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TRENDS IN THE DEVELOPMENT OF MEDICAL APPLICATIONS FOR DIABETES: FUTURE PERSPECTIVES AND KEY AREAS OF INNOVATION

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Abstract. *The article focuses on the future prospects and key areas of innovation in the development of mobile applications for individuals with diabetes. The aim of the study is to explore current trends and innovative approaches to creating medical applications designed to facilitate disease management, particularly in the areas of nutrition control and health monitoring for patients. General scientific methods of cognition, such as analysis, synthesis, generalization, and comparison, were employed in the research. The results indicate that the costs of treating diabetes in the U.S. have nearly doubled from 2012 to 2022, exerting significant economic pressure on the healthcare system. Diabetes is a condition highly dependent on proper nutrition and care, but continuous consulting support is often inaccessible due to the high cost of medical services. In this context, mobile applications become an essential tool for patients, allowing them to monitor glucose levels, plan diets, receive medication reminders, and access real-time support. Furthermore, apps like Gluroo, Glucose Buddy Diabetes, MySugr, OneTouch Reveal, and BlueStar provide comprehensive disease management through monitoring and integration with medical devices. An essential aspect of diabetes management is dietary control, and applications such as My Diabetes Diet & Meal Plan, Undermyfork, Fooducate, and Carbs & Cals help users identify foods, count calories and carbohydrates, and offer personalized diet recommendations. The prospects for developing mobile applications for diabetes patients include enhancing artificial intelligence algorithms to improve disease monitoring accuracy and integrating with medical services, such as telemedicine and wearable devices. This opens new possibilities for personalized treatment and continuous health monitoring, which could significantly improve patients' quality of life and reduce the risk of complications. These innovations are expected to contribute to further progress in diabetes management and provide more affordable and effective solutions for patients. The practical significance of the research lies in identifying development directions for mobile applications that can improve the quality of life for people with diabetes and reduce treatment costs.*

Keywords: *diabetes, mobile applications, artificial intelligence, nutrition, monitoring.*

Introduction

In today’s rapidly evolving digital world, the healthcare sector is undergoing significant changes, and medical mobile applications are becoming important tools in combating various diseases. Diabetes is one of the most common chronic diseases that require constant monitoring and control. Managing diabetes involves regular monitoring of blood glucose levels, physical activity, and diet, all of which greatly impact patients' quality of life. In the context of the digital transformation of medicine, mobile applications for monitoring and managing diabetes offer new opportunities for patients and doctors in disease control.

The growing popularity of mobile diabetes apps reflects a general trend toward personalized medicine that caters to the individual needs of each patient. These apps provide convenient tools for tracking health indicators, planning meals, developing exercise routines, and ensuring real-time communication with healthcare professionals. The integration of technologies like artificial intelligence, big data, and cloud computing creates new opportunities to improve treatment and patient self-management.

However, despite the numerous advantages that mobile diabetes apps provide, challenges remain. Issues such as the accuracy of monitoring, insufficient integration with medical systems, difficulties in adapting apps to the individual needs of different patients, and data privacy concerns are critical aspects for further research and development in this field. Moreover, there is a need to improve user interfaces and ensure broader access to such solutions.

Literature Review

The development of medical applications for diabetes, along with future prospects and key areas of innovation, has been thoroughly researched. Recent studies, including works by scholars such as Broome, Hilton, and Mehta [3], focus on the integration of artificial intelligence and machine learning in diabetes treatment. These technologies enhance glucose monitoring, predict hypoglycemia, and create personalized treatment plans, representing a significant direction in the development of digital solutions in healthcare.

Authors such as Armacki and Holloway [2] have made important contributions by analyzing applications for managing type 1 diabetes. They emphasize that these apps help patients control blood sugar levels, medication doses, and the impact of lifestyle on health. This approach allows users to receive timely feedback and better adhere to treatment recommendations.

The research of Garner and colleagues [7], which studied the usability and acceptability of apps for adolescents with type 1 diabetes, also draws significant interest. The results showed that involving users in the app development process contributes to creating intuitive and effective products tailored to the needs of different

age groups.

In addition, the study by Pienkowska and colleagues [9] focuses on apps designed for educating patients with type 2 diabetes. They highlight the importance of co-design, where end users actively participate in the development process, improving both the quality and acceptability of the apps among users.

Expert literature, including publications in contemporary online sources such as Healthline [5], InsuJet [4], and Type1Strong [10], was also used in this study to highlight the latest aspects of digital technology development for diabetes management. Despite a significant body of literature on this topic, there is a lack of systematic material on innovations in this field. Therefore, various scientific analysis methods were used to process, group, and systematize information within the scope of this topic.

