

User experiences of a mobile hospital clowning application: User-based evaluation with hospitalized children

Eira Erola¹, Johanna Viitanen¹, Kaisa Savolainen¹, Pekka Lahdenne²

¹ Department of Computer Science, Aalto University, Espoo, Finland; ² New Children's Hospital, Helsinki University Hospital, Helsinki, Finland

Johanna Viitanen, DSc (Tech), Department of Computer Science, Aalto University, Espoo, P.O. Box 15400, FI-00076 Aalto, FINLAND. Email: johanna.viitanen@aalto.fi

Abstract

When developing digital health (eHealth) services targeted for pediatric patients, it is important to consider the needs and experiences of children as the end-users of the applications. However, hospitalized pediatric patients constitute a unique and vulnerable user group, and involving them in user-based evaluation studies presents specific challenges. Our aim was to study hospitalized pediatric patients' user experience (UX) of a recently launched mobile hospital clowning application and to increase understanding of challenges related to studies with this special user group. Thus, we designed and conducted a user-based evaluation study with pediatric patients. The study data was gathered using remote interviews (n=3 participants) and an online questionnaire (n=6 respondents) in spring 2023.

Based on the initial evaluation findings, the participants had positive UX with the application and found it easy to use. However, technical difficulties and improvement requests, particularly regarding the child-clown messaging and communication features, were also identified. Based on the reported study, our key learnings and recommendations for conducting user-based evaluations with hospitalized pediatric patients include: careful planning of ethical approval and a research permit for a non-medical study, employing multiple approaches for recruiting participants, adjusting research methods to suit for children, pilot testing the methods, and involving parents to help and assist the child participants.

Despite challenges in study set-up, our evaluation resulted in usability and UX findings as well as areas for development for the hospital clowning application. This indicates that valuable insights on UX can emerge even from a small number of pediatric patients. Future work should focus on establishing sound practices for involving hospitalized pediatric patients in user-based evaluations of digital services and enhancing collaboration between researchers and children's hospitals.

Keywords: patients, hospitals, child, technology, evaluation studies, user-centered design

Introduction

Hospitals and other healthcare organizations have recognized the effect patient experience may have on the perceived quality of care [1–5]. Especially with pediatric patients, recent studies have indicated that the integration of digital health services (eHealth) into healthcare processes may improve patient experience [6–13].

When developing eHealth services, it is essential to include patients as potential users in the design process to ensure that they perceive the services as accessible, usable, and motivational [6,8,10]. Compared to adult patients, pediatric patients can be considered a special and vulnerable user group, primarily due to their developmental stage [14].

Only a few studies have investigated user experience (UX) and usability of mobile applications from children's perspective, reporting enjoyability and attractiveness [15], as well as ease of use and engagement [11], as key aspects. In this article, we add to these studies by reporting initial evaluation results and lessons learned from a study on a special mobile application developed for pediatric patients. Our aim was to study hospitalized pediatric patients' UX of a recently launched mobile hospital clowning application and to increase understanding of challenges related to studies with this special user group.

The research questions were:

1. What kinds of initial UXs do pediatric patients have with the new mobile hospital clowning application?
2. When involving hospitalized pediatric patients as participants in user-based evaluation studies, which issues require special attention for planning and conducting research?

In our previous study, we researched the UX of the application from the hospital clowns' perspectives [16] and found that despite some technical difficulties with various features of the application, these users were overall content with it [16].

Material and methods

In this study we focus on a recently developed digital service targeted to hospitalized pediatric patients: a mobile hospital clowning application, through which the clowns offer emotional support for pediatric patients remotely. Hospital clowns work alongside healthcare professionals, aiming to improve children's patient experience by alleviating fears and anxieties within the hospital context [17–19]. In Finland, the Hospital Clowns Association (Sairaalaklovnit ry in Finnish) [20] published a free mobile application for iOS and Android-based mobile devices in 2022 (Figure 1). In addition to entertainment features, such as clown-themed videos, the application includes a messaging feature that allows children to communicate remotely with the clown team.

