



Core Educational Modules and Key Features in the Tracheostomy Mobile Health App



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ABSTRACT

Aims Tracheostomy is a well-known method for securing the airway, performed by creating an opening in the anterior trachea. Mobile health pulmonary rehabilitation programs for patients with respiratory disorders play a crucial role in enhancing the quality of life for these patients. The present study aimed to identify and determine the core educational modules and key features of the tracheostomy mobile health application.

Information & Methods This systematic review was conducted in 2025. First, modules and key features were identified through a literature review of studies from five databases, including Web of Science, Scopus, PubMed, Cochrane, and Embase. Then, these requirements were evaluated by relevant experts via a questionnaire.

Findings Out of 1,119 articles retrieved, only four studies were eligible after screening. Fifty educational modules and key features were identified and reviewed by 20 relevant experts, categorized into five sections, including user profile, health status, educational hub, lifestyle, and key features.

Conclusion Using mHealth apps provides a unique opportunity for tracheostomized individuals to manage their health status more effectively.

Keywords Mobile Health; Tracheostomy; Mobile Application; Telemedicine

CITATION LINKS

[1] Percutaneous tracheostomy: A comprehensive review [2] Tracheostomy-related indications, early complications and their predictors among patients in low resource settings: A prospective cohort study in the pre-COVID-19 era [3] Tracheostomy [4] Essential principles: Tracheostomy care in the adult patient [5] What is a tracheostomy? [6] Global tracheostomy collaborative: Data-driven improvements in patient safety through multidisciplinary teamwork, standardisation, education, and patient partnership [7] Tracheostomy considerations during the COVID-19 pandemic [8] Effectiveness of a standardized education process for tracheostomy care [9] A systematic review of patient and caregiver experiences with a tracheostomy [10] The practice of tracheostomy decannulation-a systematic review [11] Tracheostomy decannulation rates in Japan: A retrospective cohort study using a claims database [12] Self-management: A comprehensive approach to management of chronic conditions [13] Self-management in chronic lung disease: What is missing? [14] Self-management of patients with tracheostomy in the home setting: A scoping review [15] Designing the essential informational needs of a smartphone application for self-management of patients with inflammatory bowel disease [16] Emerging new era of mobile health technologies [17] Mobile technology: A tool for healthcare and a boon in pandemic [18] Mobile healthcare applications: System design review, critical issues and challenges [19] Comparison of a user-centered design, self-management app to existing mHealth apps for persons living with HIV [20] Designing the critical informational components of a smartphone application for gestational diabetes self-management [21] Mobile health applications for self-management in chronic lung disease: A systematic review [22] Evaluation of m-Health-rehabilitation for respiratory disorders: A systematic review [23] Mobile health applications for chronic diseases: A systematic review of features for lifestyle improvement [24] The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers [25] The Airway App: Exploring the role of smartphone technology to capture emergency front-of-neck airway experiences internationally [26] Effect of a game-based virtual reality phone application on tracheostomy care education for nursing students: A randomized controlled trial [27] Validation of a Novel Mobile Application for assessing pediatric tracheostomy emergency simulations [28] A randomized controlled trial comparing the effect of tracheostomy training using mannequin-based simulation and smartphone application on self-efficacy and anxiety of caregivers

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Introduction

Tracheostomy is one of the oldest known methods of securing the airway, performed by creating an opening in the anterior wall of the trachea. In this procedure, a tube called a tracheostomy tube is inserted through this opening into the trachea to maintain the stoma and ensure airway patency. This artificial airway allows air to enter the trachea directly, bypassing the mouth and pharynx [1-5]. Approximately 250,000 tracheostomies are performed annually in developed countries, with around 10% of these procedures being conducted in children [6].

Tracheostomy is becoming more common in hospital ICUs, particularly for conditions like upper airway obstruction, the need for extended endotracheal intubation, and cases where pulmonary drainage is necessary. This procedure aids in airway suctioning, clears secretions, enhances patient comfort, improves mobility, supports ventilator weaning, and helps prevent long-term complications such as tracheal stenosis [7, 8].

While tracheostomies are crucial for maintaining an open airway, patients discharged with them often encounter various challenges. These include functional, physical, psychological, and social difficulties from the moment of admission until home care, all of which can impact their quality of life [9]. One of the most common issues faced by tracheostomized patients is the inability to speak through the tracheostomy tube, leading to significant anxiety and depression [10]. Improper care of the tracheostomy may result in complications such as tube obstruction, bleeding, cellulitis, ulcers, respiratory infections, and even death [11].

