

ElderCare Monitor Application Design: Elderly Health Monitoring based on Family and Community Health Center Collaboration

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Abstract - The elderly are a vulnerable group that is susceptible to various degenerative diseases. The lack of information and understanding of the elderly causes a high rate of disease complications. This study aims to design an ElderCare Monitor application that is easy to use and tailored to the needs of users. The application caters to a variety of users, including elderly families, the elderly themselves, the pre-elderly, and health center officers. Health workers at the health center and the elderly's family collaborate to independently monitor the health of the elderly and pre-elderly. The system is designed using the design thinking method. The design thinking method involves five stages: empathy, define, ideate, prototyping, and testing. The results of the study showed an effectiveness rate of 95.24% for the elderly and families and 95.83% for health center officers. The average SUS score for families and the elderly was 74.17, while for medical personnel, it was 77.5. Therefore, the ElderCare application received the "Good" usability category. This study contains numerous components that may serve as encouragement. In particular, it is imperative that we consistently improve the UI/UX of ElderCare by routinely gathering user feedback and incorporating features that can more effectively support the elderly.

Keywords: community health center; elderly; family collaboration; health monitoring application.

I. INTRODUCTION

The rising elderly population in Indonesia presents significant social and economic challenges. While healthy elderly individuals contribute positively to society, those with declining health often pose burdens on families and the healthcare system [1]. Population projections from 2010 to 2035 indicate that over 10% of Indonesia's population will be elderly [2], increasing the need for improved health care and monitoring as aging naturally leads to physical and cognitive decline, with higher risks of degenerative diseases like hypertension and diabetes [3].

Non-communicable diseases (NCDs), particularly hypertension and diabetes, are prevalent among Indonesia's elderly. The 2018 Basic Health Research (Riskesdas) reported that 36.6% of elderly Indonesians have diabetes [4]. However, NCDs often go undetected until complications arise due to their subtle symptoms, delaying treatment [5]. Non-communicable diseases (NCDs) are the leading cause of illness and premature death in many low- and middle-income countries (LMICs) worldwide. They also pose the greatest burden in terms of morbidity and mortality globally [6]. Recent estimates indicate that approximately 80% of deaths attributable to NCDs occur in low- and middle-income countries, with nearly three-quarters of global NCD-related deaths occurring after the age of 60 years [7].

The elderly population is at high risk of a variety of progressive diseases like arthritis, gout, hypertension and diabetes mellitus [8]. There are however three clinical monetary tissues types to be categorized as degenerative diseases namely, cardiovascular, neoplasm, and neuro degenerative disorders. The elements that make up the cardiovascular diseases include high blood pressure, coronary artery disease and heart attack [9]. The toll of cardiovascular diseases is not just the sickness and deaths and the burden to society that can be made, but also such diseases incurs great cost to the economy and health care systems [10]. In order to help the elderly (who are at risk) lead a life wherein they live independently and regain their self-belief for as long as possible, their psychological needs and their health situation are evaluated, but primary care is preventative). These conditions can also be helped with regular check-ups of the physical health of such persons. They are very important for the comprehensive geriatric assessment so that it helps in the prevention of serious diseases in older adults [11]. Awareness of risk factors can help prevent degenerative diseases. Such information can be enhanced through training or counseling in person or through the use of technology use [12].

The study conducted by [13] demonstrated that elderly patients experience a significantly elevated level of multimorbidity, which results in a high incidence of frailty and polypharmacy. Patients with certain conditions have a higher risk of experiencing a number of adverse health outcomes, including falls, hospitalization, malnutrition, delirium, and death. This is exacerbated by the continued aging of the global population, leading to increased long-term care needs for the elderly, with major health, economic and social implications. In addition, changes in family structure and infrastructure limitations exacerbate the challenges of caring for the elderly [14]. Furthermore, research [15] explains that annual health screening has been shown to be effective in detecting diseases at an early stage and helping to plan appropriate interventions, although there are potential dangers to be aware of, including challenges in implementation and risks to patients. In addition to good prevention benefits, campaigns on the importance of screening also provide valuable epidemiological data, helping health authorities to plan mass interventions and target high-risk populations more precisely. This screening is important because it can provide considerable opportunities to help plan curative or medical treatments that facilitate or minimize the onset of dangerous diseases in older individuals. In addition, it can also improve the quality of life and prolong the lifespan of the elderly [16]. Research [17] shows that earlier clinic visits after health screening are associated with lower risk of hospitalization due to major cardiovascular events and general mortality in a high-risk population.