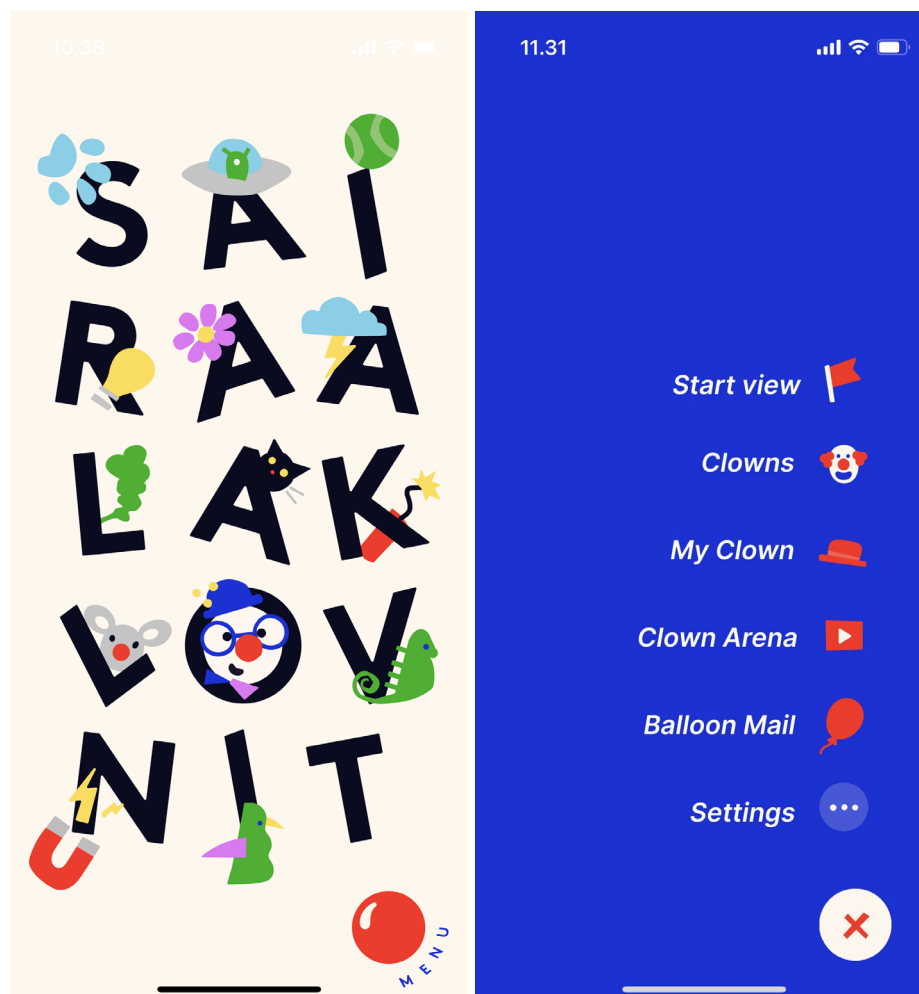


Figure 1. Screenshots of the Finnish hospital clowning mobile application’s start view and the main menu. The application is in Finnish and Swedish (the screenshots have been translated in English for this article).

The user-based evaluation study of the hospital clowning application with pediatric patients was planned and conducted from August 2022 to May 2023 in collaboration with the hospital clown organization and Helsinki New Children’s Hospital, which is part of HUS (Helsinki University Hospital) in Finland. Research involving underage children requires both research approval and statement from the ethical committee. An ethical application, including a detailed research plan, an ethical review, and a privacy statement [21], was prepared together with hospital collaborators. However, the

approval was applied from the researchers’ home university’s committee, because the HUS ethical committee declined to process applications for non-medical studies.

The target group of the study comprised Finnish-speaking hospitalized pediatric patients aged 6 to 16, who had experience using the hospital clown application. These inclusion criteria were chosen to increase the likelihood that participants would be able to describe their thoughts in more detail than younger children [22].

A mixed-method approach was applied, including interview as the primary research method and an online questionnaire as the supplementary method. Special attention was given to designing the research methods to ensure their suitability for the target group [14,22]. The interview sessions were planned to be relatively short considering that younger children may find it difficult to stay focused [14,22]. Furthermore, the approach for conducting the interviews was planned to be decided according to the participants' preferences, so that the interviews could be carried out in-person in the hospital, at home, or remotely. In the online questionnaire design, particular care was taken to create meaningful and understandable wording for questions, use clear and informative supportive illustrations, and select an accessible platform for the online questionnaire. To test the study procedure, we conducted pilot tests with two children, aged 6 and 10, outside the hospital context.

Initially, we aimed to utilize the standardized Usability Metric for User Experience (UMUX) [23,24] tool as it is widely used for measuring the usability and UX of digital services and the UMUX score is comparable to the popular System Usability Scale (SUS) score [23–25]. Findings from the pilot tests suggested that the children were confused by the alternating positive and negative statements in the original UMUX and the seven-point Likert scale.

Based on the piloting, the UMUX questionnaire was changed to UMUX-Lite [23,24], which includes two positive statements and simplifies the Likert scale to a five-point format. The five-point scale was found easier for the children to differentiate the strongly agree/disagree and the slightly agree/disagree options. In addition, clown-themed illustrations were added to assist the child participants [26] in answering questions with Likert scales (Figure 2).

The goal was to invite about 15 pediatric patients who had used the hospital clown application to the study. Participant recruitment began in four in-patient wards at the New Children's Hospital in March 2023, based on information about which wards the hospital clowns had visited recently. With the assistance of nurses working in the wards, the researcher (E.E.) visited the patients' rooms and approached potential participants and their parents face-to-face. However, none of the about 20 individuals approached were interested in or willing to participate. Other methods and approaches used to recruit participants included study promotion posters distributed in multiple public areas within the hospital, contacting families that the hospital clowns knew beforehand, following the hospital clowns on their rounds in different parts of the hospital, and contacting application users via the application's messaging feature.



Figure 2. The clown-themed illustrations of a five-point scale ranging from strongly agree to strongly disagree.

In total, three pediatric patients (two boys aged 6 and 9, and a girl aged 6), and their families were successfully recruited to take part in the interview study. One researcher (E.E.) conducted the remote semi-structured interviews via Microsoft Teams from March to April 2023. The child interviewees participated in the study with their parents present. As the interviews were held remotely, the consent form was sent to participants' parents in PDF form via email. Parents were asked to fill out and return the consent form before the interview session. During the remote interviews, the parent was operating the device the child participant joined the call with and the child could ask for support in case they had difficulties in answering a question.

The researcher began the interview sessions by explaining that the interview questions were not measuring the interviewees' skills or proficiency but were focused solely on the mobile hospital clowning application. The researcher also emphasized that there were no wrong answers to the questions [14,22] and that participants could end the interview at any point if desired. The topics of the 14 interview questions (see Table S1) were related to the interviewees' backgrounds, their views on hospital clowns in general, their experiences with the hospital clown mobile application, and suggestions for the application's future development. After the interview part, the interviewees were asked the UMUX-lite questions together with pictures supporting the response options (Figure 2). The interview session also included a few questions directed to the parents. The interview sessions lasted between 15 and 30 minutes. During the remote interview, the parents operated the device, and the children could ask for support if they had difficulties answering a question.

The questions of the online questionnaire (see Table S2) were similar to the interview questions. For

questionnaire respondents, the study information sheet and consent forms were presented on the first screen. To proceed with the questionnaire, the respondents had to give their consent to participate in the study. The online questionnaire was implemented using the researchers' home university's platform (Webropol), as the questionnaire did not include any questions related to medical or other personal and identifiable information.

Three respondents completed the questionnaire from March to May 2023. In addition to the three submitted responses, 11 additional people opened the questionnaire link but did not submit their responses.

To analyze the interview data, thematic analysis [27,28] was employed by one researcher (E.E.). First the interview recordings were transcribed, resulting in approximately 10 pages of transcribed text. In addition to these transcriptions, the data consisted of a few pages of notes taken by the interviewer during the interviews, including the interview questions with short answers. The analysis process began with coding the interview transcripts, adding these codes on notes in Miro, and then categorizing the codes under subcategories and main categories using an affinity diagram. The categories were: Interacting with hospital clowns; Current features (subcategories: Start view, My Clown, Clown arena, Balloon Mail, Settings); Development suggestions (Interaction, Navigation, Customization, Technical Challenges). The questionnaire contained similar themes as the interviews and, thus, these were added to the same Miro. Additionally, as the interviews included the same UMUX lite questions that were also a part of the questionnaire, these responses were combined.