Purpose of the article

The purpose of the research is to explore the prospects and innovative approaches in the development of mobile applications for people with diabetes.

To achieve this objective, the following ***tasks*** will be completed: identify key issues faced by modern diabetes control applications; review current trends in the development of such applications; analyze nutrition control apps and their impact on diabetes management; identify promising directions and innovative technologies that could transform the approach to diabetes treatment in the future.

Research results

Diabetes is becoming an increasingly pressing issue, significantly impacting the healthcare system. In 2012, diabetes-related costs in the U.S. amounted to $245 billion [11], rising to $412.9 billion by 2022 [1], underscoring the enormous economic burden of this disease and its continued growth. Powers, M. A., Bardsley, J., Cypress, M., Duker, P., Funnell, M. M., Fischl, A. H., Maryniuk, M. D., Siminerio, L., & Vivian, E. point out that by 2050, one in three U.S. residents could develop type 2 diabetes, making it essential to take measures to reduce the prevalence and complications associated with diabetes [11].

The average age of diabetic patients in the U.S., according to research by

Pienkowska, A., Ang, C. S., Mammadova, M., Mahadzir, M. D. A., & Car, J. in 2023, is 56 years, with the majority being of retirement age. Half of the patients receive medication treatment, including insulin or traditional medications, while the other half do not follow any treatment plan. Moreover, 63% of patients manage their condition independently, while 37% rely on the help of relatives, highlighting the importance of family support in disease management [9].

However, those providing care to patients often lack a full understanding of the needs of individuals with diabetes, which can affect the quality of care. Being healthy themselves, these caregivers may not fully grasp the specifics of the condition, making constant consultations and specialized recommendations necessary to help them provide proper care at home.

One of the most critical issues is the diet of diabetes patients. Creating a balanced and nutritious diet for such individuals requires knowledge of how to choose foods that do not raise blood glucose levels while providing the body with all the necessary nutrients. This task becomes even more challenging for those responsible for preparing meals for the entire family, as the needs of the patient must be balanced with those of other family members. Proper food selection and meal planning are essential for the health of both the diabetes patient and the rest of the family.

In addition to nutrition, physical care for patients is also crucial. This is especially true for foot care, as diabetes often leads to complications like ulcers or other tissue damage. For older adults, these problems can become critical if not properly managed. Many caregivers without medical knowledge do not understand how to care for such patients, potentially leading to serious consequences, such as limb amputation due to complications.

Therefore, constant support and access to consultations 24/7 are extremely important for relatives and caregivers. As a result, 88% of caregivers believe that mobile applications help in diabetes management. Half of the patients (or their caregivers) already use apps to monitor glucose levels or medication intake, and 75% of them notice behavioral improvements after using these apps [11].

There are many apps available for diabetes patients that help control blood sugar

levels, monitor nutrition, physical activity, and other important indicators. An analysis of the specialized literature, particularly the study by Doyle, A., & Watson, K. [5], revealed the following benefits of apps for caregivers and people with diabetes (Table 1).

Table 1 – Advantages of applications for people with diabetes

Advantage	Description
Blood glucose monitoring	Enables regular and accurate tracking of blood sugar levels, helping to respond promptly to changes
Personalized treatment management	Allows the customization of treatment plans, medication reminders, and insulin dosage adjustments
Nutrition and carbohydrate control	Tracks food intake, calculates carbohydrates, and assists in choosing healthy food options
Integration with medical devices	Synchronizes with glucometers, insulin pumps, and fitness trackers for automatic data collection
Data analysis and trends	Generates reports, charts, and forecasts for better understanding of health status and treatment effectiveness
Educational materials and advice	Provides access to information about diabetes, lifestyle recommendations, and answers to frequently asked questions
Community support	Offers the ability to connect with others with diabetes, share experiences, and receive emotional support
Convenience and mobility	Applications are available across various platforms, allowing diabetes management anytime, anywhere
Reminders and notifications	Timely alerts for glucose measurements, medication intake, or physical activity
Data security	Protects personal information and allows data sharing with healthcare providers if necessary

Note: systematized based on [7]

It should be noted that different apps offer varying functionalities, and users often combine several apps instead of relying on just one. Based on expert publications, a comparative table has been compiled showing the best diabetes apps relevant in 2023-2024 (Table 2).

Research conducted by Garner, K., Thabrew, H., Lim, D., Hofman, P., Jefferies, C., & Serlachius, A. in 2023 showed that healthcare professionals exhibit low awareness and trust in digital medical interventions, recommending the use of such apps with additional specialist support, ideally from a treating physician. This highlights the need to increase trust and awareness among medical staff regarding the effectiveness of these apps [7].

