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Utilizing Appropriate Technology for Non-Invasive Examination of Blood Sugar, Cholesterol, and Uric Acid Levels

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ABSTRAK
Gula darah, kolesterol, dan asam urat tinggi adalah penyakit tidak menular dan menjadi salah satu penyebab kematian di dunia. Umumnya, penyakit ini sangat rentan diderita oleh masyarakat lansia. Salah satu pemeriksaan untuk memantau kadar gula darah, kolesterol, dan asam urat adalah dengan alat tes sekali pakai secara invasif. Metode ini tidak efisien karena menyebabkan resiko infeksi, menambah limbah medis dan biaya yang cukup mahal. Mahasiswa kuliah kerja nyata Universitas Islam Negeri Walisongo Semarang kelompok 53 mengadakan pemeriksaan gratis di desa Krandon sebagai upaya melaksanakan pengabdian masyarakat melalui teknologi tepat guna di bidang kesehatan. Alat pemeriksaan dibuat oleh dosen dan mahasiswa menggunakan metode non-invasif (tanpa melukai tubuh). Berdasarkan hasil wawancara mahasiswa kepada masyarakat dan petugas kesehatan, program kerja ini mendapat respon yang baik karena pemeriksaan tidak menimbulkan rasa perih dan membantu mengurangi limbah medis di lingkungan.

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ABSTRACT
High blood sugar, cholesterol and uric acid are non-communicable diseases and are one of the causes of death in the world. Generally, this disease is very susceptible to be suffered by the elderly. One of the tests to monitor blood sugar, cholesterol, and uric acid levels is with an invasive disposable test kit. This method is inefficient because it causes the risk of infection, increases medical waste and is quite expensive. Real work students from Walisongo State Islamic University Semarang group 53 held a free examination in Krandon Village as an effort to carry out community service through appropriate technology in the health sector. Examination tools are made by lecturers and students using non-invasive methods (without injuring the body). Based on the results of student interviews with the community and health workers, this work program received a good response because the examination did not cause pain and helped reduce medical waste in the environment.

1. Introduction

Diabetes is one of the non-communicable diseases that is a major contributor to death in the world. Data from WHO, states that 70% of deaths are caused by non-communicable diseases such

as Diabetes Mellitus (Ente & Islamiyati, 2021). In addition, cholesterol is also the second contributor after diabetes. One of the main factors causing hypercholesterolemia or high cholesterol levels is high uric acid levels in the human body (Yani, 2015). Based on data from Basic Health Research (Riskesdas, 2013), patients with a history of hypercholesterolemia in Indonesia have reached 69.6% while 39.6% occurred in a woman. Calculations from these data state that there has been a significant increase in the prevalence rate, from 6.9% in 2013 to 8.5% in 2018 (InfoDaTIN, 2013). One of the factors that trigger high cholesterol levels is due to high levels of uric acid so that it can cause a buildup of uric acid crystals in the body. Uric acid is the end result of the purine metabolism process, which is one part of nucleic acids in the nucleus of body cells (Yunita et al., 2018). Increased uric acid causes disturbances in the body such as aches and pains in the joints. This disease usually occurs at the age of old age, but it is not uncommon for pre-elderly people (Simamora & Saragih, 2019).

In general, measurements of blood sugar, cholesterol, and uric acid levels are carried out invasively (injuring the body) using disposable devices. Sulehu and Senrimang (Sulehu & Senrimang, 2018) explained in their research that a non-invasive method is an examination method by taking a blood sample after pricking a finger with a needle. This measurement certainly causes pain because it will injure the skin and can also increase medical waste (Deviana et al., 2020). Invasive examination, can allow the risk of infection when the needle is in direct contact with the tissue, so this method is considered less effective to use. The World Health Organization (2013) states that exposure to blood by needle sticks can increase the risk of viral infections such as hepatitis B virus (HBV) by 5-40%, hepatitis C (HCV) 3-10% and Human Immune Deficiency Virus (HIV) with 0.2 – 0.5% (Septiani, 2018). In addition, measuring blood sugar, cholesterol, and uric acid levels certainly requires not cheap costs and can increase the amount of medical waste in the environment. If medical waste is different from industrial or domestic waste, more specific waste management is required. However, until now, the management of this waste requires high costs and regulations as a condition for management efforts. If non-medical waste is mixed with medical waste, it is classified as medical waste, so if it is not managed properly it will definitely increase medical waste. This certainly affects the health of waste managers, both from the aspect of occupational safety and health as well as from an environmental perspective (Adhani, 2018).