Questionnaire data were analyzed automatically by the questionnaire platform based on averages, standard deviation, and number of responses, and

various figures and graphs that helped the researcher interpret the findings. Furthermore, the UMUX-Lite questions were analyzed according to standardized guidelines [29]. Due to the low number of respondents, the overall usability score was not calculated with the two UMUX-Lite statements.

Results

Pediatric patients' initial UX with the mobile hospital clowning application

All study participants (3 interview participants and 3 online questionnaire respondents) responded to the two UMUX-Lite questions (see Table 1). The respondents agreed that they could do anything they were supposed to do with the application (average 4.3) and found the application easy to use (average 4.0).

In the interviews, the participants (n=3) reported mostly positive UX with the mobile hospital clowning application. They were satisfied with the application and enjoyed using it. However, some technical issues caused annoyance. Despite these issues, none of the participants had stopped using the application. The most preferred feature of the application was Balloon Mail (Figure 3), which provided a way to message and communicate remotely with the hospital clowns. According to one interviewee's parents, sending messages brought a lot of joy to their family. It was also useful for arranging face-to-face contact with hospital clowns during occasional patient visits to the hospital when they might otherwise miss the clown rounds in a specific ward. In addition to Balloon Mail, one interviewee listed the application's sound effects and audio design as their favorite feature. Participants also seemed to enjoy the animations and interactivity in the start view.

Table 1. UMUX-Lite results regarding the mobile hospital clowning application.

Statement (UMUX-Lite) (1 = strongly disagree - 5 = strongly agree)	Average score	Individual scores
With the hospital clown application, I could do anything I thought I could.	4.3 (n=6)	4 (n=4), 5 (n=2)
The hospital clown application is easy to use	4.0 (n=6)	3 (n=1), 4 (n=4), 5 (n=1)

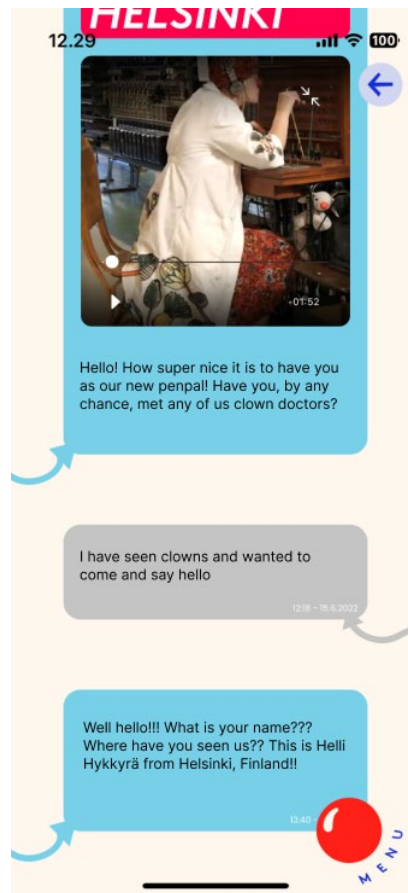


Figure 3. Screenshot of the messaging feature Balloon Mail through which the child and clown users can send messages to each other.

However, the Balloon Mail was found to have major technical issues, such as messages being left undelivered when the child tried to send them. The technical issues were not limited to the messaging feature; for example, the profile card creation (Figure 4) also posed challenges. This feature involves taking a selfie and then dressing oneself up as a clown.

For an unknown reason, users, and sometimes even the parents, struggled to align the provided accessories, such as red noses, to the selfie. One parent mentioned that this issue was more noticeable in Android-based devices compared to iOS devices.

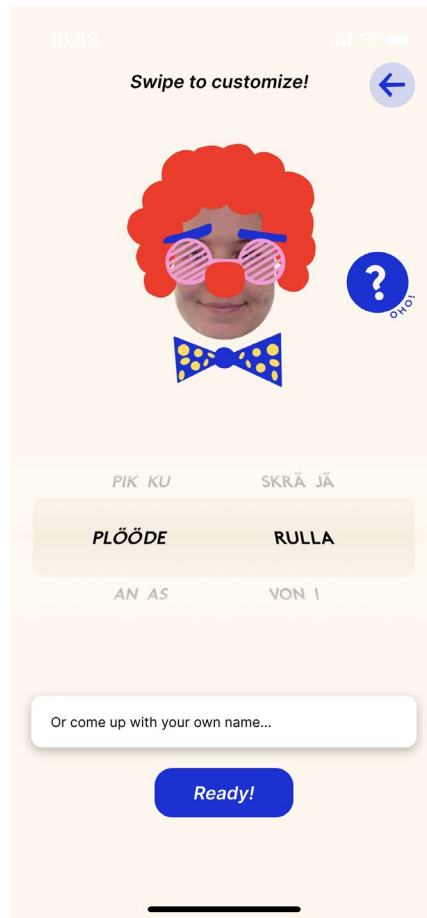


Figure 4. Screenshot of a profile card, where users can combine a selfie with various accessories and come up with their own clown name.

Based on the interviews, several development ideas were identified. Most of these ideas were related to resolving technical issues: ensuring that messages are not left undelivered (n=3/3) and fixing the alignment of accessories when creating the profile card (n=2). Other suggestions included allowing video calls (n=2) and voice calls (n=1) between children and hospital clowns to facilitate remote contact and rely less on reading and writing skills.

Issues requiring special attention in research with hospitalized pediatric patients

Acquiring an ethical approval and a research permit for a non-medical study and preparing the attached

documents required multiple documents that necessitated commitment and close collaboration between the hospital and the university researchers. Additionally, the application release was delayed multiple times, causing unexpected delays in planning and conducting the study. For example, applying for a research permit required a detailed description of methods and questions, which could not be completed until it was clear which features the released hospital clowning application would include.

