

A mobile application for postoperative education of caregivers of children with congenital hypospadias: Requirement analysis

Seyed Mohsen Laal Mousavi¹  | Niloofar Mohammadzadeh¹  |
Seyed Mohammad Ayyoubzadeh¹  | Leily Mohajerzadeh²  | Maryam Alidadi³ 

¹Department of Health Information Management, School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran

²Research Institute for Children's Health, Shahid Beheshti University of Medical Science, Tehran, Iran

³School of Allied Medical Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Correspondence

Niloofar Mohammadzadeh, School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran.
Email: nmohammadzadeh@sina.tums.ac.ir

Abstract

Background and Aims: Hypospadias, a congenital anomaly, can have long-term effects on sexual, urinary, and reproductive functions, making proper postoperative care essential for desirable outcomes, which could be facilitated through a mobile application for diseases with long-term complications. The aim of this study was to investigate the data and functional requirements or minimum data set of a postoperative education mobile application for caregivers of children with hypospadias.

Methods: A literature review of papers published until April 2023 using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement was conducted to determine the data and functional requirements of a mobile application that provides postoperative education to caregivers of children with congenital hypospadias. Based on the results, a questionnaire was prepared, and its content validity and reliability were evaluated by CVI and CVR. Additionally, data was examined by 30 residents, specialists, and subspecialists in pediatric surgery using the Delphi approach.

Results: The study identified 28 data elements in three main categories: demographic data, clinical data, and application function. Functional requirements of the mobile application were suggested for use in designing the application. Also, the most critical data elements included the definition of disease, the importance of treatment, surgical preparation, bandage, hygiene, symptoms and infection, bleeding, and emergency condition.

Conclusion: The study will pave the way for developing postoperative educational applications for caregivers of children with congenital hypospadias. M-Health app developers and clinician specialists can utilize these findings to design practical applications that assist caregivers in managing the care of hypospadias patients.

KEYWORDS

caregivers, hypospadias, mobile application, postoperative education

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivs](https://creativecommons.org/licenses/by-nc-nd/4.0/) License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2024 The Authors. *Health Science Reports* published by Wiley Periodicals LLC.

1 | INTRODUCTION

Congenital anomalies and malformations are among the well-known causes of infant and postnatal mortality. Researchers recognize congenital anomalies as structural, behavioral, functional, and metabolic disorders.¹ Hypospadias is a common congenital anomaly that appears as an abnormality in the external genitalia of male individuals, in which the folds of the urethra and abdominal skin are improperly developed, resulting in the displacement of the urethral opening from its natural position.^{2,3} The prevalence and trends of hypospadias vary across regions and populations, possibly due to genetic and environmental factors. The lowest incidence rate of this condition is observed in Asia (6–690 cases per 100,000), while the highest is reported in North America (34.2 cases per 10,000). European registries, on the other hand, have consistently reported a prevalence rate of 18.6 cases per 10,000 over the past decade.³

Hypospadias often requires surgical intervention for treatment. However, even after surgery, patients may face constant medical, social, and sexual issues.⁴ Despite early repair surgery, hypospadias can have long-term effects on sexual, urinary, and reproductive functions during adolescence and adulthood. Therefore, understanding the potential long-term risks of this condition is needed for managing patients effectively.⁵ Although surgery is a required component of treatment, providing appropriate postoperative care is essential to ensuring a desirable outcome.⁶

Studies indicate that patients are often discharged with inappropriate treatment plans, insufficient education, and incomplete information.⁷ Parents may face anxiety and uncertainty due to the abundance of unreliable information sources.² Furthermore, researchers and specialists have expressed concerns about the quality and readability of these resources.⁸ The results of a study in this regard showed that using a mobile application to provide post-discharge education for parents in caring for the patient could be helpful.⁹

The development of information and communication technology has created a significant transformation in the healthcare industry, which has essential applications in promoting health, prevention, treatment, awareness, and education.^{10,11} By integrating intelligent technologies and wireless communications through mobile phones, effective care can be provided and disease management can be facilitated.¹²

Mobile-based care applications manage health-related activities such as monitoring treatment progress, symptom surveillance, evaluating treatment side effects, maintaining a healthy diet, and physical activity.¹³ In addition, these applications help overcome time and location barriers faced by healthcare providers when delivering services.¹⁴

The results of a study conducted in 2020 to evaluate the quality of postoperative education in patients with congenital heart defects and determine the acceptance rate of a mobile-based care application for their preparation before discharge showed that parents face challenges in preparing to care for their children; moreover, most physicians and parents agreed on the usefulness of a mobile application for postoperative care education.⁹ Another study

published in 2023 to assess the feasibility and acceptance of a mobile-based congenital heart care application in supporting parents to understand and manage their children's healthcare needs showed that parents and healthcare professionals find this application an effective tool for the healthcare system and facilitating follow-up of patient treatment applications.¹⁵

The availability of mobile-based care applications holds immense potential for delivering appropriate care and providing relevant educational content related to treatment, health promotion, and the reduction of postoperative complications.⁶ Consequently, given the high prevalence of hypospadias and the importance of effective care for these patients, it is necessary to conduct studies focused on designing mobile applications that provide relevant care education. The initial stage of creating such an application involves identifying data requirements.¹⁶

This study aimed to investigate the data and functional requirements or by another name minimum data set (MDS) of a postoperative education mobile application for caregivers of children with this disease. Therefore, the findings of this study are expected to benefit individuals interested in designing and evaluating effective mobile applications.

2 | METHODS

This study is a descriptive-analytical study conducted in 2023. We have devised a four-phase plan for the development of the application using Software Development Life Cycle method (Figure 1).¹⁷ The current study represents the first phase, which primarily focuses on investigating the data and functional requirements (or MDS). The study was approved by Tehran University of Medical Sciences in 2023 with the code of ethics number IR.TUMS.SPH.REC.1402.038 obtained from the National Ethics Committee in Biomedical Research.

