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RESEARCH PAPER

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Development of an Android-based Stroke Prevention Application

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ABSTRACT

Stroke remains a significant public health problem in Indonesia, with a prevalence of 8.3 per 1,000 population and a significant contribution to disability and mortality. Limited community health literacy and underutilization of digital health media indicate the need for accessible technology-based stroke prevention interventions. This study aimed to develop and validate a community-oriented Android-based application for stroke prevention using an ADDIE-based Research and Development framework. This study contributes a validated mobile health intervention for community stroke prevention and a replicable development model adaptable to other non-communicable disease prevention programs. The development process included application design, feature and database construction, internal testing, expert validation, and small-group usability testing. experts. Media validation involved three instructional technology experts. A small-group usability test was conducted with 15 adult community members in Banjar Regency, selected through convenience sampling. Data were analyzed using descriptive statistics and feasibility classification. The application obtained a mean score of 4.7 from material experts and 4.9 from media experts, indicating a "Highly Feasible" classification. Usability testing showed an overall mean score of 16.8 out of 20, reflecting strong user acceptance. This study is limited by its small sample size and short-term evaluation without behavioral or clinical outcome assessment. Nevertheless, the application shows potential as a digital health education tool to improve stroke prevention literacy and support community-based prevention programs and national digital health strategies.

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I. INTRODUCTION

Stroke remains a major public health challenge in Indonesia, with a national prevalence of 8.3 per 1,000 population and a significant contribution to disability and mortality rates [1], [2]. In Banjar Regency, South Kalimantan, the burden of stroke and other noncommunicable diseases is further aggravated by low levels of community health awareness, limited preventive behavior, and suboptimal digital health literacy, particularly among adults and older populations [3], [4], [5]. Digital health literacy, the ability to access, understand, and apply digital health information, is increasingly recognized as a critical determinant of effective disease prevention in the era of technology-mediated healthcare. Conventional health promotion strategies, including leaflets, brief counseling sessions, and community campaigns, often demonstrate limited long-term impact due to their passive nature, restricted reach, and lack of interactivity [6]. In contrast, mobile health (mHealth) technologies offer interactive, scalable, and personalized platforms for delivering health education and promoting preventive behaviors. Within the discourse of the Fifth Industrial Revolution, which emphasizes human-centered technology integration, Android-based applications have emerged as practical tools for enhancing health education when designed using user-centered design and multimedia learning principles [7], [8], [9], [10].

Although numerous stroke-related mobile applications have been developed globally, most are oriented toward acute management, rehabilitation, or professional clinical use [11], [12]. Evidence from Indonesia indicates that community-oriented, prevention-focused stroke applications remain scarce, particularly those adapted to local sociocultural contexts and validated through systematic expert and user-based evaluation [13], [14], [15]. Moreover, previous studies rarely incorporate structured development frameworks combined with local field testing in underserved regions such as Banjar Regency [16]. Several previous studies have developed mobile-based stroke education or risk assessment applications using cross-sectional designs, survey-based validation, or simple prototype testing

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approaches [13], [14]. Most of these studies evaluated short-term user satisfaction or knowledge gain through one-time questionnaires, without iterative expert validation or structured development stages. While such approaches allow rapid application testing and low-cost implementation, their limitations include limited content validity, minimal user-centered refinement, and weak evidence of real-world feasibility. Some studies also focused on urban populations with higher digital literacy, thereby limiting generalizability to semi-rural or low-literacy communities such as Banjar Regency. Other studies employed experimental or randomized controlled trial (RCT) designs to examine behavioral or clinical outcomes of mobile health interventions [15], [16]. Although these methods provide strong causal evidence, they require longer implementation periods, larger sample sizes, and fully stabilized applications, making them less suitable for early-stage application development and feasibility assessment. Based on these gaps, this study adopted a Research and Development (R&D) approach using the ADDIE model, which enables a systematic, iterative process of analysis, design, development, implementation, and evaluation. Compared with cross-sectional or experimental designs, the ADDIE framework facilitates continuous integration of theoretical foundations, expert judgment, and user feedback throughout the development cycle. This approach is particularly appropriate for early-stage digital health interventions, where the primary objective is to ensure content validity, usability, and contextual feasibility before proceeding to large-scale effectiveness trials.

Guided by the user-centered design framework, principles of digital health literacy enhancement, and supported by co-design perspectives in mobile health development [16], this study addresses these gaps by developing and validating an Android-based stroke prevention application tailored for community use. This study aims not only to create a digital tool but also to provide an empirically evaluated model for community-based digital stroke prevention in Indonesia. The scientific contributions of this study include:

1. developing a culturally contextualized, Android-based stroke prevention application using a structured R&D approach;
2. providing expert-validated and community-tested evidence of its feasibility as a health education medium; and
3. offering a scalable development model for future mobile health interventions targeting noncommunicable disease prevention in low middle-income community settings.

