

Original Research Article

Perceptions of pharmacists and other healthcare professionals on marketed mobile applications used for self-management by type 2 diabetic patients: A systematic review

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Sent for review: 6 December 2022

Revised accepted: 27 March 2023

Abstract

Purpose: To determine the level of awareness, beliefs and experience of healthcare professionals (HCPs) regarding mobile applications for self-management of type 2 diabetes mellitus.

Methods: This review was done by searching the literature using three databases viz: PubMed, Web of Science and Scopus. Assessment of quality of studies was carried out using the scale of the Agency for Healthcare Research and Quality. The results were presented in accordance with the PRISMA 2020 guidelines.

Results: The search strategy identified 725 unique research papers, 4 of which were included. A survey among pharmacists showed that 56 % of participants were aware of the existence of mobile health applications, and that 60 % of those who were aware recommended their use. In the multi-HCPs setting, depending on the study, apps recommendation rate varied from 45.5 to 62 %. Most of the participants (88 %) agreed that a mobile app would help strengthen their treatment recommendations to the patients (88 %), and 84 % also agreed that it would help patients manage diabetes better.

Conclusion: Not much research has been done on this topic. Available data suggest that the awareness of HCPs regarding mobile applications is unsatisfactory, and that those familiar with these apps find them useful and are ready to recommend them to patients. There is need for further research and measures to increase awareness and knowledge of HCPs about available mobile applications, in order to ensure adequate support to patients with diabetes.

Keywords: Software, m-Health, Diabetes mellitus, Knowledge, Attitudes, Healthcare professionals

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INTRODUCTION

Diabetes belongs to the category of non-communicable diseases (NCDs) which, according to the World Health Organization (WHO), are responsible for 71 % of deaths

worldwide [1]. The most affected population are people aged 30 - 69 years, primarily in low- and middle-income countries. Diabetes alone is responsible for about 1.5 million deaths every year. The constant increase in the number of new cases, and the spread of the disease to the

status of a pandemic, are important public health problems in many countries.

The WHO 2030 Agenda for Sustainable Development recognizes the NCDs as a significant challenge for sustainable development. Indeed, a goal has been set for the development of national responses that will contribute to one-third reduction in premature mortality from these diseases by 2030 [2]. The responses involve improvements in the area of prevention, early detection and timely application of adequate therapy.

The accelerating development of digital technologies in recent years has contributed to significant increases in the number of options that support reduction in the spread, while ensuring better control of NCDs. Accordingly, the availability and use of software, i.e., mobile applications that help patients and health professionals in the prevention and treatment of diabetes, are also increasing [3].

The WHO defines the concept of digital health as “a field of knowledge and practice related to the development and use of digital technologies to improve health” [4]. Additional terms which are important for this topic are electronic health or eHealth which is related to healthcare services that are provided with the use of information and communication technologies (e.g., computers), and mobile health or m-health which is related to use of healthcare services and information that are provided with use of mobile communications (e.g., smartphones) [5]. Electronic health is a broader term which also includes mobile health.

A joint report on digital applications for diabetes by the European Association for the Study of Diabetes (EASD) and the American Diabetes Association (ADA) [6] indicates that the available applications comprise three groups: (i) those used to monitor the well-being of the individual, (ii) those that function as stand-alone medical devices, and (iii) those that display, download and/or use data from medical devices that diagnose, prevent, monitor or treat a certain condition.

It should be noted that there are no clearly defined regulations for mobile applications used to monitor the health and well-being of individuals, especially those that do not qualify for description as medical devices. On the other hand, mobile applications that belong to the category of medical devices must meet the regulatory requirements, and are overseen by relevant competent authorities [7].

Various studies indicate that mobile applications for diabetes have the potential to improve self-control and therapy of the disease [6]. Some of the beneficial effects identified in various studies are improved glycemic control, with reduction in HbA1c, weight loss, reduction in blood pressure, and decrease in LDL-C, as well as improvements in education and behavioral modifications [8-15]. Most users of this category of mobile apps find them to be helpful in their communication with HCPs [16].

The joint EASD-ADA report based on an assessment of the current state of digital diabetes applications, made some recommendations to different stakeholders including regulators, manufacturers, professional associations, research funding bodies, researchers, health professionals and users [6]. The recommendations state that HCPs should be aware of digital health applications and their advantages and disadvantages, and that HCPs should support and inform individuals with diabetes about the use of these apps to improve diabetes management and lifestyle modification.

While data suggest the positive impact that mobile apps may have on self-management of diabetes, especially when their use is coordinated by HCPs, there is no systematic review that focuses on the HCPs awareness, beliefs and actual experience with such applications in daily practice.

