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Designing the Critical Informational Components of a Smartphone Application for Gestational Diabetes Self-Management

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ABSTRACT

Aims The prevention and management of gestational diabetes mellitus and its adverse maternal and neonatal outcomes are critical for health promotion. Mobile health interventions have the potential to support effective self-management in this population. This study aimed to identify and analyze the critical informational components and functional capabilities required for developing a mobile self-management application tailored for women with gestational diabetes, based on expert perspectives.

Instrument & Methods This applied study was conducted in 2025 through four sequential phases. The present research represented the first phase of a four-stage cycle for developing a mobile app for the self-management of gestational diabetes, including needs assessment, design, implementation, and evaluation. A comprehensive review of scientific literature and clinical guidelines from reputable databases was performed to extract critical components. Based on the study objectives, a researcher-designed questionnaire utilizing a Likert scale was developed and administered to a panel of 20 experts from the fields of obstetrics and gynecology, endocrinology and metabolism, medical informatics, and health information management. Data were analyzed using SPSS version 26.

Findings Patient profile, educational information, medication, self-management recommendations, and functional capabilities constitute the most important informational areas for developing a mobile self-management app for women with gestational diabetes.

Conclusion The development of self-management applications for gestational diabetes should be grounded in targeted education, precise monitoring, and advanced functional capabilities to provide an effective and reliable tool for improving maternal health and preventing complications.

Keywords Gestational Diabetes Mellitus; Self-Management; Mobile Health; Mobile Application; Needs Assessment

CITATION LINKS

[1] A clinical update on gestational diabetes ... [2] Prevalence of gestational diabetes mellitus in ... [3] Molecular epidemiology of breast cancer in ... [4] Self-management interventions for gestational diabetes in Africa ... [5] Gestational diabetes mellitus: What can medical ... [6] Gestational diabetes ... [7] Diabetes mellitus ... [8] Self-management experience of first-time diagnosed ... [9] Designing the essential informational needs of a smartphone ... [10] Mobile health applications for disease screening and treatment support ... [11] A review of mobile health interventions for public private ... [12] The use of mobile health interventions for gestational diabetes ... [13] Mobile health as a primary mode of intervention for ... [14] Effectiveness of mobile health interventions for pregnant ... [15] Effectivness of specific mobile health applications (mHealth-apps) ... [16] Effects of mHealth-based lifestyle interventions on ... [17] The role of mobile health applications in ... [18] Identifying required data elements for designing ... [19] Application of mobile technology for disease and treatment ... [20] The efficacy of mobile phone apps for lifestyle modification ... [21] Mobile applications for control and self management ... [22] A mobile application for postoperative education of caregivers ... [23] What do mothers know about gestational diabetes ... [24] Health education in gestational diabetes ... [25] Evaluation of the effects of diabetes self-management education ... [26] Mobile applications to support diabetes ... [27] Managing gestational ... [28] Educational and intervention programmes for gestational ... [29] Diet and healthy lifestyle ... [30] Reducing the risk of type 2 diabetes mellitus ... [31] Quality evaluation of English mobile ... [32] Determining minimum set of features for ... [33] Reminder through mobile messaging ... [34] Reminder systems to increase compliance with glucose logging in gestational diabetes ... [35] Development, feasibility and acceptability ...

Introduction

Gestational diabetes mellitus (GDM) is among the most prevalent complications during pregnancy, affecting approximately one in every seven pregnant women worldwide [1-3]. GDM is characterized by varying degrees of carbohydrate intolerance, manifested by elevated blood glucose levels during pregnancy, typically emerging in the late second or early third trimester [4-6]. Pregnancies complicated by diabetes are associated with a higher incidence of congenital anomalies and perinatal complications compared to normoglycemic pregnancies. Moreover, diabetic mothers face increased risks of progressive diabetes-related complications, such as microvascular disease, preeclampsia, polyhydramnios, and preterm labor [7].

The complexity of care required for the optimal management of gestational diabetes poses challenges for both pregnant women and healthcare providers in selecting the most effective therapeutic approaches [6].