Identifying and developing patient-centered strategies to address these challenges is a central focus of the field of self-management [12]. Self-management is an essential strategy for individuals living with chronic illnesses [13]. In the context of patients with a tracheostomy, self-management is defined as an individual's competence in performing tracheostomy care and managing its consequences in daily life [14]. This ability enables patients to follow and adjust their treatment according to a predetermined process, thereby gaining greater control over their condition [15].

Today, smartphones are essential tools for global communication and healthcare [16, 17]. Mobile technology is rapidly evolving and has the potential to transform various areas of the healthcare system. Mobile Health (mHealth) applications represent some of the core and innovative advancements designed to support and enhance the self-management of patients [16, 18-20]. These apps enable patients to monitor and manage their health more effectively and independently through educational materials, health status tracking, proactive feedback, medication reminders, and rehabilitation support [21].

Kiani *et al.* demonstrated that mHealth pulmonary rehabilitation programs for patients with respiratory disorders play a significant role in enhancing the quality of life, self-management, and physical activity of these patients [22]. However, mHealth applications vary regarding content and features, making it crucial to understand these differences [23]. Identifying and determining the essential educational modules and key features in tracheostomy mHealth apps can significantly enhance the empowerment, information, knowledge, and usability of these tools for patients. Given that no study has been conducted in this field to date, this study aimed to identify and determine the core educational modules and key features in tracheostomy mHealth apps.

Information and Methods

This systematic review was conducted in two stages in 2025. First, the modules and features were identified through a comprehensive literature review, and then these educational modules and key features were evaluated with insights from experts. Initially, a systematic search strategy was developed. A comprehensive search was conducted across five databases, namely Web of Science, Scopus, PubMed, Cochrane, and Embase, using relevant keywords for the period from 2000 to 2025 (Table 1).

Table 1. Search strategy in five databases

Row	Search strategy
A	"smartphone" OR "mobile phone" OR "mHealth" OR "mobile health" OR "APP" OR "app" OR "mobile app*" OR "smartphone app*" OR "Portable Electronic App*"
B	"tracheotomy" OR "tracheostomy" OR "tracheostomies" OR "trach" OR "dysphagia" OR "swallow" OR "swallowing disorders" OR "deglutition" OR "tracheal incision" OR "tracheal stoma" OR "surgical airway" OR "Mechanical ventilation" OR "tracheostoma" OR "airway obstruction"
C	(A) AND (B)

The research team determined the eligibility of articles based on inclusion and exclusion criteria derived from similar studies. Articles eligible for inclusion were those published in English with full text available, that reviewed mHealth apps for tracheostomy, and that provided sufficient details about the educational modules and key features. Articles were excluded if they were review articles, meta-analyses, conference papers, letters to the editor, or book chapters. Additionally, articles that did not focus on the objectives of the present study or whose full text was not available, or that were written in a language other than English, were also excluded. The screening and selection process of articles was conducted following the PRISMA guidelines. The identified articles were first entered into EndNote version 20 software, and duplicate entries were identified and removed. The titles and abstracts of the articles were then evaluated by two independent researchers (A.H.M. and A.P.) based on established criteria.

