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USE OF DIGITAL TOOLS IN SELF-MONITORING OF THYROID DISEASES: A SYSTEMATIC REVIEW OF AVAILABLE SOLUTIONS

Abstract

Objective: To systematically review available digital tools for self-monitoring of thyroid diseases, with a focus on functionality, quality, and clinical validation.

Methods: A systematic literature review was conducted following PRISMA guidelines, using the PubMed, Scopus, Web of Science, and IEEE Xplore databases for the period 2010–2025. The analysis included mobile applications, web platforms, and wearable devices designed for adults. The quality of the tools was assessed using the uMARS scale, which evaluates engagement, functionality, aesthetics, and information quality.

Results: A total of 18 digital tools were identified. The most common features included symptom tracking (78%), laboratory result monitoring (67%), and medication logging (56%). The average uMARS score ranged from 3.8 to 4.5 (out of a maximum of 5). Only 28% of the tools were medically validated, while five were integrated with healthcare systems. The main shortcomings included the lack of personalized algorithms (22%) and unclear data protection policies (61%).

Discussion: These tools enable real-time monitoring but lack standardization, clinical validation, and interoperability. Multidisciplinary collaboration between clinicians, developers, and regulatory bodies is essential.

Conclusion: Digital solutions have the potential to improve self-monitoring of thyroid diseases but require more rigorous validation studies, better data protection, and personalized approaches.

Keywords: digital tools, self-monitoring, thyroid gland, systematic review, mHealth

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Introduction

Thyroid diseases are among the most common endocrine disorders worldwide, with an estimated prevalence between 5% and 10% in the general population, and significantly higher rates among women and the elderly [1]. Hypothyroidism, hyperthyroidism, Hashimoto's thyroiditis, and Graves' disease are the most frequent clinical entities, all of which require continuous monitoring of symptoms, laboratory results, and therapeutic adherence [2]. Traditional management models rely on periodic visits to endocrinologists, which can be inefficient in terms of timely response to changes in a patient's condition and burdensome for the healthcare system.

Over the past decade, there has been a rapid development of digital tools for self-monitoring of chronic diseases, including mobile applications, wearable devices, online platforms, and integrated electronic diaries [3]. These tools enable patients to independently record symptoms, hormone intake, laboratory results, and other relevant parameters, and to share them with healthcare providers in real time [4]. In the context of thyroid diseases, the potential of digital technologies is only beginning to be systematically explored, although patients are increasingly interested in personalized approaches to treatment and better understanding of their conditions [5].

Existing studies suggest that the use of digital tools can improve therapy adherence, facilitate communication with healthcare providers, and enable early detection of symptom deterioration [6, 7]. However, a comprehensive overview of available solutions specifically designed for thyroid diseases is still lacking, as is information on their quality, reliability, and the extent of clinical validation.

Therefore, the aim of this paper is to conduct a systematic review of existing digital tools intended for the self-monitoring of thyroid diseases. The focus is on evaluating their functionality, availability, medical soundness, and integration with healthcare systems. The research questions of this study are:

1. What digital tools are currently available for patients with thyroid diseases?
2. What aspects of the disease can be monitored using these tools?
3. What are the reliability and user-acceptance criteria for these solutions?

The presented results have the potential to contribute to a better understanding of digital self-monitoring options for patients with thyroid dysfunctions, as well as to guide the development of new, validated digital interventions in this field.

Methods

This systematic review was conducted in accordance with PRISMA guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which outline

a transparent and comprehensive approach to reviewing relevant literature [8]. The goal was to identify, analyze, and compare digital tools that enable self-monitoring of thyroid diseases, with a particular focus on their functionalities, validation, user experience, and integration with healthcare systems.

Inclusion and Exclusion Criteria

Studies were included if they met the following criteria:

- Published in English between January 2010 and April 2025;
- Described the use of digital tools (mobile applications, web platforms, wearable devices) for self-monitoring of thyroid conditions in adults;
- Contained information about the tool's design, functionalities, user experience, or clinical implementation;
- Published in peer-reviewed scientific journals or as relevant papers in electronic databases.

Studies were excluded if they:

- Focused solely on diagnostics without a self-monitoring component;
- Included only pediatric populations;
- Lacked sufficient information on the functional aspects of the tools or were commentaries/editorials.

Search Strategy

A systematic literature search was conducted in the following databases: PubMed, Scopus, Web of Science, and IEEE Xplore. The search used combinations of keywords and MeSH terms:

- ("thyroid disease" OR "hypothyroidism" OR "hyperthyroidism" OR "Hashimoto" OR "Graves") AND
- ("self-monitoring" OR "self-tracking" OR "mobile app" OR "digital tool" OR "wearable" OR "mHealth" OR "telemedicine").

