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Innovation Article

Design and development of the diabestfriend android application for type 2 diabetes self-care management

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A B S T R A C T

Background: Effective self-care management is essential for controlling type 2 diabetes mellitus (T2DM); however, many existing mobile health applications lack comprehensive and guideline-based features aligned with core diabetes self-care pillars.

Purpose: This study aimed to design, develop, and evaluate the feasibility of the diabestfriend android application as a digital self-care management tool for patients with T2DM.

Methods: A research and development (R&D) study using the ADDIE model (analysis, design, development, implementation, and evaluation) was conducted. Application features were developed based on the Indonesian endocrinology association diabetes self-care guidelines. Feasibility was assessed through expert validation by media and content experts and user experience evaluation among patients with T2DM.

Results: Media expert validation rated the application as excellent (score: 83.8), while content expert validation indicated a very good rating (score: 81.6). Feature feasibility testing among 22 users demonstrated that the application successfully supported structured data entry for blood glucose monitoring, diet management, physical exercise, and medication reminders. User experience evaluation involving 10 patients with T2DM showed high acceptability, with an overall satisfaction score of 88.95%, highlighting ease of navigation, clarity of educational materials, and usefulness of reminder features.

Conclusion: The Diabestfriend application demonstrates strong feasibility and usability and is suitable for use as a comprehensive digital self-care management tool for patients with T2DM.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) remains a major global public health problem and contributes substantially to morbidity, mortality, and healthcare costs.[1] In Indonesia, national health data indicate that the prevalence of diabetes has reached 1.5%, with a high proportion of patients experiencing chronic complications such as cardiovascular disease, nephropathy, and neuropathy.[2] These complications significantly reduce quality of life and impose a considerable burden on individuals, families, and the healthcare system.

Effective self-care management is a cornerstone of T2DM control. More than 95% of diabetes-related daily activities—including blood glucose monitoring, dietary regulation, physical activity, medication adherence, and early recognition of complications—are performed independently by patients.[3-5] However, sustaining consistent and effective self-care remains challenging, particularly due to limited access to continuous education, monitoring tools, and professional support.

Recent advances in mobile health (mHealth) technologies offer promising opportunities to support diabetes self-care through accessible, flexible, and cost-effective digital platforms.[6] Numerous mobile-based diabetes applications have been developed to improve patient education and adherence. Nevertheless, many existing applications remain limited in scope and functionality. Several provide only basic educational content and simple data logging without integrated calorie-based dietary calculations, structured blood glucose monitoring, or physical activity

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assessment based on metabolic equivalents.[7]

Other applications have demonstrated improvements in health-related quality of life but lack comprehensive patient assessments or direct access to healthcare professional consultations.[8] In addition, many available apps are not fully aligned with national diabetes self-care guidelines, particularly in integrating diet management, physical activity tracking, and structured medication reminders.[9]

These limitations indicate a clear gap in the availability of comprehensive, guideline-based diabetes self-care management applications. Few existing platforms integrate essential self-care components—such as structured education, medication reminders, glucose monitoring, lifestyle tracking, and professional consultation—within a single, user-friendly system.[10-14] Moreover, the limited use of modern programming frameworks in current applications raises concerns regarding system stability, responsiveness, and long-term usability across devices.[15,16] Therefore, this study aims to design, develop, and evaluate the feasibility of the Diabestfriend Android application as a comprehensive digital self-care management tool for patients with type 2 diabetes mellitus.

METHOD

This study employed a research and development design using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model to guide the systematic development and feasibility testing of the Diabestfriend Android application.[17]

Analysis Phase

A literature review was conducted to identify essential self-care components for type 2 diabetes mellitus management, including patient education, blood glucose monitoring, dietary management, physical activity, medication reminders, and consultation services. The needs analysis was further enriched through informal consultations with Prolanis officers and patients with type 2 diabetes mellitus to ensure alignment with clinical practice and user needs.[18]

Design Phase

Based on the analysis results, the application architecture and feature flow were designed. The Diabestfriend application was developed using Android Studio as the integrated development environment (IDE) and Kotlin as the primary programming language. Kotlin version 1.9 was selected due to its stability and ability to support compilation across multiple platforms, including the java virtual machine (JVM), JavaScript, and native binaries..

