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Empowering Health Cadres Through Smartphone-Based Educational Applications for Chronic Kidney Disease (CKD) Prevention

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ABSTRACT

Background: *Chronic kidney disease (CKD) remains a significant public healt issue, especially in communities with limited acces to early detection and prevention services. In Ciangir Village, low health literacy and limited utilization of health cadres contribute to delayed identification of CKD risk. The aim of the initiative is to empower health workers to enhance their knowledge and skills in the prevention of chronic kidney disease through a smartphone-based educational app, thereby supporting public education and the early detection of risk factors.*

Methods: *The implementation methods include program dissemination, health cadre training, application of the Suster Kita application as an educational medium, as well as mentoring and evaluation. The target of this activity was health cadres in Ciangir Village, Legok District, Tangerang Regency, who then provided education to beneficiary households in their area. The activity was evaluated by measuring knowledge levels using pre-tests and post-tests and assessing the cadres' ability to use the application as an educational medium.*

Results: *The total knowledge score increased from 238 (pre-test) to 256 (post-test), indicating an improvement of 18 points. In addition, cadres demonstrated improved ability to deliver structured health education using digital thechnology.*

Conclusion: *Empowering health cadres through smartphone-based applications shows potential as an effective strategy to improve knowledge and support CKD prevention at the community level. However, further evaluation is needed to assess long-term impact.*

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INTRODUCTION

Chronic Kidney Disease (CKD) represents a major public health challenge with broad implications for health system resilience, with systemic impacts on global health resilience (1). Based on the latest data from global disease burden studies, the prevalence of CKD has increased dramatically alongside population aging and rising metabolic risk

factors worldwide (2). In 2023, global estimates indicate that more than 788 million individuals are living with persistent kidney function impairment, making it the ninth leading cause of death globally (3). This condition places substantial pressure on health infrastructure, especially in low- and middle-income countries that face limited medical resources (4).

The inability to detect CKD in its early stages causes most patients to fall into terminal conditions that require very high treatment costs through dialysis or transplantation. Therefore, primary prevention strategies are now a top priority in the global health agenda to reduce mortality rates, which are predicted to continue to rise until 2030 (3). The transformation of health services must shift from a curative model to strengthening chronic disease management in community settings (5). In this context, empowering health cadres through digital-based education is essential to support early detection and community-level prevention efforts.

In Indonesia, the epidemiological profile of CKD shows a worrying trend despite structured government intervention efforts (6). According to the 2023 Indonesian Health Survey (SKI), the doctor-diagnosed prevalence of CKD was reported at 0.18% in the population aged over 15 years, but this figure is often considered not to represent the true burden of the disease due to low screening rates (7). The real burden in the field is reflected in the operational data of the Indonesian Health Insurance Agency (BPJS Kesehatan), where funding for kidney failure rose sharply to IDR 11 trillion in 2024 (8).

This increase in costs was dominated by routine hemodialysis services for 134,057 active patients, most of whom were in the end stage (8). The high number of dialysis patients indicates that the early detection system at the primary care level has not been able to identify patients at an early stage who are more responsive to conservative therapy (6). This catastrophic economic impact not only threatens the stability of social security funds but also significantly reduces the quality of life of patients (2). Downstreaming health research strategies are crucial for creating applicable preventive innovations in the community (9).

Focusing on the regional locus, Banten Province faces serious challenges with the high prevalence of non-communicable diseases, particularly in Tangerang Regency (7). Ciangir Village in Legok Subdistrict is one of the areas experiencing rapid demographic transition and lifestyle changes due to the influence of urbanization (7). The shift in people's consumption patterns towards processed foods and low physical activity in this region directly contributes to the increase in the incidence of hypertension and type 2 diabetes mellitus (6). Recent studies show that diabetes mellitus is the most dominant risk factor in triggering CKD in urban areas in Indonesia (6,10).

Although the Bojong Kamal Community Health Center has made efforts to increase service coverage through the ILP Pustu unit in Ciangir Village, community visits for independent kidney health checks are still below the national target (7). This creates a hidden risk where many CKD patients are unaware of their declining kidney function until it reaches a life-threatening stage (11). In Ciangir Village, key challenges include limited public health literacy and suboptimal utilization of health cadres in chronic disease monitoring.

Although cadres play a strategic role within community-based health services, their capacity to deliver structured and sustained education remains constrained by limited resources and tools (11). Health cadres, who are at the forefront of empowerment, often lack adequate tools to systematically educate and collect data on risk factors (9). The use of conventional educational media such as posters or leaflets has proven to be ineffective

in triggering sustainable changes in clean and healthy living behaviors (5). In addition, the lack of a follow-up system after health checks has resulted in many residents with metabolic risks not undergoing routine check-ups (6). The low utilization of information technology at the posyandu level also hinders the creation of an accurate database of residents' health (9). These challenges require solutions that can bridge the limitations of medical professionals with active community participation (5).

