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Integrated Mobile Health System as A Potential Tool to Control Non-Communicable Diseases in Indonesia

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Abstract

The prevalence of non-communicable diseases increases significantly from year to year. The data show that non-communicable diseases are the top three causes of death in the world, respectively, are cardiovascular disease, cancer, and chronic respiratory disease. The financial burden of non-communicable diseases is increasing due to disabilities and prolonged treatment. It needs a comprehensive, integrated, and massive effort to control these diseases. The use of information technology for surveillance, health promotion, and service delivery in the industrial era 4.0 has the potential to be developed due to the increasing use of smartphones supported by the expansion of the internet network to rural areas. The development of an "integrated mobile health system" is highly relevant to three important elements in controlling non-communicable diseases in Indonesia, including structuring surveillance activities, strengthening health promotion, and strengthening health services. Integration of health services, development of health professional competencies, and management of health services in one system using a mobile application will increase the coverage of screening for persons at risk, effective in service-delivery, efficient in the aspect of the financing, easy to obtain information about patients, and broad in scope of health promotion.

Keywords: *mobile health, non-communicable diseases, financial burden*

Introduction

Similar to other developing countries, Indonesia has experienced an epidemiological transition in the last few decades. The prevalence of non-communicable diseases (NCDs) increases significantly from year to year. Non-communicable diseases are non-infectious health conditions that cannot be transmitted from one person to another, generally occur over a long time, and are chronic. Changes in lifestyle, consumption of unhealthy foods, lack of physical activity, and high levels of stress are all factors associated with an increase in the prevalence of NCDs. A systematic overview of reviews proves that depression, high blood cholesterol, hypertension, obesity, poor diet, smoking, less physical activity, alcohol consumption, and air pollution are the determinant factors for NCDs[1].



¹ Data shows that non-communicable diseases are the top three causes of death in the world, including cardiovascular disease, cancer, and respiratory diseases. Cases of death due to cardiovascular disease reached 17.79 million worldwide in 2017[2]. The prevalence and mortality rate of NCDs will continue to increase if not controlled and prevented earlier. NCDs even became the top five causes of death in Indonesia in the same year. The same pattern is shown, in which cardiovascular disease and cancer are in the top two causes of death, while digestive diseases, diabetes mellitus, and respiratory diseases rank 3-5. It was recorded that 597,995 people died due to cardiovascular disease in Indonesia in 2017[2].

NCDs require prolonged medication, more than one drug, prolonged disability, and decreased productivity. Prolonged treatment and disability due to NCDs are the causes of the financing burden. It increases the burden on patients, their families, and the national health financing. The financing burden due to NCDs includes direct and indirect financing burdens. Direct financing burden includes costs incurred for medical check-ups, hospitalization cost, caregiver, home care, medication, and medical equipment. Meanwhile, the indirect burden is caused by decreased productivity and loss of effective time to work. The financing burden for five NCDs in Indonesia, including cardiovascular disease, cancer, chronic obstructive pulmonary diseases, diabetes mellitus, and mental disorders reached 4.47 trillion USD or 17,863 USD per capita in 2012-2030[3]. The national health insurance agency experiences a financial deficit of IDR 9 trillion in 2014, IDR 6 trillion in 2016, IDR 13.5 trillion in 2017, and IDR 15.5 trillion in 2019[4]. The high NCDs financing causes a financial deficit in the national health insurance agency.

Comprehensive efforts are required to control NCDs, including surveillance to detect the risk of NCDs, health promotion to improve a healthy lifestyle and reduce risk factors, and health service delivery to prevent complications and accelerate the recovery process. The use of information technology for surveillance, health promotion, and service delivery in the industrial era 4.0 is very promising. It's possible due to the widespread use of smartphones supported by the expansion of internet providers to rural areas. Data from the Indonesian Digital Report shows a significant increase in internet users, reaching 175.4 million from a total of 272.1 (64%) population in Indonesia in 2020[5]. Data from the same source shows that the average internet usage through any device is 7 hours 59 minutes per day. They access the internet from any device one-third of the time in a day. The number of internet users will continue to increase in line with the expansion of the internet network, the increasing use of smartphones in all circles, and the use of information technology in all lines of life.