This systematic literature review was undertaken with the aim of understanding the current perceptions of pharmacists and other HCPs who may be in position to assist patients with use of mobile applications for self-management of type 2 diabetes. The goal is to understand if additional training and involvement of HCPs in this area are needed to ensure more effective contribution to the control of the increased use of mobile applications that support improvements in control of therapy and the course of the disease. This will indirectly contribute to the reduction of complications and mortality from diabetes.

METHODS

Research question formulation and search strategy preparation were done in line with the Population, Intervention, Comparison, Outcomes and Study (PICOS) framework [17].

Literature review was performed using the advanced search options in PubMed, Scopus and Web of Science, and the search was concluded on July 18, 2022.

The review and the presentation of results were done in accordance with the updated PRISMA 2020 guidelines for reporting of systematic reviews [18]. The search strategy involved preparation of four search blocks related to diabetes as a disease of interest, mobile applications, as well as the perceptions and attitudes of pharmacists and other HCPs.

In the search, the following terms were used, as well as their applicable variations: “Mobile Application”, “Digital Technology”, “M-health”, “Diabetes Mellitus, Type 2”, “Pharmacist”, “Health Personnel”, “Healthcare professional”, “Attitude”, “Awareness”, “Belief”, “Opinion”, “Culture”, “Perception”, “Education” and “Knowledge”. In addition, Boolean tags “AND” and “OR” were used to link different keywords that formed the search blocks. The research papers published since 2016 were selected as current research papers for this search. Thus, a filter was applied to include only studies published from 2016 to 2022. The search strategy was adjusted as per the available options for different databases. The complete search strategy is presented as supplementary material 1.

The list of all inclusion criteria used for this review is presented in Table 1. If any paper identified by the search did not meet all of the inclusion criteria, it was excluded from the review. Initial independent review of the titles and abstracts of all articles and the full texts of eligible articles was done by DV, followed by reviews by DK and MO. Wherever there were disagreements, a decision was arrived through consensus.

The extracted data comprised information about title, first author, publication year, study design, country in which the research was conducted, HCPs who participated in the research, number of participants, and objective of the research. Data extraction was done by DV, while DK did the double-checking. In case of any disagreement, MO made the final decision.

Table 1: Inclusion criteria

Criterion	Characteristic
Population	Patients with type 2 diabetes
Perceptions	Study that referred to the knowledge, awareness, beliefs, education, attitudes, perceptions or opinions of pharmacists and/or other healthcare professionals in particular.
Mobile application type	Includes the use of marketed digital technology, i.e., mobile applications to support patient’s self-management of the disease
Others	Full text of research papers available in English Original research papers Papers published within the period 2016-2022

The quality of included studies was assessed using the relatively widely-used scale of the Agency for Healthcare Research and Quality (AHRQ scale), as there were no more accepted instruments for assessing the quality of cross-sectional studies [19]. The scale consisted of 11 items, and the possible answers for each of them were “yes”, “no”, “unclear” or “not applicable”. The answers “no”, “unclear” and “not applicable” were assigned score of 0, while the answer “yes” was assigned a score of 1. Based on the total score for all 11 items, the studies were classified into the following categories: low quality (0 – 3), medium quality (4 - 7), and high quality (8 – 11) [20]. The assessments were done by DV and DK, while MO made the final decision where there was a disagreement between DV and DK.

It was not possible to make a direct comparison with meta-analysis, since the included studies were heterogeneous in design.

RESULTS

Using a systematic literature search, 725 unique papers were identified, out of which 706 papers were excluded after reviewing titles and abstracts in accordance with the inclusion criteria (the corresponding author may be contacted for a complete list of the excluded papers).

The research papers that were excluded in this way fell into five groups:

- (a) papers that referred only to patients with type 1 diabetes or gestational diabetes
- (b) papers that primarily focused on various cardiovascular diseases
- (c) papers that dealt with the use of telemedicine
- (d) papers that addressed patients’ perceptions
- (e) other papers that were not relevant to this search.