2.1 | Data collection

To determine the data and functional requirements for the mobile application, we conducted a literature review using library resources, such as reference books, including *Genitourinary Disorders*,¹⁸ *Operation Pediatric Urology*,¹⁹ and *Pediatric Surgery*.²⁰ Additionally, we analyzed patient records and consulted with pediatric surgeons to identify and classify the essential aspects of care for children with congenital hypospadias.

Using MeSH terminology, we performed a search in electronic databases, including Medline (via PubMed), ISI Web of Science, Scopus, Science Direct, and UpToDate, using keywords such as Hypospadias, Mobile application, Self-care, and Data-elements until April 2023. The search strategy is shown in Table 1, and this review of databases was conducted in adherence to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement, ensuring a rigorous and standardized approach.²¹

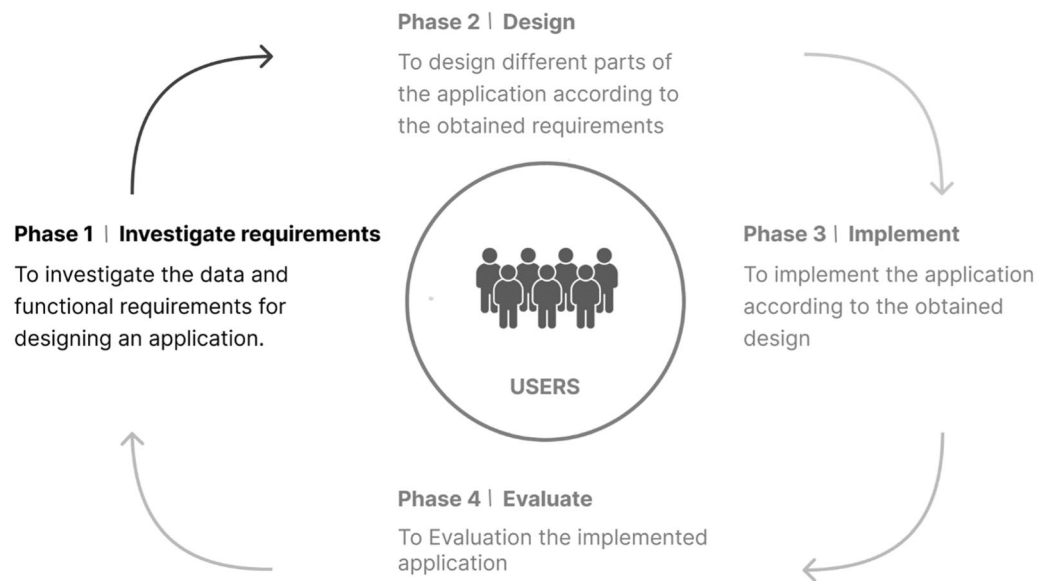


FIGURE 1 Application development plan.

TABLE 1 Search strategy in the databases.

Search strategy	[A]	"hypospadias" OR "congenital abnormalities" OR "child" OR "pediatrics" OR "Infant" OR "Newborn" OR "Neonate"
	[B]	"mobile applications" OR "smartphone" OR "mobile health" OR "medical app" OR "Mobile" OR "portable devices" OR "M-health" OR "Mhealth" OR "mobile phone" OR "App" OR "mobile software"
	[C]	"self care" OR "self management" OR "postoperative care"
	[D]	"data elements" OR "minimum data set" OR "data requirements" OR "technical capabilities" OR "data set"
	[E]	[A] AND [B]
	[F]	[A] AND [C]
	[G]	[A] AND [D]
Final search query	[E] OR [F] OR [G]	

2.2 | Inclusion criteria

1. Research articles addressing postoperative education for caregivers of children with congenital hypospadias.
2. Articles for which the full text was available.

2.3 | Exclusion criteria

1. Review articles.
2. Letters to the editor.
3. Abstracts of conferences.
4. Articles that had no full version available.
5. Articles outside the English language.

2.4 | Identification and selection of elements

The initial draft of the researcher-designed questionnaire was prepared based on the findings of the literature review. The final version of the questionnaire was developed by combining and refining various questions and components, along with input and feedback from pediatric specialists. The questionnaire consists of 32 questions divided into three main sections: demographic information (6 questions), clinical section including hypospadias in children (4 questions), education related to surgery (4 questions), postoperative education (12 questions), and application function (6 questions).

The content validity of the questionnaire was confirmed by a panel of eight experts composed of subspecialists, specialists, and residents of pediatric surgeons working at the Children's Surgery Research Center of Mofid Hospital and two Health Information Management experts from the Tehran University of Medical Sciences. Using the Lawshe table, the validity index (CVI) and the content validity ratio (CVR) were confirmed. Cronbach's alpha coefficient was used to check the reliability of the questionnaire. The collected data were analyzed using SPSS software version 16.

The research population consisted of 84 subspecialists, specialists, and residents of pediatric surgeons working at the Children's

Surgery Research Center of Mofid Hospital. This hospital was chosen due to its previous research in hypospadias care, the presence of a dedicated children's surgery research center, a high number of pediatric surgeons, and a substantial patient population with this disease. The available sampling method was utilized to select participants from the target population, ultimately resulting in 30 questionnaire participants. Face-to-face interviews were conducted to collect data and increase the number of participants in the study. Each participant signed an informed consent form.

Using the Delphi approach, each questionnaire data element was evaluated on a Likert scale from one to five. Data elements scoring above 70% (more than 3.5 out of 5) were considered essential. Elements scoring between 50% and 70% (2.5–3.5 out of 5) underwent further consideration in the subsequent Delphi stage, while elements scoring below 50% (less than 2.5 out of 5) were deemed non-essential and excluded from the list. Details of the design and sequential process of the study phases are presented in Figure 2.