Self-management strategies have emerged as essential and effective methods for controlling and managing GDM [8]. Women with gestational diabetes can achieve optimal glycemic control and prevent diabetes-related complications through self-management interventions, including dietary modifications, physical activity, blood glucose monitoring, and appropriate medication adherence [4]. Self-management empowers patients to follow and adjust their treatment plans according to a predefined process, thereby enhancing their control over their health status [9].

Today, the transformation in healthcare delivery is inseparable from advancements in intelligent technologies and mobile health applications [10]. Compared to other digital technologies, mobile health offers a promising resource for health improvement, particularly in low- and middle-income countries [11].

Mobile health is recognized as one of the most prominent technologies for managing gestational diabetes. The widespread adoption of mobile technologies presents a hopeful opportunity to enhance diabetes care and facilitate self-management by fostering active engagement between patients and healthcare professionals [12].

The prevention and management of GDM and its adverse outcomes are critical for maternal and neonatal health, and mobile health interventions can substantially contribute to these goals [13].

Mobile health plays a vital role in glycemic control and self-management among pregnant women with GDM, as evidenced by the proliferation of numerous mobile health applications developed for this patient population in recent years [14].

Multiple studies have demonstrated that mobile health applications significantly improve lifestyle behaviors and glycemic control, thereby positively impacting the management of gestational diabetes [15, 16].

These applications have emerged as powerful tools in healthcare, offering innovative approaches to enhance patient engagement and improve health outcomes [17]. Identifying the critical informational components for designing a mobile application constitutes a crucial step in the development cycle of self-management mobile apps [18].

According to the authors' comprehensive review, no prior study has specifically addressed the identification of informational components necessary for developing self-management mobile applications for women with gestational diabetes. Accordingly, this study aimed to identify and analyze the critical informational components and functional capabilities required for developing a mobile self-management application tailored for women with gestational diabetes, based on expert perspectives.

Instrument and Methods

Study design

This descriptive applied study was conducted in 2025 to identify and analyze the critical informational components and functional capabilities necessary for developing a mobile self-management application for women with gestational diabetes. The study represented the first phase of a four-stage cycle for developing a mobile app for the self-management of gestational diabetes. The initial phase, needs assessment, involves identifying and determining the critical informational components and technical capabilities required for the development of the mobile self-management application for gestational diabetes.

Table 1. Systematic search strategy in four major databases

Keywords	Keywords for Search Strategy
Keywords #A	"Gestational Diabetes" OR "Gestational Diabetes Mellitus" OR "GDM"
Keywords #B	"Smartphone" OR "mobile phone" OR "mobile health" OR "APP" OR "Mobile Application" OR "mobile app" OR "smartphone app" OR "Portable Software"
Keywords #C	"self-care" OR "self-management"
Keywords #D	"Common Data Element" OR "Minimum Data Set" OR "Data Requirements" OR "Technical capabilities" OR "data elements" OR "data set"
Final search strategy	(#AB) OR (#AC) OR (#AD)

Comprehensive literature review

To identify the critical informational components and functional capabilities required for the development of a mobile self-management application for women with gestational diabetes, a comprehensive review of scientific literature was conducted. This review included research articles, clinical guidelines on self-management for women with gestational diabetes, and educational books. Using relevant keywords and their synonyms—such as gestational diabetes, self-

management, mobile health, mobile applications, and needs assessment—related articles were systematically searched up to the end of February 2025 and extracted from reputable databases, including PubMed, Web of Science, Scopus, and Google Scholar (Table 1).