When recruiting participants multiple approaches were used to reach hospitalized pediatric patients: posters, direct chat messages within the application, and the researcher's (E.E.) weekly visits to

patient rooms in the hospital wards. Several challenges emerged in recruiting participants. Since the hospital clowns were not hospital employees but worked separately with a special permit, they could not recruit children. Initially, the researchers planned for the nurses to recruit children, but it quickly became clear that the nurses did not know which pediatric patients were using the application. To avoid adding to the nurses' workload, it was decided that the researcher (E.E.) and the hospital's customer services manager would do the recruitment. During recruitment, both children's and parents' consent was required, adding another layer of complexity.

The specific and vulnerable target group of the study significantly influenced the selection and application of evaluation methods. Successfully designing study methods required understanding the cognitive levels of children. This included modifying the initial methods and questions, such as adding supportive illustrations (Figure 2) shown to participants during the interviews and in the online questionnaire to help them understand the different scales and answer questions more effectively.

Conducting a pilot study was found extremely important due to the special target group. The pilot study identified questions that needed refinement. Despite piloting both the interview questions and the questionnaire, the researchers noticed that some pediatric patients had difficulty understanding certain questions. When asked about features of the application, two children misunderstood the question as relating to in-person clowning interactions at the hospital rather than the digital application.

Remote interviews via Teams required an adult to help and assist the child participant. Young participants could not operate their devices alone, so an adult had to help them join the video call. The

parents also helped with the technical aspects and assisted the children in wording their thoughts on some questions. Two out of the three interviewees were distracted during the interview at least once and physically left the video call for a while, leaving their parents in front of the camera. During their absence, the parents answered the questions from their own perspectives providing another view of the children's experiences.

Discussion

To ensure that vulnerable user groups of eHealth applications, such as hospitalized pediatric patients, can use the applications successfully, it is crucial to test these applications together with potential users before deployment. Further, according to the principles of human-centered design [30], users should be involved in the development process of the applications. Our research focused on a special application developed for pediatric patients, a mobile hospital clowning application, whose user experiences we had previously investigated from the perspective of the clowns [16]. Conducting the user-based evaluation study from the children's point of view was more challenging, but it resulted in valuable findings related to UX, usability, and application development.

Main findings

Positive UX but also improvement areas

Based on our initial evaluation findings, the pediatric patients using the recently launched mobile hospital clowning application were quite content with the application's usability and found it enjoyable to use. They liked sending and receiving messages from the hospital clown teams, and their parents appreciated the personal messages as well. The clowns also identified messaging as the main feature of the application [16]. However, the child

participants noted the absence of some expected communication features, such as voice and video calls with the clowns. Similarly, the clowns suggested adding new functionalities, such as video calls and live-streaming hospital content, to support more continuous communication between the children and the clowns [16]. As the application's goal was to extend real-world interaction into digital form, missing interaction features might hinder some remote contact. These findings underscore the importance of including end-users in the early phases of software development, similarly to earlier studies [10] and as stated in the industry standards [30].

Another important and critical finding was the technical challenges that influenced the children's UX and led to difficulties in sending messages to clowns and aligning visual elements within the application. Identifying technical failures in the deployed application is critical. The technical functionality of the application should be thoroughly tested before its deployment in solutions intended for such a vulnerable user group as hospitalized pediatric patients. Similar technical issues were found in earlier study with the clowns [16]. Technical challenges have also in other studies been noticed to affect user experience and use of newly developed eHealth services for children [31,32]. These technical deficiencies can be attributed to failures in the software development process, such as lack of technological capacity or the absence of iterative process and user-driven evaluations [30].

Challenges in studying UX of hospitalized pediatric patients

Involving hospitalized pediatric patients in user-based evaluation studies presents specific challenges. When planning the study, we utilized our previous experiences from studies with pediatric patients and their parents [6,8,9,33] as well as

hospital clowns in a children's hospital [16,34]. As hospitals are obliged to protect their patients, ethical approval is required before research can commence [35,36], and researchers must follow specific practices, such as infection precautions, rules regarding visitation hours, and patient confidentiality [37,38]. Due to hospitals' strict policies concerning study approvals, many researchers have experienced difficulties accessing patients in hospitals [36,37].

Participants' young ages and cognitive abilities should be carefully considered when designing the study and methods. Many of the challenges we experienced are in line with those reported by Coyne et al [36], whose research focused on the opportunities for the hospitalized pediatric patients to express their experiences regarding consultations and decision-making. We found that technical difficulties are to be expected when conducting interviews remotely with child participants. Because joining a video call can be difficult for younger children, an adult should be available to help with the technology and possibly with the questions. Furthermore, children's ability to concentrate may not be sufficient for a video interview. Regarding questionnaires, it is crucial to design simple questions that leave little room for misinterpretation, and supportive illustrations can help children select their answers for scale-based questions [38]. Other researchers have pointed out that the validated UX questionnaires, such as the User Experience Questionnaire method, do not suit the study of children's experiences without the researcher explaining the questions to children [15]. However, our experiences support earlier findings [38] that using simplified versions of standardized questionnaires, such as UMUX-Lite, can be useful with children as a target group.

To summarize, our experiences concur with earlier studies: interviews with pediatric patients produce rich data, but conducting research with hospitalized pediatric patients requires researchers to have special interaction abilities, collaboration skills, an understanding of the hospital environment and context, and an empathetic approach [36]. When planning and conducting user-based evaluation studies with pediatric patients, we recommend considering the following challenges and lessons learned:

- Research conducted in a hospital setting requires both a research permit and ethical approval, which may be sought for non-medical research from the researchers' own organization.
- Recruiting hospitalized pediatric patients as study participants can be challenging and might take a considerable amount of time, even with multiple recruitment methods.
- When conducting research with pediatric patients, their age and cognitive abilities need to be carefully considered, as these children are vulnerable due to both their young age and their medical conditions.

Limitations and strengths

The number of participants in our evaluation study was very limited. Therefore, the findings about UX of the mobile hospital clowning application should be considered preliminary, and a larger sample is needed to support further design and refinement of the application.

Even though we had previous experience with research involving pediatric patients and their families in the hospital context [6,8,9,33,34] multiple challenges were encountered. The study was promoted in the hospital wards through a poster that included a direct link to the online questionnaire.