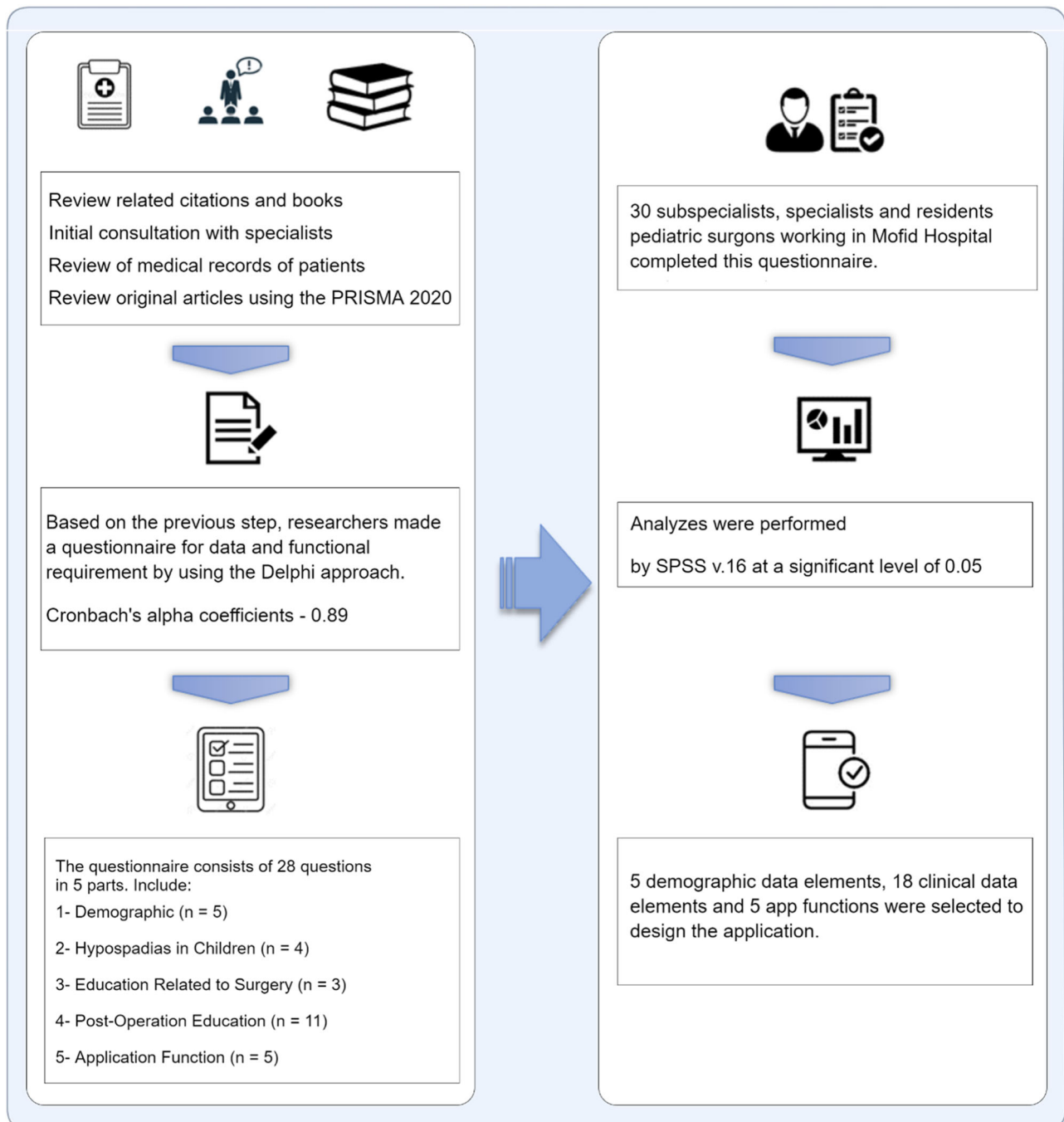


FIGURE 2 Sequential process of study phases.

3 | RESULTS

3.1 | Data collection

At first, there were 1602 articles discovered. After eliminating duplicate records ($n = 133$), the total number of screened articles was reduced to 1469. Among these, 1446 articles were excluded based on criteria, leaving 23 articles for eligibility assessment. In the end, 13 studies were deemed suitable and included in the study. The selection process is presented in Figure 3.

Based on the reviewed articles, the minimum data set of these articles is presented separately in three areas: demographics, clinical, and functional. These are displayed in Table 2.

3.2 | Demographic data of participants

Table 3 provides demographic data on the participants, including gender, age, degree of education, and work experience.

3.3 | Content validity ratio and scoring

All participants ($n = 30$) responded to all questions (with a response rate of 100%). During the calculation of CVR to assess the questionnaire's validity, four data elements were excluded and CVI also obtained an overall average of 0.93%, which is approved. Also, its reliability was confirmed by Cronbach's alpha coefficient equal to 0.76. Excluded elements were "gender" from the demographic group, "hospitalization" and "diarrhea and vomiting" from the clinical group, and "body mass index (BMI)" from the application function group. Ultimately, 28 data elements (from 32 data element) were chosen for the expert survey.

The results indicated that all data elements scored above 70% and were deemed essential. Among the clinical group, the elements "bandage," "symptoms and infections," "bleeding," and "emergency conditions" scored the highest average of (5/5). Moreover, two elements, "name" and "height," had the lowest average in the demographic group (both with an average of 3.6/5). Figure 4 shows the data and functional requirements for developing a mobile application, categorized into three areas.