Out of the remaining 19 papers reviewed in full, 15 papers were excluded because they did not meet the inclusion criterion which stipulated that studies should include the use of marketed digital technology (mobile applications) to support patient's self-management of the disease. Four of the 15 excluded papers dealt with the desired characteristics when creating new applications [20 - 23]; one paper focused on the use of applications that supported decision making in primary health care [24], while 3 papers addressed the use of eHealth platforms (not mobile apps) by nurses for communication with diabetes patients and the impact of digital technologies on medical relationships between nurses and patients [25 - 27]. Moreover, 2 of the papers focused on the exchange of patient data and communication between HCPs and patients using digital technologies [28, 29]; 1 paper covered a digital questionnaire for reporting outcomes by patients [30], 1 paper dealt with eHealth video educational material based on avatar technology [31], while another paper covered eHealth online goal setting platforms [32]. The last 2 papers addressed the missing features and barriers for use of mobile applications for diabetes self-management [33, 34]. Therefore, only 4 of the 19 papers were included for further analysis [35 - 38]. The qualities of these studies were assessed using the AHRQ scale. As a final result, 3 papers were rated as medium-quality, while 1 paper was classified as low-quality work. The complete quality assessment is provided in supplementary material 2. The flowchart used in the selection of research papers is shown in the form of PRISMA diagram in Figure 1.

One of the included studies was done in England, two were in the United States, and one study was multinational (conducted in 73 countries). All studies were classified as cross-sectional studies: the participants were heterogenous types of HCPs comprising pharmacists, primary care physicians, diabetes educators, endocrinologists, registered dietitian nutritionists, registered nurses, certified diabetes educators, board-certified advanced diabetes management practitioners, advanced practice nurses, doctors of pharmacy, and medical degree practitioners.

The number of participants in the studies ranged from 76 to 1001. The studies had different goals, one study examined the opinions of HCPs about a specific diabetes management application used in combination with a new and accurate blood glucose meter [35]. Another study examined pharmacists' general awareness of mobile health apps, the extent to which they recommend these apps to the public, and how familiar the pharmacists were with the health app guide which included a mobile app for diabetics [36]. The third study determined factors that may be linked to use of applications by HCPs working in the field of diabetes and patients' weight management care [37], while the fourth one assessed the acceptability of apps by HCP and their preferences for features in apps [38].

Research related to the assessment of the diabetes management application [35] showed that most of the HCPs who participated agreed that the mobile application helped to strengthen their treatment recommendations for patients (88 %), and 84% also agreed that it helped patients to manage diabetes better. Most HCPs (78 %) recommended the use of the tested mobile application to their patients, and the percentage was even higher (84 %) with respect to recommendation of the mobile application to insulin patients. Majority of participants (91 %) in this study agreed that, when used in combination and together with the recommendations of HCPs for treatment, blood glucose meter and mobile application assisted patients to stay engaged with the physicians in-between visits.

A study that involved pharmacists [36] showed that just over half of the participants (56 %) in the study were aware of the existence of health mobile applications, and that 60 % of those who were familiar with the apps recommended their use. The vast majority of participants (72 %) were unaware of the existence of a guide on mobile applications that included an application for patients with diabetes.