Development Phase

During the development phase, the application prototype underwent feasibility validation by expert reviewers. Media experts consisted of information technology lecturers, while content validation was conducted by nursing lecturers with expertise in diabetes care. Expert feedback was used to refine both the technical functionality and the accuracy of educational content prior to implementation.

Implementation Phase

The implementation phase was conducted from February to March 2025. Application feasibility was evaluated among 22 patients with type 2 diabetes mellitus by assessing features related to blood glucose monitoring, dietary management, physical activity, and medication reminders. In addition, user experience was evaluated by providing the Diabestfriend application to 10 patients for a one-month trial period. User feedback was collected using a structured questionnaire comprising both closed- and open-ended questions.

Evaluation Phase

The evaluation phase involved a comprehensive review of outcomes from the analysis, design, development, and implementation phases. Feedback and findings from each stage were synthesized to assess overall feasibility and usability, resulting in a final version of the Diabestfriend application ready for use.

Ethical Considerations

Ethical approval for this study was obtained from the Health Research Ethics Committee of the Yogyakarta Ministry of Health Polytechnic (No. e-KEPK/POLKESYO/0184/II/2022) and the Banyumas Regency Investment and One-Stop Integrated Services Office (No. 070.1/104/OL/II/2022).

RESULTS

Results of Needs Analysis

The needs analysis was conducted through a literature review and interviews with diabetes program officers and patients with type 2 diabetes mellitus. Interviews with diabetes officers indicated that follow-up of diabetes screening and routine monitoring was still suboptimal due to limited patient visits to health facilities. Officers emphasized the need for an easy-to-use digital tool to support continuous self-care monitoring outside healthcare settings.

Interviews with ten patients with type 2 diabetes mellitus in Teluk Village, South Purwokerto District, Banyumas Regency revealed that most patients rarely visited health facilities for diabetes management and had never used a diabetes-related mobile application. Patients expressed the need for simple educational materials, blood glucose monitoring, dietary guidance, physical activity support, medication reminders, and access to healthcare consultation in a single application. These findings informed the selection of core features for the Diabestfriend application.

Application Design Outcomes

Based on the needs analysis and national diabetes self-care guidelines, the Diabestfriend application was designed as a comprehensive digital self-care management tool. The application content was adapted from the Indonesian

Endocrinology Association guidelines, covering six core pillars of diabetes self-care management: education, diet management, physical exercise, pharmacological therapy, blood glucose monitoring, and consultation with healthcare professionals.

The application architecture consists of interconnected feature modules, including educational content, blood glucose monitoring, diabetes diet calculation, physical exercise tracking, medication reminders, and consultation services. Content was organized into simple, practical chapters to enhance usability and comprehension. The application was developed using Android Studio with the Kotlin programming language to ensure system stability, responsiveness, and compatibility with Android smartphones (Figure 1).

Expert Validation Results

The Diabestfriend application underwent feasibility validation by media experts and content experts. Media validation focused on layout design, text clarity, packaging, video integration, notification and medication reminder features, and programming functionality. Media experts suggested simplifying the login process and adding a question-and-answer (QnA) feature to improve user interaction. These suggestions were incorporated into the revised version of the application. The final media validation results categorized the application as very good and suitable for use.

Content validation was conducted by nursing lecturers with expertise in diabetes care. Validation aspects included application appearance, quality of educational materials, and accuracy of diabetes-related content and videos. The content experts rated the Diabestfriend application in the superior category and declared it appropriate for implementation after minor revisions.

Implementation Results: Feature Feasibility Testing

Characteristic Respondent

The implementation phase was conducted from February to March 2025 and involved 22 respondents. Demographic characteristics of respondents are presented in Table 1. Most respondents were female (86.36%) and aged between 50 and 60 years (54.54%). Based on blood glucose measurements at the time of implementation, 77.27% of respondents were classified as normal, 4.54% as pre-diabetic, and 18.18% as diabetic.

