Detection of Non-Communicable Disease Risk Using Android-Based Application (Design of DERI PTM Application)

Feranita Utama1*, Windi Indah Fajar Ningsih1, Widya Lionita1
1Faculty of Public Health, Sriwijaya University, Indonesia

ARTICLE INFO

Non-communicable diseases (NCDs) are chronic diseases often not realized by sufferers and continue to experience a significant increase. They are the largest contributor to the cause of death in the world. NCDs also affect a person's susceptibility to exposure to coronavirus 19 (covid 19) and increase the severity of covid 19 sufferers. This study aimed to design a health application that the community can use for early detection of NCD risk factors, especially modifiable behavioral risk factors and metabolic risk factors. The application design method used the prototype method. Needs analysis and application trials were conducted at Sriwijaya University. A needs analysis was performed by conducting in-depth interviews with five students, three lecturers, three employees, a leadership of faculty, and ahead of the university's healthy campus program. User trial results are evaluated through Zoom and by filling out a questionnaire on Google Forms. The results of the needs analysis survey showed that most users want the design of an Android-based health application that assesses the risk of NCDs and recommendations for the results of risk assessment. In conclusion, an android-based health application has been designed to independently detect the risk of non-communicable diseases under the name DERI PTM. This application can be developed into an effective educational media for preventing and controlling non-communicable diseases in the community. It can be utilized as an information system (surveillance) of NCDs at Sriwijaya University.

Kata kunci:
Android; Aplikasi mobile; Penyakit Tidak Menular; Deteksi resiko.

Corresponding Author:
Feranita Utama
Faculty of Public Health, Sriwijaya University, Indonesia
Email: feranita@fkm.unsri.ac.id
INTRODUCTION

World Health Organization (WHO) claimed that more than 70% of deaths worldwide are caused by non-communicable diseases (NCDs). Many deaths due to NCD (about 75%) occur in countries with low and middle income (World Health Organization, 2018; World Health Organization, 2020b). Death from NCD in Indonesia reached 73%, and 26% probability of premature death (World Health Organization, 2020b). Basic Health Research Results (Riskesdas) in 2018 showed the prevalence of several NCDs in Indonesia had increased, compared to the previous Riskesdas results, including the prevalence of hypertension (increased from 25.8% to 34.1%), diabetes mellitus (increased from 6.9% to 8.5%), and stroke prevalence (increased from 7‰ increased to 10.9‰) (Kementrian Kesehatan RI, 2013; Ministry of Health RI, 2018).

The world is facing a pandemic, the coronavirus disease-19 (Covid-19). The number of confirmed cases reported by WHO on 21st March 2021 has been more than 122 million cases, and the case fatality rate (CFR) of 2.2% (World Health Organization, 2021). In Indonesia, confirmed cases on 21st March 2021, the total is more than 1.46 million cases with a CFR of 2.7% (Satuan Tugas Penanganan COVID-19, 2021). Individuals with NCD are more easily exposed to the coronavirus 19, and their condition will be even more severe if attacked by this virus (P2PTM Ministry of Health RI, 2020; World Health Organization, 2020a). Started from 13th October 2020, there were 1488 confirmed patients with co-morbidities (50.5% with hypertension, 34.5% with Diabetes Mellitus, and 19.6% with heart disease), and out of these 1488 cases, 13.2% died with hypertension, 11.6% died with Diabetes Mellitus and 7.7% died with heart disease (Ministry of Health RI, 2020). For this reason, individuals with NCD need to increase their vigilance in preventing the transmission of Covid-19, especially since sufferers are elderly.

NCD is often not realized by sufferers, but if it is quickly discovered, the faster the treatment will be carried out so that the prognosis of this disease can be better. One way of early detection of this disease is to assess the risk factors in individuals. Some modifiable NCD risk factors include tobacco use behavior, unhealthy eating patterns, lack of physical activity, and harmful use of alcohol. This risky behavior will lead to overweight and obesity, increased blood pressure, and increased cholesterol, and eventually cause NCD (World Health Organization, 2020b; World Health Organization, 2018).