One of the steps taken by the government to improve elderly health is by organizing the Posyandu Lansia program. This program aims to enhance the quality of elderly health at the community level [18]. However, the participation rate of the elderly is still relatively low. Based on data from the Watopute Health Center, only a small portion of the 542 registered elderly regularly attend the posyandu [19]. Several factors contributing to the low participation include limited access to information, the absence of personal health records, long distances to the posyandu location, and a lack of family support [20], [21].

Health monitoring applications have proven effective in managing patient care through real-time data. For example, Health-M was developed to monitor COVID-19 patients remotely [22], while [23] created an IoT-based application for real-time cardiovascular monitoring in rural areas. For elderly care, [11] developed a system for caregivers to track health data, and [24] introduced a web-based application for

managing elderly health records at Posyandu. The SEDEKA application was enhanced by the integration of health education by [25] which enhanced the comprehension of degenerative diseases among geriatric patients.

Current healthcare solutions mainly focus on self-monitoring by patients and existing healthcare providers, while neglecting the important role of family members in elderly care. Optimal family support plays an important role in improving the health of the elderly. In addition, such support helps the elderly undergo regular daily activities without being overwhelming. Research conducted by [26] also shows that the better the family support, the more the elderly's ability to be independent in carrying out daily activities (Activity Daily Living / ADL) increases. With age comes some challenges such as social isolation, poor knowledge of health risk factors, poor nutrition access, medication disorders and some psychological and emotional challenges. Hence, the elderly health care management calls for the integration of families and communities, and modern health technologies to focus on the different spheres of elderly health [27]. The family unit is a crucial part when it comes to addressing these problems. Family members can help a patient emotionally, help them manage their medications and nutrition, and engage in the daily health assessment of the patient [28]. For that reason there is need for integration of families and communities as well as the use of modern health technologies to enhance the health of old people. ElderCare Monitor is an application designed to address these limitations by encouraging active family participation in health monitoring. With real-time data and user-friendly features, this app paves the way for collaboration between families and healthcare providers to enhance elderly care

Although previous studies have emphasized the importance of family involvement in healthcare, few have explored technological solutions that facilitate direct collaboration between families and healthcare services [21]. The ElderCare Monitor aims to fill this gap by employing a design thinking approach that integrates critical features such as health record access, appointment reminders, and enhanced communication between families and healthcare professionals. This research aims to design the ElderCare Monitor application, an app intended for monitoring the health of the elderly, to be used by healthcare centers and involve families. The main goal is to enhance elderly health monitoring through technology, supporting better elderly care.

II. METHOD

This research applies the design thinking approach to developing the ElderCare Monitor application, which aims to improve elderly health monitoring through collaboration between families and community health centers (Puskesmas). The process includes five stages: empathize, define, ideate, prototype, and test. Each stage plays a critical role in ensuring the application design is user-centered and effectively addresses real-world challenges (Fig.1).

The first stage is the empathy stage. It focuses primarily on the understanding of the needs, the challenges, and the feelings of the elderly residents and their families, as well as the health care officer involved in elderly care. The data is gathered through semi-structured interviews and observations at Puskesmas Watopute and related Posyandu activities for the elderly. The interviewees are key stakeholders of the process, e.g. Puskesmas officer, and elderly service users and their family members. The interview reports various issues. Some of them include insufficient easy access to the elderly's patients' medical records, limited or no family involvement in the healthcare management of the care, and communication gaps between the office of the puskesmas and the families. Non-participant observation was conducted to provide an overview of the operational practices at the elderly Posyandu. This observation focused on the physical environment, the service delivery flow, and the interactions between healthcare workers and the elderly. The results of the observation were used to gain better insights into the logistical and social barriers faced by providers of elderly healthcare services, which will be addressed by this application.