Use of mobile applications in smartphones is beneficial for people with high work intensity who do not have time for routine medical check-ups in health care facilities. This application can assist them in screening risk factors for NCDs, make them aware that they are at risk for NCDs, provide them with specific information on guidelines for a healthy lifestyle, and at the same time provide information on nearby health services that can help them reduce risk factors and conduct medical check-ups if necessary[6]. mHealth is not only used for screening risk factors for NCDs, obtaining information about healthy lifestyle, home care, availability of nearest health service facilities, it also can be used by health professionals to increase their competence in NCDs management, understand the NCDs management algorithm, and decide the right medical treatment for the patient. In addition, mHealth can be used to improve human resource management including competency improvement training through digital media, performance measurement, and performance-based incentives.

It is very potential to develop an integrated health mobile application that can be used and accessed by the public, patients, health professionals, health service managers, and the government. This integrated mobile application can improve the effectiveness and efficiency of prevention or management of non-communicable diseases, increase the competence and performance of health professionals, provide rewards and incentives according to performance accurately, and provide easy access to patient data, health service data, and financial data.

Burden of Non-Communicable Diseases (NCDs)

The prevalence of NCDs has shown an increase in the last 5 years based on basic health research conducted by the Indonesian Ministry of Health in 2013 and 2018. The prevalence of cancer increased from 0.14% to 0.18%, stroke increased from 0.7% to 0.9%, and diabetes increased from 1.5% to 2%[7],[8]. This will continue to increase if it is not controlled through an integrated, structured, and massive program by utilizing various health promotion media. NCDs increase the financial burden on the health care system in Indonesia. Several related factors include the burden of medical treatment costs, medical equipment costs, and hospitalization costs. The World Economic Forum predicts that the impact of non-communicable diseases will cost a budget of 4.47 trillion USD from 2012 to 2030 in Indonesia[3]. Health financing prepared by the government through health insurance managed by the Healthcare and Social Security Agency (BPJS Kesehatan) will not be sufficient if the NCDs are not controlled and prevented. The number of BPJS health insurance clients is increasing, but BPJS is still deficient in financing medical costs. The BPJS finance and investment director said the number of clients who paid premiums by the end of 2018



could not cover the 2017 deficit which reached Rp 9.75 trillion[9]. BPJS health insurance spends IDR 20.2 trillion to finance NCDs as a whole. The three types of non-communicable diseases with the highest cost, respectively, are heart disease, cancer, and stroke[10].

The financial burden due to non-communicable diseases will continue to increase if prevention and control are not implemented adequately, structurally, and massively. An integrated prevention program by utilizing information technology is needed to control these diseases. The NCDs control program includes: 1) screening persons at risk, 2) health promotion about healthy living to the community and information on home recovery management to patients and their families, 3) information about the nearest health facilities and available NCDs control programs, 4) assessment for the performance of health professional, 5) payment for health services. These programs can be integrated into one service system using a mobile health application that can be accessed by all levels of society, health professionals, and health service managers.

Strategy to control NCDs in Indonesia

There are three important elements in a strategy to control NCDs: strengthening surveillance programs, health promotion, and health services (Fig. 1). Health promotion are activity to campaign healthy lifestyle, increase community social support, improve community skills in preventing NCDs, and increase the competence of health professionals. Surveillance is an important program in order to detect person at risk NCDs based on social, environmental, lifestyle and biological characteristics. The results of surveillance are used to determine the right strategy in health promotion and campaigns for healthy lifestyles to all people, especially persons at risk. Strengthening health services is focused on reorienting health services to primary, secondary and tertiary prevention. Health programs are prioritized and focused on primary prevention to control NCDs. Secondary and tertiary prevention aims to prevent complications, reduce disability, and improve quality of life.