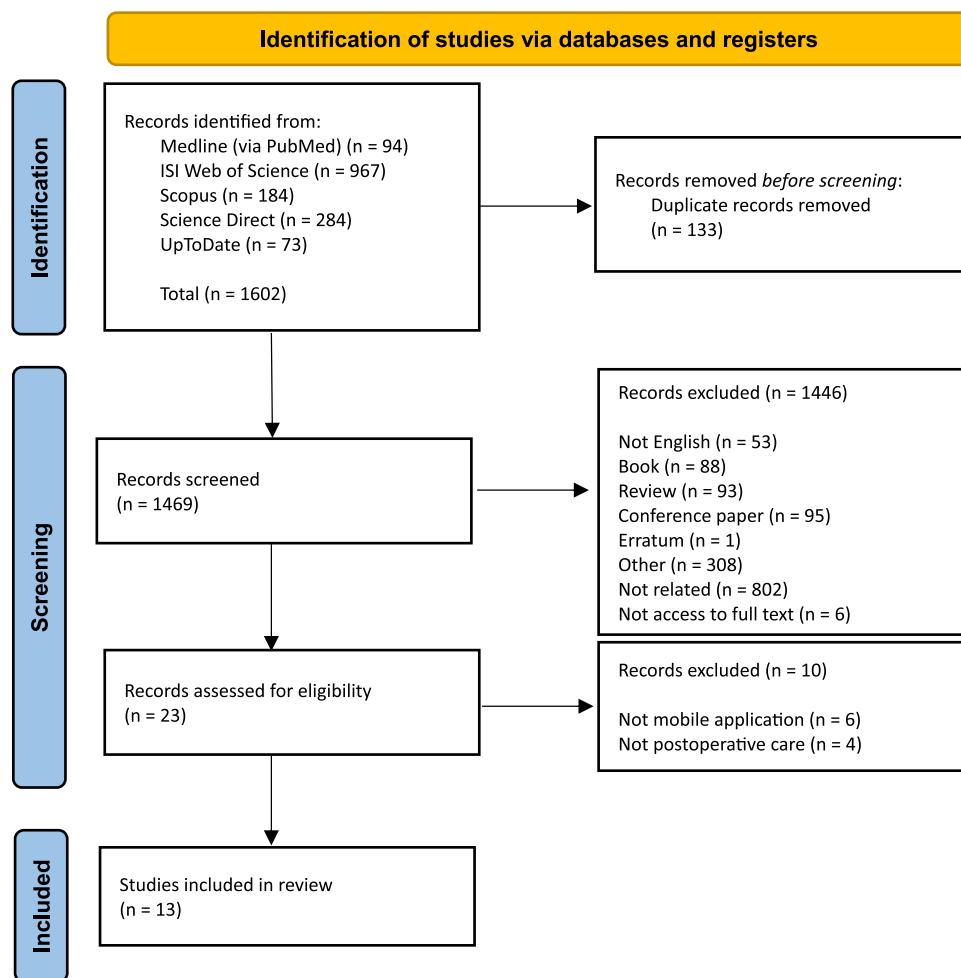


FIGURE 3 Search results from databases.

TABLE 2 Article review for minimum data set.

#	Author	Title	Year	Classification	Research type	Minimum data set related to this study		
						Demographic	Clinical	Functional
1	Rangraz Jeddi et al. ¹⁶	A smartphone application for caregivers of children with severe burns: a survey to identify minimum data set and requirements	2023	Mobile app	Not mention	Name, gender, date of birth	Pain management, symptoms and infection—mobility and play, hygiene (changing diapers), treatment methods, nutrition	Medication reminders, physician appointment reminders, calculate BMI
2	Mohammad et al. ²²	Identifying data elements and key features of a mobile-based self-care application for patients with COVID-19 in Iran	2021	Mobile app	Descriptive-analytical	Name, gender, weight, height, date of birth	Fever, symptoms and infection, nausea and vomiting, nutrition	Medication reminders, calculate BMI, medical center information
3	Goldenholz et al. ²³	Common data elements for epilepsy mobile health systems	2018	Mobile app	Not mention	Demographic (no detail)	Nutrition, emergency conditions	-
4	Scheper et al. ²⁴	A mobile app for postoperative wound care after arthroplasty: ease of use and perceived usefulness	2019	Mobile app	Prospective cohort	-	Pain management, fever, postoperative education (no detail)	-
5	Seyfi et al. ²⁵	Identifying required data elements for designing mobile-based application for self-care of women living with endometriosis	2023	Mobile app	Cross-sectional descriptive	Name, weight, height, date of birth	Definition of the disease-treatment methods, pain management, nutrition, symptoms, and infection	Medication reminders, physician appointment reminders, calculate BMI
6	Hajizadeh et al. ²⁶	Identification of the minimum data set to design a mobile-based application on overweight and obesity management for children and adolescents	2021	Mobile app	Descriptive-analytical	Weight, height, gender, date of birth	Definition of the disease, importance of treatment, treatment methods, nutrition	Nutrition reminders, calculate BMI
7	Phillips et al. ²⁷	Feasibility of an mhealth self-management intervention for children and adolescents with sickle cell disease and their families	2021	Mobile app	Feasibility study	-	Definition of the disease, importance of treatment, treatment methods, symptoms, and infection	-
8	Choi et al. ²⁸	A 2-step integrative education program and mhealth for self-management in Korean children with spina bifida: feasibility study	2019	Mobile app	Feasibility study	-	Hygiene (changing diapers), hygiene (bathroom), treatment methods, bandage	-
9	McLorie et al. ²⁹	A prospective randomized clinical trial to evaluate methods of postoperative care of hypospadias	2001	Hypospadias	Prospective randomized trial	Gender, date of surgery, date of birth	Definition of the disease, disease-causing factors, importance of treatment, treatment methods, surgical preparation, surgical procedures, pain management, bandage—hygiene (urinary tube),	Medical center information