Because the anonymous online questionnaire was available to anyone with the link, it cannot be determined whether the interviewees also responded to the questionnaire. Based on our experience, future studies with hospitalized pediatric patients could benefit from clear guidelines and instructions from the hospitals. For example, when conducting non-medical studies with hospitalized pediatric patients, it would be reasonable to consider condensing the study information. In our study the consent form was prepared following the hospital guidelines; however, a simpler and shorter version of the information sheet and consent form could be designed for children ensuring that even younger participants can understand the study's focus and methods without finding it tiring or tedious.

Conclusions

eHealth services are increasingly being developed to support patient care and improve patient experiences. Ensuring that mobile applications designed for pediatric patients are easily approachable, usable, engaging, and offer a pleasant UX is of utmost importance. Our findings from a UX evaluation study of a recently adopted mobile hospital clowning application emphasize the importance of conducting user-based evaluations before releasing applications. Despite the challenges of involving pediatric patients in these studies, ensuring that children find the application usable and enjoyable is critical. As our study demonstrated, even a very small number of pediatric patients can yield important insights into usability, UX, and areas for improvement, supporting further application development.

Developing successful eHealth applications, targeted at vulnerable user groups requires collaboration with potential end-users. In practice, this collaboration requires frameworks, and good

practices for software developers, researchers, and hospital representatives on how to involve pediatric patients in the development process and evaluation studies while adhering to ethical principles. However, these practices and previous research on the subject are still very limited. In the future, we recommend cooperative work between researchers and hospitals to create best practices for involving hospitalized pediatric patients in user-based evaluation studies.

Supplementary materials

Table S1: The list of interview questions presented to the child participants; Table S2: Questionnaire questions

Funding

This research received no external funding.

Institutional review board statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the

Research Ethics Committee of Aalto University (protocol code D/1004/03.04/2022, 24.10.2022).

Informed consent statement

Informed consent was obtained from all subjects involved in the study.

Acknowledgments

This study was conducted in collaboration with the New Children's Hospital in Helsinki and the Finnish Hospital Clowns Association. We would like to thank the people who made this study possible, the participants and their families, and people from the New Children's Hospital, especially Tuula Kortekangas who made it possible for the study to be conducted and the participants to be recruited within the hospital's premises. Warm thanks to Kari Jagt and the Finnish Hospital Clowns Association for supporting us through the research process.

Conflicts of interest

The authors declare no conflict of interest.

References

- [1] Friedel AL, Siegel S, Kirstein CF, Gerigk M, Bingel U, Diehl A, Steidle O, Haupttshofer S, Andermahr B, Chmielewski W, Kreitschmann-Andermahr I. Measuring Patient Experience and Patient Satisfaction-How Are We Doing It and Why Does It Matter? A Comparison of European and U.S. American Approaches. *Healthcare*. 2023 Mar 8;11(6):797. <https://doi.org/10.3390/healthcare11060797>
- [2] Beattie M, Murphy DJ, Atherton I, Lauder W. Instruments to measure patient experience of healthcare quality in hospitals: a systematic review. *Syst Rev*. 2015 Jul 23;4:97. <https://doi.org/10.1186/s13643-015-0089-0>

- [3] LaVela SL, Gallan AS. Evaluation and measurement of patient experience. *Patient Exp J*. 2014;1(1):28–36. <https://doi.org/10.35680/2372-0247.1003>

- [4] Ahmed F, Burt J, Roland M. Measuring patient experience: concepts and methods. *Patient*. 2014;7(3):235-41. <https://doi.org/10.1007/s40271-014-0060-5>

- [5] Wood KC, Bertram JJ, Kendig TD, Pergolotti M. Understanding Patient Experience with Outpatient Cancer Rehabilitation Care. *Healthcare (Basel)*. 2023 Jan 25;11(3):348. <https://doi.org/10.3390/healthcare11030348>

- [6] Karisalmi N, Kaipio J, Lahdenne P. Lasten potilaskokemukset digitaalisten palveluiden kehittämisen lähtökohtana [Development of digital services based on children's patient experience]. *FinJeHew* 2017;9(2–3):167–183. <https://doi.org/10.23996/fjhw.63090>
- [7] Jurdi S, Montaner J, Garcia-Sanjuan F, Jaen J, Nacher V. A systematic review of game technologies for pediatric patients. *Comput Biol Med.* 2018 Jun 1;97:89–112. <https://doi.org/10.1016/j.compbiomed.2018.04.019>
- [8] Karisalmi N, Kaipio J, Lahdenne P. Improving patient experience in a children's hospital: New digital services for children and their families. In: Ugon A, Karlsson D, Klein GO, Moen A. *Building Continents of Knowledge in Oceans of Data: The Future of Co-Created eHealth. Proceedings of MIE2018.* IOS Press. *Studies in Health Technology and Informatics.* 2018;247:935–939. <https://doi.org/10.3233/978-1-61499-852-5-935>
- [9] Karisalmi N, Stenhammar H, Kaipio J. What constitutes the patient experience of children? Findings from the photo elicitation and the video diary study. *Patient Exp J.* 2018;5(2):54–68. <https://doi.org/10.35680/2372-0247.1292>
- [10] Bird M, Li L, Ouellette C, Hopkins K, McGillion MH, Carter N. Use of Synchronous Digital Health Technologies for the Care of Children With Special Health Care Needs and Their Families: Scoping Review. *JMIR Pediatr Parent.* 2019 Nov 21;2(2):e15106. <https://doi.org/10.2196/15106>
- [11] Tark R, Metelitsa M, Akkermann K, Saks K, Mikkel S, Haljas K. Usability, Acceptability, Feasibility, and Effectiveness of a Gamified Mobile Health Intervention (Triumpf) for Pediatric Patients: Qualitative Study. *JMIR Serious Games.* 2019 Sep 30;7(3):e13776. <https://doi.org/10.2196/13776>
- [12] Rantala A, Jansson MM, Helve O, Lahdenne P, Pikkarainen M, Pölkki T. Parental Experiences of the Pediatric Day Surgery Pathway and the Needs for a Digital Gaming Solution: Qualitative Study. *JMIR Med Inform.* 2020 Nov 13;8(11):e23626. <https://doi.org/10.2196/23626>
- [13] Cheng L, Liu F, Mao X, Peng W, Wang Y, Huang H, Duan M, Wang Y, Yuan C. The Pediatric Cancer Survivors' User Experiences With Digital Health Interventions: A Systematic Review of Qualitative Data. *Cancer Nurs.* 2022 Jan-Feb 01;45(1):E68–E82. <https://doi.org/10.1097/NCC.0000000000000885>
- [14] Punch S. Research with Children: The same or different from research with adults? *Childhood* 2002;9(3):321–341. <https://doi.org/10.1177/0907568202009003005>
- [15] Mispa K, Mansor EI, Kamaruddin A. Evaluating children's user experience (UX) towards mobile application: The fantasy land prototype. In: *Proceedings of the 5th International ACM In-Cooperation HCI and UX Conference (CHlUXiD'19).* Association for Computing Machinery, New York, NY, USA; 2019. p. 46–54. <https://doi.org/10.1145/3328243.3328250>
- [16] Erola E, Viitanen J, Karisalmi N, Savolainen K. Improving children's patient experience with a mobile hospital clowning application – Initial user experiences from the clowns' perspective. *FinJeHeW* 2023;15(2):157–173. <https://doi.org/10.23996/fjhw.126855>
- [17] Barkmann C, Siem AK, Wessolowski N, Schulte-Markwort M. Clowning as a supportive measure in paediatrics - a survey of clowns, parents and nursing staff. *BMC Pediatr.* 2013 Oct 10;13:166. <https://doi.org/10.1186/1471-2431-13-166>