Sriwijaya University (UNSRI) is a university that supports healthy campus programs. Researchers have conducted several studies related to NCD in the UNSRI environment. The study's results in 2020 showed that 40.8% of UNSRI employees had prehypertension, 13.2% had hypertension, 32.9% were obese, and 36.8% had cholesterol above normal. There were still 40.8% of employees who had a habit of smoking in the past month (Utama et al., 2021).

Android is a technology that is commonly used by many people today. Various applications, including a health application, can be added to the Android system. The Ministry of Health has designed an application to support NCD surveillance, both web and android-based. However, it is only used by NCD surveillance officers to facilitate reporting of NCD surveillance data. Based on the development of NCD and the current pandemic conditions, the general public can conduct an independent NCD risk factor assessment. Research on Prevention and Control Programs for Non-Communicable Diseases in Indonesia offers a solution for responding to the increasing burden of NCDs, including increasing technology-based health promotion (Wahidin et al., 2022). The use of information technology is also a necessity in the era of the industrial revolution 4.0. The NCD detection application is expected to be able to invite the public to pay more attention to long-term health and routine health checks (Aulia & Widyati, 2020). Therefore, researchers were interested in designing an Android-based health application that was utilized by the general public in independently detecting NCD risk factors early. Therefore, researchers were interested in designing an Android-based health application that was utilized by the general public in independently detecting NCD risk factors early.

This study aimed to design and build health applications to detect early NCD risk factors that were flexible and to the community's needs, especially at Sriwijaya University. The results of this study were used as a basis for developing health applications that supported health information systems and as media for health promotion related to NCD.
METHOD

An application design research in terms of prototype method was used in this research. The research was conducted from March to December 2021. The steps in designing and developing this health application included:

1. Application needs analysis
   The initial target users of the application for early detection of risk factors for non-communicable diseases were the academic community of Sriwijaya University. Requirements analysis was carried out qualitatively to explore the needs and desires of the user, researchers conducted in-depth interviews. The initial informants in digging up information on application needs were 15 people. Student informants (5 people), lecturers (3 people), and staff (3 people) were taken from various faculties to get a general description of the information to be explored. They were chosen to get a perspective regarding the use of technology to facilitate the detection of NCD in the campus environment. The faculty leadership informants were selected from the public health faculty because they were considered more familiar with the risk factors for NCD and the management of PTM prevention and control. The head of the university's healthy campus program was selected as an informant, so the resulting application supported the university's need to realize Sriwijaya University as a healthy campus.

2. I was designing application prototypes based on user needs and desires. At this stage, the researcher communicated to the programmer that the application design was based on the needs analysis results.

3. Prototype trials for users and evaluation
   The prototype trial was conducted on 25 people consisting of students (15 people), lecturers (4 people), and employees (6 people). Students, lecturers, and employees were selected to consider the diversity of respondents in the campus environment so that comprehensive information could be obtained. Input was obtained by distributing prototype evaluation questionnaires via the Google form. The information required from respondents is (a) the functionality of the menus in the application, (b) input on the appearance of the application, and (c) input on the desired additional menu.

4. Designing and building the final system
   The results of the evaluation were then implemented in the improvement of the prototype. The researcher communicated to the programmer suggestions for changes to be implemented in designing the final system.

5. The application was ready to use
   After the prototype changes were made and the expected final design of the application was produced, the application was promoted to the Sriwijaya University community.

6. Final evaluation
   The researchers reviewed the applications that were designed, assessed the strengths and weaknesses, and made recommendations for improvement and development of applications to increase the usefulness of the applications that were designed.

RESULT

The Application Needs Analysis

The results of interviews regarding the needs and desires of users for health applications for early risk detection of non-communicable diseases showed that all informants were interested in designing applications related to the early detection of non-communicable diseases. The majority suggested that media access this application via a smartphone (mobile) because it tends to be used more often than web-based. However, some suggested web-based to make a mobile version then as well.