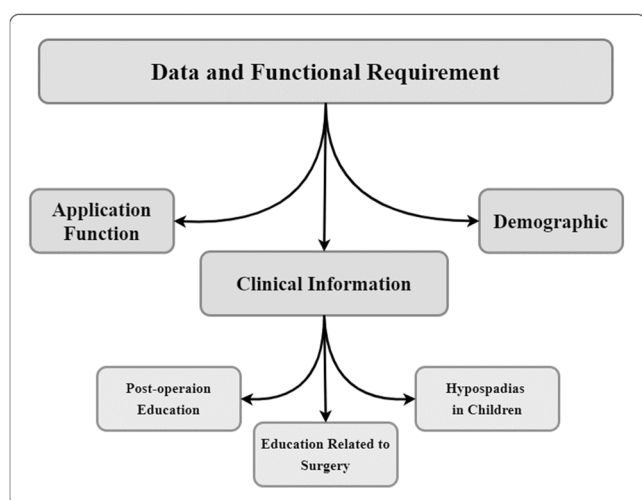
TABLE 2 (Continued)

#	Author	Title	Year	Classification	Research type	Minimum data set related to this study		
						Demographic	Clinical	Functional
10	Grobbelaar et al. ³⁰	Hypospadias repair: the influence of postoperative care and a patient factor on surgical morbidity	1996	Hypospadias	Case series	Date of surgery, date of birth	Definition of the disease, disease-causing factors, importance of treatment, treatment methods, surgical procedures, pain management, hygiene (urinary tube), hygiene (changing diapers), symptoms and infection, risks after surgery, emergency conditions	symptoms and infection, bleeding, risks after surgery, emergency conditions
11	Sugar et al. ³¹	Urinary prophylaxis and postoperative care of children at home with an indwelling catheter after hypospadias repair	1988	Hypospadias	Case series	Date of surgery, date of birth	Bandage, Hygiene (urinary tube), (changing diapers), hygiene (bathroom), mobility and play, emergency conditions	-
12	Denson et al. ³²	Hypospadias repair. Preoperative preparation, intraoperative techniques, postoperative care	1988	Hypospadias	Not mention	Date of birth, date of surgery	Definition of the disease, disease-causing factors, treatment methods, bandage, surgical preparation, surgical procedures, hospitalization, hygiene- nutrition, symptoms and infection, fever, emergency conditions, pain management	-
13	Abbas ³³	An objective hypospadias classification system	2022	Hypospadias	Case series	-	Definition of the disease, disease-causing factors	-

Abbreviation: BMI, body mass index.

TABLE 3 Demographic data of the participants.

Demographic data		Number	Percent
Gender	Male	18	60%
	Female	12	40%
Age	Between 30 and 40	8	27%
	Between 40 and 50	4	13%
	Above 50	18	60%
Degree of education	Specialty	14	47%
	Expert	6	20%
	Resident	10	33%
Duration of work experience	Under 10 years old	10	33%
	Between 10 and 20	8	27%
	Above 20 years	12	40%

**FIGURE 4** Selected data elements and application requirements.

It is important to note that functional abilities in this study, such as medication reminders, physician appointment reminders, nutrition reminders, medical center information, and frequently asked questions (FAQ), were reviewed by experts and approved. Demographic data, clinical data about the definition of the disease, treatment methods, surgical preparation, bandage, symptoms and infection, bleeding, and emergency conditions were identified as essential elements to be covered in education for care providers. The final data elements and functional abilities (or MDS) identified by the questionnaire for the design of a postoperative educational application are shown in Table 4.

4 | DISCUSSION

To ensure proper care and support for children during the postoperative period, having a well-designed practical educational application for caregivers is essential.³⁴ This application should

encompass all key aspects of caring for a child with congenital hypospadias after surgery, including physical care, treatment follow-up, and practical considerations.³⁵

4.1 | Demographic data

In applications, demographic data is essential information for identifying, contacting, and following up on patients. These data can provide a more personalized experience by providing age, gender, date of birth, and date of surgery. They can tailor their content and recommendations to meet specific user needs.^{16,34–36} The results of this study showed that demographic information, such as date of birth and date of surgery, is essential from an expert's perspective for the necessary personalization of the application.

4.2 | Clinical information

4.2.1 | Hypospadias in children

Providing a clear understanding of the disease and its treatment methods can alleviate parental stress. By comprehending the underlying causes and available treatment options, caregivers can ensure timely and appropriate management, thereby enhancing patient treatment outcomes and quality of life.^{20,37} In this research, from the point of view of experts, an essential information element in the section related to the introduction of the disease is the recognition of the importance of treating this disease.

In the results of the study by Arya et al.,²² parents of children with congenital heart defects were more likely to seek counseling than experts thought. This information briefly included knowledge of the disease and factors contributing to it. Additionally, parents often could not remember all the information they received and required recontact with experts or a reliable way to receive necessary educational information.

4.2.2 | Education related to surgery

One essential element that should be included in the educational application is information about the surgical procedure itself. The application should effectively educate caregivers on the surgical technique, expected duration, and recovery timeline, prioritizing pain management, and related complications.²² The findings from a study conducted by Dreuning et al.,²³ which evaluated the impact of various information delivery methods, including mobile applications, on alleviating preoperative stress and anxiety in children and parents, revealed that families who received educational information through these methods expressed greater satisfaction with the preoperative surgical information and preparation processes. These findings underscore the significance of adopting novel approaches, such as mobile applications, to enhance the quality of information delivery and improve overall family satisfaction during the surgical care period.

TABLE 4 The mean score and selected data elements/functional abilities.

