CAC), 16 used the app for one month (28 October to 29 November 2022). Furthermore, nine parents (56.3%) were willing to be interviewed in online focus group discussions (FGDs) via the Google Meet application. Table 1 shows the characteristics of the participants who used the mHealth CAC application.

Table 1 shows that, generally, the ages of parents are in the early adult category (56.3%), female (93.8%), secondary education level (68.8%), not working (81.3%), coming from West Sumatra Province (37.5%) and Jambi (37.5%). Children are 4-6 years (50%) and are male (62.5%). Eight children underwent high-risk chemotherapy protocols (50%), and seven were in the induction phase (43.8%).

Table 2 shows that the frequency of using the app by parents whose children are treated at Arifin Achmad Hospital Pekanbaru is more frequent than those treated at Dr. M. Djamil Hospital Padang.

Table 3 describes the characteristics of parents who attended the FGD. Six out of nine participants whose children were treated at Arifin Achmad Hospital Pekanbaru had regional origins from Riau Province (n=4), West Sumatra Province (n=1), Nanggroe Aceh Darussalam Province (n=1).

We analyzed transcripts from two focus group discussions for emerging themes regarding the

perceived use of the mHealth CAC application by end-users in real-world settings based on participants' experiences, perceptions, and satisfaction with using the CAC application. Participants used the app for one month and received questions about how much the symptoms bothered their ALL child undergoing chemotherapy, then they were given self-management strategies for any such symptoms. Three themes were identified from the focus group discussions. From the Consolidated Framework for Implementation Research (CFIR) used as a theoretical framework in CAC's research into implementing mHealth applications in natural settings, the themes identified by participants were related to use of CAC and expectations of additional uses, application quality, and current and future use of CAC. The results are governed by the three primary constructs below. Themes and excerpts from the content analysis conducted from the focus group discussions are reported in Table 4.

### Theme 1. Use of CAC and expectations of additional uses

Based on participants' expressions, we developed the theme *"Use of CAC and other usage expectations."* This theme revealed that CAC was useful in treating children with ALL and parents' desire to increase the application of CAC.

#### CAC benefits

Parents stated that the CAC application has several benefits, including assessing the child's condition, solutions for dealing with child complaints, training mothers' patience, and increasing insight into caring for children.

*"I feel this application helps me in assessing my child's condition."* (P6)

*"... besides that, we are also given directions or suggestions on what I can do to deal with my child's complaints."* (P6)

*"Besides that, this application can train mother's patience too."* (P5)

*"It's the best because we parents know what complaints children experience and what actions parents can take. This application can also add to our insight in caring for children."* (P6)

#### User expectations for the CAC application

Four out of nine parents stated that this CAC application needed to add information to care for their children, as stated by one of following parents.

*"In my opinion, there should be more information and education regarding children's health, for example, maintaining the cleanliness of the child's genital area. Parents sometimes miss that cleanliness is important so that children stay healthy and protected from disease."* (P6)

### Theme 2. Quality of CAC application

Participants conveyed the quality of the features and ease of application of CAC. This theme shows how good the quality of CAC can be seen from

the features that are favorites and the obstacles encountered in using the application.

#### Use of favorite application features

When parents were asked about the features of the CAC application that they liked the most, they conveyed, among other things, nutritional needs, music and murottal therapy, and doctor consultations.

*"... apart from that, there is a nutrition menu as well so I can also see my child's nutritional needs, ma'am."* (P1)

*"Usually, my child is often fussy, crying so when I assess his condition, there is a suggestion to give music therapy; so if my child is fussy, I usually turn murottal so he can calm down ma'am, and this is routine therapy that I do, and, Alhamdulillah, my child can sleep well, and I always follow and carry out the suggestions given from the application, ma'am."* (P2)

*"Recently, my child has had a cold cough, ma'am, so this application suggests consulting a doctor to be given the medicine."* (P6)

#### Application usage constraints

There are two obstacles experienced by parents while using the CAC application, namely problems downloading applications for certain cell phones and problems logging in if you forget your password or email.