The next stage is the define stage, where we take all the insights gathered from the empathize stage. This phase aims to clearly identify what the application will solve (the root problems). After conducting interviews and mapping user journeys, the issues were divided into smaller abnormal usage problems observed in the system, following problem analysis. Based on the characteristics and needs of three core groups, user personas were created to assist the design process: elderly users, family caregivers, and Puskesmas officer. These personas enable the research team to keep each user group in mind while designing the product.

In the ideate stage, the issues were discussed and potential solutions were explored. Using the How Might We (HMW) approach, these problems were transformed into questions to uncover innovations and generate bolder ideas on how the ElderCare Monitor could be utilized. The user flow is also defined at this stage. User flow diagram demonstrates ideas that are carefully structured and well-organized. This diagram illustrates how elderly users, family members, and healthcare officer would interact with the application to record their data or schedule check-ups.

At the prototype stage, the application flow framework is designed based on the mapping of needs obtained in the previous stage. This prototype is compiled by establishing a design system that includes colors, button fonts, and other required UI components. After that, wireframes (Low-Fidelity Prototyping) are made. Low-fidelity wireframes are created to outline the basic application structure and user interactions. These wireframes allow for rapid feedback and iteration before moving on to more detailed designs. Finally, a high-fidelity prototype is produced, incorporating all visual elements and interactive features. This prototype closely resembles the final product, allowing users to interact with the application more realistically during testing.

The final stage is testing. This stage is crucial for evaluating the application's usability and determining its ability to satisfy users. Interface testing for general use was conducted on eight people including: Puskesmas officers, elderly residents and families. The participants were given tasks which involved using the high-fidelity prototype, after which their interactions with the application tools were all recorded in order to determine how usable, efficient and satisfying the application was. This was followed by a SUS questionnaire in which participants rated their experience on various elements of the system after completing the tasks. The SUS score will be divided into several categories: best imaginable ($85 < \text{score} \leq 100$), Excellent ($75 < \text{score} \leq 85$), good ($55 < \text{score} \leq 75$), okay ($35 < \text{score} \leq 55$), poor ($25 < \text{score} \leq 35$), and worst imaginable ($0 < \text{score} \leq 25$). Through this SUS score, further action can be determined to find the root of the problem, or rethink the design solution completely.

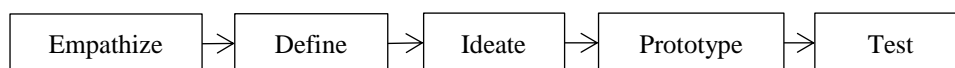


Fig. 1 Research stages

III. RESULT AND DISCUSSION

A. Empathy Stage

Observation was due to working together and starting off by looking at the local community health center (Puskesmas) regarding the timing of Posyandu activities for the elderly and seeking permission to do the observations. This step ensured that the Puskesmas were not only made aware of the research say or targeted aspect, but they were also fully included in the research design and their assistance sought in the course of observation. All observations were made directly at various places and at different times that had been earlier scheduled. Observations in May 14, 2024 were carried out in Bangkali Village of Bangkali Village Hall situated along Jalan Poros Raha Masara in Watopute District. Subsequently, May 15, 2024, observations were made in the Wali Satu Village which is administratively Watopute District Village Hall, Lorong Pasar, after that observation was conducted on Wali Dua Village on May

16. There was the last observation held in Labaha village on May 17, 2024. All observation activities started at 09:00 AM WITA. Table I is a summary of the results of these observations, which include the Posyandu locations and facilities, health services provided family involvement, information delivery method, and health education.

The rule-prescribed interviews were held with 20 elderly persons, 10 family members, and 6 Posyandu officer. The results of these interviews pointed to a number of important concerns in relation to the organization and timing of the Posyandu activities, how the results of health examinations were communicated, and the absence of problem-solving equipment. Table II describes the problems frequently encountered in the elderly and their families.