Category	No	Data element/functional ability (or MDS)	CVR	Mean	Accept/reject
1. Demographic Data	1	Name	1	3.6	Accept
	2	Weight	1	4.3	Accept
	3	Height	1	3.6	Accept
	4	Gender	0.4	-	Reject
	5	Date of surgery	1	4.6	Accept
	6	Date of birth	1	4.6	Accept
2. Clinical Data					
2.1. Hypospadias in children	7	Definition of the disease	1	4.8	Accept
	8	Disease-causing factors	0.8	4.3	Accept
	9	Importance of treatment	0.8	4.9	Accept
	10	Treatment methods	1	4.8	Accept
2.2. Education related to surgery	11	Surgical preparation	1	4.8	Accept
	12	Hospitalization	0.4	-	Reject
	13	Surgical procedures	1	4.6	Accept
	14	Pain management	1	4.6	Accept
2.3. Postoperative education	15	Bandage	1	5	Accept
	16	Nutrition	0.8	4.5	Accept
	17	Hygiene (urinary tube)	1	4.9	Accept
	18	Hygiene (changing diapers)	1	4.9	Accept
	19	Hygiene (bathroom)	1	4.8	Accept
	20	Fever	1	4.8	Accept
	21	Symptoms and infection	1	5	Accept
	22	Bleeding	1	5	Accept
	23	Nausea and vomiting	0.6	-	Reject
	24	Mobility and play	1	4.8	Accept
	25	Risks after surgery	1	4.8	Accept
	26	Emergency conditions	1	5	Accept
3. Application function	27	Medication reminders	1	4.6	Accept
	28	Physician appointment reminders	0.8	4.8	Accept
	29	Nutrition reminders	0.8	4.3	Accept
	30	Calculate BMI	0.2	-	Reject
	31	Medical center information	1	4.2	Accept
	32	Frequently asked questions (FAQ)	1	4.5	Accept

Abbreviations: BMI, body mass index; MDS, minimum data set.

4.2.3 | Postoperative education

According to experts, it is needed to include information regarding postoperative care in educational applications. In the context of the

present study's applied educational application for postoperative care of hypospadias surgery, certain data elements such as bandage, symptoms and infections, bleeding, and emergency conditions hold significant importance.

In the study by Purcell et al.²⁴ according to the parents, it can be challenging to handle the various side effects and unforeseen situations that arise during the recovery phase because many parents find the process of recovering confusing. Furthermore, other studies have highlighted the benefits of mobile applications in providing education and support for mothers of children with congenital heart disease during their home care.⁹

A qualitative study conducted by Hjorth-Johansen et al.¹⁵ examined an application designed for infants with congenital heart disease. This study demonstrated the importance of information addressing treatment-related issues, such as post-heart surgery recommendations and shunts. Other research has shown that children who undergo hypospadias surgery after the age of two often experience postoperative complications that lead to long-term hospitalization. Effective education on appropriate postoperative care is highly recommended. This education should focus on precise management of dressing and stent care, medication compliance, and reinforcement of dressing and stent stability, particularly for vulnerable children.²⁵ The use of mobile applications for wound care, bleeding, and infection prevention are areas where these applications can significantly impact patient outcomes.²⁶ Mobile applications can facilitate improved wound care by providing guidelines for dressing, monitoring wound progress, identifying signs of infection, and offering instructions on when to seek medical attention.²⁷ Bleeding is another important aspect where mobile applications can positively impact patient outcomes. By enabling real-time monitoring of bleeding levels and providing guidance on managing bleeding, these applications serve as essential tools for both patients and healthcare providers. They can also promptly alert healthcare providers about excessive bleeding, allowing for swift intervention and improved outcomes.²⁸ Mobile applications can also be used to prevent infections. These applications can offer invaluable information on proper hand hygiene, wound cleaning techniques, and other preventative measures to reduce the risk of infection. Additionally, healthcare providers can leverage mobile applications to monitor patients' symptoms and detect signs of infection at an early stage, leading to timely treatment and significantly improving patient outcomes.^{27,29}

4.3 | Application function

Reminders are essential in care management applications, as they help ensure that essential tasks are remembered and noticed. Caregivers often have multiple responsibilities and tasks to remember, which can be overwhelming. They can use the mobile application to set reminders for tasks such as medication schedules, physician appointments, nutrition, and other activities. Reminders help ensure that tasks are remembered and attended to them.^{30,31} Overall, mobile applications empower caregivers to effectively carry out essential tasks, thereby improving patient care and mitigating stress and anxiety levels. Studies show that mobile health interventions, mainly appointment reminders, can increase necessary follow-up visits in children.³²

Blazquez-Ramos et al.,³³ in their study on developing a remote drug management application for patients with congenital thrombophilia, found that patients rated medication reminders and drug alerts the highest.

Durham et al.³⁴ researched a mobile app with an educational purpose for children and families impacted by bladder exstrophy-epispadias-cloacal exstrophy complex (BEEC). They stated that the purpose of the FAQ section is to make parents more aware of their child's diagnosis while allowing for more constructive conversations and a greater focus on long-term treatment management.

Recent studies have demonstrated the significant potential of mobile applications in enhancing postoperative care. Specifically, these studies have shown that such apps can aid patients in effectively managing pain levels, reducing the risk of complications, and improving overall recovery outcomes.³⁵⁻³⁷

5 | LIMITATIONS OF THE STUDY

Despite the participation in this study, some limitations need to be addressed. One limitation is that some experts could not cooperate due to work overload. Therefore, if more experts participated in the study, needs-based data could be better defined. In addition, this study was only focused on the caregivers' perspective, so future research should collect data from other stakeholders, such as healthcare providers and children with congenital hypospadias. Furthermore, given the limited number of similar studies available for comparison in this specific field, this study relied on findings from related fields. Finally, this study only tested the application on a small group of participants, so further testing with more extensive and diverse groups is necessary to confirm the findings.

6 | CONCLUSION

The development of a postoperative educational application due to the lack of studies in this field specifically designed for caregivers of children with congenital hypospadias can contribute to the comfortable and successful recovery of patients. The findings from this study indicate a significant research need for the development of postoperative educational applications catering to caregivers of children with congenital hypospadias. By addressing this need, we can further enhance the care and support provided to these patients and their caregivers. This study is a supplementary study to identify the care requirements of patients in designing a mobile application that could be a suitable path for future research in this area. The future trend of this study will lead to the development of postoperative educational applications for caregivers of children with congenital hypospadias.

7 | SUMMARY TABLE

What was already known on the topic:

- The prevalence of hypospadias varies across different regions and populations, highlighting the importance of understanding the potential long-term risks associated with this condition.
- Postoperative care for hypospadias patients is needed to ensure favorable outcomes, but current discharge practices often lack appropriate treatment plans and sufficient education for parents.
- The development of mobile-based care applications in healthcare has transformed disease management by integrating intelligent technologies and wireless communications to facilitate effective care provision.