Table 1. Characteristic Respondent (n=22)

Characteristic	Result
Gender	
Male	3 (13.63%)
Female	19 (86.36%)
Age, yrs	
< 50	13.63%)
50 – 60	1 (54.54%)
> 60	5 (22.72%)
Diabetes Status	
Normal	17 (77.27%)
Pre-diabetes	1 (4.54%)
Diabetes	4 (18.18%)

Blood Glucose Monitoring Feature

The feasibility of the blood glucose monitoring feature was demonstrated through recording of two-hour postprandial blood glucose values. 77.27% of recorded values were <140 mg/dL, while 22.72% were ≥140 mg/dL. These results indicate that the application successfully facilitated structured blood glucose data entry and categorization according to clinical thresholds.

Diabetes Diet Feature

The diabetes diet feature calculated daily calorie requirements using the Broca and Harris–Benedict formulas. As presented in Table 2, most respondents required 1,300 kcal/day (45.45%), followed by 1,100 kcal/day (27.27%). Activity levels were predominantly classified as light (95.45%). Reminder notifications supported dietary adherence; however, only 18.18% of respondents (patients with diabetes mellitus) actively followed diet reminders, while the remaining respondents did not utilize this feature, largely because they were not receiving pharmacological therapy.

Table 2. Feasibility Results of the Diabetes Diet Feature

Diet Feature Components	Frequency (%)
Total Calories per Day	
1100kcal	6 (27.27%)
1300kcal	10 (45.45%)
1500kcal	1 (4.54%)
1700kcal	2 (9.09%)
2100kcal	1 (4.54%)
Activity Type	
Rest	0 (0.00%)
Light	21 (95.45%)
Moderate	1 (4.54%)
Heavy	0 (0.00%)
Very Heavy	0 (0.00%)
Diet Reminder Notification Usage	
Activated	4 (18.18%)
Not Activated	18 (81.81%)

Physical Exercise Feature

The physical exercise feature calculated burned calories based on metabolic equivalent (MET), body weight, and duration of activity. As shown in Table 3, most respondents engaged in 30 minutes of walking (59.09%), resulting in burned calories predominantly exceeding 70 kcal (59.09%). These findings demonstrate that the application was able to systematically record physical activity and estimate energy expenditure.

Table 3. Feasibility Results of the Physical Exercise Feature

Exercise Feature Components	Frequency (%)
Time Activity	
30 minutes	13 (59.09%)
25 minutes	2 (9.09%)
15 minutes	2 (9.09%)
10 minutes	2 (9.09%)
5 minutes	1 (4.54%)
Estimated Calories Burned	
< 50 kcals	5 (22.72%)
50-70 kcals	2 (9.09%)
> 70 kcals	13 (59.09%)

Medication Reminder Feature

The medication reminder feature was used by 18.18% of respondents (n=4), corresponding to patients diagnosed with diabetes mellitus who required pharmacological therapy. The remaining respondents did not activate this feature because they were not prescribed diabetes medications. This indicates that the reminder system functioned appropriately according to user needs.

User Experience and Acceptability Results

User experience testing was conducted among ten patients with type 2 diabetes mellitus who used the Diabestfriend application for one month. Overall, users reported that the application was easy to use, informative, and helpful for supporting blood glucose monitoring, medication reminders, and physical exercise. The educational feature was perceived as particularly useful for improving understanding of diabetes self-care. Users suggested additional improvements, including automatic storage of completed physical exercise records and further enhancement of online consultation features. Overall usability was rated as excellent, with a mean score of 88.95%, indicating high acceptability of the application among users.

Evaluation Results

The final evaluation integrated findings from all ADDIE stages. Feedback from expert validators and users led to refinements of the Diabestfriend application, including simplification of the login process and the addition of a QnA feature. The final product was assessed as feasible, user-friendly, and suitable for use as a digital self-care management application for patients with type 2 diabetes mellitus.