Technological developments in the 5.0 era provide many benefits in all fields. As Allah has explained in the Qur'an Surah Yunus verse 101:

قُلِ انْظُرُوْا مَاذَا فِى السَّمٰوٰتِ وَالْاَرْضِ ۗوَمَا تُغْنِى الْاٰيٰتُ وَالنُّذُرُ عَنْ قَوْمٍ لَّا يُؤْمِنُوْنَ

Meaning: *Say, "Pay attention to what is in the heavens and in the earth!" Signs (of Allah's greatness) and messengers are not useful for those who do not believe* (Kemenag, 2022).

The verse above explains that even in the Qur'an there are also several animal stories that can provide lessons in everyday life. The diversity of these lessons suggests to us that God has ordered humans to pay attention to phenomena in the environment that are signs of God's greatness. This phenomenon is not only observed with the eyes of the head, but also researched, studied, and analyzed. This is a form of developing science and technology in this increasingly advanced era so that it can be used by many people (Qismah, 2012).

Previous research was conducted by Mahaendrajaya, Hidayanto, and Arifin (Marhaendrajaya et al., 2017) with the manufacture of a cholesterol level measuring instrument and Sulistyani, Yulianto and Syaifudin (2017) a non-invasive measuring blood sugar level using an oximeter sensor and both produce an accuracy value of up to 96%. Therefore, students of the State Islamic University of Walisongo Semarang innovated by making appropriate technology tools as a means of measuring blood sugar, cholesterol, and uric acid levels which were carried out non-invasively, namely not injuring the patient's skin. This tool is a development of previous research by Nurma'atin (2021), which is a non-invasive blood cholesterol detection tool with a telemedicine system. The use of the oximeter sensor on the prototype tool produces an accuracy value of 99.74%.

After previous trials, the correlation coefficient for blood sugar tests was 0.9282, cholesterol was 0.9614, and uric acid was 0.8548. This tool shows great potential to measure blood sugar, cholesterol, uric acid levels with non-invasive methods because the correlation coefficient is more than 0.8 (Arisandy, 2013). This tool can reduce medical waste in the surrounding environment, because it can be used continuously without having to replace the lancet needle. In addition, considering that medical waste in Indonesia continues to increase from year to year (CNN Indonesia, 2021), this tool can be a solution as an effort to reduce medical waste in the surrounding environment in order to realize the Go Green Movement implemented by the Walisongo State Islamic University campus, Semarang. alone.

Devotion itself is a form of students in practicing and cultivating science and technology as a form of advancing community welfare (Ristekdikti, 2021). Therefore, group 53 students of the Special Mission Real Work Lecture at Walisongo State Islamic University Semarang contributed to community service through the application of appropriate technology by providing free examinations including measuring blood sugar, cholesterol, and uric acid using non-invasive methods (without injuring the body). This tool was designed by lecturers and students of the State Islamic University of Walisongo Semarang, which is a non-invasive measuring tool for blood sugar, cholesterol, and uric acid.

2. Methods

This community service activity by community service program students is a manifestation of efforts to prosper the village community through various types of work programs, especially public health. Seeing the many impacts caused by the COVID-19 pandemic starting from health, economy, to the environment. As a community service effort in the field of health and the environment, community service program students contribute to the provision of free examinations with the target audience of the elderly. The implementation of this activity was carried out on Tuesday, July 13, 2022 in Krandon Village, Guntur District, Demak Regency.

This service is carried out to the surrounding community by utilizing a free blood sugar, cholesterol, and uric acid detection measuring device using a non-invasive method. This is very helpful for the local community and local medical personnel because the measurements are carried out at no cost and do not leave pain due to needle sticks. In addition, the presence of non-invasive measurement tools can reduce medical waste in the surrounding environment.