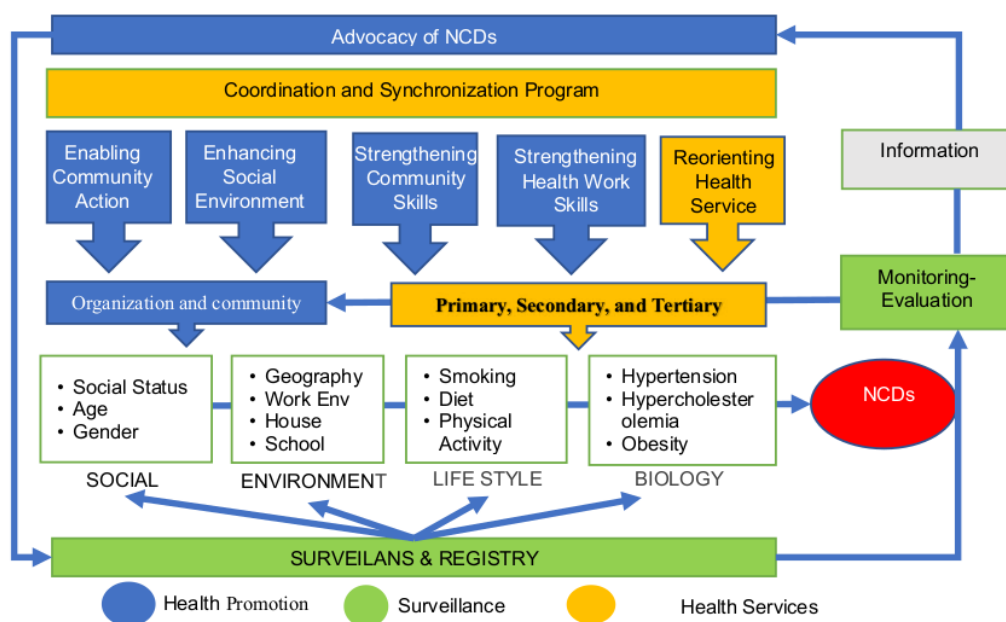


Figure 1. Comprehensive Strategy on NCDs

Prevention and control of risk factors for NCDs is carried out in four ways: 1) advocacy, collaboration, counselling, and NCDs management, 2) promotion, prevention, and reduction of risk factors for NCDs through community empowerment, 3) strengthening health care competence, and collaboration between the private and public sectors, and 4) surveillance, monitoring, and research in the case of NCDs[11]. The NCDs control program in Indonesia includes several activities: advocacy, partnerships, networking, and capacity building. Collaboration between sectors and direct community involvement in NCDs control networks is encourage. The NCDs control program in Indonesia is relevant to WHO global recommendations (Global Action Plan 2013-2020). The government prioritizes the 4 by 4 strategies which focuses on 4 NCDs that cause 60% of deaths (cardiovascular, diabetes mellitus, cancer, and chronic pulmonary diseases). Control NCDs is focused on four risk factors including an unhealthy diet (unbalanced diet, less consumption of vegetables / fruits, high consumption of sugar, salt and fat), and lack of physical activity, smoking, and alcohol consumption. Control of these 4 risk factors can prevent the occurrence of 4 NCDs as much as 80%. In addition to the four NCDs, control is also carried out for other NCDs that can reduce the quality of life such as visual impairment, hearing loss, disability, thyroid disorders, lupus, thalassemia, osteoporosis, and psoriasis[11].

Research Review of mHealth

Application in computer terms is an instruction or statement arranged in such a way that the computer can process input into output. The use of information technology provides many benefits in health service management. Various mobile applications have been developed in the health sector, especially to provide health information, early detection of diseases, emergency management and rehabilitation of various diseases. In order to provide evidence-based solutions, the author conducted literature searches and reviews. The author reviewed articles with the following criteria: mHealth intervention, aimed at controlling and managing NCDs or other functions, and published within the last 10 years. The mHealth research presented in Table 1 has gone through a review process in which the articles reviewed are those that fit the criteria and have a low risk of bias.

