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Pharm-Care Tadulako: Web-based Design Application to Improve Pharmaceutical Care Services

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Abstract

Pharmaceutical services recently require new ideas and innovation to provide maximum benefit concerning the pharmacological treatments of patients and take responsibility for monitoring their therapy. One of the proposed efforts by pharmacists is the pharmaceutical care program designed to ensure pharmacists can monitor safe and effective medication use and provide timely access to medicines for the population. Moreover, eHealth application in terms of technology is expected to be effective, networked, patient-centered, and accessible for patients. Therefore, Pharm-Care Tadulako, a personalized eHealth application designed with key features of pharmaceutical care to enhance communication between pharmacists and patients, is presented in this study. Some of the services intended to be provided by this application include electronic medical records (EMR), drug reminders, pharmaceutical messenger, clinical data monitoring, and medication analysis. The application was developed using Software Development Life Cycle (SDLC) Waterfall. A pilot study was conducted at four pharmacies in Palu City, Centre of Sulawesi, Indonesia, using 30 patients who volunteered willingly to participate in the experiment. It was discovered that 65% of the 30 patients were 26-45 years old, out of which 36% suffered from hypertension. The Pharm-Care Tadulako application positively impacted pharmacists when providing pharmaceutical care services to patients. At the same time, they could monitor their treatment through the five main features of the application

Keywords: pharmaceutical care, pharm-care tadulako, SDLC, applications

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Introduction

A continuous increase in scientific and technological knowledge is associated with clinical pharmacy and pharmaceutical care. This is observed from the contribution of pharmaceutical care to the evolution of the pharmaceutical profession, which is discovered to have started expanding to other sectors, specifically the community pharmacy.[1] Moreover, improving the effectiveness of treatment and disease management requires innovations in telemedicine through electronic or website-based applications.[2,3]

It is important to note that pharmacists act as intermediaries between doctors and patients by providing both medicines and free medical advice.[4] They are also crucial to the health systems because they can offer health services by dispensing medicinal products, advising patients on drug assumption regimens, and offering pharmacovigilance services.[5]

Patients need more opportunities to increase their attention towards their health and disease management in recent times.[2,6] They can optimize therapeutic outcomes through the development of tools and applications that can provide information on the treatment of diseases with a focus on compliance and adherence, Adverse Drug Reactions (ADRs), and Drug-Drug Interactions (DDIs).[7,8] Moreover, more applications have been developed for pharmacists to utilize their expertise, knowledge, skills, and commitment to providing all the information needed to increase the quality of life of individuals.[4,9]

Pharmacists perform specific clinical roles, including providing information to increase patient compliance in taking drugs required to improve their safety, efficacy, and positions in drug dispensing.[10,11] Previous studies showed several cases of drug contraindications, excessive doses, side effects, and drug interactions due to the lack of health services, specifically from pharmacists.[12,13] This indicates the need to ensure faster and more flexible access to pharmacists. Therefore, Europe was reported to have developed a web-based application to be used by patients through QR codes to connect with pharmacists to evaluate drug use.[14]

There is minimal monitoring of drug use by pharmacists, as indicated by the results of a previous study that 56% of patients are not familiar with pharmacists. In comparison, 86.6% are expected to consult on drug-related problems.[15,16] Therefore, this study aims to facilitate the activities of pharmacists in drug administration and evaluation and to increase patient knowledge of their treatments.

Materials and Method

System Development Life Cycle (SDLC) creates and modifies systems, models, and methodologies to develop software.[17] At the same time, the waterfall method is generally used for systematic development from one stage to another.[18] It is important to note that the SDLC method was applied to develop software to solve obstacles related to the development of health information technology. The process was initiated with the need identification stage, followed by prototypes, functional validation, and evaluation.[19]

Meanwhile, the waterfall method follows a linear sequential flow, with the progress observed to be flowing down as it was in the developing phase. This approach does not allow a return to the previous step but will enable changes. Moreover, the SDLC model used a step-by-step approach to complete the software development process. It is essential to note that a robust process usually leads to a solid final product and a successful project.[20]

The seven stages involved in the development of the Pharm-Care Tadulako application using this method are explained as follows:

1. Planning: This stage involves searching for information related to the reasons for developing the Pharm-Care Tadulako applications and the needs of pharmacists towards improving pharmaceutical services and care services as the foundation for the development of the application.
2. Needs Analysis: This involves analyzing the features to be added to the design of the proposed application about the main problems.
3. System Design: This stage involves developing the preliminary system design related to the proposed application as indicated by the algorithms in the form of flowcharts/flow diagrams, details of the features to be added, and the inclusion of cases from the perspectives of admins and users.
4. Development: This stage focuses on searching and finding the needs to be completed before creating the application. Some of the things considered include the software, hardware, and brainware required to ensure the successful development of the application.
5. Implementation: The developers combine the system design and development stages to execute the application using the previously highlighted software, hardware, and brainware requirements. It is important to note that the sublime text code editor was used for coding, which serves as the application's core.
6. Evaluation: This stage involves analyzing the shortcomings and weaknesses of the application. A black box method which is usually used to assess an application from the outside without critical observation was applied in this study.
7. Maintenance: This stage involves determining the shortcomings and weaknesses of the application and how they can be resolved. Maintenance is usually conducted after evaluation for a specific time.

Data Collection

This study invited four pharmacies in different sub-districts to use the Pharm-Care Tadulako application developed. The clinical study was approved by the Faculty of Medicine, Tadulako University, number 5480/UN.21.8.30/KL/2021. All pharmacists in each store were provided with detailed information concerning the application and the data collected between October 19th to 23rd, 2021, in Palu City, Centre of Sulawesi, Indonesia. It is important to note that pharmacists and patients were asked to fill out an informed consent form.

Data Analysis

The Pharm-Care Tadulako application was used for pharmaceutical services at several pharmacies in Palu in October 2021. The users who also served as the respondents include four pharmacists between 23-37 years old and 30 patients of all ages. The data analyzed include the patient disease patterns, age, gender, medications, and the most often used features of the Pharm-Care Tadulako application.

Results and Discussion

In developing The Pharm-Care Tadulako, seven processes were run to a successful application. Based on observation of the pharmacy condition in Tadulako, we have planned and designed the features for Pharm-Care Tadulako. (Fig. 1). The web domain was purchased from Hostinger (http://hostinger.co.id). The web-based application was created using HTML, CSS, PHP, and Javascript.

The system internally saved all data inside the website. The website was well-developed to make it easier for users to access it. The

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steps for using the web started with the login, registration, EMR drug reminders, and clinical data monitoring, the pharm messenger and medication analysis (Fig.2) were also accessible on the website. To start the application testing, we submitted an ethical clearance. This study was approved by the Research Ethics Committee of the Faculty of Medicine and Health, Faculty of Medicine, the University of Tadulako, with the number 5480/UN/28.1.30/KL/2021. All efforts were made to protect participants' data on the website.

A total of 4 pharmacists, including three males and one female between the age range of 29-35 years, willingly participated. This showed that young pharmacists better understand application usage than older ones. Meanwhile, patients who used the application were between 6-74 years, most in the adult category (65%), while the least were the children and the elderly (3%) (Fig. 3).

It is important to note that pediatric patient data was filled in by their parents, who are 35 years old and categorized as adults. In contrast, elderly patients were assisted by their children, who are 25 years old and included in the adult category. This can be concluded that adult patients have a better understanding of the usage of the application technology and are also considered more susceptible to disease.

It was observed that the technological gap among internet users is associated with the age factor, which has profound implications. Several studies explained that the inability of the elderly group to adopt digital media in their daily lives has a significant effect on their personal and broader lives. On a personal level, they are excluded from modern development, leading to wider negative consequences such as reducing their participation in the work environment, ultimately creating financial problems for them.[21]