What this study added to our knowledge:

- Designing a mobile application specifically tailored to provide postoperative education for caregivers can contribute to delivering proper care, relevant educational content, and reducing postoperative complications.
- In the process of developing an educational mobile application, the importance of demographic data, clinical information, and practice practices in providing effective postoperative care and support for children undergoing hypospadias surgery is emphasized.

AUTHOR CONTRIBUTIONS

Seyed Mohsen Laal Mousavi: Data curation; formal analysis; project administration; writing—original draft; writing—review and editing.

Niloofar Mohammadzadeh: Conceptualization; project administration; writing—original draft; writing—review and editing.

Seyed Mohammad Ayyoubzadeh: Methodology; supervision; writing—original draft; writing—review and editing.

Leily Mohajerzadeh: Resources; supervision; validation.

Maryam Alidadi: Methodology; writing—original draft; writing—review and editing.

ACKNOWLEDGMENTS

We would like to express our heartfelt gratitude to all those who contributed to the successful completion of this study and the writing of this article. First and foremost, we extend our deepest appreciation to the medical professionals at Mofid Hospital who generously shared their time, expertise, and valuable insights throughout the research process. Their guidance and collaboration were instrumental in shaping this work. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

This article is a part of Master thesis project titled "Design and development of a post operation training application for caregivers of children with congenital hypospadias" approved by Tehran University of Medical Sciences, in 2023 with code of ethics number

IR.TUMS.SPH.REC.1402.038 obtained from National Ethics Committee in Biomedical Research.

TRANSPARENCY STATEMENT

The lead author Niloofar Mohammadzadeh affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

ORCID

Seyed Mohsen Laal Mousavi  <http://orcid.org/0000-0003-0723-1103>

Niloofar Mohammadzadeh  <http://orcid.org/0000-0001-7586-9227>

Seyed Mohammad Ayyoubzadeh  <http://orcid.org/0000-0001-8450-7818>

Leily Mohajerzadeh  <http://orcid.org/0000-0002-9945-8964>

Maryam Alidadi  <http://orcid.org/0000-0002-2278-5262>

REFERENCES

1. Meraji M, Mahmoodian S, Ramezanghorbani N, Eslami F, Sarabi E. Management of congenital anomalies in Iran: developing a national minimum data set. *J Health Administration (JHA)*. 2018;21(73). doi:10.5555/2019306362
2. Chan KH, Panoch J, Carroll A, Wiehe S, Cain MP, Frankel R. Knowledge gaps and information seeking by parents about hypospadias. *J Pediatr Urol*. 2020;16(2):166.e1-166.e8. doi:10.1016/j.jpuro.2020.01.008
3. Wood D, Wilcox D. Hypospadias: lessons learned. An overview of incidence, epidemiology, surgery, research, complications, and outcomes. *Int J Impotence Res*. 2023;35(1):61-66. doi:10.1038/s41443-022-00563-7
4. Bergman JEH, Loane M, Vrijheid M, et al. Epidemiology of hypospadias in Europe: a registry-based study. *World J Urol*. 2015;33:2159-2167. doi:10.1007/s00345-015-1507-6
5. Mallenahalli S, Fang AH, Tong CMC, Dangle PP. A review of literature on long-term outcomes of proximal hypospadias—urinary, sexual, and psychosocial. *Current Sexual Health Rep*. 2021;13:38-44. doi:10.1007/s11930-021-00304-9
6. Nguyen N, Leveille E, Guadagno E, Kalisya LM, Poenaru D. Use of mobile health technologies for postoperative care in paediatric surgery: a systematic review. *J Telemed Telecare*. 2022;28(5):331-341. doi:10.1177/1357633X20934682
7. Chare Joo S, Navidian A, Sharifi S. Evaluating the effectiveness of planned discharge program in the quality of life of gastrointestinal cancer patients undergoing chemotherapy: a clinical trial study. *Med-Surg Nurs J*. 2020;9(1):e101442. doi:10.5812/msnj.101442
8. Cisu TI, Mingin GC, Baskin LS. An evaluation of the readability, quality, and accuracy of online health information regarding the treatment of hypospadias. *J Pediatr Urol*. 2019;15(1):40.e1-40.e6. doi:10.1016/j.jpuro.2018.08.020
9. Mannarino CN, Michelson K, Jackson L, Paquette E, McBride ME. Post-operative discharge education for parent caregivers of children with congenital heart disease: a needs assessment. *Cardiol Young*. 2020;30(12):1788-1796. doi:10.1017/S1047951120002759
10. Mohammadzadeh N, Rezayi S, Tanhapour M, Saeedi S. Telecardiology interventions for patients with cardiovascular disease: a systematic review on characteristics and effects. *Int J Med Inform*. 2022;158:104663. doi:10.1016/j.ijmedinf.2021.104663