Table 1. mHealth intervention and its impact on NCDs control

Study (year)	mHealth Intervention	Function	Subject	Result
Kirwan et al.[12] (2013)	A diabetes-related smartphone application and text-message support from a health care professional	Information delivery (health promotion)	Adults with type 1 diabetes throughout Australia	Glycemic control (HbA1c) significantly improved in the intervention group compared to the control group. There is no significant improve in self-efficacy, self-care activities, and quality of life in both groups.
Woo et al.[13] (2015)	Korea University Health Monitoring System for Stroke Patients	Risk factor screening	Stroke patients had one or more risk factors: diabetes, obesity, smoking, hypertension, or a sedentary lifestyle	There was an increase in the target achievement of blood pressure and glycated haemoglobin (HbA1c) in the intervention group
Dharma et al.[6] (2020)	Mobile-Stroke Risk Scale and Life Style Guidance (M-SRSguide)	<ul style="list-style-type: none"> Risk factor screening Information delivery (health promotion) 	Persons at risk of stroke in the community (moderate or severe).	There is increase in healthy diets, activity patterns, and stress control after the use of M-SRSguide.
Carter et al.[14] (2013)	The smartphone application: My Meal Mate (MMM) for self-monitoring of diet and activity	<ul style="list-style-type: none"> Information delivery (health promotion) 	Overweight persons with a body mass index (BMI) of more than 27 kg/m ² .	The MMM app increases the healthy behavior of persons with overweight so that their weight decreases and is feasible to use.



Study (year)	mHealth Intervention	Function	Subject	Result
Cingi et al.[15] (2015)	A mobile phone application: physician on call patient engagement trial (POPET)	<ul style="list-style-type: none"> • Communication tools between doctor and patient 	allergic rhinitis and asthma patients	The intervention group who used POPET app increase significantly in health outcomes and quality of life. They show increases in activity, productivity, disease perception, and emotion.
Fairman et al.[16] (2016)	Interactive Mobile Health and Rehabilitation (iMHere)	<ul style="list-style-type: none"> • Information delivery (rehabilitation skill for disability patients and rehabilitation professionals) 	Patients with chronic disabilities and rehabilitation professionals	iMHere improves self-management skills in patients with chronic disabilities
Liu et al.[17] (2011)	A mobile telephone-based interactive asthma selfcare system	<ul style="list-style-type: none"> • Recording daily activities and disease symptom 	Patients with asthma in the moderate to severe persistent category	The intervention group had better quality of life and fewer episodes of exacerbation.

The review shows the positive impact of mHealth on prevention and management in patients with NCDs. The synthesis of the 7 studies above shows that mHealth is used for several functions such as risk factor screening, information delivery (health promotion, rehabilitation skills), communication tools between doctors and patients, and recording daily activities and disease symptoms (fig.2). In general, mHealth is used for screening NCDs risk factors, providing information about a healthy lifestyle, reducing risk factors, and home care / rehabilitation, monitoring disease symptoms, and communicating between health professionals and patients. mHealth is not much used for the management of health professionals who treat patients (such as competency improvement programs and performance assessments), providing rewards, health care payments, and information on the availability of health facilities for NCDs. Basically, all of these functions can be integrated into one application system called an integrated mobile health system (IMHS).



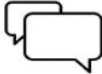

 Information delivery (health promotion, rehabilitation skill)	 Risk Factor Screening	 Communication tools between doctor and patient	 Recording daily activities and disease symptom
Kirwan et al. (2013) A diabetes-related smartphone application and text-message support Dharma et al. (2020) Mobile-Stroke Risk Scale and Life Style Guidance (M-SRSguide) Carter et al. (2013) The smartphone application: My Meal Mate (MMM) for self- monitoring of diet and activity Fairman et al.16 (2016) Interactive Mobile Health and Rehabilitation (iMHere)	Woo et al. (2015) Korea University Health Monitoring System for Stroke Patients Dharma et al. (2020) Mobile-Stroke Risk Scale and Life Style Guidance (M-SRSguide)	Cingi et al.15 (2015) The smartphone application: My Meal Mate (MMM) for self- monitoring of diet and activity	Liu (2011) A mobile telephone- based interactive asthma selfcare system

Figure 2. The function of mHealth in the control of NCDs based on a literature review

The existing phenomenon is that the use of mHealth for the control and management of NCDs is still partial and not integrated. Mobile applications are most widely used for screening, providing information about healthy lifestyles, self-monitoring, and home care. Although proven effective in improving the health outcomes of patients or mHealth users, its partial use will reduce the effectiveness and benefits of mHealth. A mobile application that is integrated into one system is needed for all health programs in the context of controlling non-communicable diseases that can be used by persons at risk, patients and their families, health professionals, and health care facilities. The integration of surveillance programs, service delivery, and human resource development into one mobile health system has a positive impact. Data collection of persons at risk will become easier, service delivery will be more effective, patient information will be easily accessible, and health promotion will be wider. The use of integrated mobile applications in one system can streamline the implementation of the NCDs prevention program.