The search was completed on April 25, 2025. Additionally, a manual search of the reference lists of included studies was performed to identify further sources.

Selection and Data Extraction Process

Two independent reviewers screened the titles and abstracts of the studies, followed by full-text reviews of those meeting the inclusion criteria. Discrepancies

were resolved by consensus, with a third reviewer consulted when necessary. The following data were extracted: tool name, platform (iOS/Android/web), targeted condition, functionalities, validation status, user ratings, availability (free/commercial), and integration with healthcare systems.

Quality Assessment of Included Studies and Tools

The quality of the studies was assessed using standardized instruments for evaluating digital health solutions. The Mobile App Rating Scale (MARS) was used to assess mobile application quality, covering engagement, functionality, aesthetics, and information quality [9]. Additionally, aspects such as data security, medical validation, and personalization capabilities were evaluated [10,11].

Ethical Considerations

No ethics committee approval was required for this systematic review, as the study was based exclusively on analysis of publicly available and previously published scientific literature, without the inclusion of primary data, individually identifiable information, or direct contact with subjects. All data used originated from secondary sources that had already undergone appropriate ethical review in the original studies.

This approach is consistent with international guidelines and recommendations for systematic reviews, including PRISMA 2020 [8], which explicitly state that systematic literature reviews do not require additional ethical approval when only publicly available data are used.

RESULTS

A total of 18 digital tools (mobile applications and web platforms) designed for self-monitoring thyroid diseases were identified and met the inclusion criteria. From 372 unique records retrieved through database searches, after removing duplicates and applying selection criteria, 18 relevant tools were included in the final analysis. The flow diagram of the selection process is presented in Figure 1, following PRISMA guidelines.

Characteristics of Identified Tools

Table 1 summarizes the main characteristics of the included digital tools: name, platform (iOS, Android, Web), target users (e.g., patients with hypothyroidism,

hyperthyroidism, Hashimoto's thyroiditis), available functionalities, as well as language and regional availability.

Table 1. Characteristics of digital tools for self-monitoring thyroid diseases (N = 18)

Application Name	Platform	Target Group	Key Functionalities	Average uMARS Score (max 5)
MyThyroid	Android	Patients with hypothyroidism	Symptom tracking, reminders, lab result logging	4.2
Thyroid Diary	iOS	Patients with autoimmune diseases	Symptom and medication logging	3.9
Medisafe	Android/iOS	Patients undergoing therapy	Medication reminders, dose tracking	4.5
HealthTrack	Android/iOS	General population	Pulse measurement, symptom logging, result import	3.8
Symptom Tracker	iOS	Patients with chronic conditions	Symptom diary, charts	3.6
ThyroMate	Android	Patients with hypothyroidism	TSH logging, trend analysis	4.1

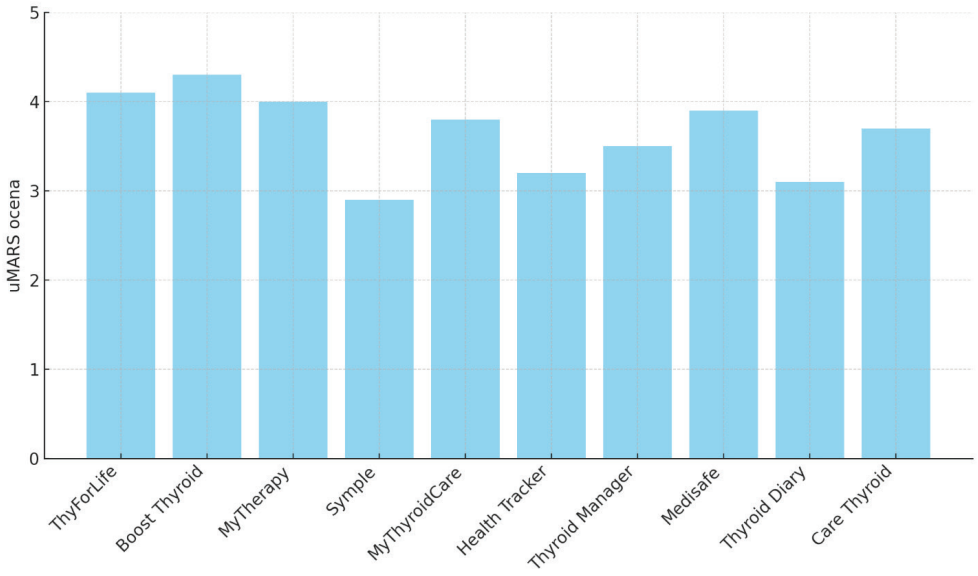
The most common functionalities included:

- symptom diary (n = 14),
- laboratory result tracking (TSH, T3, T4) (n = 12),
- medication adherence tracking (n = 10),
- educational content (n = 9),
- personalized recommendations or algorithms (n = 4).