Inclusion and exclusion criteria

The inclusion criteria encompassed English-language articles with accessible full texts that contained sufficient details regarding informational components related to patients with gestational diabetes. The exclusion criteria included conference papers, letters to the editor, review articles, and studies lacking adequate detail on the informational components of gestational diabetes. All retrieved articles were imported into a reference management software, EndNote, and duplicate records were removed. The titles and abstracts of the articles were independently reviewed by two researchers to exclude studies that were clearly irrelevant to the research objectives. Any disagreements were resolved through discussion or by consulting a third reviewer. To assess quality, selected articles were evaluated using the Mixed Methods Assessment Tool (MMAT), version 2018. Disagreements were resolved through discussion or consultation with a third reviewer. Only studies scoring above the median threshold were included in the final extraction. The identified informational components and functional capabilities were extracted from the selected literature and compiled into an Excel spreadsheet.

Identification of informational components

In this phase, aligned with the study objectives, a structured questionnaire based on a Likert scale was developed, comprising 42 closed-ended questions across five domains, including patient profile, educational information, medications, self-management recommendations, and functional capabilities. The questionnaire items were scored as very important (5), important (4), neutral (3), somewhat important (2), and not important (1). Due to the limited sample size (n=20), advanced psychometric analyses, such as exploratory factor analysis, were not feasible. Therefore, the validity assessment focused primarily on content validity, which was rigorously evaluated and confirmed by a specialized expert panel consisting of 20 faculty members with diverse expertise in obstetrics and gynecology, endocrinology and metabolism, medical informatics, and health information management. The panel reviewed the questionnaire items for relevance, clarity, coherence, and comprehensiveness.

To quantitatively support content validity, indices, such as the content validity ratio (CVR) and content validity index (CVI), were calculated based on expert ratings, following established methods. The CVI and CVR were confirmed. In addition, an open-ended section was included to collect qualitative feedback and suggestions from the experts, further enhancing the instrument's content relevance. The reliability of the questionnaire was assessed by calculating Cronbach's alpha coefficient using SPSS version 26. The questionnaire was administered in person to a group of experts who were not involved in the content validity assessment to minimize bias. The study objectives were explained to participants, and the confidentiality of their responses was assured.

Findings

Among the experts, 80% were female and 20% were male. The majority had 10 to 15 years of professional experience (45%), and 40% were aged between 40 and 50 years (Table 2).

Table 2. Frequency distribution of participating experts

Parameter	Category	Values
Gender	Male	4(20)
	Female	16(80)
Age (year)	30-40	2(10)
	40-50	8(40)
	50-60	6(30)
	>60	4(20)
Work experience (year)	5-10	2(10)
	10-15	9(45)
	15-20	6(30)
	≥20	3(15)
Specialty	Obstetrics & gynecology	5(25)
	Endocrinology & metabolism	5(25)
	Health information management	5(25)
	Medical informatics	5(25)

A total of 26 informational components and 14 functional capabilities essential for developing a mobile self-management application for pregnant women with diabetes were identified and defined. The informational components were categorized into four domains, including patient profile, educational information, medications, and self-management recommendations (Table 3).

Patient profile module

The patient profile was emphasized as the foundational and initial module of the self-management application. Components, such as full name, age, and gestational age, received the highest ratings from experts and were recognized as essential informational elements for personalizing and targeting management within the application. These components are particularly critical for tailoring self-management processes, enabling focused monitoring, and providing individualized recommendations for each patient.

Educational information module

A key finding of this study was the unanimous consensus among experts on the necessity of providing comprehensive, multilayered educational content. Including the definition of gestational diabetes, types of diabetes during pregnancy, signs and symptoms, risk factors, diagnostic tests, treatment approaches, complications, disease outcomes, and proper self-management techniques, were all confirmed as mandatory and fundamental informational components of the application.

Table 3. Critical informational components of a smartphone application for self-management of gestational diabetes