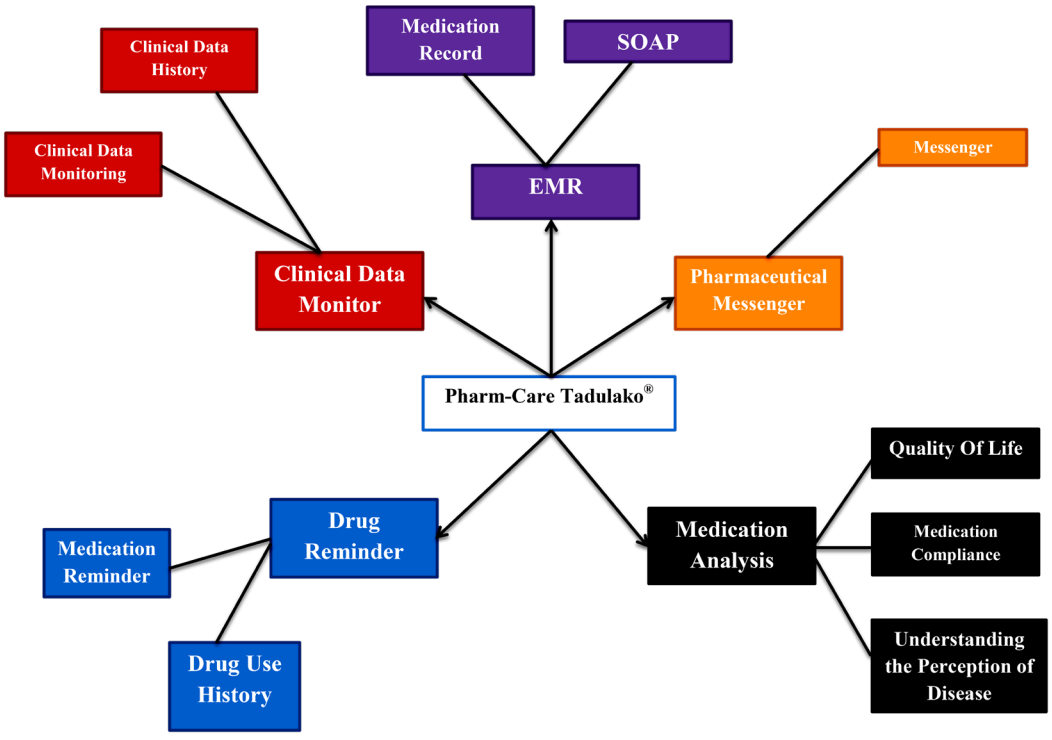

Figure 1. Pharm-Care Tadulako Application Features

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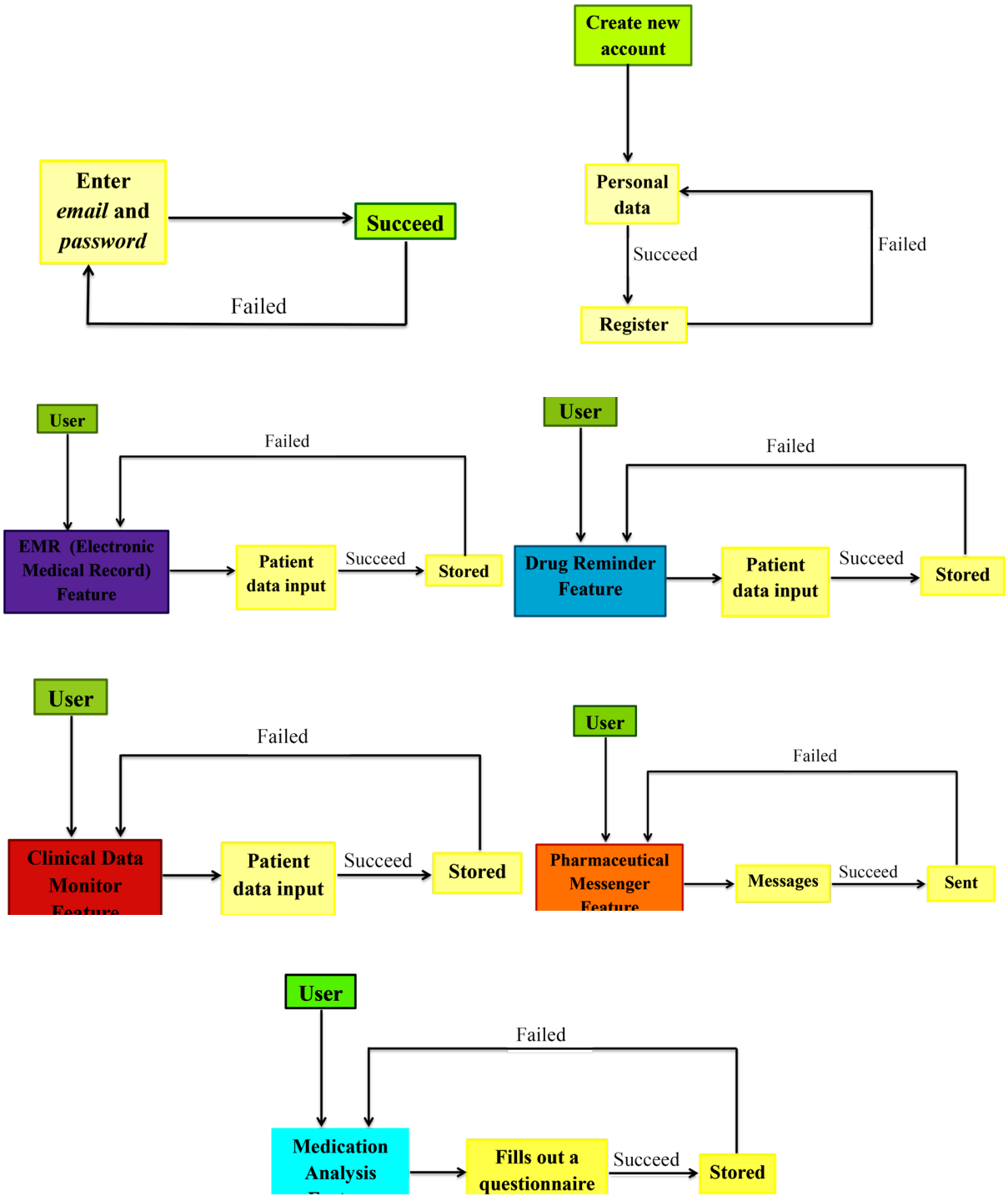