Table 2 – Review of key apps for people with diabetes and their functional capabilities

Name	Main features	Advantages
Gluroo [10]	Real-time glucose monitoring, food log with photos, reminders, tracking of diabetes supplies	Free, supports data sharing between Android and iOS, allows communication with "GluCrew", integrates with smartwatches
Glucose Buddy Diabetes [10]	Tracks blood sugar, insulin, nutrition, physical activity; 12-week educational program; integrates with Apple Health and Dexcom; data export for doctors	High user ratings, detailed monitoring, explains the impact of food on blood sugar levels, free
MySugr [10]	Carbohydrate calculation, glucose tracking, HbA1c estimation, bolus calculator, syncs with glucometers	Ideal for type 1 diabetes, offers reports for various periods, ability to export data to a doctor
Diabetes [10]	Diabetes log, bolus calculator, reminders, glucose trend tracking, integrates with fitness apps	Ability to create multiple profiles, tracks the impact of nutrition and lifestyle on blood sugar levels
Health2Sync [10]	Tracks glucose, mood, nutrition, physical activity; food photos; trend monitoring	Over 1.3 million users worldwide, allows sharing with family and doctors
OneTouch Reveal [10]	Automatic glucose analysis, trend detection, notifications, integrates with OneTouch glucometers, doctor access	Proactive adjustments, easy data viewing, high user ratings
BlueStar by Welldoc [10]	Medication management, logs glucose and nutrition, syncs with Apple Health, real-time coaching	FDA-approved, class II medical device, free, available on iOS and Android, connects with medical team
Glooko [10]	Uploads and shares data from over 100 devices, including glucometers and CGMs, syncs with iOS and Android	Free, allows data sharing with clinics and healthcare providers, integrates with various devices
One Drop [4]	Blood sugar management, health data tracking, interactive learning; reminders; integrates with medical devices and apps	Suitable for people with diabetes and other chronic conditions; access to personal health coach; AI-powered glucose forecasts
Diabetes M [2]	Diabetes log, tracks insulin doses, glucose levels, nutrition, physical activity, monitors injection and testing sites	Built-in bolus advisor, ability to track medical metrics, free and paid versions with additional features
Quin [2]	Diabetes management, tracks insulin doses, nutrition, physical activity, connects to glucose sensors	Predicts glucose levels 5 hours ahead, "Insulin Phases" feature, free, available only on iOS
Glucose Tracker [5]	Personalized tracking with tags, data export	Detailed tracking, customizable tags, data sharing with healthcare professionals

Note: systematized by the author based on [2, 4, 5, 10]

In general, there is sufficient support among healthcare providers for using apps to promote psychological well-being among adolescents with diabetes, provided the content is adapted to their specific needs, as well as broad support for apps that educate on the nutritional value of foods [7].

Mobile apps with food recognition features play a crucial role in simplifying dietary management and maintaining optimal blood sugar levels. These technologies enable people with diabetes to easily track consumed foods, count carbohydrates and calories, and understand the impact of various meals on their bodies.

The significance of food recognition technologies lies in automating and simplifying the process of dietary monitoring, which is critical for diabetes management. Traditional methods of carbohydrate counting can be complicated and time-consuming, increasing the risk of errors. Mobile apps like Carbs & Cals [2] use food photos and extensive food databases, providing users with quick access to nutritional information. This helps users more accurately dose insulin and avoid unwanted blood sugar fluctuations.

Trends in the development of these technologies point to increased integration with other medical devices and services. For instance, the app Undermyfork [10] combines food intake data with continuous glucose monitoring, helping users understand how specific foods affect their blood sugar levels. This provides a more personalized approach to diabetes management and supports informed decision-making about diet.

Mobile apps also offer personalized recommendations and meal plans, taking into account the user's individual needs and goals. For example, My Diabetes Diet & Meal Plan [10] provides customized meal plans and over 1,000 diabetic-friendly recipes, helping users maintain a healthy lifestyle with minimal effort. This boosts motivation and encourages a more responsible approach to personal health.

Let's examine some of the most commonly used meal-planning apps in Table 3.

The prospects for food recognition technology in mobile apps for diabetics are quite promising. Further improvements in artificial intelligence and machine learning algorithms are expected to enhance the accuracy and speed of data processing. Deeper

integration with medical services and professional support, as implemented in the Virta app [4], will provide users with access to medical professionals and resources for nutritional therapy. This will allow more effective blood sugar control with minimal medication use.