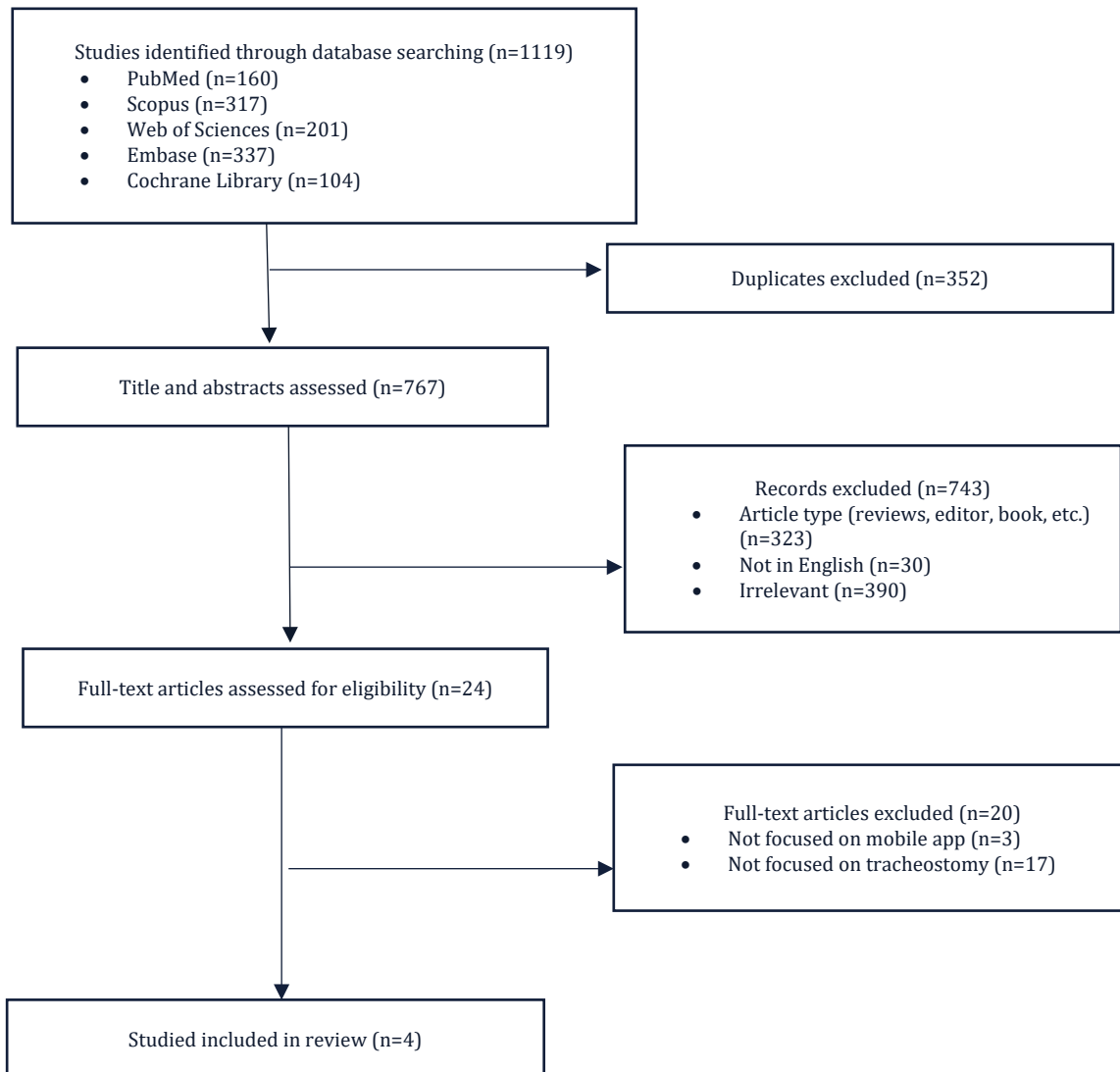


Figure 1. Flow diagram of the study selection process following the PRISMA guideline.

In cases of disagreement or uncertainty regarding the inclusion or exclusion of studies, the third author (A.H.D.) was involved in the discussion and made the final decision (Figure 1).

The 2018 version of the Mixed Methods Assessment Tool (MMAT) was used to assess the risk of bias in the included articles [24]. This tool is specifically designed for the critical appraisal of primary studies in systematic reviews. The MMAT has been developed to allow for rigorous and consistent assessment of quantitative, qualitative, non-randomized, randomized controlled, and mixed-methods studies. The MMAT questions offer three response options: “yes,” “no,” and “cannot tell.”

After reviewing the retrieved articles, A.P. and A.H.D. conducted the data extraction process and recorded the information in an Excel spreadsheet. The extracted data included the article title, journal name, country, study type, year of publication, app name, app purpose, platform type, digital tools used to access the app, app users, app content type, app content, app benefits, and app limitations.

To determine the core educational modules and key features based on the results of data extraction, the researchers designed a questionnaire consisting of 50 questions. The questionnaire was written in Persian and included five sections: user profile (7 questions), health status (17 questions), educational hub (9 questions), lifestyle (5 questions), and key features (12 questions). An open-ended question was included at the end of the questionnaire to collect suggestions and feedback from experts. The measurement scale used in this questionnaire was a 5-point Likert-type scale, with the following scores: very important, important, no opinion, somewhat important, and unimportant.

To ensure compliance with ethical standards, the identities and responses of the participants were kept confidential throughout the study. Participants were informed that their participation was voluntary and that they could withdraw from the study at any time.