- [18] Koller D, Gryski C. The life threatened child and the life enhancing clown: towards a model of therapeutic clowning. *Evid Based Complement Alternat Med.* 2008 Mar;5(1):17-25. <https://doi.org/10.1093/ecam/nem033>
- [19] Sridharan K, Sivaramakrishnan G. Therapeutic clowns in pediatrics: a systematic review and meta-analysis of randomized controlled trials. *Eur J Pediatr.* 2016 Oct;175(10):1353-60. doi: 10.1007/s00431-016-2764-0. Epub 2016 Sep 8. Erratum in: *Eur J Pediatr.* 2017 May;176(5):681-682. <https://doi.org/10.1007/s00431-017-2889-9>
- [20] Sairaalaklovnit ry – Pieni ILO on ISO asia! Helsinki: Sairaalaklovnit ry; 2025 [cited 29 January 2025]. Available at: <https://sairaalaklovnit.fi/>
- [21] HUS. Tutkimuslupa, opinnäytetyön tutkimuslupa ja tietolupa. HUS; 2025 [cited 29 January 2025]. Available at: <https://www.hus.fi/tutkimus-ja-opetus/tutkijan-ohjeet/tutkimuslupa-opinnaytetyon-tutkimuslupa-ja-tietolupa>
- [22] Kortesuoma RL, Hentinen M, Nikkonen M. Conducting a qualitative child interview: methodological considerations. *J Adv Nurs.* 2003 Jun;42(5):434-41. <https://doi.org/10.1046/j.1365-2648.2003.02643.x>
- [23] Borsci S, Buckle P, Walne S. Is the LITE version of the usability metric for user experience (UMUX-LITE) a reliable tool to support rapid assessment of new healthcare technology? *Appl Ergon.* 2020 Apr;84:103007. <https://doi.org/10.1016/j.apergo.2019.103007>
- [24] Borsci S, Federici S, Bacci S, Gnaldi M, Bartolucci F. Assessing user satisfaction in the era of user experience: Comparison of the SUS, UMUX, and UMUX-LITE as a function of product experience. *Int J Hum Comput Interact* 2015;31(8):484–495. <https://doi.org/10.1080/10447318.2015.1064648>
- [25] Lewis J, Sauro J. How to Estimate SUS Using the UX-Lite. *MeasuringU*; 2025 [cited 29 January 2025]. Available at: <https://measuringu.com/how-to-estimate-sus-with-ux-lite/>
- [26] Wang Y, Zhang Y, Chen Y. A longitudinal study of children’s perceived usability: Methodology and measurements. *Int J Hum Comput Interact* 2022;39(18):3604-3619. <https://doi.org/10.1080/10447318.2022.2100065>
- [27] Juhila K. Teemoittelu. Laadullisen tutkimuksen verkkokäsikirja [Online handbook for qualitative research]. Tampere: Yhteiskuntatieteellinen tietokanto [cited 29 January 2025]. Available at: <https://www.fsd.tuni.fi/fi/palvelut/menetelma-opetus/kvali/analyysitavan-valinta-ja-yleiset-analyysitavat/teemoittelu/>
- [28] Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol.* 2006;3(2):77–101. <https://doi.org/10.1191/1478088706qp063oa>
- [29] Sauro J, Lewis JR. Quantifying the user experience: Practical statistics for user research. 2nd ed. Morgan Kaufmann; 2016.
- [30] Ergonomics of Human-System Interaction. Part 210: Human-Centred Design for Interactive Systems (ISO 9241-210:2019); Geneva: ISO; 2019.
- [31] Hill C, Reardon T, Taylor L, Creswell C. Online Support and Intervention for Child Anxiety (OSI): Development and Usability Testing. *JMIR Form Res.* 2022 Apr 13;6(4):e29846. <https://doi.org/10.2196/29846>
- [32] Orr M, Isaacs J, Godbout R, Witmans M, Corkum P. A usability study of an internet-delivered behavioural intervention tailored for children with residual insomnia symptoms after obstructive sleep apnea treatment. *Internet Interv.* 2019 Aug 15;18:100265. <https://doi.org/10.1016/j.invent.2019.100265>