II. MATERIALS AND METHOD

This study employed a Research and Development (R&D) approach using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), which is widely applied in instructional media and digital health application development to ensure systematic design and iterative refinement. During the Analysis phase, a needs assessment was conducted through literature review and informal consultations with public health practitioners in Banjar Regency to identify stroke risk factors, local prevention knowledge gaps, and community digital literacy challenges. The Design phase involved developing application flowcharts, user interface wireframes, and content architecture based on user-centered design principles. In the Development phase, educational content and databases were constructed, integrated into the Android platform, and internally tested.

The Implementation phase included expert validation and small-group usability testing. Finally, the Evaluation phase consisted of quantitative feasibility analysis and qualitative thematic analysis to inform iterative revisions.

A. Dataset

The dataset comprised three main components generated during the ADDIE development stages.

1. Content Dataset**:** This dataset consisted of scientific and clinical reference materials derived from national and international stroke prevention guidelines, including those from the Indonesian Ministry of Health and the World Health Organization. These sources informed the educational content, risk assessment items, and preventive recommendations embedded in the application.
2. Expert Validation Dataset: Expert validation involved six experts, selected through purposive sampling based on their professional expertise and relevance to stroke prevention and digital health applications. The experts were divided into two groups: Material Experts (n = 3):
   These experts were selected from primary healthcare providers responsible for stroke and hypertension programs in Puskesmas, consisting of: (a) one physician responsible for the Stroke Program, (b) one physician responsible for the Hypertension Program, and (c) one nurse responsible for the Stroke Program. All material experts had direct clinical and programmatic experience in managing stroke and cardiovascular risk factors at the primary care level.
   Media Experts (n=3): Media validation was conducted by three information technology professionals: (a) an application developer from the project team, (b) an IT staff member from a Puskesmas, and (c) an IT specialist from Poltekkes Kemenkes Banjarmasin.
   These experts provided complementary perspectives from technical development, field implementation, and academic domains.
3. User Testing Dataset: Feasibility-testing data were collected from 15 adult female participants recruited from a Primary Health Care Center (Puskesmas) in Banjar Regency using convenience sampling. Participants ranged in age from 20 to 50 years, with the majority having a senior high school education and being actively employed. Most participants reported a history of hypertension for 1–3 years, a major risk factor for stroke.

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These characteristics were documented to provide contextual background for interpreting usability and feasibility findings.

B. Data Collection

Data collection was performed during the Implementation and Evaluation phases of the ADDIE model and comprised three stages:

1. Expert Validation Stage: Expert validation involved both material experts and media experts evaluating the application independently using structured assessment instruments adapted from standardized instructional media evaluation tools. Each item was rated on a 5-point Likert scale covering content accuracy, instructional quality, and technical performance. Inter-rater reliability was assessed using Cronbach's alpha to ensure consistency across evaluators.
2. Small-Group Usability Testing Stage: A total of 15 participants completed a guided trial session using the application. After interacting with the system, participants completed a structured feasibility questionnaire assessing: (a) content quality, (b) ease of use, and (c) visual design and layout.
Convenience sampling was used due to logistical limitations and the exploratory nature of this early-stage prototype evaluation. The potential selection bias is acknowledged as a study limitation.
3. Qualitative Feedback Collection: Open-ended feedback was collected from both experts and users to capture perceptions of strengths, weaknesses, and suggestions for application improvement.

C. Data Processing and Analysis

Quantitative data from expert validation and user testing were analyzed using descriptive statistics, including means and standard deviations. Reliability of expert instruments was assessed using Cronbach's alpha. Feasibility classification was based on predetermined cut-off scores adapted from validated instructional media evaluation criteria: 4.21–5.00 = Highly Feasible, 3.41–4.20 = Feasible, 2.61–3.40 = Moderately Feasible, and below 2.60 = Low Feasibility. Qualitative data were analyzed using thematic content analysis, following these steps: familiarization, open coding, category development, and thematic grouping. Data triangulation between quantitative and qualitative findings was applied to enhance trustworthiness.

D. Ethical Considerations

Ethical clearance was obtained from the Ethics Committee of Poltekkes Kemenkes Banjarmasin (Approval No: 203/KEPK-PKB/2025). All participants received a detailed explanation of study objectives, procedures, potential risks and benefits, data confidentiality, and their right to withdraw at any time without consequences. Written informed consent was obtained prior to participation. All collected data were anonymized and analyzed in accordance with the Declaration of Helsinki and national ethical guidelines for human research.