"Mmm ... mobile, I guess. it is a good mobile application" (WR)

"In Mrs. Em's opinion, it is easier to use a cell phone. If using the web, sometimes you want to open everything first, right?" (EM)

"Just mobile, simple. I can bring it and can see it anywhere " (IT)

"Mobile, it is easier, because most people now use cellphones. It is hard to open a computer or laptop" (IM)

"Hmm ... better to use mobile. Mobile can do it too" (EN)

"For me, the priority is those that can be accessed by using a smartphone. Nowadays, who does not have a smartphone, people already have one, right?." (JM)

"In my opinion, I am more interested in mobile" (AL)

"So yeah, I am interested, but for example, the documentation does not seem like you need to use an application
either. It is also web-based, and the price is also lower for the web.” (RZ)

“It is web-based but can be accessed via mobile too” (MM)

For application content, informants were interested in designing health applications that provided independent assessments, recommendations, and education regarding non-communicable diseases and their risk factors.

“If the application you want to make is only for the public, the general scope is public... So, we input ourselves later, and we monitor ourselves. This early detection becomes data input, and there is a conclusion later, Oh, this is his blood pressure is high above average according to the same standard no, or whether he is at risk for illness or not,”...” So, as a medium of self-control and a medium of counseling is the point” (MS)

“If it is about NCD, like the definition, symptoms, and impacts, those are included in the input, enter the menu. If the information is in the form of recommendations as an output rather than filling in the data earlier” (MM)

“Yes, if there is good information, and the information is about the NCD, it is good from the definition of impact symptoms, and suggested some suggestions or suggestions on how to overcome it.”... “Yes, anyway, if you can, the application can quickly find out the possibility of diseases that we might suffer” (EM)

“By using the data that has been inputted, both Heights, our Weights. So, it can suggest the same reminder as its function.” (WR)

“There must be types of non-communicable diseases. What is included in non-communicable diseases, what are the symptoms, how can we avoid them, and how can we follow a healthy lifestyle? There are also suggestions so we also have a healthier life.”... “If it is better, make the same information, it can be detected early... So, we know we have been in which process, right, at which level? Let us know better.” (IM)

“In my opinion, I agree, early detection and sources of information are important elements” (AG)

Some informants also suggested the application as a database.

“Mmm ... It is possible to know the graph of this level well ... the level of the disease, meaning the prevalence, the prevalence of the disease in Unsri, probably yes.” (IT)

Other feedback related to the application to be designed is suggested to be easy to use and attractive.

“But do not be complicated on the application so that everyone can access it, so you can also promote the term.” (MS)

“I am interested. Hmm ... which must be mobile-friendly” (EK)

“Hmm, I am interested, for the features, if possible, that are interesting, more user friendly” (AL)

Based on the results of user needs analysis, the researchers formulated applications designed based on smartphones using android and self-assessment to assess the risk of non-communicable diseases and added educational content related to non-communicable diseases.

The Analysis of Application Prototype Trial Evaluation Results

The application prototype was designed by considering input from informants during the needs survey. The next step was to test drive the application. Researchers conducted the first trial to assess the function of the menu that was already available (Table 1).

<p>| Table 1. Application Functionality Test Results |</p>
<table>
<thead>
<tr>
<th>Menu</th>
<th>Working (active)</th>
<th>Not working</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profile menu</td>
<td>√</td>
<td>-</td>
</tr>
<tr>
<td>Questionnaire menu</td>
<td>√</td>
<td>-</td>
</tr>
<tr>
<td>Material menu</td>
<td>√</td>
<td>-</td>
</tr>
<tr>
<td>Calculator menu</td>
<td>√</td>
<td>-</td>
</tr>
<tr>
<td>Gallery Menu</td>
<td>√</td>
<td>-</td>
</tr>
<tr>
<td>Information Menu</td>
<td>√</td>
<td>-</td>
</tr>
<tr>
<td>Help menu</td>
<td>√</td>
<td>-</td>
</tr>
<tr>
<td>About menu</td>
<td>√</td>
<td>-</td>
</tr>
</tbody>
</table>

After testing, all the menus in the application already functioned according to the researcher’s expectations. The next activity was outreach and testing on users. This activity was carried out virtually via Zoom and was attended
by 44 participants. After explaining the application, the participants were asked to install and test the use of the application and provide an evaluation. Some of the evaluations related to the application were delivered directly via Zoom, and most of the participants filled out the evaluation form via Google form.