After the empathize phase, a problem analysis was conducted to group and clarify the identified issues. These problems were analyzed in depth during the define phase, as summarized in Table III.

TABLE I
OBSERVATION RESULTS

No	Observed Aspect	Observation Description
1	Posyandu locations and facilities	Four Posyandu Lansia locations were observed: Desa Bangkali, Desa Wali Satu, Desa Wali Dua, and Desa Labaha. All locations were strategically accessible for the elderly.
2	Health services provided	Elderly individuals received basic health check-ups such as body weight, waist circumference, independence assessments, and lab tests for uric acid, blood pressure, cholesterol, and blood sugar, followed by medication and health advice.
3	Family involvement	Family involvement in elderly health monitoring was minimal. There were no dedicated tools for families to follow up on the elderly's health conditions, such as digital applications or health record books.
4	Information delivery method	Health information was delivered verbally, with no supplementary digital or printed media for clarification.
5	Health education	Health education was provided orally, without visual aids or written materials to assist elderly individuals in understanding their health conditions.

TABLE II
INTERVIEW RESULTS

No	Problem	Discussion	Source
1	Lack of awareness about Posyandu schedule	Many elderly individuals forget Posyandu schedules unless personally reminded by Puskesmas officer. Family involvement in reminding or assisting elderly individuals to attend Posyandu was minimal. The schedule was communicated manually via paper and word-of-mouth.	Puskesmas, Family
2	Limited access to health check-up results	Elderly individuals were informed about their health only during the check-up, with no additional documentation provided. This led to difficulties in remembering and following medical advice at home, which also affected the family's ability to support health management.	Puskesmas, Family
3	Difficulty in tracking health history	Neither elderly individuals nor their families had access to tools for monitoring past health data. This made it challenging for families to evaluate whether the elderly's health was improving or worsening over time.	Family, Elderly
4	Need for specific application features	Both families and Puskesmas officer expressed interest in features such as reminders for medical appointments and medication schedules, easy access to health information, and communication tools for direct interaction with healthcare providers.	Puskesmas, Family

TABLE III
PROBLEM ANALYSIS

No	Problem	Empathize Phase	Define Phase
1	Lack of effective reminder systems for elderly individuals and their families	Many elderly individuals and their families forget the Posyandu schedule, leading to irregular health monitoring.	The absence of a digital reminder system for Posyandu schedules needs to be addressed.
2	Lack of communication tools for sharing health results	Health results are only shared verbally during check-ups, making it difficult for families to support the elderly's health management at home.	A communication system that allows families to access health results and follow-up instructions is essential.
3	Difficulty in tracking health history	Families need to track the elderly's health data over time but have no access to previous records.	A digital system for tracking health history is needed for continuous monitoring.
4	Specific feature requirements	Users requested specific features, such as automatic reminders and accessible health information.	The application must include these features to meet user needs.

B. Define Stage

User personas were developed following to the problem identification phase, using the stakeholder interviews that were conducted. The ElderCare Monitor was developed with the objective of supporting the elderly and their families, which was influenced by these personas. The personas include: Puskesmas officer and family members. These personas encompass the different users with the different perspectives of the elderly relatives in caregiving roles and the challenges they face. Monitor in pursuit of the elderly and their family support. The personas include: Puskesmas officer (PO1 and PO2), elders (EL1 and EL2), and family members (FM1 and FM2). These personas encompass the different users with the different perspectives of the elderly relatives in caregiving roles and the challenges they face. Fig. 2 depicts the three user personas.

C. Ideate Stage

We conducted a How Might We (HMW) exercise with the identified problems and user personas to generate potential solutions for the challenges faced by the elderly, families, and Puskesmas officer. Table IV lists some of the queries HMW posed along with a number of creative answers that the ElderCare Monitor application uses.