Table 3 – Apps for food control and recognition aimed at calorie counting and weight loss programs

App Name	Options	Advantages
My Diabetes Diet & Meal Plan [10]	Over 1,000 diabetic recipes, personalized meal plans, reminders, progress tracking	Easy to use, provides nutritional info for insulin dosing, creates shopping lists, motivates a healthy lifestyle
Undermyfork [10]	Combines food tracking with CGM data, food photos, carb and glucose tracking	Free, available on iOS and Android, integrates with Dexcom CGM, helps understand food impact on blood sugar levels
Fooducate [10]	Tracks nutrition and physical activity, barcode scanner, personalized education, dietary advice	Helps choose the best foods, considers individual needs and goals, free with premium upgrade options
Diabetic Recipes [4]	Collection of diabetic recipes; shopping list creation; step-by-step instructions; built-in carb counter	Helps plan healthy meals; ideal for newly diagnosed; free access to a variety of recipes
Virta [4]	Virtual clinic for weight loss and diabetes management; support from medical professionals; resources for dietary therapy	Helps control blood sugar with minimal medication use; personalized support; integrated health approach
Carbs & Cals [2]	Carb and calorie counting through food photos, database of over 19,000 items	Quick and easy access to nutrition info, includes dishes from popular restaurants, free and paid versions
MyFitnessPal [2]	Database of over 14 million foods, carb counting, barcode scanner, option to add custom items	Helps track nutrition and carb intake, free and paid versions, compatible with iOS and Android

Note: systematized by the author

In the future, mobile apps may become even more comprehensive tools for managing diabetes, combining monitoring of diet, physical activity, stress, and other health-related factors. This opens new possibilities for improving the quality of life for people with diabetes, making disease management more convenient and effective.

Medical apps designed for diabetes management are gaining increasing importance in modern medicine, especially given the wide range of innovative

solutions they offer. Studies by Evans [6] and articles by Kerr et al. [8] help identify key directions and future prospects for these technologies.

One of the main trends is the integration of digital health interventions that not only monitor blood glucose but also manage medication prescriptions, diet, and exercise regimens. Evans [6] highlights the importance of apps that help diabetes patients keep track of their metrics in real time, thus improving well-being and reducing the risk of complications.

Kerr et al. [8] present data indicating that the implementation of digital technologies in diabetes treatment not only improves clinical outcomes but also reduces healthcare costs by lowering the rates of hospitalizations and emergency calls.

The future prospects for medical apps for diabetes include expanding the capabilities of artificial intelligence and machine learning in processing large amounts of data for personalized medicine [3]. For example, deep learning algorithms are expected to identify patterns in glucose level changes and automatically adjust treatment regimens based on measurements and patient behavior.

A key area of development is wearable technologies that allow continuous glucose monitoring without the need for user intervention. Devices like CGMs (continuous glucose monitors) integrate with mobile apps, providing patients and their doctors with 24/7 access to vital health metrics.

Additionally, Kerr et al. [8] emphasize the importance of telemedicine in diabetes management, enabling patients to receive online consultations with doctors, reducing hospital visits, and improving regular health monitoring.

These innovation directions indicate significant potential for further development of medical apps, which could drastically change the approaches to diabetes treatment and monitoring in the near future.

Conclusions

The cost of treating diabetes in the U.S. has nearly doubled from 2012 to 2022, highlighting the substantial economic burden on the healthcare system. Diabetes is a condition that greatly depends on proper nutrition and care, making continuous consulting support essential, though it may not always be feasible due to high costs. In

this context, mobile apps play a crucial role, allowing patients to monitor glucose levels, plan their diet, receive medication reminders, and provide real-time support for both patients and caregivers.

Mobile apps for diabetes offer a wide range of health monitoring options, including glucose level control, tracking physical activity, and managing medications. Key apps for diabetes include Gluroo, Glucose Buddy Diabetes, MySugr, OneTouch Reveal, and BlueStar, which offer comprehensive disease management through monitoring and integration with medical devices. For nutrition, apps like My Diabetes Diet & Meal Plan, Undermyfork, Fooducate, and Carbs & Cals are essential, helping users identify foods, count calories and carbohydrates, and provide personalized recommendations for maintaining an optimal diet.

The prospects for food recognition technology in mobile apps for diabetics include improving artificial intelligence algorithms to enhance disease management accuracy and efficiency. Greater integration with medical services, including telemedicine and wearable devices, opens possibilities for personalized treatment and continuous monitoring, which can significantly improve patients' quality of life and reduce complications.

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