Most participants who filled out the evaluation link were students (60%), and the other 40% were lecturers and employees of Sriwijaya University. The age of the application trial participants was 18 to 40 years; as many as 32% of the participants were in the age group > 30 years. An overview of the trial participants’ assessment of the DERI PTM application prototype is seen in Table 2.

In general, all trial participants were satisfied with the application that had been designed, and a small number thought that this application needed to be more attractive; application installation was not very easy, the application sometimes stopped when running, and it needed to explore sufficiently.

In addition to closed questions, the researcher’s evaluation questionnaire also explored opinions and suggestions for improving this application. Most participants stated that this application was good enough and helpful in detecting risk factors for non-communicable diseases. The following was a snippet of participants’ opinions on the DERI PTM application.

“This application is quite helpful to know the NCD risk” (DSA)
“The existence of this application is beneficial, especially for Unsri residents. Very innovative and hopefully can be applied in a wider scope in the future.” (ATT)

In general, it was concluded that the participants in the DERI PTM application trial thought this application was quite good and could also be helpful in monitoring health related to non-communicable diseases.

The participants in the application trial also provided several inputs for improving this application, as seen in some of the snippets of input from the participants.

“There are several things such as the exit button, the choice of yes or no, the color is not visible because they are both white and the same as the background, so it is a bit confusing.” (AF)
“We recommend that this application be included in the Play Store, so the download is much safer for Android.” (RH)
“Added more information about NCD in the material or news section, and by using language that is easily understood by ordinary people too.” (DP)
“In the future, the appearance may be even more attractive, especially regarding colors, fonts, and font sizes. Furthermore, it also maintains the quality and stability of the application so that it does not lag or hang when used.” (ATF)

The input from the evaluation trial participants was considered in improving the previously designed application.

<table>
<thead>
<tr>
<th>Variable</th>
<th>The assessment of application prototype trial participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very agree</td>
</tr>
<tr>
<td></td>
<td>n</td>
</tr>
<tr>
<td>Application view</td>
<td></td>
</tr>
<tr>
<td>Application view</td>
<td>7</td>
</tr>
<tr>
<td>Understandable application</td>
<td>7</td>
</tr>
<tr>
<td>Understandable language</td>
<td>10</td>
</tr>
<tr>
<td>Installation and instructions for use</td>
<td></td>
</tr>
<tr>
<td>The installation process is easy</td>
<td>7</td>
</tr>
<tr>
<td>The instruction for use is clear</td>
<td>7</td>
</tr>
<tr>
<td>Smooth use of the application</td>
<td></td>
</tr>
<tr>
<td>The application does not stop when used</td>
<td>4</td>
</tr>
<tr>
<td>The application does not cause the phone to stop</td>
<td>4</td>
</tr>
<tr>
<td>Application function</td>
<td></td>
</tr>
<tr>
<td>The application has adequately explored NCD risk</td>
<td>3</td>
</tr>
<tr>
<td>Satisfaction with the application</td>
<td></td>
</tr>
<tr>
<td>Overall satisfied with the application</td>
<td>5</td>
</tr>
</tbody>
</table>
DERI PTM Application

Applications designed considering input from needs survey informants and application trial participants were named DERI PTM (Non-communicable Disease Risk Detection). The following is an explanation regarding the application that has been designed.

1. How to install the application

This application was available in web and mobile versions. Users who want to use this application offline install the application by downloading the application from the website: https://deriptm.aplikasikesehatan.com/

Currently, the application is only compatible with smartphones with the Android operating system. If the application was installed, the logo appeared as shown in picture 1 on the main screen of the user's Android phone.

![Application Logo DERI PTM](image1)

Figure 1. Application Logo DERI PTM

2. How to log in

The users can click on the DERI PTM logo on the phone screen to start using the application. In the early stages, a question will appear whether you have used the application before. If the user uses this application for the first time and clicks "never", then the application will guide the user to register first. After agreeing to the terms and conditions, the user will be directed to fill out the profile first. Email and password are required when the user re-enters this application, and email is also needed if the user later forgets the password when entering the application. After filling in the profile, click "sign up." Then, the user can immediately use the application by filling in the email and password that was registered before and then clicking "sign this". The application is ready to use.