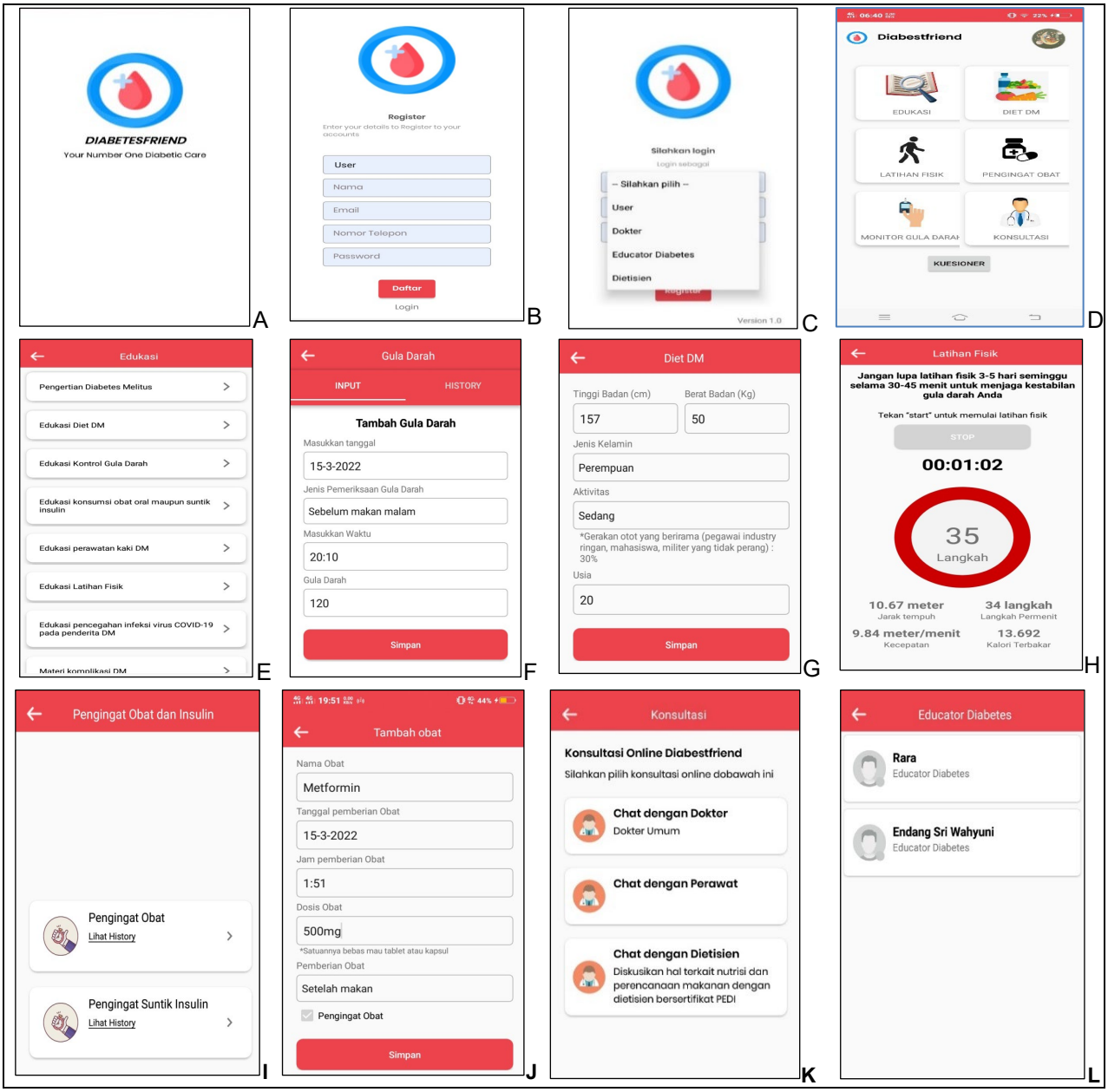

Figure 1. Diabestfriend application interface. (A) App entry; (B) Register page; (C) Login page; (D) Main menu; (E) Educational content; (F) Blood glucose monitoring; (G) Diabetes diet feature; (H) Physical exercise feature with pedometer; (I–J) Medication reminder feature; (K–L) Consultation feature with doctors, nurses, and dietitians.