Figure 2. Algorithm Features
(a) Registration. (b) Log in. (c) EMR. (d) Clinical Data Monitoring. (e) Pharmaceutical Messenger. (f) Medication Analysis

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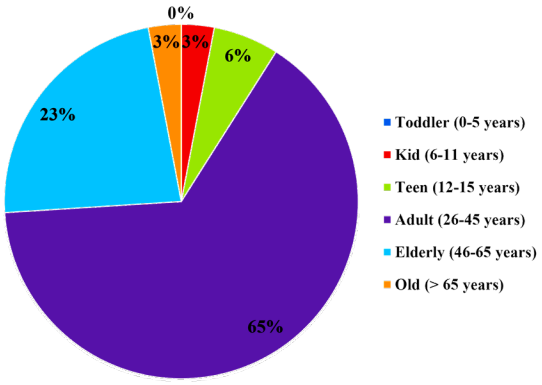

Figure 3. Age Distribution among Pharm-Care Users

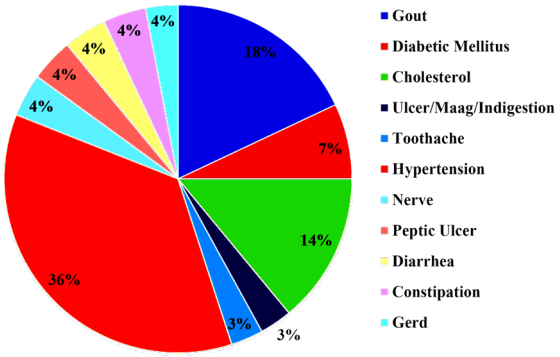

Figure 4. Disease Patterns of Pharm-care Users

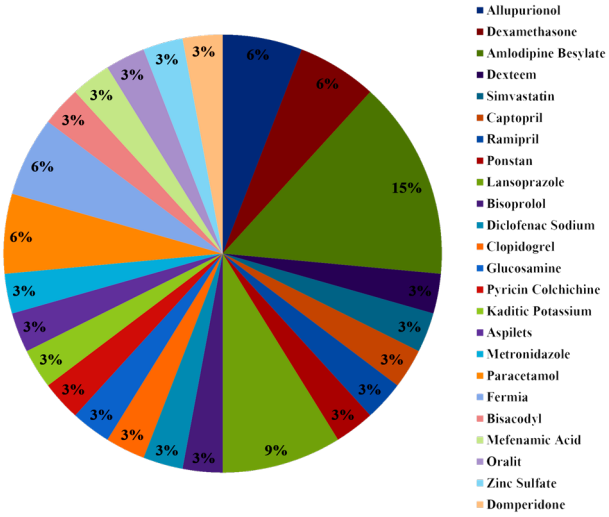

Figure 5. Drug Profiles

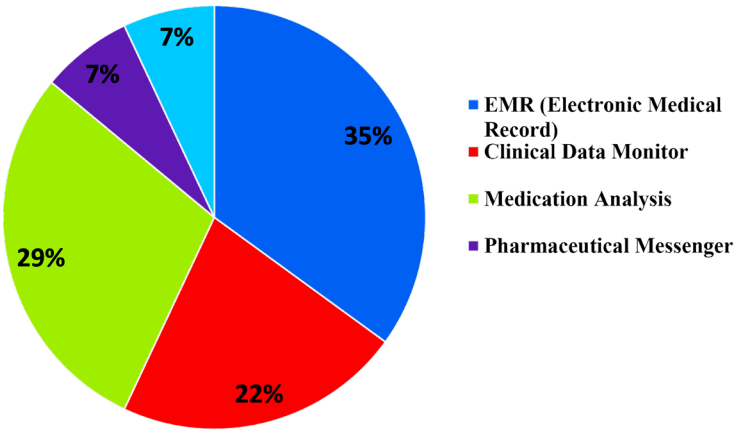

Figure 6. Pharm care Most Used Features

This was proved using the statistical data from the survey conducted by the Association of Indonesian Internet Service Providers (APJII) in 2016, which showed internet usage reached 132.7 million users in the country. The penetration was dominated by those between 25-34 years, which represented 75.4%, while those between 55 years and above were only 2%.[22] The patient profile showed that the most dominant disease out of the 11 used in the application was hypertension, with 36%. (Fig.4) Hypertension or elevated blood pressure (BP) is a severe medical condition that significantly increases the tendency of the other organs in the body to become damaged. It has been estimated that 1.28 billion adults aged 30-79 years worldwide have this disease, with most, approximately two-thirds, living in low- and middle-income countries. Moreover, 46% of adults with hypertension are unaware that they have this disease (WHO, 2021).

Its prevalence has also been reported by Riskesdas (2018) to be relatively high, with 34.1% among those aged 18-24, 20.1% for those aged 25-34, and 31.6% for those aged 25-44. The trend increased compared to the 25.8% recorded for those between 18 years and above in 2013. Hypertension has some modifiable risk factors, such as an unhealthy diet in the form of excessive salt consumption, high saturated fat, and trans-fat diet, low intake of fruits and vegetables, lack of physical activity, tobacco and alcohol consumption, and being overweight or obese. However, the non-modifiable risk factors include family history, over 65 years of age, and comorbidities such as diabetes or kidney disease (WHO, 2021).

The most common drug use profiles included amlodipine at 15%, lansoprazole at 8%, and allopurinol at 8%. (Fig.5) Meanwhile, amlodipine belongs to the CCB dihydropyridine (DHP) class, an L-type calcium channel blocker that reduces Ca^{2+} entry into vascular smooth muscle. It has a slow rate of elimination over 40-60 hours, but it is an excellent first-line drug compared to other hypertensive agents.[28-30] The first-line agent indicated for the uric acid-lowering disease is allopurinol, inhibiting xanthine oxidase. It is usually recommended due to its effectiveness, low cost, and availability. It can also reduce the excretion of uric acid for 24 hours more but has a severe side effect of allopurinol hypersensitivity syndrome when the wrong dosage is administered. Therefore, NSAIDs are initially given for 3-5 days to reduce the gout therapy algorithm.[31-33]