3. Menu in the application

This application has eight main menus: profile menu, questionnaire, material, calculator, gallery, information, help, and about the menu.

a. The profile menu contained information on user identity data such as name, date of birth, gender, address, cellphone number, email, and password to enter the application. In addition to password information, data stored in this menu can be changed by clicking the "edit" button. When finishing, press the "save" button, and the user can return to the main screen by clicking the "home" button in the form of an image in the bottom center.

![Main Screen Display of The Application DERI PTM](image2)

Figure 2. The Main Screen Display of The Application DERI PTM

b. The questionnaire menu consisted of three sub-menus: a questionnaire related to risk factors for non-communicable diseases, a questionnaire for the history of diagnosis of non-communicable diseases, and a questionnaire for the history of non-communicable diseases in family members.
   (1) The non-communicable disease risk factor questionnaire sub-menu contains questions related to consumption patterns, physical activity, smoking behavior, alcohol consumption, and the results of measurements of blood pressure, weight, height, blood sugar, and total cholesterol levels. After completing this questionnaire, the non-communicable disease risk assessment results and recommendations based on these results will come out.
   (2) The non-communicable disease diagnosis history questionnaire sub-menu contains questions related to the doctor's diagnosis of several non-communicable diseases.
   (3) The sub-menu of the non-communicable disease history questionnaire in family members contains questions related to non-communicable diseases suffered by family members.
Utama et al., Detection of Non-Communicable Disease Risk Using Android-Based Application … 273

Figure 3. Steps to Use The Sub-Menu NCD Risk Factor Questionnaire

Figure 4. Questionnaire Sub-Menu Display History of NCD Diagnosis and Family History of NCD

c. The material menu contained educational material related to non-communicable diseases. Users can select educational information based on the type of disease they want to know about, such as diabetes mellitus, coronary heart disease, high blood pressure, and various other types of NCD. This material menu contained educational information on disease-causing pathologies and recommendations for consumption patterns in preventing NCD.

d. The calculator menu contained questions related to measurement results. This menu was part of a special questionnaire containing measurement results such as blood pressure, weight, height, blood sugar, and cholesterol levels. This menu was made specifically so that users can monitor risk factors for infectious diseases related to measurement results without filling out the entire questionnaire. Just like the questionnaire menu, after filling in the calculator menu, the user will get the results of a risk assessment and get recommendations according to the assessment results.

e. The gallery menu contained health information related to NCD, which was presented through attractive posters so that users could easily understand information about NCD.

f. The information menu contained brief information about non-communicable diseases.

g. The help menu contained information regarding the application, how to install it, and more.

h. The menu contained information regarding the DERI PTM application development team.

DERI PTM can be used to give more information about the preventive action of NCDs, while some applications are more focused on the medication. Moreover, users are suggested to try the calculation menu, such as body mass index, blood pressure, and blood sugar levels, which can warn us whether NCD risk factors are inside our bodies. On the other hand, program developments are needed for the application since it is accessed for Android users only. While several users use DERI PTM, it will deal with the
capacity of data storage, which should be another concern in the future.

**DISCUSSION**

Through the development of human civilization, information technology was developed to become a tool for various purposes, one of which is in the health sector. Three digital health technologies currently being developed are electronic health (e-health), telehealth, and mobile health (mHealth) (Jannah et al., 2021). Among the three forms, mHealth was better known by the public because of the ease of access using smartphones and internet services. This was a sizeable opportunity for providing health services that users could access wherever and whenever they needed health assistance.

mHealth innovation was the use of a set of tools aimed at monitoring health conditions or improving the quality of health, including assisting in online clinical decision-making (online) (Ghosh et al., 2020). Sunjaya (2019) stated that health services and patient health status improved through the more open exchange of medical information from health workers using electronic technology, especially promotive and preventive health services. A literature review reveals that patients who use mHealth are helped to adhere to the treatment, manage a healthy lifestyle, and reduce the cost and time for visiting health centers (Nurhafid & Afriyani, 2017).

mHealth has the main advantage of a data collection mechanism. With smart devices, data can be collected and analyzed continuously, meaning they can gather information actively and passively throughout the day for as long as necessary. This results in an enormous volume of data being collected, with an expanded variety of captured variables. Modern smart devices allow for extensive data collection beyond what can typically be achieved through traditional face-to-face interviews. (Cosco et al., 2019)