An expert panel was formed to ensure the content validity of the questionnaire, comprising health

information management experts (2 members), medical informatics specialists (2 members), and ear, nose, and throat (ENT) specialists (2 members). The panel members were carefully selected based on their extensive experience and expertise; all were university faculty members with more than ten years of professional experience. Once the questionnaire was approved, it was distributed for an in-person survey to 20 specialists, including five thoracic surgeons, five ENT specialists, five health information

management specialists, and five medical informatics specialists. These 20 specialists were selected based on purposive sampling.

Findings

Out of 1,119 articles, four eligible articles were finally selected after removing duplicates and screening titles, abstracts, and full texts. Based on the quality assessment using MMAT, three articles scored 4 out of 5, while one article scored 3 out of 5.

Table 2. Characteristics of the studies reviewed

Author(s)	Country	App name	Platform	Type of application content	Users	Content	Advantages	Results	Limitation
Duggan et al. [25]	Canada	Airway App	iOS, Android	Questionnaire (report)	Physicians	A questionnaire enabling healthcare providers to record and their first-hand eFONA experiences	A platform for sharing scientific and medical experiences	The application is able to collect data and help increase the knowledge of airway management	The application is only available in English
Bayram et al. [26]	Turkey	Not mentioned	Android	Game-based virtual reality	Nursing students	Tracheostomy Care Skill: Preparing correct for suctioning/inner cannula cleaning/peristomal skin care/suctioning tracheostomy tube/cleaning tracheostomy inner cannula/conducting peristomal skin care	Access anytime, anywhere, without internet	at This application is useful for practices in tracheostomy care	Not mentioned
Tawfik et al. [27]	USA	NeoCHAR T+™	iOS	Video-recorded simulations	Physicians	Video-recorded critical action steps of tracheostomy: Assesses breathing, situ calls for help, suction, trach problem, length-type, maskable, shoulder roll, removes trach, bag mask, inserts trach, trach vent, trach ties	Effective tool for 12 real-time capture of time-critical steps in tracheostomy emergency simulations	This data application is accurate and reliable for evaluating performance in pediatric tracheostomy simulations	The application is only available for iOS at this time, which could limit use in some tracheostomy settings
Bahramnezhad et al. [28]	Iran	Not mentioned	Android	Text, podcasts, video	Caregivers of patients with tracheostomy	Education about the needs of patients with tracheostomy, maintenance, and care tracheostomy, respiratory physiotherapy, how to communicate with the patient with a tracheostomy, and how to deal with secretions and emergencies	Access at any time a The opportunity for more effective training in a calm and stress-free environment	The application increased caregiver self-efficacy, decreased caregiver anxiety, and was cost-effective	The application lacks the ability to send a reminder

Table 3. The core educational modules and key features in the tracheostomy mHealth app

Category	Item	Very Important	Important	No opinion	Somewhat important	Not important	Average score
User Profile	Name and surname	12	5	3	0	0	4.45
	National code	10	0	5	5	0	3.75
	Age	15	5	0	0	0	4.75
	Gender	15	5	0	0	0	4.75
	Address	8	2	5	0	5	3.4
	Place of birth	5	5	5	5	0	3.5
	Contact number	9	4	3	2	2	3.8
Health Status	History of respiratory diseases	17	0	0	0	3	4.4
	History of use of respiratory devices	15	0	0	0	5	4.0
	History of previous surgeries	15	0	0	1	4	4.05
	History of allergies to food, drugs, specific substances	14	0	0	1	5	3.75
	History of other diseases	12	0	2	0	6	3.6
	Tracheostomy history	12	3	0	5	0	4.1
	Tracheostomy type (permanent or temporary)	14	5	1	0	0	4.65
	Tracheostomy tube type	15	5	0	0	0	4.75
	Name of the medication	12	4	1	3	0	4.25
	Time and dosage of the medication	11	6	3	0	0	4.4
	Side effects or drug interactions	11	7	2	0	0	4.45
	Fever	12	8	0	0	0	4.6
	Redness or swelling	15	5	0	0	0	4.75
	Bleeding or unusual discharge	13	6	1	0	0	4.6
	Cough and shortness of breath	15	4	1	0	0	4.7
Nausea and vomiting	11	3	3	3	0	4.1	
New or unusual symptoms	10	5	5	0	0	4.25	
Educational Hub	How to change and replace a tracheostomy tube	12	5	3	0	0	4.45
	How to perform suction	14	3	0	3	0	4.4
	How to dress and clean the skin around the tracheostomy site	17	3	0	0	0	4.85
	How to humidify the patient's breathing air	11	5	2	2	0	4.25
	How to manage emergency situations	20	0	0	0	0	5
	Respiratory rehabilitation	11	8	0	1	0	4.45
	Speech and swallowing rehabilitation	12	8	0	0	0	4.6
	How to manage pain	14	6	0	0	0	4.7
	Frequently Asked Questions (FAQ)	15	5	0	0	0	4.75
	Lifestyle	Self-esteem management	8	12	0	0	0
Managing emotions (stress, anxiety, anger)		14	5	1	0	0	4.65
Behavioral and communication management		5	10	2	3	0	3.85
Diet management		5	5	5	5	0	3.5
Exercise and activities		10	7	3	0	0	4.35
Key Features	Medication reminder	14	6	0	0	0	4.7
	Doctor's appointment reminder	18	2	0	0	0	4.9
	Periodic check-up reminder	15	4	1	0	0	4.7
	Tracheostomy tube cleaning and suction reminder	17	3	0	0	0	4.85
	By message	6	10	3	0	1	4
	By video (virtual examination)	2	6	7	2	3	3.1
	Support for iOS and Android	15	5	0	0	0	4.75
	Educational videos	18	2	0	0	0	4.9
	Provide motivational messages	17	3	0	0	0	4.85
	Provide patient reports to the doctor or care provider center	4	13	1	2	0	3.95
	Patient notebook	8	6	6	0	0	4.1
Have a password	7	6	6	0	1	3.9	