Lansoprazole is a PPI drug that inhibits H+ K+ATPase independently of acidic pH but requires 3 to 5 days to provide the maximum acid-blocking effect. Japan developed a new drug known as lansoprazole in 2015, and it is declared to be better and more effective in the long term than lansoprazole. Vonoprazan inhibits novel potassium-competitive acids that benefit acid disorders.[34,35] According to indications, patients must consult a doctor or pharmacist to use these two drugs. This makes it essential to develop applications for drug information services to ensure patients have better knowledge of the medicines used towards ascertaining their medication adherence.

There are five main features in Pharm-Care Tadulako: EMR, medication analysis, drug reminder, clinical data monitoring, and pharmaceutical messenger. The most frequently used is EMR, as indicated by 35% usage, followed by medication analysis with 29% due to its ability to assess the quality of life, medication adherence, and understanding of disease perception. (Fig. 6) This application provides questionnaires to be filled in by people with or without the disease to assess their quality of life.

Moreover, the clinical data monitor is designed to monitor patient clinical data, specifically for those on clinical examination, and this means it is only for a particular class of patients. A feature rarely used is the drug reminder because some respondents claimed to have forgotten the names of the drugs they are using while others have even stopped taking their medicines. Pharmaceutical messengers also have low usage because patients are not always required to have virtual chats with their pharmacists.

Conclusion

The current Pharm-Care Tadulako application has five main features, including electronic medical records, drug reminders, clinical data monitors, pharmaceutical messengers, and medication analysis, which produced several results based on age, disease patterns, drugs, and users. Age was found to have a significant influence on the usage of the application, as indicated by the fact that those between 26-45 years of age who are classified as adults and other age categories guided by adults mostly used the Pharm-Care Tadulako application. The results also showed that pharmaceutical care applications are widely used for degenerative diseases like hypertension and gout, requiring special attention. This eHealth Pharm-Care Tadulako is expected to assist pharmacists in performing their pharmaceutical care services and monitoring patients' health.

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