The ElderCare Monitor application is designed so that both the family and the elderly can use the same account, which belongs to the elderly. By using the elderly person's account, health information, examination history, and medical needs are well integrated into a single platform. This approach also aims to simplify the family's ability to monitor the elderly's health without having to create a separate account. Additionally, using a single account helps reduce confusion for both the elderly and their families, ensuring easy access to health data. This fosters more effective communication and collaboration in maintaining the elderly's health. Here is the user flow of the proposed solution for each identified issue.

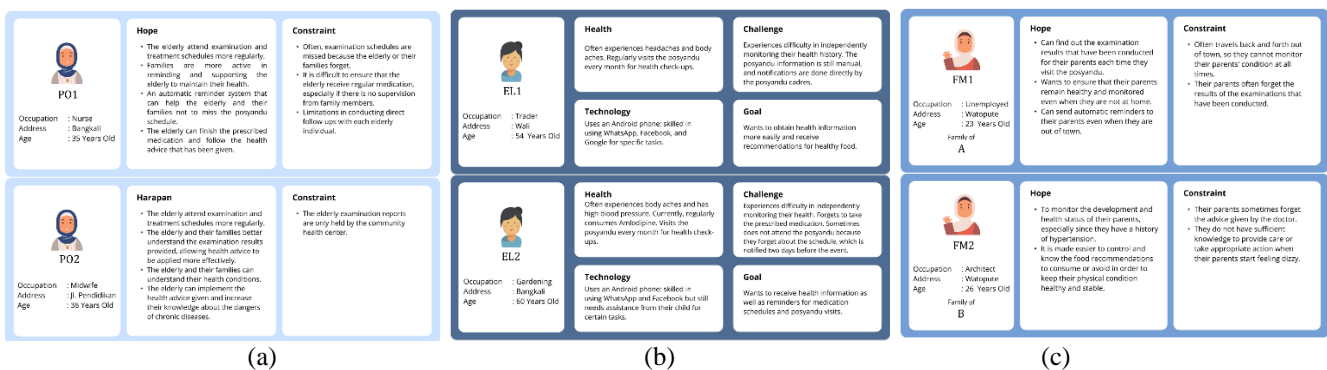


Fig. 2 User Persona: (a) PO1 and PO2; (b) EL1 and EL2; (c) FM1 and FM2

TABLE IV
HOW MIGHT WE RESULTS.

No	Problem	How (HMW)	Might We (HMW)
1	Lack of reminder systems	How might we ensure that elderly individuals and their families remember the Posyandu schedule?	Provide a system that delivers schedule reminders via a mobile application or SMS notifications.
2	Lack of communication for health results	How might we help elderly individuals and their families retain and follow health advice?	Develop an intuitive system for communicating health results and instructions via a user-friendly platform.
3	Lack of continuous health tracking	How might we enable continuous tracking of health data for elderly individuals and families?	Create a digital platform for storing and reviewing health data over time.
4	Feature needs	How might we integrate specific features for elderly health monitoring?	Add features such as medication reminders, online consultations, and easy access to health data.

Fig. 3 shows the Eldercare user flow. User flow of this application is one way to find out the steps taken by users from start to finish until all the features offered can be fully utilized. Users will begin with an onboarding process and will then be taken to a login screen where they will enter their register NIK or BPJS number and a password assigned to them by their Puskesmas. Once the users have completed the verification, they will be permitted to change the password and proceed to the main page of the application. For those users who enter the application, once there are no more challenges for them, they are immediately taken to the homepage which acts as a central point for navigation to other applications features.

At the home page, result of the examination and a reminder are presented to the users for easy retrieval of the health examination result, medical directions, and important reminders in order to promote the welfare of the elderly. This flow was developed based on the previous document review that has been attached, as well as the inputs from the family and the health center, to ensure that the application works to optimally respond to users. The Dashboard menu provides a number of check-up results and the latest available information. The user flow of the ElderCare Monitor application has a design that should make users easily manage and monitor elderly health information ranging from personal and emergency contacts, medical history, medication reminders and present graphical charts that are easy to operate and acceptable to users. This flow is intended to facilitate access for the elderly or the elderly family to view and monitor health conditions comprehensively. In the profile section, users can manage personal information and the account settings. Applicative properties may permit a user to create new messages, which can be sent to designated persons regarding health issues and other reminders. Generally, the flow of the

application is targeted in letting the user regardless of any age access health information, handle relevant communication, and even manage personal details, information pages with ease.