*"Maybe the division fills the nutritional needs of children, ma'am, because I don't understand that part. For example, if I adjust the calories, the result is that the nutrition has not been fulfilled or is still lacking. So, I'm confused, ma'am."* (P5)

*"If I ever recommend to other parents. But because the cellphone is insufficient, they cannot download this application. Many want it, but the problem is insufficient cell phone type, ma'am."* (P2)

*"Apart from that, when I registered, I had quite a bit of trouble, ma'am, because we had to enter our email and password. Well, when parents log out to log in again, they must enter their email and password. OK, sometimes I forget that."* (P6)

### Theme 3. Current and future use of the application

The participants used the CAC application for 28 days, but revealed that the application was not used every day. There were variations in the use of the application in terms of time, reasons for usage, and willingness to use the application in the future.

#### Application usage time

Participants revealed that the application was used when parents found their child experiencing the symptoms contained in the application. Furthermore, some parents rarely use the application for work reasons, prefer to ask friends or volunteers at shelters, and don't know how to use it.

*"But not all of our children experience the symptoms in the application, ma'am. Because of*



*that, we didn't charge it on that day."* (P2)

*"But I rarely use this application because my cellphone is often held by children."* (P3)

*"I answered the questions according to what was in the application, then such as the symptoms experienced by children, weight, but for other menus, I could not open them because I was working."* (P4)

*"I have never used this application, just looking at it, ma'am, since it was introduced. Because my child and I live in a halfway house, ma'am, there are also consultants available regarding child problem measures, so if Aqil has a problem, I usually ask him right there, ma'am."* (P8)

*"This is the first time I know about this application, ma'am, so I don't understand how to use it."* (P4)

#### Future use of the app

Participants expressed that they wanted to use the application and would recommend it to parents who needed information support through the CAC application.

*"While this application can help us, why not, ma'am, for me, God willing, I will continue to use this application."* (P2)

*"Yes, ma'am, we can recommend this application, especially for those who are new to becoming parents. Sometimes they don't know what action to take when a child experiences complaints."* (P6)

## Discussion

This study aimed to evaluate the effectiveness of implementing Chemo Assist for Children (CAC), a chemotherapy-related symptom monitoring app, and a free, evidence-based symptom management strategy in a naturalistic context. The results provide preliminary data to support using CAC to assess chemotherapy-related symptoms for children with cancer who have access to Android devices. Previous studies reported that children with cancer experience the impact of chemotherapy and its side effects on their lives, such as feeling constrained, sick, and tired. The existence of a family is the most important aspect for children with cancer during their diagnosis and treatment (Mant et al., 2019). Children with chronic conditions require educational-based interventions; involving parents as the primary caregivers of children, and using eHealth and mHealth can improve children's health or psychosocial status (Lau et al., 2020; Sheng et al., 2019; Stenberg et al., 2019). Therefore, this study also identified barriers and challenges associated with end-user use and uptake of mHealth CAC applications.

Similar to what has been reported in other mHealth studies (Amagai et al., 2022; Pfammatter et al., 2017), we encountered challenges with recruiting and retaining participants in this naturalistic context outside of traditional clinical research trials. Of the 18 parents invited to participate, 16 used the app, and only 50% used the app more than three times a month. This is in contrast to the CAC validation

trial, which recruited 30 parents of children and adolescents with acute lymphoblastic leukemia and retained all enrolled participants throughout the study (Novrianda et al., 2022). We suspect there are vital contextual differences that may explain these differences. The current study recruited and included participants regardless of the type of cellphone parents used. The CAC application is designed to be installed on cellphones with the Android 10 operating system. Of the 18 people who were willing to be involved in this research, two people used iOS cellphones. The upcoming public version of CAC should consider the possibility of the application being accessible for all mobile phone operating systems, both Android and iOS. These contextual differences reflect real-world problems that parents who download and use CAC may face in their daily lives outside a tightly controlled and well-resourced research trial environment.