Interventions based on digital health technology, or mobile health (mHealth), offer transformative opportunities to strengthen primary health services (5). The use of smartphone applications has been shown to increase patient compliance, improve communication between patients and nurses, and facilitate access to health information (5). In community settings, mHealth can empower cadres to conduct more precise and documented risk screening (11). However, the effectiveness of digital technology is highly dependent on user-centered design and sensitivity to local culture (9). Many current health applications have not integrated local wisdom into their educational delivery, making them difficult to adopt by cadres in rural or suburban areas (5). Therefore, there is a need for application innovations that are not only technical in terms of features but also humanistic in terms of interaction (9).

This community service activity presents innovative solutions through the use of the “Suster Kita” Educational Application (9). This application was developed using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) methodological framework to ensure the quality and relevance of its features (9). “Suster Kita” is designed as an interactive telenursing application that prioritizes cultural sensitivity in each of its educational modules (9). The main features of this application include an estimated glomerular filtration rate (eGFR) calculator that allows cadres to detect early kidney damage in a practical manner (9). In addition, there are daily reminder features for water consumption and salt restriction, animated educational videos, and an integrated patient health profile feature (9). This innovation aims to transform the role of cadres from mere data collectors to reliable digital health educators (5).

The urgency of this community service stems from the global health crisis of chronic kidney disease, which requires treatment at the most basic level. The use of the “Suster Kita” application in Ciangir Village aims to fill the gap between massive educational needs and the limited reach of medical personnel (9). By increasing the capacity of health cadres as agents of digital change, the community will have better access to early detection and management of kidney risk factors (5). An approach that prioritizes cultural sensitivity and technological convenience is expected to create real behavioral changes for a better quality of life for the community (9). This collective effort is an invaluable health investment for the future of the Indonesian nation (3).

The implementation of the “Suster Kita” application in Ciangir Village is aimed at building community capacity for CKD prevention (9). Through intensive training, health cadres are equipped with the ability to use the application's features as a medium for assisting beneficiary households (9). The use of this digital technology is expected to minimize errors in interpreting health risks and speed up the referral process to health facilities if danger signs are found (5). The synergy between the local wisdom of cadres and the accuracy of digital data creates a community health ecosystem model that is adaptive to the era of digital transformation (11). This program also supports the government's vision of strengthening national health resilience through the digitization of primary services (7). The success of this empowerment will be measured through an increase in cadres' knowledge and readiness scores in utilizing mHealth technology (9).

METHODS

Design and Approach of Activities

This community service activity uses an approach of community empowerment based on health education with the support of digital technology as a medium of intervention. The main target of the activity is health cadres in Ciangir Village, Legok Subdistrict, Tangerang Regency, who act as health education facilitators and community assistants in kidney health maintenance. This approach positions health cadres as agents of change through increasing their knowledge, skills, and utilization of smartphone-based educational media.

Location and Activity Targets

The activity was carried out in Ciangir Village, Legok District, Tangerang Regency, Banten Province. The target of the activity was 36 active village health cadres on July 26, 2025. Partners in the activity included the village administration, the local community health center, and health cadres who were members of the Posyandu and PKK activities.

The activity was implemented through several structured stages, including preparation, education, and practical training. Each stage was designed to ensure effective knowledge transfer, skill development, and active participation of health cadres in CKD prevention efforts. Stages of activity implementation:

1. **Program Dissemination and Administrative Clearance**
   The initial stage of the activity began with obtaining licenses and coordinating with the village administration and local community health center. Socialization was carried out through direct communication and the sending of official invitation letters to the Head of the TP PKK and village officials regarding the selection of training participants. This stage aims to build the commitment of partners and ensure support for the implementation of activities.
2. **Preliminary Assessment**
   A preliminary assessment was conducted to determine the level of understanding of health cadres regarding chronic kidney disease and their readiness to use smartphone-based educational media. The results of the assessment are used as the basis for developing training materials and assistance strategies in line with the needs of cadres and the community.
3. **Health Cadre Training**
   Health training focused on increasing knowledge of CKD and skills in using smartphone-based health education applications. The training material is organized into five topics covering disease introduction, risk factors, early detection, kidney health maintenance, and self-care at home. Training methods include lectures, discussions, and hands-on practice using the application.
4. **Application of Health Education Technology**
   After training, health cadres apply health education using smartphone-based applications to the community. Each health cadre assists at least three beneficiary households in using the application as a medium for health education. This application aims to expand the reach of education and improve community understanding on an ongoing basis.

