



The Utilization of Electrocardiograph (ECG) Monitoring System for Patient With Cardiovascular Disease Based On Community: A Literature Review

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ABSTRACT

Objective: to know the utilization of ECG monitoring system for patients with cardiovascular disease.

Methods: The design of this manuscript uses literature review. Data was retrieved from database research journal used in Science Direct, Proquest, SpringerLink and Wiley and internet searches Online in the period of 2012-2017. Analysis result from paper research was there were 13 journals.

Results: Electrocardiogram in the community use wireless sensor, mobile and community platform used receiving, analysing, and transmitting data. The system will make easier to monitor the patient's condition for 24 hours and send data from remote and unlimited locations.

Conclusion: This monitoring system can help to detect altered electrical cardiac signal, that will automatically send alarms to server accompanied by google maps to show patient's location. This system makes nurses easy to change diet plans, cure, and the changes. This system is very flexible, easy to use, cheap, and confidentially ensure patient. This system using online system leads to decrease individual social contacts and allow for delay in data transmission process. This study show that the implementation system can develop to reduce mortality due to heart disease.

BACKGROUND

Cardiovascular disease is one of the global diseases with the greatest mortality. Mortality caused by heart 4% in high-income country and low-income country (Departemen Kesehatan Republik Indonesia, 2015). World Health Organization (2017), Heart diseases causes 17,7 million mortality each year and is one cause of global mortalities by 31% ("WHO | World Heart Day 2017," 2017). In Indonesia, mortality caused heart disease account for 37% of all mortality and it is estimated that by 2020, more than 11 million people die causes heart disease (WHO, 2014). Riskesdas 2007 reported, the proportion of mortality caused by ischemic heart disease at all ages was 5,1% (Riskesdas, 2007). Currently, coronary heart disease, heart failure, and stroke is 15,23% (Riskesdas, 2013). Complications cause mortality account for 9,4% from hypertension, 45% from heart disease, and 51% from stroke, and estimated by 2030 will increase to 23,3 million deaths in worldwide (Departemen Kesehatan Republik Indonesia, 2015).

The high prevalence and mortality caused by heart disease need attention and effort to handle the problem, especially for nurse in controlling and monitoring health of heart disease patients who can be done anytime through using technology and information system. Utilization of technology to be one of the right solutions to reduce mortality caused by heart disease that should not be late to handle by health professionals especially for nursing to control medical records, medications, and physical exercises which done by patients. Patients with cardiovascular disease were used to performing regular check up such as heart recording using electrocardiogram (ECG) which in hospital used a conventional way as an attempt to control their condition, but this may take a long time check up process to be ineffective. In addition, when emergency condition, patients lead overdue provision of help by health professional because need a long time to ask for help (Saputro, Widasari, & Fitriyah, 2017).

Technological advances recently in health facilitate in monitoring the condition of patients with cardiovascular disease by using community based ECG monitoring system. This system is supported by smartphones and wireless sensors as a transmitter to change the signal from the control process to analog radio or data analysing using software (Gogate, Marathe, Mourya, & Mohan, 2017). Lin, Wong, & Tseng (2016) report, a community based ECG monitoring system equipped

electronic signals will assist heart's electronic signals, detecting pathological ECG signals and assisting in the process of analysing ECG data in patients. Utilization wireless system is preferred because it provides great mobility in sensor completeness and reduces cost (Parihar, Tonge, & Ganorkar, 2017). The patient monitoring system will make it easier for doctors and nurses to know the patient conditions because obtained data will go into database which sent by web server from android and forwarded to the PC. Nurses can control ECG patients for 24 hours without being limited by time and distance. In an emergency, this monitoring system will also send a message to the nurse or doctor accompanied by google map as to facilitate access in provision of assistance and find patient location (Lin et al., 2016).

Based on these studies, this monitoring system is one of solutions to reduce mortality rate caused by heart disease due to difficulty in controlling the condition of the patient, and delay in obtaining treatment so that all of patients with cardiovascular disease can use this system to monitor their condition at all time. They need for monitoring patients especially in community is needed in the provision of public health services and control and monitor patient's condition. The purpose of this literature review is to know the utilization of ECG monitoring system for patients with cardiovascular disease.

METHOD

This manuscript uses literature review. Data was retrieved from database Science Direct, ProQuest, SpringerLink and Wiley in the period of 2012-2017, national journal, and internet searches. The researcher was done literature review by applying the keyword health monitoring, wireless monitoring, android monitoring system. There are 13 journals with the same topic and then the researcher analyses them.

RESULTS

The electrocardiogram (ECG) is to record the patient's electrical heart activity resulting from the process of polarization and cardiac depolarization that translates into a wave form describing a person's heart condition recorded at the actual time (Patil et al, 2015; Lavanya, 2014). Other researchers also defined the ECG as a thoracic interpretation describing cardiac activity recorded using the aid of chest-mounted electrodes resulting from polarization and cardiac depolarization

processes (Lavanya, 2014).