These results indicate that the parents involved in this study had positive perceptions and experiences of using CAC to monitor and manage chemotherapy-related symptoms in children with ALL. Participants found CAC helpful in recognizing complaints that children felt and overcoming these complaints. This result follows previous studies (Slater et al., 2018). Participants' comments about their experiences with CAC were generally positive. They reported that the application is practical, acceptable, feasible, sustainable, and has broad penetration potential. Almost all participants (9/9) said they would use CAC during their child's treatment later in life; however, they described the limited time to use the app and the required commitment as a challenge. These challenges were also identified by participants in the CAC validation study (Novrianda et al., 2022). Future versions of the CAC should take this feedback into account to improve compliance. Furthermore, the current study was only one month in duration; therefore, future versions of the app should also consider additional incentives for long-term use. Participants' perceptions of the app's suitability varied. Participants reported that the application was beneficial for assessing and understanding children's conditions but needed a more detailed assessment, additional recommendations, and other information, such as genital hygiene. This version of the CAC recommends strategies participants can take to manage or reduce their child's chemotherapy-related symptoms. Based on the current research results, it is vital to conduct CAC implementation studies after their effectiveness has been demonstrated to optimize their relevance to children with cancer in the real world.

The findings from the study indicated that our participants considered CAC to have good qualities, including having nutritional needs regulated, being useful for self-management of symptoms due to chemotherapy, and having the potential to be used as a communication tool with healthcare providers. CAC is intended to provide evidence-based self-management strategies to help parents of children

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with ALL deal with their child's complaints; therefore, this study supports this intention. In addition, this study adds to the existing literature on the application of mHealth as a potentially effective tool for treating chemotherapy-related symptoms, which can help improve health outcomes. However, some participants still experienced challenges in using the CAC application, such as managing caloric needs, installing the application on specific cellphone devices, and logging into the application when they forgot their password. Setting calorie needs is an additional feature of the CAC application, where parents can adjust the calories obtained from each food nutrient in grams. So that, in the future, this feature for setting nutritional needs can use household size standards, although problems with inaccuracies in measurements will arise later. In addition, this application needs to be improved so that it can be used on all cellphones and make it easy to log in and register applications while maintaining system security.

The findings of this study demonstrate the novelty of digital-based interventions for children with cancer in Indonesia. The successful implementation of mobile health applications in the industrial revolution era needs to be supported by other contributing factors, including user acceptance to commit to using the application, apart from the convenience and benefits the user feels.

The strength of this study is evaluating the use of the CAC mobile health application at two government referral hospitals in central Sumatra in management of symptoms related to chemotherapy. Therefore, these findings represent parents' experience with children with ALL undergoing chemotherapy to identify the perceived benefits, favorite features and those that need to be improved, obstacles encountered during the application use, and expectations for using the application in the future.

The limitation of this study was that parents who used the CAC application for 28 days in two hospitals could not be analyzed statistically to determine whether the characteristics of parents, children, and chemotherapy affected the app usage frequency. However, it is generally seen that parents use the application more often at Arifin Achmad Hospital. Thus, future research must explore other parental characteristics such as self-efficacy, intention to use mobile health applications, and support systems. In this study, we only have one FGD, which became another limitation of the study. We recommend for subsequent research do a longitudinal study.

## Conclusion

The CAC application has several benefits for parents in assessing the child's condition and dealing with the child's symptoms, but there are still some challenges. Therefore, it is necessary to improve the aspect of ease of use of the application so that the continuity of using the application by parents is better.

## Declaration of Interest

The author(s) declare there is no conflict of interest.

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## Data Availability

The corresponding author's data supporting this study's findings are available upon reasonable request.

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