One study was from the United States, one from Canada, one from Iran, and one from Turkey, indicating the geographical distribution of the studies across three continents: America, Europe, and Asia. None of the study participants were patients. In two studies, the app users were physicians; in one study, they were caregivers; and in one study, they were nursing students.

The application designed in two of the studies was developed for the Android platform, in one study for the iOS platform, and in another study for both iOS and Android platforms simultaneously. Two studies were published in 2024, one study in 2018, and one study in 2019.

Although the number of studies conducted in this area is minimal, the increase in the number of published articles indicated growing attention and focus on the development of tracheostomy mHealth apps (Table 2).

Overall, based on the experts' views, the item "name and surname" in the user profile category, the item "history of respiratory diseases" in the health status category, the item "how to manage emergencies" in the educational hub category, the item "managing emotions" in the Lifestyle category, and finally, in the key features category, the items "doctor's appointment reminder" and "educational videos" received the highest scores (Table 3).

The educational hub category, with an average score of 4.62, was the most crucial from the experts' perspective, followed by health status, which had an average of 4.52, key features, with an average of 4.39,

and Lifestyle, with an average of 4.06. In contrast, the user profile category, with an average score of 3.8, was considered the least important from the experts' viewpoint (Figure 2).

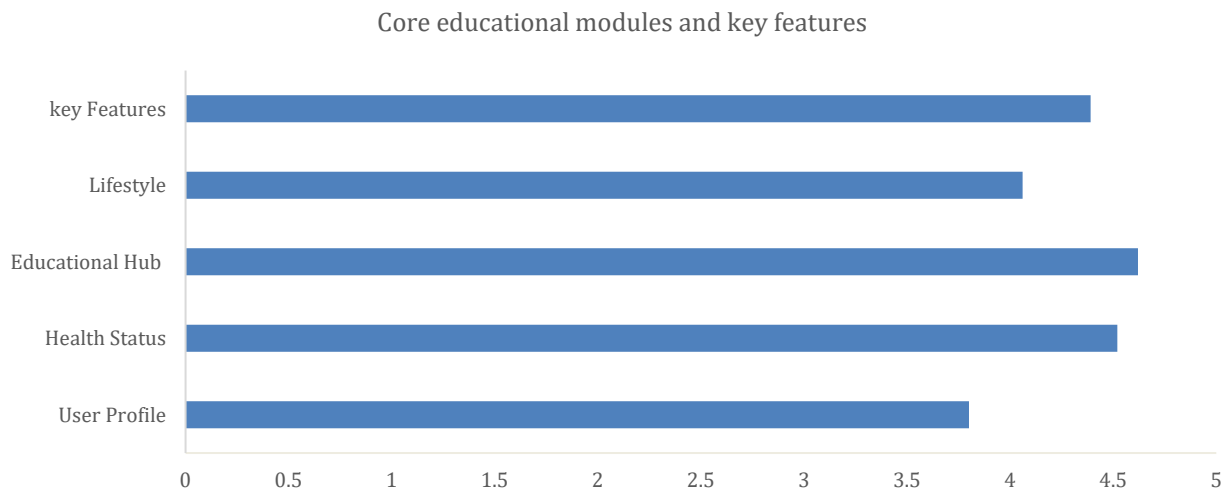


Figure 2. Average scores obtained in each category of modules and known key features of the tracheostomy mHealth app