D. Prototyping Stage

The prototype is created by designing the application flow framework based on the requirements mapping obtained in the previous stage. This prototype is assembled in the form of a high fidelity prototype. In the login page, the user will only enter the NIK or BPJS number and password that has been registered by the health center. The login flow of the ElderCare Monitor application was designed based on the results of discussions with the family and the health center. In this process, it was decided not to add a separate account registration feature. This decision was made because some families can only operate but still do not understand the registration to start using the application. To make it easier for the elderly and their families, it was decided that when the elderly's data was inputted into the system, they would automatically be registered for an ElderCare Monitor account.

Fig. 4 displays the home page, which provides information on user data, the latest drug examination results, user tips, and recommendations for healthy and unhealthy foods. General information, including age, blood type, height, and weight, is displayed on the dashboard page. This information also includes medical record numbers, health conditions, allergies, and the most recent examination history of the elderly. In addition, the dashboard page includes a history of substance use and checking history. The checkup results in the medical information section can be selected to display a graph of previous checks, facilitating the monitoring of the elderly's health over time.

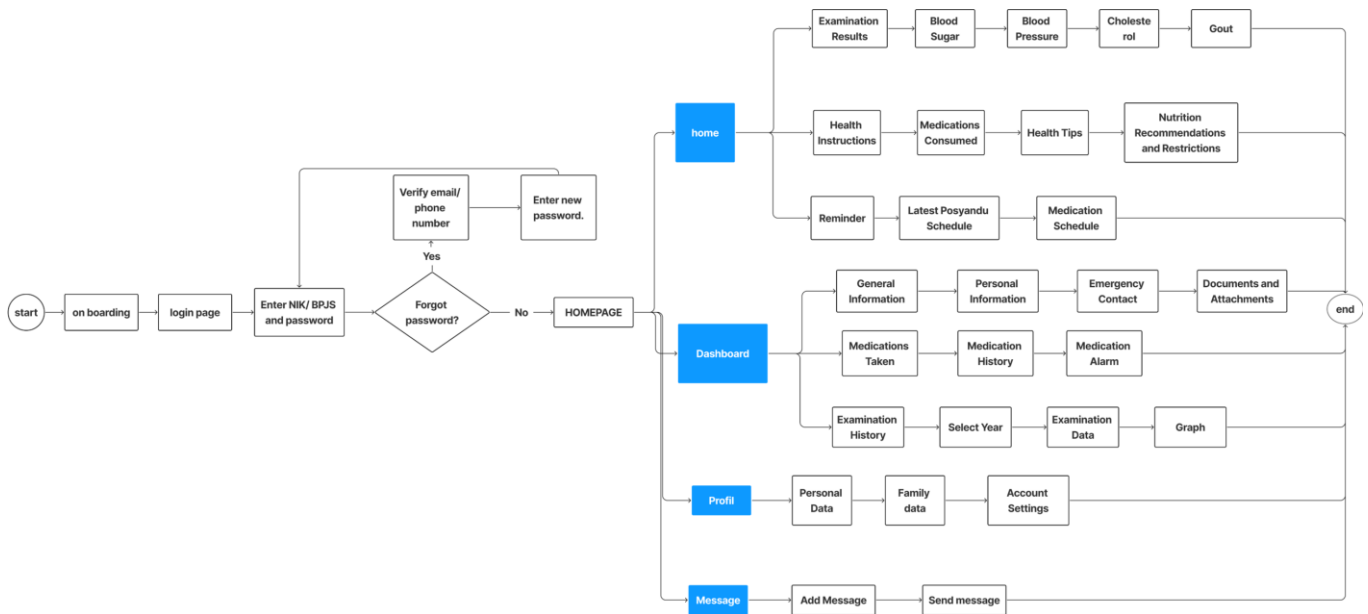


Fig. 3 Eldercare user flow

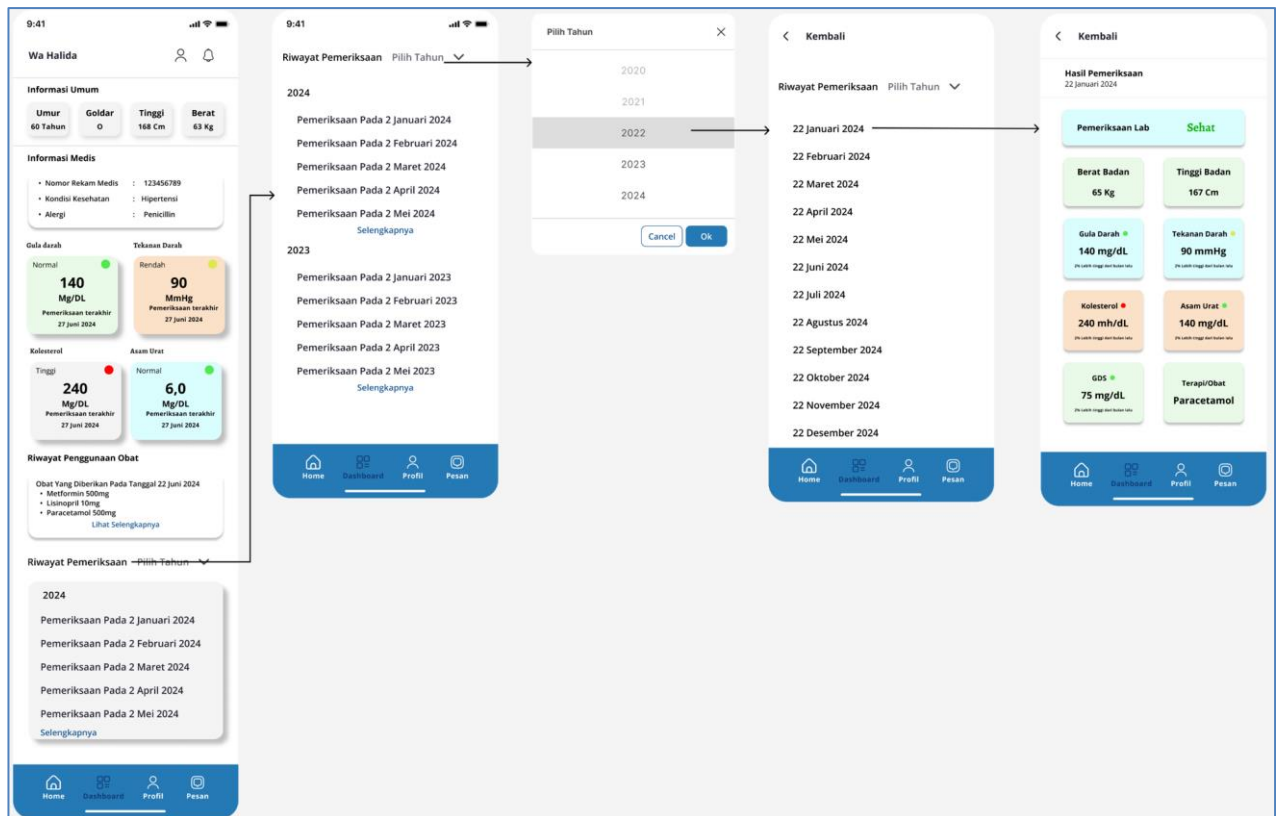


Fig. 4 Home page

Users have the ability to access their previous examination history by selecting the year and month. The examination history for the selected month and year will then be displayed. Users have the ability to access their

drug history by selecting the year and month. The history and information regarding drug use in the selected month and year will be displayed in Dashboard page. The Messages page will display the latest messages sent by

the health center, as well as messages from users who wish to communicate with the health center. The message layout adopts a WhatsApp-like design, as requested by the elderly and their families, who are used to using WhatsApp as their main communication platform. The Profile Page showcases the user's profile, including registered elder and guardian information. On this page, users can disable notifications.