5. **Assistance and Evaluation**
   Assistance is provided during the application implementation process by health cadres. Activity evaluation includes measuring the community's level of knowledge using questionnaires, assessing the cadres' skills in using the application through observation sheets, and measuring the cadres' satisfaction with the application through satisfaction questionnaires or usability tests. The evaluation results are used as a basis for improving and strengthening program implementation.
6. **Program Sustainability**
   Program sustainability is achieved through regular monitoring of application usage and the formation of a WhatsApp-based communication group as a medium for coordination and ongoing assistance between the service team and health cadres. This strategy is expected to maintain the continuity of health education and community condition monitoring.

RESULTS

Implementation of Activities

Community service activities were carried out on July 26, 2025, in Ciangir Village, Legok District, Tangerang Regency. Activities included basic health checks, health education on CKD, and evaluation of participants' understanding through pre-tests and post-tests. Participants consisted of health cadres and community members who participated in the entire series of activities.

Participant Characteristics and Health Examination Results

A total of 36 participants underwent basic health examinations, which included measurements of age, weight, height, cholesterol levels, and uric acid levels. The examination results showed variations in the health conditions of the participants, with some falling into the category of being close to metabolic disease risk factors associated with kidney disorders.

Table 1. Participant Characteristics and Health Examination Results

Variabel	Average	Minimum	Maximum
Age (years)	37.3	18	85
Weight (kg)	64.3	45	89
Height (cm)	158.1	145	182
Cholesterol (mg/dL)	172.4	112	224
Uric acid (mg/dL)	5.45	3.7	8.6

The average age of participants was 37.3 years, indicating the involvement of the productive age group. The average cholesterol level of 172.4 mg/dL indicates that some participants are close to the risk threshold for hypercholesterolemia, while the average uric acid level of 5.45 mg/dL shows that some participants have values above the normal range. This condition reinforces the relevance of the need for early kidney health education in community settings.

Results of Participant Knowledge Evaluation

Knowledge was evaluated using pre- and post-tests administered to 36 participants who attended health education sessions. The results showed a shift in the distribution of

scores toward higher categories after the educational intervention was provided. The analysis results show that the participants' pre-test score was 238, while the post-test score increased to 256, with an increase of 18 points after training.

Table 2. Pre-Test and Post-Test Knowledge Scores

Score pre-test	Score post-test	Absolute change
238	256	+18

Partner Participation and Activity Benefits

Activity partners, consisting of village officials, community health centers, and health cadres, actively participated in all stages of the activity, from planning and implementation to evaluation. Health cadres not only served as training participants, but also as health education facilitators for the community. The benefits of the activities can be seen from the increased knowledge of the participants, their awareness of the importance of kidney health maintenance, and the readiness of health cadres to use health education applications as a medium for continuous education.



Figure 1. A Health Cadre Training and Assessing the Cadres' Skills in Using the Application

Implementation Constraints

During the implementation of the activities, the constraints encountered were relatively minimal, mainly related to variations in the digital literacy levels of participants in using smartphone-based applications. These constraints were overcome through direct assistance and repeated practice in using the applications during the activities. Overall, participants were able to adapt well and actively engage in all educational sessions provided.

DISCUSSION

The results of this community service activity show that providing health education on CKD through the empowerment of health cadres supported by the use of smartphone-based applications can improve participants' knowledge and awareness of kidney health maintenance. The increase in post-test scores compared to pre-test scores reflects a better understanding of the educational material provided, while also indicating that context-specific educational approaches are well received in community settings. In addition, the active involvement of health cadres in the education process and mentoring of beneficiary households shows the potential for strengthening the role of cadres as agents of health behavior change in community settings.

These findings suggest that integrating health education with cadre empowerment and digital support mechanisms can meaningfully enhance community-level preventive efforts. However, the observed improvements should be interpreted within the context of short-term interventions, as sustained behavioral change typically requires prolonged engagement and systemic reinforcement. The increase in public knowledge found in this community service activity is in line with various research findings that confirm the strategic role of health

Health education that is designed in a targeted and contextual manner has been proven to increase individuals' capacity to understand health information, while also strengthening awareness of disease risks and the importance of healthy living behaviors. A number of studies report that health education interventions not only increase knowledge scores but also improve health literacy and individuals' readiness to make decisions related to their health (12,13). Similar findings have also been shown in community-based health education interventions that are able to increase public understanding of diseases and prevention strategies, although long-term behavioral change requires other supportive approaches (14,15).

Thus, the increase in community knowledge in this activity can be understood as the result of a systematic, accessible, and relevant educational process, particularly in the context of preventing and managing chronic diseases such as chronic kidney disease. However, the effectiveness of health education is also influenced by the demographic and social characteristics of the community, so that adaptive and sustainable educational approaches are key to maintaining these positive impacts (16,17). Continuous engagement of health cadres is therefore essential to ensure the long-term effectiveness of community-based health education programs.