- [33] Kaipio J, Karisalmi N, Hiekkanen K, Stenhammar H, Lahdenne P. Development of the Patient Experience Questionnaire for Parents of Pediatric Patients (PEQP). *Stud Health Technol Inform.* 2019;257:200-205. <https://doi.org/10.3233/978-1-61499-951-5-200>
- [34] Karisalmi N, Mäenpää K, Kaipio J, Lahdenne P. Measuring patient experiences in a Children's hospital with a medical clowning intervention: a case-control study. *BMC Health Serv Res.* 2020 Apr 26;20(1):360. <https://doi.org/10.1186/s12913-020-05128-2>
- [35] Balen R, Blyth E, Calabretto H, Fraser C, Horrocks C, Manby M. Involving children in health and social research: “Human becomings” or “active beings”? *Childhood.* 2006;13(1):29–48. <https://doi.org/10.1177/0907568206059962>
- [36] Coyne I, Hayes E, Gallagher P. Research with hospitalized children: ethical, methodological and organizational challenges. *Childhood* 2009;16(3):413–429. <https://doi.org/10.1177/0907568209335319>
- [37] Loring B, Karn KS, Privitera MB, Wilcox SB, McDowell R, Feldman S. Healthcare facility access challenges for conducting user research. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care.* 2017;6(1):172–176. <https://doi.org/10.1177/2327857917061036>
- [38] Einarsdóttir J. Research with children: Methodological and ethical challenges. *Eur Early Child Educ Res J.* 2007;15(2):197–211. <https://doi.org/10.1080/13502930701321477>

Supplementary materials

S1 - Interview questions for children

Questions for the child user. Questions marked with two numbers (e.g. 5.1.) are optional and presented if needed to get more details to the previous question.

No.	The original question in Finnish	The English translation
1	Oletko aikaisemmin tavannut sairaalaklovneja?	Have you met any hospital clowns before?
2	Mitä olette tehneet klovniien kanssa?	What have you done with the hospital clowns?
3	Mitä mieltä olet sairaalaklovneista?	What are your thoughts on the hospital clowns?
4	Onko sinulla joku lempiklovni sairaalassa?	Do you have a favorite clown at the hospital?
5	Mikä oli Sairaalaklovnit-sovelluksessa parasta? Mitä teit eniten sovelluksella?	What was the best thing in the Sairaalaklovnit application? What did you do the most with it?
5.1.	Miksi juuri se/ne oli parasta?	Why was that the best thing?
6	Oliko sovelluksessa jotain ärsyttävää? Mitä?	Was there something annoying in the application? What was it?
6.1.	Miksi juuri se/ne oli ärsyttävintä?	Why was it annoying?
7	Klovniareena on se näkymä, jossa on videoita ja podcasteja. Mitä mieltä olit Klovniareenasta?	The Clown Arena is the view with videos and podcasts. What did you think about the Clown Arena?
7.1.	Katsoitko sairaalaklovnien videoita?	Did you watch any hospital clown videos?
7.2.	Millaiset videot ovat kivoimpia? Miksi?	What videos did you like the most? Why?
7.3.	Jos ei katsonut: Miksi et katsonut?	If not: Why didn't you watch any videos?
8	Klovniareenassa oli videoiden lisäksi myös Klovniratio eli muutama podcast-jakso. Podcastissa klovnit puhuvat erilaisista asioista. Kuuntelitko Klovniratiota?	The Clown Arena includes podcasts in addition to the videos. In these podcasts the clowns are talking about different topics. Did you listen to the podcast?
8.1.	Haluaisitko kuunnella lisää Klovniratio jaksoja? Mitä haluaisit kuulla jaksoissa?	Would you like to listen more podcast episodes? What would you like to hear in the podcast?
8.2.	Jos ei: Miksi et kuunnellut?	If not: Why didn't you listen to the podcasts?

No.	The original question in Finnish	The English translation
9	Klovneilla on omat klovnikortit, joissa on klovnin kuva ja kerrottu heidän klovnitaidoistaan. Mitä mieltä olit klovnikorteista?	The hospital clowns have their own clown cards with a picture and list of their skills. What did you think about these cards?
9.1.	Teitkö oman klovnikortin?	Did you create your own clown profile card?
9.2.	Miltä kortin tekeminen tuntui? Miten se sujui?	How did it feel to create your own card? How did it go?
9.3.	Mitä mieltä olit kortin asusteista [klovnikorteissa]? Oliko vaihtoehdot sinun mielestäsi sopivia?	What did you think about the accessories [in the clown card creation tool]? Were the options suitable for you?
9.4.	Vastasitko klovnikortin kysymyksiin? Jos et, miksi et?	Did you answer to the clown card questions when creating your own card? If not: why didn't you answer them?
9.5.	Miltä kysymyksiin vastaaminen tuntui?	How did it feel like answering the questions?
10	Lähtöruudussa oli erilaisia kirjaimia ja niiden yhteydessä erilaisia animaatioita, joita pystyi klikkailemaan. Kokeilitko lähtöruudun animaatioita?	In the starting view, there are multiple buttons that look like letters. You can play different animations by pressing them. Did you try them out?
10.1.	Miltä animaatioiden kokeileminen tuntui?	How did trying out the animations feel like?
10.2.	Lähtöruudusta löytyy myös pierugeneraattori, josta pääsee pieruääniä. Mitä mieltä olit pierugeneraattorista?	From the starting view, you can also find the fart sound generator. What did you think about the generator?
11	Klovneille voi lähettää viestejä Pallopostilla. Lähetitkö klovneille viestejä Pallopostilla?	You can send messages to the hospital clowns via Balloon Mail. Did you send any messages with it?
11.1.	Miltä tuntui lähettää viestejä sairaalaklovneille?	How did it feel like when sending the messages?
11.2.	Klovneille voi lähettää tekstin lisäksi myös ääniviestejä tai kuvia. Lähetitkö tekstin lisäksi myös ääniviestejä tai kuvia?	You can also send images or voice messages in addition to the text messages. Did you send the clowns any voice messages or pictures in addition to text messages?
11.3.	Miten ääniviestien/kuvien lähettäminen sujui? Oliko niiden lähettäminen helppoa?	How did it go when you sent voice messages/pictures? Was it easy?