III. RESULTS

A. Application Development Phases

The development and evaluation of the Android-based Stroke Prevention Application were conducted through six structured phases following the ADDIE framework. A consolidated summary of each phase is presented in Table 1, followed by detailed analytical explanations.

Table 1. Summary of Application Development Phases

Phase	Key Activities	Main Output	Key Revisions
1	Workflow design & feature mapping	User flow diagram & feature list	Clarification of user navigation and decision pathway
2	Database & content development	Structured prevention content database	Content alignment with national stroke guidelines
3	Internal testing & refinement	Functional application prototype	Addition of NIK, Puskesmas field, and removal of "previous stroke history" from symptoms
4	Final feature integration	Final interface & modules	User interface simplification
5	Expert validation	Validity & feasibility scores	Revision of medical terminology and layout contrast
6	Usability testing	User feasibility evaluation	Text size adjustment and icon optimization

As shown in Table 1, the development process was not linear but iterative. Revisions in later phases were informed by findings from internal testing, expert validation, and user feedback, ensuring that the final application reflected both scientific accuracy and contextual usability.

B. Phase 1: Workflow Design and Navigation Structure

The first phase produced a comprehensive application workflow diagram illustrating user interactions, navigation flow, and decision-support logic (Fig. 1). This workflow positions users at the center of the interaction process, starting with login/registration and then accessing four main modules: stroke information, risk assessment, symptom self-screening, and prevention strategies. The

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workflow design reflects user-centered design principles, ensuring clarity, minimal navigation steps, and logical sequencing to reduce cognitive load, as recommended in usability theory.

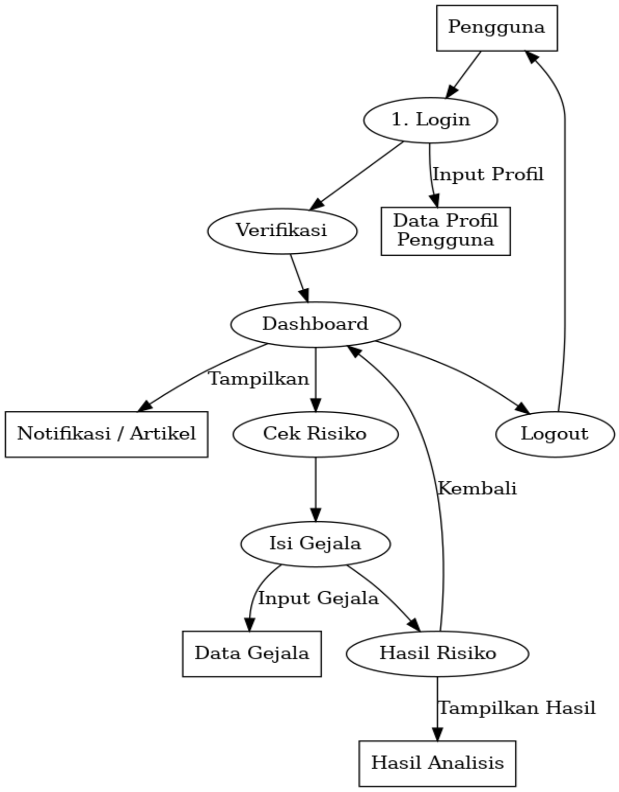

Fig. 1. Workflow Diagram of the Android-Based Stroke Prevention Application.

C. Phase 2–4: Database Development and System Refinement

In Phase 2, a structured content database was developed based on national and WHO guidelines for stroke prevention. During Phase 3, internal testing identified two major areas for revision:

1. Refinement of the registration module through the addition of National Identity Number (NIK), district/city name, Puskesmas name, and a password visibility feature.
2. Correction of the risk assessment algorithm by removing "history of previous stroke" from symptom inputs, as it represents a medical history variable, not an acute symptom indicator.

These revisions improved construct validity and minimized classification bias.

In Phase 4, all finalized features were integrated into the main user interface. The application's final visual structure is illustrated in Fig. 2, which displays the main dashboard and the four core functional modules. Fig. 2 demonstrates how the application organizes essential features into an intuitive layout: stroke education materials, risk assessment tools, symptom screening functions, and prevention guidance. This design facilitates easy navigation and improves user interaction, especially for users with limited digital health literacy.