Discussion

This study aimed to identify and determine the core educational modules and key features in tracheostomy mHealth apps. The core educational modules and key features of the tracheostomy mHealth app were identified and categorized into five sections: user profile, health status, educational hub, lifestyle, and key features. These requirements were extracted through a systematic review and a survey of experts. A total of 38 educational modules and 12 key features were identified and evaluated by experts.

The MMAT tool was employed to assess the quality of eligible articles from the systematic review. Most studies had appropriate methodology and design. Utilizing this tool enhances confidence and validity in the results and interpretations of the included articles.

mHealth can play a crucial role in the screening, diagnosis, prevention, and treatment of diseases by providing healthcare information. Mobile applications are particularly critical for patients with a tracheostomy, as these individuals require specialized training, continuous monitoring of respiratory status, and rapid access to accurate medical information. mHealth applications can effectively meet the educational needs of these patients.

One of our key findings is the special importance of educational modules in the educational hub category from the experts' perspective, indicating the genuine need for tracheostomized patients to acquire informational knowledge related to tracheostomy. Additionally, these findings may highlight a gap and weakness in the existing education available for tracheostomized patients.

Duggan *et al.* [25] have developed an app called the Airway App for the emergency management of the anterior cervical airway. Their focus has been to collect clinical data and support group decision-making in the development of a mobile app. Although their results indicate potential for expanding knowledge in the field of emergency management of the anterior cervical airway, tracheostomized patients are not included in the study.

Bayram and Caliskan [26] conducted a clinical trial to evaluate a virtual reality-based application aimed at educating nursing students on how to properly care for patients who have undergone tracheostomy surgery and reported that using a game-based virtual reality application is very effective in teaching nursing students tracheostomy tube suction skills. Although the researchers focused on providing educational content in a practical and interactive format within the application, the target group for the designed application is not tracheostomized patients. Tawfik *et al.* [27] in the United States used a mobile application called NeoCHART+™ to simulate the performance of group therapy and emergency procedures after tracheostomy, showing that the application is highly accurate.

In 2024, Bahramnezhad *et al.* [28] conducted a randomized clinical trial to compare the effects of two training methods: simulation using a mannequin and training through a mobile application, indicating that training via a mobile app can significantly boost self-efficacy and reduce anxiety.

One of the strengths of this study was the use of a specialized panel of experts to validate the questionnaire. Additionally, a survey among these experts helped identify the most critical educational modules and key features for patients undergoing

tracheostomy. This method combined scientific and practical insights from the experts.

However, a systematic review of the literature reveals a lack of studies on the development of mHealth apps specifically for tracheostomy patients, as most existing apps are designed for populations other than patients. This represents a significant research gap, especially given the critical role of mHealth tools in engaging patients in their treatment and improving their quality of life. The study not only identified this gap but also provided a practical solution for policymakers, developers, and health professionals by pinpointing essential modules and key features. Future research should expand on the development of mHealth tools for tracheostomized patients, building on the results of this study.

The study does have some limitations. Notably, the survey involved a small number of experts, which is significant. This constraint limits the ability to generalize the findings to larger populations, making it essential to interpret the results carefully. Additionally, the study only considered articles published in English, excluding those in other languages. This language restriction means that relevant studies published in non-English languages were not included in the analysis.

One of the main challenges for this group is limited access to specialized applications, primarily due to the small number of apps developed for tracheostomy. By identifying the educational modules and capabilities required for a tracheostomy mHealth application, this study can serve as a practical reference for specialists and developers, facilitating the creation of efficient and targeted applications. Additionally, it is recommended that healthcare professionals and technology developers consider incorporating artificial intelligence in the design of mHealth apps to enhance quality, efficiency, and user satisfaction, providing a foundation for further improving patients' conditions.

Conclusion

Using mHealth apps provides a unique opportunity for tracheostomized individuals to manage their health status more effectively.

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