No.	The original question in Finnish	The English translation
11.4.	Kuinka kauan odotit klovneilta vastausta viestiisi? Tuliko vastaus samana päivänä vai pitikö odottaa seuraavaan päivään?	How long did you wait for a response from the hospital clowns? Did they reply the same day or did you have to wait for the next day?
11.5.	Miltä vastauksen odottaminen tuntui?	How did it feel like to wait for a response?
12	Oletko tavannut klovneja sairaalassa Pallopostittelun jälkeen?	Have you met the hospital clowns at the hospital after you have sent them messages?
13	Mitä uutta haluaisit lisätä Sairaalaklovnisovellukseen? Miksi?	What new would you like to add to the Sairaalaklovnit application? Why?
14	Onko jotain, minkä haluaisit poistaa sovelluksesta? Miksi?	Is there anything you would like to remove from the application? Why?

S2 - Questionnaire questions

No.	The original question in Finnish	The English translation	The goal of the question
1	Minkäikäinen olet? 6–10 v 11–14 v 15–17 v 18 v tai vanhempi	How old are you? 6–10 yrs 11–14 yrs 15–17 yrs 18 yrs or older	Background of the respondent
2	Kuinka usein olet käynyt Uudessa lastensairaalassa viimeisen vuoden aikana? Päivittäin Kerran viikossa 1–3 kertaa kuukaudessa Harvemmin	How often have you visited the children's hospital during the past year? Daily Once a week 1–3 times a month Less	Background of the respondent
3	Oletko tavannut sairaalaklovneja sairaalassa käydessäsi? Kyllä Ei	Have you met hospital clowns while visiting the children's hospital? Yes No	Background of the respondent
4	Millaisia kokemuksia sinulla on enimäkseen sairaalaklovneista? Mukavia/positiivisia Neutraaleja Ikäviä/negatiivisia	What kinds of experiences have you had with the hospital clowns? Nice / Positive Neutral Unpleasant / Negative	Background of the respondent

No.	The original question in Finnish	The English translation	The goal of the question
5	Sairaalaklovnit-sovelluksella voin tehdä kaikkea, mitä etukäteen odotinkin. Täysin samaa mieltä – täysin eri mieltä	With the Sairaalaklovnit application, I can do everything I expected to be able to do. Strongly agree – Strongly disagree	Usability Metric for User Experience LITE (UMUX-LITE) - The usability of the application
6	Sairaalaklovnit-sovelluksen käyttö oli helppoa. Täysin eri mieltä – täysin samaa mieltä	Using the Sairaalaklovnit application was easy. Strongly agree – Strongly disagree	Usability Metric for User Experience LITE (UMUX-LITE) - The usability of the application
7	Pallopostin käyttöönotto. Miten helppoa tai vaikeaa oli käyttää klovnivaihtoa Pallopostin avaamiseen? Todella vaikeaa (1) – Todella helppoa (10) + En osaa sanoa	Unlocking Balloon Mail. How easy or difficult was it to use the QR code to unlock the Balloon Mail feature? Extremely difficult (1) – Extremely easy (10) + I can't say	Feedback for individual features
8	Oman klovnikortin luominen. Miten helppoa tai vaikeaa oman klovnikortin luominen oli? Todella vaikeaa (1) – Todella helppoa (10) + En osaa sanoa	Creating your own clown card. How easy or difficult was it to create your own clown card? Extremely difficult (1) – Extremely easy (10) + I can't say	Feedback for individual features
9	Viestien lähettäminen. Miten helppoa tai vaikeaa viestien lähettäminen oli? Todella vaikeaa (1) – Todella helppoa (10) + En osaa sanoa	Sending messages. How easy or difficult was it to send messages? Extremely difficult (1) – Extremely easy (10) + I can't say	Feedback for individual features
10	Ilmoitus uusista viesteistä. Miten helppoa tai vaikeaa oli huomata ilmoitukset klovnien lähettämisestä uusista viesteistä? Todella vaikeaa (1) – Todella helppoa (10) + En osaa sanoa	Notifications of new messages. How easy or difficult was it to notice new messages? Extremely difficult (1) – Extremely easy (10) + I can't say	Feedback for individual features
11	Klovniareenan videot. Miten mielelläsi katselit videoita? En pitänyt videoista lainkaan (1) – Pidin videoista todella paljon (10) + En osaa sanoa	Videos in Clown Arena. What are your thoughts on the videos? I didn't like the videos at all (1) – I liked the videos very much (10) + I can't say	Feedback for individual features
12	Lähtöruutu ja liikkuvat kuvat eli animaatiot. Mitä mieltä olit lähtöruudusta ja sen animaatioista? En pitänyt animaatioista lainkaan (1) – Pidin animaatioista todella paljon (10) + En osaa sanoa	Starting view and animations. What are your thoughts on the animations? I didn't like the animations at all (1) – I liked the animations very much (10) + I can't say	Feedback for individual features

No.	The original question in Finnish	The English translation	The goal of the question
13	Mikä toimii hyvin? Mikä ei toiminut? Voit vapaasti kirjoittaa palautetta Sairaalaklovnit-sovelluksesta.	What works well? What didn't work? Feel free to give open feedback on the Sairaalaklovnit application.	General feedback
14	Oletko käyttänyt tai ollut lapsen mukana käyttämässä Sairaalaklovnit-sovellusta? Kyllä Ei	Have you used the application personally or with the child user? Yes No	Usage of the application
15	Jos kyllä, mitä ominaisuuksia? Valitse kaikki, joita olet käyttänyt. Päävalikon animaatiot Pierugeneraattori Klovniareenan videot Klovniareenan podcastit Valmiit klovnikortit Oman klovnikortin luominen Palloposti-viestintä klovnien kanssa Sovelluksen informaatiovalikko Sovelluksen asetukset	If yes, what features have you used? Select all that apply. Animations in the starting view Fart sound generator Videos in the Clown Arena Podcasts in the Clown Arena Existing clown cards Creation of your own clown profile card Messaging via Balloon Mail Information menu Application settings	Usage of the application
16	Arvioi miten Sairaalaklovnit-sovelluksen käyttö on vaikuttanut fyysisiin kohtaamisiin sairaalaklovnien kanssa. Vaikuttanut erittäin negatiivisesti (1) - Vaikuttanut erittäin positiivisesti (10) + En osaa sanoa	Estimate how using the application has affected the physical contacts with the hospital clowns. Affected very negatively (1) - Affected very positively (10) + I can't say	Sovelluksen vaikutus fyysisiin kohtaamisiin