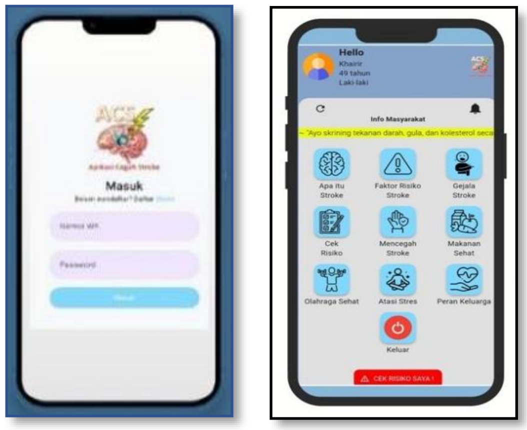

Fig. 2. Main Dashboard Showing Four Core Modules.

D. Phase 5: Expert Validation Results

Material Expert Evaluation: The results of material expert validation are presented in Table 2. Three material experts evaluated the application across three aspects: content feasibility, language clarity, and presentation structure.

Table 2. Material Expert Evaluation Results

Aspect	Mean	SD	Category
Content Feasibility	4.7	0.58	Highly Feasible
Language	4.7	0.58	Highly Feasible
Presentation	4.7	0.58	Highly Feasible
Overall Mean	4.7	0.58	Highly Feasible

As shown in Table 2, all aspects achieved a mean score of 4.7 with a low standard deviation (SD = 0.58), indicating strong inter-expert agreement. This reflects high content validity, appropriate language use, and systematic presentation of stroke prevention material. The media expert evaluation results are presented in Table 3.

Table 3. Media Expert Evaluation Results

Aspect	Mean	SD	Category
Content–Objective Alignment	5.0	0.00	Highly Feasible
Instructional Design	4.7	0.58	Highly Feasible
Technical Quality	5.0	0.00	Highly Feasible
Overall Mean	4.9	0.29	Highly Feasible

Based on Table 3, the highest score was recorded for content–objective alignment (Mean = 5.0), indicating that the application's features are strongly aligned with educational goals. The low SD values indicate consistent scoring. These findings suggest that the application meets professional standards for instructional design and technical quality.

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E. Phase 6: Small-Group Usability Testing

A small-group usability test was conducted among 15 female participants aged 20–50 years from a Puskesmas setting. The detailed results of this user evaluation are presented in Table 4.

Table 4. Small-Group Usability Testing Results

Aspect	Mean	SD	Category
Content Quality	17.4	1.02	Highly Feasible
Ease of Use	16.6	1.15	Highly Feasible
Visual Design	16.3	1.21	Highly Feasible
Overall Mean	16.8	1.12	Highly Feasible

As illustrated in Table 4, the highest mean score was achieved in the content quality domain (17.4), followed by ease of use (16.6) and visual design (16.3). The overall mean score of 16.8 indicates that users perceived the application as highly feasible in terms of functionality, clarity, and appearance.

F. Qualitative Feedback Analysis

Qualitative user feedback further supported the quantitative findings. Three main themes emerged:

1. Content Clarity: Users found the explanations on stroke risks and symptoms easy to understand..
2. Ease of Navigation: Users reported smooth navigation, although they suggested larger font sizes for older populations.
3. Visual Attractiveness: Users appreciated icon design and color schemes, but recommended increased contrast for better readability.

These qualitative findings complement the statistical results shown in Table 4 and justify the final design refinements.

G. Technical Challenges and Limitations Observed

Two technical limitations were identified during development and usability testing: login delays on older Android devices due to limited memory, and data synchronization issues under unstable internet connections. These challenges highlight areas for future system optimization and infrastructure adaptation, especially for low-bandwidth community settings.

H. Benchmarking with Previous Studies

Compared to previous stroke prevention mobile applications developed in Indonesia and Japan with feasibility scores ranging from 4.2 to 4.6, this application demonstrated slightly higher outcomes, particularly in media validation and user acceptance.

I. Analytical Synthesis

Overall, the findings demonstrate that logical, staged development combined with continuous expert and user input significantly improved the application's design quality, content validity, and usability. The integration of results from Table 1, Table 2, Table 3, and Table 4 confirms that the application achieved strong feasibility across technical, instructional, and user experience dimensions.