Module	#	Informational components	Maen rating	Frequency
Patient profile	1	Name and full name	5	100
	2	Age	5	100
	3	National code	3.8	76
	4	Pregnancy history	4.6	92
	5	Residence	3.5	70
	6	Telephone number	3.5	70
	7	Height and weight	4.5	90
	8	Pregnancy age (weeks)	5	100
	9	Marriage age (years)	4	80
	10	Education status	3.5	70
Educational information	11	About gestational diabetes	5	100
	12	Types of gestational diabetes	4	80
	13	Signs and symptoms	4.8	96
	14	Risk factors	4.4	88
	15	Diagnostic tests	4.8	96
	16	Treatment approaches	5	100
	17	Common complications	4.2	84
	18	Prognosis in the event of delivery	4.1	82
Medication	19	Insulin dosage	5	100
	20	Complementary and alternative medicine	4.2	84
	21	Side effects and drug interactions	4.5	90
Self-management recommendations	22	Pregnancy care	5	100
	23	Postpartum care	5	100
	24	Proper diet	5	100
	25	Stress management	5	100
	26	Weight management	4.9	98
	27	Physical activity	4.5	90
	28	Frequently asked questions (FAQ)	4	80

Table 4. Frequency distribution of functional capabilities required of a smartphone application for self-management of gestational diabetes

Category	#	Features	Maen rating	Frequency
Functional capabilities	1	Patient notebook	3.4	68
	2	BMI (body mass index) determination ability	4.5	90
	3	Blood sugar tracking	5	100
	4	Password protection	4	80
	5	Blood sugar monitoring results report	4.5	90
	6	Patient emotion report	4.2	84
	7	Abnormal signs and symptoms report	4.6	92
	8	Doctor appointment reminder	5	100
	9	Medication reminder	5	100
	10	Exercise reminder	4.8	96
	11	Daily blood sugar monitoring reminder	5	100
	12	Contact doctor	4	80
	13	Customization	4.2	84
	14	Motivational messages	4.5	90

These results reflected the experts' belief that accurate patient education regarding disease pathology not only enhances awareness but also plays a pivotal role in preventing disease progression and reducing complications.

This underscores the critical importance of continuous education and the delivery of comprehensive scientific content within the application.

Medication module

Within this module, important components, such as insulin dosage, the use of complementary and alternative medicines, side effects, and drug interactions, received high scores and were identified as essential for precise treatment management and monitoring therapeutic efficacy. Given the sensitivity of pharmacotherapy, documenting these details in the application can significantly help prevent medication errors and enhance patient safety.

Self-management recommendations module

The self-management recommendations module plays a central role in managing gestational diabetes through mobile applications. Components, such as appropriate diet, stress management, weight control, physical activity, and prenatal and postnatal care, each received high importance ratings.

This indicates that experts were well aware of the impact and significance of self-management advice in controlling blood glucose levels and preventing disease complications.

Functional capabilities module of the application

In this domain, the highest scores were attributed to reminders and patient monitoring features, including body mass index (BMI) calculation, abnormal symptom reporting, and blood glucose monitoring. Functional capabilities are recognized as key factors influencing the efficiency and attractiveness of the application for patients. The success and effectiveness of mobile health applications depended on the optimal integration of educational and

informational content with practical technologies, such as reminders and disease monitoring, to enhance active participation, motivation, and behavioral adherence among patients. Notably, experts placed special emphasis on reminders, vital signs monitoring, and continuous recording of disease indicators—features that can serve as strengths in next-generation mobile health applications within the pregnancy care domain (Table 4).

Discussion

This study aimed to identify and determine the critical informational components for developing a self-management application for patients with GDM. GDM is a common pregnancy complication with significant implications for maternal and fetal health. Self-management is a pivotal approach to controlling this condition and mitigating its complications. Mobile health applications serve as effective tools for patient self-management by incorporating functional modules such as lifestyle modification monitoring, health education, medication or insulin management, clinical measurement logging, and health feedback. These applications facilitate the collection of disease- and lifestyle-related data, thereby simplifying health status monitoring [19, 20].

Needs assessment represents the foundational step in application development. Based on expert opinions, critical informational components for designing a self-management app for women with GDM were identified. These components were categorized into five main modules, namely patient profile, educational information, medications, self-management recommendations, and functional capabilities. Consistent with the present study, Brzan *et al.* [21] recommend that developers of diabetes self-management applications include items, such as self-management advice, blood glucose monitoring, insulin dose tracking, medication management, nutrition, physical activity, and educational content in their applications.