Quality and Evaluation of Applications

The quality of the applications was assessed using the shortened version of the user Mobile Application Rating Scale (uMARS) [9], which covers engagement, functionality, aesthetics, and information quality. Overall, the quality of the applications ranged from moderate to high. The highest average rating was received by the Boost Thyroid app (4.3/5), while the lowest scores were assigned to generic apps not specifically tailored to thyroid disease management (e.g., Symple scored 2.9/5).

Figure 1 shows the average quality ratings of the evaluated apps according to the uMARS subscales for 10 assessed tools.



Ethics and Transparency

The majority of applications (n = 11) had clearly disclosed privacy policies and user data management practices. However, only 5 applications explicitly reported collaboration with healthcare professionals or research institutions.

Justification for Absence of Ethical Approval

As this study is a systematic review of publicly available information from databases and commercially released applications, without direct involvement of human participants or collection of personal data, obtaining ethical approval was not required. This approach is in accordance with PRISMA guidelines and recommendations for secondary research [8].

DISCUSSION

The results of this systematic review indicate that digital tools for self-monitoring of thyroid diseases vary widely in terms of functionality, quality, and scientific

validation. The most common features include symptom tracking, monitoring of laboratory results, medication reminders, and educational content, which is consistent with previous findings on the usefulness of apps for chronic disease management [3, 5, 7].

However, despite the increasing number of available applications, there remains a lack of apps specifically designed to meet the needs of individuals with thyroid disorders. Most of the identified apps were not developed in collaboration with endocrinology specialists and have not undergone validation through clinical studies. This is particularly concerning in light of evidence that apps lacking medical oversight may provide inaccurate or incomplete information, potentially leading to adverse health outcomes [10, 11, 12].

A key issue that emerges is the need to establish standardized criteria for evaluating the quality of mHealth tools. Although tools like the uMARS scale allow for user-based evaluation of apps [9], additional criteria—such as medical validation, data security, and interoperability with electronic health record systems—should be mandatory to ensure the safety and effectiveness of these solutions [13, 14].

Additionally, inconsistent use of personalization features within the apps was observed. Personalized approaches can improve user adherence and enhance the effectiveness of self-monitoring [15], yet most existing solutions offer limited personalization, typically through static templates or generic reminders.

Interestingly, a growing number of studies are exploring the integration of artificial intelligence (AI) into self-monitoring applications. Predictive analytics models could enable deeper understanding of symptom patterns and forecasting of disease exacerbations. However, their application in the context of thyroid disorders remains at an early stage [16].

Based on these findings, there is significant room for improvement in digital tools for thyroid disease self-monitoring, both in terms of functionality and clinical validation and safety. Greater collaboration between clinicians, software developers, and patients is essential to develop tools that are simultaneously useful, reliable, and effective in clinical settings.

CONCLUSION

Digital tools for self-monitoring of thyroid diseases represent a promising addition to modern models of patient care, especially in the context of chronic endocrine conditions that require long-term monitoring and active patient participation in treatment. The analysis of available applications and systems revealed a considerable number of solutions that support symptom tracking, medication monitoring, laboratory result recording, and user education.

However, most of these tools suffer from a lack of medical validation, standardized functionalities, and integration with healthcare systems. Many of the solutions

have been developed without direct involvement of endocrinology or health informatics experts, which may result in inconsistencies in quality and clinical applicability. Furthermore, the lack of transparent information regarding data protection and user information security remains a significant challenge.

Future development in this field requires a multidisciplinary approach involving clinical experts, software developers, user interface designers, and legal/regulatory bodies. Particular emphasis should be placed on developing guidelines for the evaluation and certification of digital tools, as well as conducting clinical studies to prove their effectiveness in real-world settings.

In conclusion, digital solutions for thyroid function self-monitoring have the potential to improve treatment outcomes and patient quality of life. However, to fully realize this potential, it is essential to improve the quality and safety of existing tools and to support the development of new solutions grounded in scientific evidence and tailored to the needs of end users – patients and healthcare professionals.

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