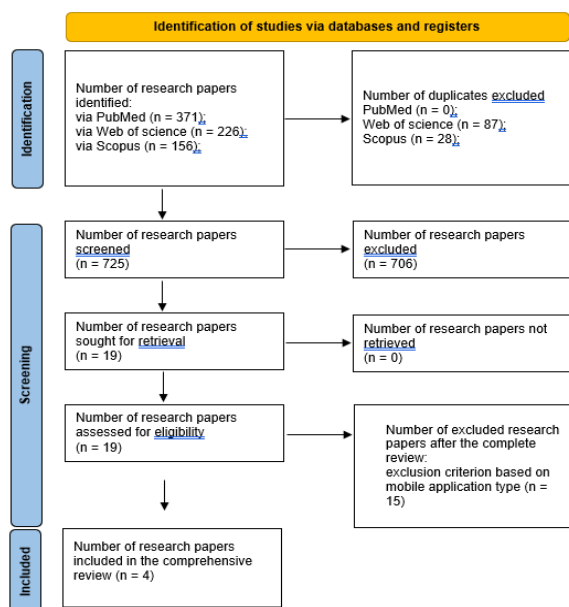


Figure 1: PRISMA diagram

Table 2: Overview of the characteristics of the included research papers

Paper title	“Patient and healthcare professional satisfaction with a new, high accuracy blood glucose meter with color range indicator and wireless connectivity” [35]	“Awareness and use of health Apps: A study from England” [36]	“Results of the Clinician Apps Survey: how clinicians working with patients with diabetes and obesity use mobile health Apps” [37]	“What healthcare professionals think of nutrition & diet apps: an international survey” [38]
First author	Katz LB	Kayyali R	Karduck J	Vasiloglou MF
Publication year	2016	2017	2018	2020
Study design	Cross-sectional study	Cross-sectional study	Cross-sectional study	Cross-sectional study
Country in which the research was conducted	USA	England	USA	Multinational (73 countries, Europe (29), North America (4), Oceania (2), Africa (13), Asia (18), South America (7))
HCPs who participated in the research	Primary care physicians, diabetes educators, and endocrinologists	Pharmacists	Registered dietitian nutritionist, registered nurse, certified diabetes educator, Board-certified advanced diabetes management practitioner, advanced practice nurse, Doctor of Pharmacy, medical degree practitioner	Dietitian and/or nutritionist, medical doctors, nurses, others
Number of participants	76	95	719	1001
Objective of the research	Assessment of a specific diabetes management application by HCPs	Pharmacists' awareness of mobile health applications and the extent to which they recommend them to the public	Determining the factors that are linked with use of applications by HCPs working in the field of diabetes and weight management patient care	Assessment of acceptability of applications HCPs for “nutrition and diet”

A significant population (67 %) of those who were familiar with the guide found it useful, while 78 % of this population recommended the use of applications (78 %).

A study among clinicians working with patients with diabetes and obesity [37] showed that more than half of the participants were app enthusiasts (53 %). A significant number of clinicians used health-related apps personally (61 %), and for work purposes (49 %). Majority of the physicians (62 %) recommended smartphone apps to their clients for tracking of diet and physical activity: 62 % were of the view that the apps were superior to the traditional methods for tracking dietary intake, while 58 % considered the apps suitable for monitoring physical activity. The proportions of those who considered the apps suitable for making better food choices, losing weight, and tracking blood glucose were 34, 45 and 43 %, respectively.

In the multinational study [38], less than half of the HCPs (45.4 %) confirmed that they recommended the apps to their clients. Among the different HCPs, nurses were more likely to recommend apps. Moreover, HCPs who were already using the apps were more likely to recommend them than those who were not using the apps. A number of HCPs (23.8 %) who recommended apps were not satisfied with the app use, due mainly to lack of accuracy, inadequate databases for diet, misunderstanding, requirement for significant number of manual entries, absence of estimations for micronutrient contents, focus on weight loss rather than behavioral changes, and limited access to information technology. The main reasons given by HCPs who did not recommend the apps to clients, and the corresponding HCP percentages, were lack of trust in apps (27.6 %), unawareness of existence of the apps (22.5 %), preference of pencil and paper methods (17.6 %), belief that using apps

was time-consuming (10.6 %), and unfamiliarity with smartphones (2.4 %). However, 34.7 % of the HCPs had no opinion or had other reasons. The main criteria for selecting the app were ease of application (87.1 %), absence charge (72.6 %), and validity (68.1 %).

DISCUSSION

This systematic review of the literature provides a novel insight into the currently available data that address the perceptions of pharmacists and other HCPs regarding mobile applications that provide support and aid patients in self-management of type 2 diabetes. As per the proposed criteria, the review showed that not many papers addressed this topic from the proposed angle. Most research papers on mobile applications for patients with diabetes investigated the relevance of these apps to patients, and numerous data are available to justify their use, although conventional data on the safety and efficacy of mobile health applications for diabetes remain limited [6].

Although the applications are intended for use by patients with diabetes, the perceptions and involvement of pharmacists and other HCPs are crucial to ensure adequate usage of the apps. The low number of studies that were analyzed indicate insufficient level of evidence in this field. Therefore, there is need for further research in this area.

The data presented indicate that HCPs who were familiar with the existence and possibilities of various health mobile applications for patients with diabetes saw the possible benefits of these apps for patients, and were ready to recommend them for use. On the other hand, the impression got was that a relatively small number of HCPs were actually familiar with the existing mobile applications in the market, as well as their functionalities. The available data suggest that the awareness and knowledge of HCPs about mobile applications for patients with diabetes are interconnected with the perception of the usefulness of the mobile applications and the readiness of the HCPs to recommend them to the patients. However, lack of training and information about available mobile applications might prevent HCPs from providing adequate patient support and ensuring proper use of safe mobile applications that will benefit patients with diabetes in the management of therapy and disease [28].

A considerable number of applications for patients with diabetes were available, but the data indicate that the level of their use was not

high, due to numerous factors, many of which could easily be handled by HCPs. In a research on the influence of factors such as patient's age, gender and psychological needs, Fu *et al.* reported that the level of app use might be increased especially in older men with lower education and longer disease duration, through the use of tailored training and continuous technical support [39]. On the other hand, in a research paper on the use of mobile applications in self-care in patients with type 2 diabetes, Jeffrey *et al.* reported that patient's satisfaction with the use of these applications was increased if the apps were recommended by HCPs, but that it was only for a small number of respondents were HCPs in any way involved in the use of the applications [40]. Additionally, Graffigna *et al.* have reported that the readiness of patients with type 2 diabetes to use self-care applications with adherence was directly influenced by the level of perception of the ability of HCPs to motivate the patients [41]. The findings in this review are consistent with all the above-mentioned reports: HCPs were not aware and well-trained in the field of existing mobile applications, and so could not provide suitable support and guidance to the patients with diabetes.