DISCUSSION

This study successfully designed, developed, and evaluated the feasibility of the Diabestfriend Android application as a comprehensive digital self-care management tool for patients with type 2 diabetes mellitus. Using the ADDIE framework, the application was systematically developed and demonstrated high feasibility, usability, and acceptability based on expert validation and user testing.

The findings from the implementation and usability evaluation indicate that Diabestfriend effectively supports key components of diabetes self-care management, including education, blood glucose monitoring, dietary management, physical activity tracking, medication reminders, and access to healthcare consultation.[19-25] Expert validation results categorized the application as very good to superior, confirming that both the technical design and educational content were appropriate for patient use. High user satisfaction scores further suggest that the application is user-friendly and relevant to patient needs.[26,27]

These findings are consistent with previous studies demonstrating that mobile health applications can enhance patient engagement and self-care behaviors by providing accessible, structured, and continuous support.[28,29] Prior research has shown that mobile health literacy and familiarity with digital technologies are associated with improved diabetes self-management behaviors and perceived health status. Similarly, systematic reviews and meta-analyses have reported that smartphone-based self-management interventions may contribute to improved glycemic control and medication adherence when implemented alongside standard care. However, unlike effectiveness-focused studies, the present research emphasizes application feasibility and usability as essential preliminary steps prior to large-scale clinical evaluation.[30-33]

A key strength of the Diabestfriend application lies in its comprehensive integration of diabetes self-care components within a single platform, aligned with national diabetes self-management guidelines.[34] Unlike many existing applications that focus on limited features, Diabestfriend combines education, lifestyle management, medication reminders, monitoring tools, and professional consultation in a unified system. This integrated approach may enhance user engagement and continuity of self-care practices.[35-36]

From a technical perspective, the use of Kotlin as the primary programming language offers advantages in terms of application stability, efficiency, and scalability. Kotlin's interoperability with Java and its support for both object-oriented and functional programming paradigms enable the development of responsive and maintainable Android applications. These technical characteristics are particularly relevant for long-term implementation and potential integration with broader digital health systems.

Despite these strengths, this study has several limitations. The sample size for implementation and usability testing was relatively small, and the study design did not include a control group or pre–post clinical outcome measurements. Therefore, conclusions regarding the effectiveness of the Diabestfriend application in improving glycemic control or long-term self-care outcomes cannot be drawn. Future research should involve randomized controlled trials with larger samples and longer follow-up periods to evaluate clinical effectiveness and health outcomes.

Overall, the Diabestfriend application demonstrates strong feasibility and acceptability as a digital self-care management tool for patients with type 2 diabetes mellitus. The findings support its potential use as a complementary tool in diabetes care programs, while further evaluation is warranted to determine its impact on clinical outcomes.

CONCLUSIONS AND RECOMMENDATION

This study successfully designed and developed the Diabestfriend Application as a digital self-care management tool for patients with type 2 diabetes mellitus. Based on expert validation and user feedback, the application demonstrated high feasibility, usability, and acceptability. Media and content experts rated the application in the very good to superior categories, and feedback from patients indicated that Diabestfriend is suitable to support daily diabetes self-care activities.

Although the application showed promising feasibility and user acceptance, this study did not evaluate clinical effectiveness or long-term health outcomes. Therefore, further research is recommended to assess the impact of the Diabestfriend Application on self-care behaviors and clinical indicators using larger samples and controlled study designs.

Future development of the application may include enhanced data output features, such as automated summaries of self-care management levels or interpretations of self-care conditions, to support patient monitoring and decision-making. In addition, incorporating a question-and-answer (Q&A) feature, as suggested by media experts, could further improve user experience by enabling users to independently access information alongside existing consultation services.

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