11. Zakharenko AA. On necessity of development of instant interplanetary telecommunication based on some gravitational phenomena for remote medical diagnostics and treatment. *Canadian J Pure Applied Sci.* 2018;12(2):4481-4487. doi:10.5281/zenodo.1301289
12. Shahmoradi L, Borhani A, Langarizadeh M, Pourmand G, Fard ZA, Rezayi S. Predicting the survival of kidney transplantation: design and evaluation of a smartphone-based application. *BMC Nephrol.* 2022;23(1):219. doi:10.1186/s12882-022-02841-4
13. Ghadam MS, Poorgholami F, Badiyepymaie Jahromi Z, Parandavar N, Kalani N, Rahmmanian E. Effect of self-care education by face-to-face method on the quality of life in hemodialysis patients (relying on Ferrans and Powers Questionnaire). *Glob J Health Sci.* 2015;8(6):121. doi:10.5539/gjhs.v8n6p121
14. Moulaei K, Bahaadinbeigy K, Ghaffaripour Z, Ghaemi MM. The design and evaluation of a mobile based application to facilitate self-care for pregnant women with preeclampsia during COVID-19 prevalence. *J Biomed Phys Eng.* 2021;11(4):551-560.
15. Hjorth-Johansen E, Børøund E, Martinsen Østen I, Holmstrøm H, Moen A. Acceptability and initial adoption of the heart observation app for infants with congenital heart disease: qualitative study. *JMIR Formative Res.* 2023;7(1):e45920. doi:10.2196/45920
16. Rangraz Jeddi F, Nabovati E, Mobayen M, et al. A smartphone application for caregivers of children with severe burns: a survey to identify minimum data set and requirements. *J Burn Care Res.* 2023;44(5):1200-1207. doi:10.1093/jbcr/irad027
17. Lalband N, Kavitha D. Software engineering for smart healthcare applications. *Int J Innova Technol Exploring Enginee.* 2019;8(6S4):325-331. doi:10.35940/ijitee.F1066.0486S419
18. Gray M. *Genitourinary Disorders.* Mosby-Year Book; 1992.
19. J. David Frank F, John P, Gearhart MF, Howard M, Snyder III, M. *Operative Pediatric Urology.* Churchill Livingstone; 2002.
20. Puri P. *BOOK: Pediatric Surgery: Pediatric Urology.* Springer Nature; 2023. doi:10.1007/978-3-662-43567-0
21. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Int J Surg.* 2021;88:105906. doi:10.1016/j.jisu.2021.105906
22. Mohammad H, Elham M, Mehraeen E, et al. Identifying data elements and key features of a mobile-based self-care application for patients with COVID-19 in Iran. *Health Informatics J.* 2021;27(4):14604582211065703. doi:10.1177/1460458221106570
23. Goldenholz DM, Moss R, Jost DA, et al. Common data elements for epilepsy mobile health systems. *Epilepsia.* 2018;59(5):1020-1026. doi:10.1111/epi.14066
24. Scheper H, Derogee R, Mahdad R, et al. A mobile app for postoperative wound care after arthroplasty: ease of use and perceived usefulness. *Int J Med Inform.* 2019;129:75-80. doi:10.1016/j.ijmedinf.2019.05.010
25. Seyfi Z, Salehi F, Pahlevanynejad S, Shoshtarian Malak J, Safdari R. Identifying required data elements for designing: a mobile-based application for self-care of women living with endometriosis. *Front Health Informa.* 2023;12:138. doi:10.30699/fhi.v12i0.416
26. Hajizadeh E, Shahmoradi L, Mahmoodi M, Rakhshan A, Nazari R, Barzgar S. Identification of the minimum data set to design a mobile-based application on overweight and obesity management for children and adolescents. *J Diabetes Metab Disord.* 2021;20(1):1011-1020. doi:10.1007/s40200-021-00807-1
27. Phillips S, Kanter J, Mueller M, et al. Feasibility of an mHealth self-management intervention for children and adolescents with sickle cell disease and their families. *Transl Behav Med.* 2021;11(3):724-732. doi:10.1093/tbm/ibaa132
28. Choi EK, Jung E, Ji Y, Bae E. A 2-step integrative education program and mHealth for self-management in Korean children with spina bifida: feasibility study. *J Pediatr Nurs.* 2019;49:e54-e62. doi:10.1016/j.pedn.2019.09.002
29. Mclorie G, Joyner B, Herz D, et al. A prospective randomized clinical trial to evaluate methods of postoperative care of hypospadias. *J Urol.* 2001;165(5):1669-1672. doi:10.1016/S0022-5347(05)66388-4
30. Grobbelaar AO, Laing JHE, Harrison DH, Sanders R. Hypospadias repair: the influence of postoperative care and a patient factor on surgical morbidity. *Ann Plast Surg.* 1996;37(6):612-617. doi:10.1097/0000637-199612000-00007
31. Sugar EC, Firlit CF. Urinary prophylaxis and postoperative care of children at home with an indwelling catheter after hypospadias repair. *Urology.* 1988;32(5):418-420. doi:10.1016/0090-4295(88)90414-1
32. Denson CE, Terry WJ. Hypospadias repair. Preoperative preparation, intraoperative techniques, postoperative care. *AORN J.* 1988;47(4):906-915. doi:10.1016/s0001-2092(07)66546-6
33. Abbas TO. An objective hypospadias classification system. *J Pediatr Urol.* 2022;18(4):481.e1-481.e8. doi:10.1016/j.jpuro.2022.05.001
34. Abd el-Salam R, Mohamed M, Abolwafa N, Mohamed S. Impact of pre-operative instructions regarding hypospadias repair on mothers' knowledge, practices and selected post-operative outcomes. *Minia Scientific Nurs J.* 2022;011(1):80-89. doi:10.21608/MSNJ.2022.137516.1025
35. Gozar H, Bara Z, Dicu E, Derzsi Z. Current perspectives in hypospadias research: a scoping review of articles published in 2021. *Exp Ther Med.* 2023;25(5):211. doi:10.3892/etm.2023.11910
36. Mehraeen E, Safdari R, SeyedAlinaghi S, Mohammadzadeh N, Mohraz M. Common elements and features of a mobile-based self-management system for people living with HIV. *Electron Physician.* 2018;10(4):6655-6662. doi:10.19082/6655
37. Snodgrass P, Snodgrass W, Bush N. Parental concerns of boys with hypospadias. *Res Rep Urol.* 2021;13:73-77. doi:10.2147/RRU.S285626

How to cite this article: Laal Mousavi SM, Mohammadzadeh N, Ayyoubzadeh SM, Mohajerzadeh L, Alidadi M. A mobile application for postoperative education of caregivers of children with congenital hypospadias: requirement analysis. *Health Sci Rep.* 2024;7:e1942. doi:10.1002/hsr2.1942