The study by Ronda *et al.* was not included in this review as it dealt with a web portal that allowed patients to have access to their electronic health records as well as appropriate options for communication with the HCPs. However, the results were considered relevant and supplemental to the findings of this systematic review since they showed the evaluation of opinions of HCPs on the use of the portal. Those results indicated that HCPs did not provide maximum support and encouragement to the patients for the use the portal, nor did they provide additional information or check on whether patients were really aware of the benefits derivable from using the portal. It may be posited that additional training by HCPs on the benefits of using the portal, and emphasis on identifying barriers that patients may have, with provision of adequate support, may contribute to changing the practice of HCPs regarding the use of this digital technology [28].

To the best of our knowledge, this is the first attempt to systematically study the awareness, beliefs and actual experience of pharmacists and other HCPs awareness, about mobile applications intended to be used by patients with diabetes type 2, so as to understand the perceptions and current level of involvement of HCPs in communication with patients on this topic. The included studies had different limitations. Quality estimated with AHRQ scale

demonstrated that none of the included studies was a high-quality investigation. The sample size of the included healthcare workers was relatively small, and in general, the studies were heterogeneous. Therefore, direct comparison and synthesis of data was not possible. An additional limitation of the systematic review is that it included only papers published in English language, and only within the databases covered in the search.

Due to the rapidly-evolving environment of mobile applications development in recent years, a filter for papers published in the last seven years was applied so as to extract only recent relevant studies. As per available data, this systematic review indicates that not only community pharmacist, but all HCPs involved in the care of patients with diabetes type 2 were not sufficiently aware, not adequately trained and not effectively involved in use of mobile applications intended to support this category of patients.

Taking into account that the regulations in the field of different types of health-related applications are not fully defined, and in view of the fact that patients have access to a growing number of mobile applications, it would be important that additional efforts are made to ensure that HCPs are well informed and trained in this area. The most important measure is to ensure proper awareness of HCPs that will allow them to perform critical appraisal of mobile application characteristic and appropriateness for their patients.

The role of community pharmacists has been changing throughout history, and the need for alignment of practice with the advances in biomedical areas as well as in information technology has been recognized [42]. Community pharmacists as HCPs with regular contact with type 2 diabetes patients are well positioned to take over a more significant role in counselling patients regarding existing mobile applications. Further research is needed to allow for evidence-based decisions that will ensure improvements of competencies of HCPs and praxis in provision of support and guidance regarding proper selection and use of mobile applications that improve self-management of diabetes by patients.

CONCLUSION

Based on this systematic review, the number of papers that addressed the topic of awareness, beliefs and actual experience of pharmacists and other health professionals regarding mobile applications that support patients with self-

management of type 2 diabetes are very limited. The data indicated insufficient awareness of pharmacists. On the other hand, pharmacists who were familiar with this topic in most cases decided to recommend the use of applications to users of their services. Studies that involved different HCPs show that the percentage of those who recommended the applications to clients depending on the study setting, ranges from 45.5 to 62 %. The data also indicate that HCPs believe that mobile applications could empower patients with diabetes and help them stay engaged in the field of self-care within the period between visits to the physician. Since the available data were not numerous, new high-quality research on this topic would make for better understanding of the current situation and draw conclusions about the necessary measures. The aim of the measures would be to increase awareness and knowledge of HCPs on mobile applications for patients with diabetes. This would allow HCPs to support patients to ensure much better and more correct usage of mobile applications, thereby contributing to better control of therapy and disease. The preparation of national guides and continuous training plans for HCPs on available mobile applications would be useful in achieving this goal.

DECLARATIONS

Acknowledgements

We would like to thank all the authors whose articles are referenced in this review.

Funding

This research of DK and MO was funded by the Ministry of Education, Science and Technological Development, Republic of Serbia [Grant Agreement No: 451-03-68/2022-14/200161].

Ethical approval

None provided.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

No conflict of interest associated with this work.

Contribution of Authors

We declare that this work was done by the author(s) named in this article, and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. DV, DK and MO conceived and designed the study, DV collected and DV, DK and MO analyzed the data and wrote the manuscript. All authors read and approved the manuscript for publication.

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