One of the most utilized modules in self-management apps is the patient profile, which records demographic information. This supports personalized self-management recommendations and enables tailored services to meet individual patient needs [22].

Patient education and comprehensive disease information are critical in GDM self-management. This includes definitions, symptoms, causes, treatments, outcomes, and complications of GDM that affect maternal and fetal health [23]. The current study's disease knowledge module emphasized education on general disease aspects, treatment, complications, diagnostic tests, and therapeutic approaches. Mirfeizi *et al.* [24] demonstrate that education positively impacts the quality of life in these patients.

Similarly, Rokni *et al.* [25] found that educating patients on self-management recommendations effectively improves quality of life and regulates blood glucose levels in women with GDM. Mobile applications, with their easy accessibility and educational delivery, play an important role in patient self-management and awareness enhancement [14]. Krall *et al.* [26] showed that these apps provide continuous support, enabling patients to acquire and maintain the necessary knowledge and skills for self-management.

Lifestyle interventions represent one of the most important informational components in the self-management recommendations module for GDM patients [27]. Interventions, such as adopting a low glycemic index diet, increasing physical activity, and managing weight, significantly reduce maternal blood glucose levels. Lifestyle modification alone can effectively control blood glucose in 70 to 85% of cases [28, 29], and mobile health applications can enhance adherence to lifestyle modifications among GDM patients [30].

A systematic review revealed that mobile health interventions targeting lifestyle changes in diabetic mothers have a favorable effect on preventing GDM in overweight and obese pregnant women and offer an effective strategy for out-of-hospital self-management [16].

Kalhori *et al.* [31] evaluated the quality of English-language mobile applications for GDM and found that such apps are scarce and generally of low quality. Most modules lacked essential features, such as reliable references, feedback, tracking, goal setting, evidence-based therapeutic strategies, and monitoring, which should be addressed.

The most critical functional requirements for the application included patient diaries, BMI calculation, encryption capability, reporting features (blood glucose monitoring, patient feelings, abnormal symptoms), reminders (for medical appointments, medication, physical activity, blood glucose monitoring), physician communication, customization, and motivational messaging. Salari *et al.* [32] highlighted that blood glucose tracking is among the highest-priority features for diabetes self-management apps. Reminders significantly influence medication adherence and appointment attendance [33].

Previous studies indicate that reminders can be effectively used for blood glucose monitoring, diabetes screening tests, physical activity, and dietary adherence in GDM patients [12, 21, 34]. A notable aspect is the delivery of motivational messages, which Al Hashmi *et al.* [35] demonstrated positively influences lifestyle modification and patient encouragement. One of the main limitations of this study is the relatively small sample size (20 experts), which restricted the ability to perform more comprehensive psychometric analyses, such as factor analysis for assessing construct validity. Additionally,

the limited sample size may affect the generalizability of the findings. Future studies with larger sample sizes are recommended to conduct more extensive validation, including structural analyses and other psychometric evaluations, to ensure the robustness and applicability of the measurement tool. Furthermore, a limitation of the present study is the use of English-language resources, including educational books, articles, and self-management guidelines for pregnant women with diabetes. This may have resulted in the exclusion of relevant texts in other languages.

Our findings strongly suggest that developing self-management applications for women with gestational diabetes should be grounded in comprehensive demographic data collection, targeted education, precise monitoring of medication and lifestyle, and advanced functional capabilities. Such applications can serve as effective and reliable tools to enhance maternal health and prevent complications. The results provide practical guidance for developers, healthcare professionals, and policymakers in the health sector.

Conclusion

Developing self-management applications for women with gestational diabetes should be grounded in comprehensive demographic data collection, targeted education, precise monitoring of medication and lifestyle, and advanced functional capabilities.

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Ethical Permissions: This study was reviewed and approved by the review board and ethics committee of Abadan University of Medical Sciences (IR.ABADANUMS.REC.1404.001). All methods were performed in accordance with the relevant guidelines and regulations. Informed consent was obtained from all participants involved in the study.

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