The mHealth application’s success can be hindered by age and economic factors. Older users may need help navigating the application on their mobile devices. This application requires internet access and device ownership in the form of a smartphone, which can burden those in the lower middle class. Moreover, user trust and adherence to the smartphone application play a significant role in the effectiveness of the mHealth application in maintenance therapy. Additionally, incomplete application features can contribute to the application’s lack of usage. (Wahyudi & Rahman, 2019)

**DERI PTM** application has been developed based on user interests and needs for the function, appearance, and quality of the information provided in the menu features. Schlatter & Levinson (2013) said that the user interface was essential to be arranged in such a way in terms of consistency of appearance (consistency), arrangement of the importance hierarchy of objects (hierarchy), first impressions (personality), layout of elements (layout), typography (type), color, usage images (imagery), as well as system interaction through the screen (control and affordance). A study shows that color and control design affect the ease of use of mobile applications. Mobile apps with orange color and design controls with icons and text are easier for users to use. The layout design component has little effect on the ease of use felt by mobile application users (Ghiffary et al., 2018). This application has used icons and text as design controls and used a contrasting color between the text and the background color, with the dominant colors being blue and white.

**DERI PTM** application has a questionnaire feature to assess risk factors for NCDs and a calculator feature to measure categories of results measuring users’ nutritional status, blood pressure, blood sugar, and cholesterol levels and provide recommendations according to the results. The mHealth application has the same features as in a 2019 study that examined the use of mHealth in patients with congenital heart disease. In this study, the mHealth application gave an alarm when the patient’s blood pressure and weight crossed the limit and provided lifestyle advice and instruction to the patients. It enables early detection of relapse and a new diagnosis of arrhythmia, hypertension, and heart failure. Additionally, mHealth is well received with high adherence and positive patient experiences. (Kauw et al., 2019)

**DERI PTM** application also has a material menu containing educational information related to disease-causing pathologies to recommendations for consumption patterns in preventing NCD, where users can select educational information based on the type of disease they want to know. Health education about non-communicable diseases is needed to increase public knowledge to have a healthy lifestyle and to prevent these diseases (Haris et al., 2022). Research by Yuniarti et al. (2020) showed that application-based education can
increase patient dietary knowledge. The diet application is a substitute for leaflet media because the operating system is user-friendly or easy to use. Its attractive appearance is equal to other educational media, such as booklets and leaflets. Based on the prototype trial, twenty percent of users strongly agreed, and eighty percent agreed/were satisfied with all aspects displayed in the DERI PTM application (Table 2). In terms of the usefulness of the application, users expected this application not only to be a reminder to monitor the risk factors they already had periodically but also as a basis for decision-making for health policymakers in controlling non-communicable diseases at the local and even national levels. The content contained in the application was intended as a reminder and educational, helpful tool for increasing user knowledge and awareness of NCD risk. It increased public knowledge about the prevention of NCD and aimed to make people aware of the dangers of NCD by taking actions/behaviors that could prevent NCD (Kurniasih et al., 2022). DERI PTM Health Application continued to be developed by technological developments and community needs because application development must innovate and be mutually integrated with other digital applications to resolve social problems in society. (Marpaung & Irwansyah, 2021).

CONCLUSION

The results of the study concluded that the DERI PTM application was designed to consider the user's input. This application consisted of eight main menus: the profile menu, questionnaire, material, calculator, gallery, information, help, and about the menu. The target application users were the general public, especially the Sriwijaya University community. The primary function of this application was the early detection of non-communicable disease risks that were carried out independently by the user and recommendations according to the risk assessment results. Suggestions from this study so that this application was developed further by adding material and information related to non-communicable diseases, so this application was also more effective in educating users regarding the prevention and control of non-communicable diseases and optimizing the use of applications for surveillance activities, especially in the environment of Sriwijaya University.

REFERENCES


Cosco, T. D., Firth, J., Vahia, I., Sixsmith, A., & Torous, J. (2019). Mobilizing mHealth Data Collection in Older Adults: Challenges and Opportunities Corresponding Author: 2(2). https://doi.org/10.2196/10019