Figure 1. Non-invasive 3 in 1 measuring tool

The working principle of this non-invasive tool is to measure blood sugar, cholesterol and uric acid levels by utilizing the characteristics of infrared absorption and red LED on the DS-100A oximeter sensor (Nugroho, 2019; Umar & Amin, 2019). Power on all transmitter circuits, using a power bank to reduce battery waste. After the tool is on as shown in Figure 1, the Arduino Uno R3 microcontroller will send data during measurements and convert analog data into digital data (Handoko, 2017; Susanto et al., 2013). The results of the examination of blood sugar, cholesterol, and uric acid levels will be displayed on a 20x4 LCD screen.

3. Results and Discussion

Free health check is one of the programs that is carried out routinely once a month by one of the villages in Demak Regency, namely Krandon Village. This program is highly recommended to be carried out considering the importance of maintaining health as a form of the Healthy Living Community Movement (Germas) which was instructed by the President of the Republic of Indonesia in 2017. The purpose of this movement is as an effort to reduce the cost of health services, improve health status, and community productivity (Presiden RI 2017). Germas activities can be realized through:

1. Increase community activities in physical form
2. Providing healthy food and accelerating nutrition improvement programs
3. Improve a healthy lifestyle
4. Improve the quality of the surrounding environment
5. Improve disease prevention and early detection
6. Increase learning about healthy lifestyles (Kemenkes RI, 2017).

These free check-ups include measuring height and weight, measuring blood pressure, and measuring blood sugar, cholesterol, and uric acid levels. Some students helped in measuring height and weight, while others carried out examinations using non-invasive methods as shown in Figure 2. After measuring 56 communities targeting the elderly, the results showed that the majority of Krandon villagers had blood sugar levels, and high cholesterol in both men and women. In addition to examinations, health workers also provide medicine and food to help heal the diseases experienced by the community and provide explanations regarding foods that must be consumed or avoided to help the healing process.

(a)

(b)

Figure 2. Free health checks on the measurement of (a) height and weight (b) blood sugar, cholesterol and uric acid levels using non-invasive tools by community service program students.

Based on the results of student interviews with several communities and health workers, this work program received a very good response. They feel very helpful from this activity, because the examination does not cause pain in the skin. The impact of this measurement can also reduce medical waste in the surrounding environment. This is because medical waste can interfere with health both in terms of individuals and the surrounding community (Salam, 2018). Considering the importance of efforts to reduce the amount of waste in the environment, especially medical waste which began to increase after the COVID-19 pandemic (APBN, 2022).

However, the constraint of the examination using this non-invasive tool is the inaccuracy when measuring blood sugar and high cholesterol. This is due to the limitations of the tool that can only detect at low levels. This limitation occurs because when performing the calibration test only uses low blood sugar and cholesterol levels. Therefore, when the tool is used to detect high levels, the results that appear are not in accordance with disposable test kits using non-invasive methods. So, this tool can only be used for measuring normal blood sugar and cholesterol levels.

Many students have done services related to appropriate technology, both in the fields of environment, economy, and health. As done by Rifqiawan (2015) through the "Vetiver Grass" technology as an effort to mitigate landslides in the Beringin area, Ngaliyan. In addition to the environmental field, the use of appropriate technology can also be carried out in the economic field, as has been done by Sugiyanti (2015) through the "MAP (Modified Atmosphere Packaging)"

packaging technology as an effort to increase community productivity by utilizing mocaf flour in Meteseh village, Kendal. Community service through appropriate technology can also be carried out in the health sector, such as the application of a syringe crusher by Pamuji, Kusuma and Prayogo (2019) at the UPTD Puskesmas Sumberberas Banyuwangi. Therefore, group 53 students of the Walisongo State Islamic University community service program also held free checks for blood sugar, cholesterol, and uric acid levels with a non-invasive method. The activity received a good response from the community, and they gave a positive response regarding the things ordered by the health workers and thanked the students for contributing through the provision of free examinations.

4. Conclusion of Activity Results

Community service activities based on the application of appropriate technology in the health sector are very helpful for the community, especially in Krandon Village, both in terms of individuals and the environment. This non-invasive measuring tool for blood sugar, cholesterol and uric acid levels makes them not hesitate and be afraid to have an examination because it is painless and prevents infection and can help reduce medical waste in the environment. This activity can also support the healthy living community movement (Germas) because it implements disease prevention and early detection and improves environmental quality by reducing medical waste. The success of this work program also looks more real when it gets a positive response from the community.

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