The role of health cadres as agents of change is a key factor in improving the effectiveness of health education at the community level. Health cadres, especially posyandu cadres, are community-based health workers who have social proximity and contextual understanding of the conditions of the community's living environment. This proximity allows cadres to convey health messages in a more communicative, understandable, and appropriate manner to the needs of the target community. Various studies show that the active involvement of cadres in health education contributes to increased utilization of health services and positive changes in the behavior of seeking health services in the community (18).

In the context of this community service activity, the involvement of health cadres in the process of educating and assisting beneficiary households strengthens the process of knowledge transfer while increasing the community's trust in the health information provided. However, the optimization of cadres' roles is greatly influenced by the availability of training, resource support, and a sustainable mentoring system (19). Therefore, strengthening the capacity of cadres through structured training and technological support is an important strategy to ensure the sustainability of cadres' roles as agents of change in chronic disease promotion and prevention efforts in the community.

The use of digital technology in community service activities makes an important contribution to strengthening the health education and mentoring processes carried out by health cadres. Smartphone-based health education applications enable the delivery of health information in a more systematic, accessible, and sustainable manner, thereby reaching a wider audience than conventional education methods. Various studies show that the use of mobile health applications can increase community knowledge, attitudes,

and involvement in health prevention and management efforts, including on the issues of stunting and hypertension (20,21).

In this activity, the Suster Kita application serves as a supporting medium that facilitates health cadres in providing consistent education and monitoring public understanding through pre-test and post-test features. In addition, the integration of digital technology contributes to improving the digital literacy of health cadres, which is an important aspect in strengthening their capacity in the era of digital-based health service transformation (22,23). However, the successful use of digital technology is greatly influenced by user readiness and infrastructure availability, and ongoing support (24). Therefore, digital technology in this activity needs to be understood as part of a comprehensive approach that complements education, the role of cadres, and community health system support.

Preventing chronic kidney disease in the community is a strategic approach to reducing morbidity, mortality, and the burden of healthcare costs in Indonesia. Hypertension, diabetes mellitus, and certain infectious diseases such as hepatitis are known to be major risk factors for chronic kidney disease, which are still largely undetected and not optimally managed at the community level (10,25). Early screening and health education efforts are key to primary and secondary prevention, especially among high-risk communities.

Limited access to advanced health services, including renal replacement therapy and referral systems, further emphasizes the importance of strengthening community-based interventions as the front line of prevention (26). In this context, health education emphasizes lifestyle modification, blood pressure and blood sugar control, and increased awareness of the early symptoms of chronic kidney disease is a relevant and sustainable strategy (27). The involvement of health cadres supported by digital education applications has the potential to bridge the gap between prevention policies and practices in the field, especially in resource-limited areas.

Overall, the results of this community service activity show that empowering health cadres through smartphone-based health education is a relevant and contextual approach in efforts to prevent CKD at the community level. These findings are in line with various studies that confirm that improving health literacy, supporting cadres as agents of change, and utilizing digital technology can strengthen the effectiveness of promotive and preventive interventions in the community (18,20,27). The use of health education applications not only facilitates systematic and continuous access to information but also strengthens the role of cadres in educating, collecting data, and assisting target families.

However, this activity still has limitations, including limited coverage and dependence on the digital literacy readiness of cadres and the community. Therefore, the sustainability of the program through continued mentoring, monitoring of application use, and integration with primary health services are important aspects to ensure long-term impact. In practical terms, this community activity makes a real contribution to strengthening community-based CKD prevention efforts and has the potential to become an adaptive model of service that supports technological developments and the achievement of sustainable health development goals.

CONCLUSIONS AND SUGGESTIONS

This community service activity demonstrates that empowering health cadre can be effective in increasing public knowledge and awareness of kidney health maintenance. Health cadre training supported by the use of the Suster Kita app has strengthened the

cadres' capacity to convey health information in a systematic, accessible, and sustainable manner, as well as supporting the process of mentoring beneficiary households in community settings. This approach, which integrates health education, the role of cadres, and digital technology, makes a real contribution to the promotion and prevention of chronic kidney disease, especially in areas with limited health service resources. It is recommended that cadre-based health education programs using digital applications be expanded to similar areas with continued assistance and monitoring to ensure sustainability and improve cadre capacity and community health literacy. Furthermore, integration with primary health services and evaluation of long-term behavioral changes are needed to strengthen a comprehensive and sustainable CKD prevention system.

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DECLARATION OF USE OF AI IN SCIENTIFIC WRITING

AI tools were used solely for grammar and language editing. The authors take full responsibility for the content and integrity of the manuscript.

CONFLICT OF INTERESTS

The author declares that there is no conflict of interest in the implementation of community service activities or in the preparation of this article.

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