IV. DISCUSSION

This study demonstrates that a systematically developed Android-based stroke prevention application can achieve high levels of content validity, technical feasibility, and user acceptability when grounded in a structured Research and Development framework and guided by user-centered design principles. Rather than merely confirming feasibility, the findings highlight how iterative design, expert validation, and user involvement contribute to the development of a context-appropriate digital health education tool for communities with limited structured access to stroke prevention information, such as those in Banjar Regency. The application development incorporated user-centered design (UCD) principles throughout its stages. Concrete examples of this include the addition of the National Identity Number (NIK) and Puskesmas information fields to improve identity verification and system integration, the introduction of a password visibility option to reduce entry errors, and the removal of "history of previous stroke" from symptom-based screening to avoid bias in primary prevention classification. These changes were directly informed by user and expert feedback, demonstrating an iterative co-design process among developers, health professionals, and potential end-users. This is consistent with Noorbergen et al. (2021), who emphasized that UCD enhances trust, usability, and long-term engagement with digital health applications by aligning technological design with real-world user contexts and needs [16], [17], [18], [19], [20]. The application's design aligns with multimedia learning principles, particularly Mayer's coherence, signaling, and segmenting principles. By organizing complex health information into structured modules supported by text, visuals, and interactive menus, the application reduces cognitive overload and improves information processing among lay users [21], [22], [23], [24]. This is highly relevant in communities with varying levels of digital literacy, such as Banjar Regency, where overcomplex interfaces can limit technology adoption.

Furthermore, when evaluated through the lens of the Mobile App Rating Scale (MARS), the application demonstrates strong alignment across domains of engagement, functionality, aesthetics, and information quality. Unlike many existing stroke-related applications that primarily focus on post-stroke management or rehabilitation, this application emphasizes **primary prevention**, risk awareness, and lifestyle modification, positioning it as a preventive digital tool rather than a reactive clinical aid [25], [26]. The application was designed and tested within the primary health services (Puskesmas) ecosystem in Banjar Regency, making it contextually relevant to local community health structures. Given that digital health literacy in semi-urban and rural Indonesian populations remains uneven, the use of simplified language, culturally appropriate visual

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elements, and integration of local health system identifiers plays a critical role in enhancing acceptability and adoption [16], [27]. Although geographic identifiers such as district and Puskesmas name were included in the application, this study did not perform geospatial risk analysis. Therefore, any potential for regional stroke mapping is considered a future development possibility rather than a current research outcome, avoiding unsupported speculation.

Compared to previous mobile health applications focusing on stroke prevention and education, many of which emphasize clinical settings or tertiary care, this application introduces three notable innovations:

1. Integration of risk self-assessment and prevention education in a single platform.
2. Validation by both clinical experts and technical stakeholders from primary healthcare settings.
3. Direct usability testing within the target community rather than controlled academic environments.

These features strengthen its contribution to community-based stroke prevention strategies, especially in low- to middle-income and rural- semi-urban health contexts, which are often underrepresented in digital health development studies [28], [29]. While this study applied basic principles of confidentiality and anonymized data processing, long-term implementation raises critical concerns regarding data privacy and system security. Health-related applications that collect personal identifiers, such as NIKs, require robust data protection mechanisms, including encrypted data storage, secure authentication systems, and controlled access permissions. These aspects are increasingly emphasized in digital health governance frameworks to prevent misuse, unauthorized access, and data breaches [30], [31]. Several limitations must be acknowledged. The small sample size (n = 15) in the usability testing restricts generalizability. The use of convenience sampling may introduce selection bias, and although expert validation strengthens content credibility, professional subjectivity remains possible. Furthermore, the study focused only on short-term feasibility and did not evaluate long-term behavioral change or clinical outcomes related to stroke risk reduction. In addition, participants were limited to adult female users from one geographic area, which narrows demographic generalizability [27], [32]Thus, the generalizability of the findings beyond female hypertensive populations remains limited and requires further validation across more diverse demographic and clinical groups.

Future research should conduct longitudinal evaluations to assess the application's effectiveness in improving preventive behaviors and controlling major stroke risk factors such as hypertension, diet, and physical activity. Additionally, further development should include integration with national health information systems such as SIKDA, adaptation to multilingual versions for diverse Indonesian populations, and enhancement of the cybersecurity architecture. Such directions are aligned with WHO and AHA recommendations, emphasizing scalable, technology-based approaches for non-communicable disease prevention [29], [33]**.** The findings should therefore be cautiously interpreted when applied to male populations or non-hypertensive risk groups.

V. CONCLUSION

This study aimed to develop and validate an Android-based stroke prevention application for community use using an ADDIE-based Research and Development approach. The application achieved a mean score of **4.7** from material experts and **4.9** from media experts, indicating a **Highly Feasible** classification. At the same time, usability testing among 15 community participants yielded an overall mean score of **16.8 out of 20**, reflecting strong user acceptance. These findings indicate that the application is a valid and feasible digital health education tool to support community-based stroke prevention and aligns with Indonesia's digital health transformation agenda. However, limitations related to sample size, geographic scope, and device compatibility should be acknowledged. Future research should focus on longitudinal effectiveness testing, wider population implementation, and integration with national health information systems to support scalability and sustainability.

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