On the other hand, a prototype for administrators (Posyandu Officer) was also developed. On the Dashboard Page, there is a graph that shows the number of elderly, a list of recent activities that displays the latest activities in the system including the addition of elderly data, health data updates and drug reminders. In addition, there is a graph that shows the history of health checks over time. And the finally there is a notification that displays notifications about the latest appointments or activities that will be held related to the elderly. On the Elderly Data Page and Data Input Page, the administrator can show the data of all elderly people who have registered. On this page, the admin can input and register new users. On this Reminder Page, the admin can access the latest information about the Posyandu schedule and also add new reminders. The Report Page and Check Result input page presents a comprehensive list of all elderly individuals, the outcomes of their completed checks, and a graph illustrating the examination results. In addition, there is a page that provides a form to add the latest checking results. The messages page offers a message feature that enables elderly users or their families to communicate with administrators or Puskesmas officers.

E. Testing Stage

Based on the seven tasks assigned to the elderly and their families, and six tasks for the Puskesmas officer, there are three indicators that describe the level of success in completing the tasks: (S) if the user successfully completes the task according to the scenario, (P) if the user completes the task with some errors, and (F) if the user fails or gives up on the task. Score $S=1$, $P=0.5$, and $F=0$. The list of success levels is presented in the table below, along with other tables that reflect the achievements of each user. The success rate or the effectiveness testing results for four elderly families and the elderly completing seven tasks reached 95.24%. Meanwhile, the effectiveness testing results for two Puskesmas Watopute Officers completing six tasks was 95.83%. Therefore, the success rate in the effectiveness testing for elderly families, the elderly, and Puskesmas officer is considered good.

User satisfaction can be measured through their experiences while using the application. This satisfaction measurement is conducted using the System Usability Scale (SUS) questionnaire. The SUS questionnaire is directed towards two elderly users, four family members of the elderly, and two officers from the Elderly Posyandu at Puskesmas Watopute who are involved in the testing. The questionnaire consists of ten questions to be answered on a scale from 1 to 5 [29]. The usability test results showed that the ElderCare Monitor application performed well in terms of effectiveness, efficiency, and user satisfaction. Users were able to complete tasks relatively easily, and feedback from the elderly, families, and health center staff was very positive. SUS scores of 74.17 and 77.5 indicated that the application was acceptable and in the "Good" usability category.

In order to enhance the ElderCare application's user experience, particularly for the elderly, we require an inclusive design-based approach and iterative development. An accessibility-friendly design, automatic reminders, personalization, interactive features, and integration with wearable devices are all necessary. To improve the content of this application, we require consistent feedback. Furthermore, it is imperative that we conduct consistent assessments of the productivity of Puskesmas officers. During the application's initial phases, training is necessary for optimizing its functionality. In the same vein, the presence of a support team that is responsive is crucial for the resolution of technical issues.

IV. CONCLUSION

The ElderCare Monitor application helps improve the effectiveness of elderly health monitoring, both independently by families and the elderly themselves, as well as through collaboration with medical personnel. The user experience of the ElderCare application is designed based on the problems and needs of its users. This is reflected in the effectiveness testing results, where families and the elderly scored 95.24%, and medical personnel from community health centers (Puskesmas) scored 95.83%. The average SUS score for families and the elderly was 74.17, while for medical personnel, it was 77.5. Therefore, the ElderCare application received the "Good" usability category. Based on the researcher's observations, we can consider several aspects of this study for future action. Specifically, we need to continuously enhance the UI and UX of ElderCare, including the addition of features that can better assist the elderly by regularly collecting user feedback. Despite the proven effectiveness of the app for

community health center personnel, future research could concentrate on its ability to alleviate medical officer's workload and enhance overall healthcare productivity and efficiency.

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