Integrated Mobile Health System (IMHS) to control NCDs

The integrated mobile health system is an integrated mobile application that can be accessed via a smartphone to control NCDs, with its function including risk factor screening, self-monitoring of daily activities and symptoms, information resources for a healthy lifestyle, home care, and rehabilitation, online counselling, health service

management, and human resources management, that can be accessed by patients, health professionals, and health care facilities.

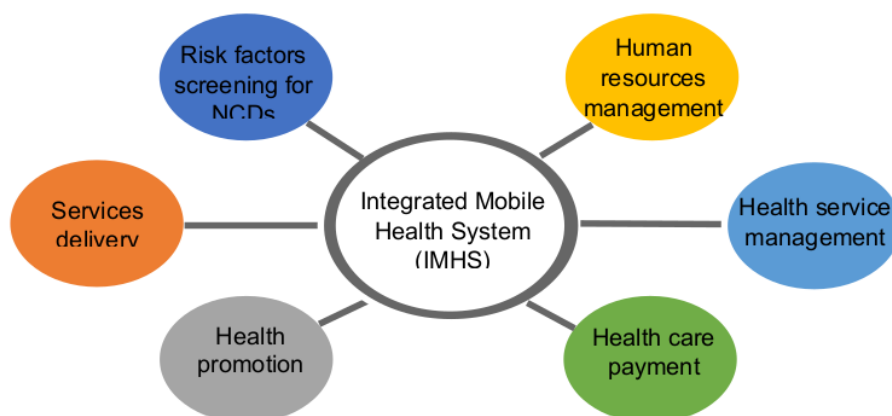


Figure 3. Integrated mobile health system for controlling NCDs

Figure 3 describes the integrated mobile health system scheme which includes: 1) services to the community including risk factors screening for NCDs, health promotion on healthy lifestyle and self-management control, service delivery, and counselling, 2) human resource management including training for increasing competence, assessing the performance of health professionals, and providing incentives, 3) financial services, and 4) health service management, in one mobile health application that can be accessed by patients and their families, health professionals, and health service managers. The integrated mobile health system is relevant to the national program for the control of NCDs. According to the national program, mHealth can be used to strengthen risk factor surveillance and research on NCDs. The use of mHealth for health promotion and service delivery can support the prevention of risk factors. The use of mHealth for human resources management serves to strengthen the capacity and competence of health services. The use of mHealth for health care management can improve the quality of NCDs care for the community.

The Integrated mobile health system can be implemented for the management of one of the NCDs. It can be used for stroke prevention and rehabilitation in the communities.

- In screening risk factors, mHealth can be developed for self-assessment of risk factors for stroke.
- In health promotion, mHealth can be developed to provide detailed information on controlling stroke risk factors.
- In service delivery, mHealth can be developed to provide health counselling and information delivery about post-stroke home care.

- In human resources management, mHealth can be developed as a tool to determine the workload of health professionals, increase knowledge and competence of health professionals, and for performance assessment.
- In health service management, mHealth can be developed to provide algorithms and standard operational procedures (SOPs) as a guide for providing services.
- In health care payments, mHealth can be developed to calculate the cost of health services.

The six services above are integrated into one mobile application that can be accessed anytime and anywhere by patients as consumers, as well as health professionals and management as providers. Use of integrated mHealth makes it easy to access patient data. This data can be used to determine health care policies and health research. Health promotion through mobile applications is very effective in reaching the wider community, not limited by time and space. For the provider, it can also be used to determine the health professional's performance accurately, which then becomes the basis for providing incentives. Algorithms and service SOPs stored in the application make it easy for health professionals to determine the right services for patients.

Recommendations

The high prevalence of non-communicable diseases causes a financial burden in national health financing, so it requires special attention. The significant increase in the number of internet users and the average time to use the internet per day is a great opportunity to develop an integrated mobile health application. This tool is able to reach the wider community and streamline the implementation of the NCDs prevention program. Based on this, the authors recommend developing "the integrated mobile health system" as a supporting tool for the prevention of NCDs in Indonesia. Through a series of development processes and testing the feasibility of this tool, it is hoped that it can provide benefits in controlling NCDs in Indonesia.

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