The development of electrocardiogram (ECG) in communities with the use of ECG monitoring with wireless is more popular than off-line recording such as ECG Holter (Lin et al., 2016). The wireless sensor consists of a number of wireless-capable sensor devices that have one or more base stations that collect all the connected data from the sensor device making it easier to monitor patients both in the hospital and within the community (Lin et al., 2016; Miane Afasneh, Sanati-Mehrizi Ali, Paymen Sanati-Mehrizi, 2013). This wireless monitoring system will facilitate the interaction of patients and professionals including nurses to improve health services in patients with heart disease to record the patient's electrical heart activity resulting from the process of polarization and cardiac depolarization that translates into waveforms (S. R. Patil et al., 2015).

The monitoring system using wireless ECG strongly supports patient monitoring because of the ability to measure heart rate in real time and detect irregular heartbeat (Liu, Liu, Chen, & Liang, 2014). Wireless monitoring systems are not only able to measure, analyze, store patient's physiological data continuously and realtime, and make it easier to see the patient's ECG changes (Desmukh, 2013; Hashim et al., 2014).

Description of ECG Wireless Monitoring System in Community

Health technologies that use sensors and wireless as a medium of communication can help people with heart failure in finding abnormalities in patients when they are at home quickly so as to reduce mortality (Desmukh, 2013). Monitoring of ECG monitoring systems in the community reduces the limitations and disruptions to patient activity during recording and is suitable for long-term use (Lin et al., 2016; Liu et al., 2014). The recording of a community-based ECG system is capable of recording impulse travels to the heart muscle and can record in or during activity to see the physical response during activity (Lavanya, 2014).

The use of a community-based ECG wireless system is supported by a hardware system in the form of wearable ECG equipped with dry electrodes that can detect heartbeat and alarm installed by transmitting data to the back and mobile server platforms for real time analysis and 24-hour emergency call per day without distance limit (Lin et al., 2016). Another study was conducted by Hashim et al. (2014) who use wireless

in patient monitoring using Zigbee communication that helps the process of transmitting data to PC via wireless (Hashim et al., 2014).

Enhancements consist of dry electrodes, wireless module devices, and mechanical designs that support the performance of ECG devices. Dry elektorda is made to measure ECG signals even though it is coated with thin clothing. Electrodes and leads are attached in a vest and connected with a wireless ECG placed in the waist band. The transmission of data obtained using Bluetooth will assist health personnel in monitoring, diagnosing, and managing treatment in patients (Gogate et al., 2017). The captured signal will then be amplified, filtered and sent to the phone via bluetooth (Lin et al., 2016).

Mobile dan Community Platform Help Detect and Provide Health Information

The mobile and community platforms used by android systems are helpful in receiving, analyzing, and transmitting data (Lin et al., 2016). The use of mobile and community platforms makes it easy to obtain physical data signals wherever and whenever and can assist in detecting emergencies and viewing patient health information (S. R. Patil et al., 2015). Research conducted by Lou et al. (2013) on health monitoring systems using wireless android-based operating systems, mobile and community platforms will assist in monitoring, detecting and transmitting the patient's physiological conditions (Lou et al., 2013). This is supported by another study that says the use of mobile and community platforms in ECG monitoring with more ergonomic devices will make it easier to monitor the patient's condition for 24 hours and to transmit data from remote and unlimited locations (Lin et al., 2016; Parihar et al., 2017).

DISCUSSIONS

ECG-based cardiology monitoring system is very useful to detect and monitor the health of heart patients through analysis of ECG changes that occur so that if there is a pathological change in heart patients, the system will automatically send alarms on the server so as to facilitate the provision of help to patients because it comes with google map which can be detected by the GPS aid used to inform the patient's position at critical condition (Lin et al., 2016). This is in contrast to studies conducted by Aminian (2013) that make the monitoring system but not equipped with GPS

and mapping so that when there is a change of vital signs in patients, the system will send information using sms / e-mail so that health workers do not know the position or the patient's exact location (Aminian, 2013b). The use of a community-based ECG monitoring system presents effective ECG recording results and can monitor changes in the patient's cardiac activity throughout the day over a long period of time and its dynamic use (Lin et al., 2016). This is supported by several researchers who claim that monitoring systems can detect, monitor and display physiological measurements clearly and easily interpreted. The data stored in the database will be displayed in accordance with the actual conditions. This is very useful for controlling patients with long distances smoothly and possibly very small errors (Lou et al., 2013; A. B. C. Patil, 2017; Saputro et al., 2017).

In addition to having benefits, a technology allows to have a negative impact. Because the use of electronic monitoring systems will reduce individual social contacts because of the large number of communications made without face-to-face between health workers and patients (Lin et al., 2016).

ECG monitoring using wireless systems is very effective and enables health workers to diagnose emerging symptoms, assist in managing electronic patient records electronically, and providing nursing services. Dry electrode on the tool used has a small size, the design used is simple and able to detect the ECG signal despite using thin clothes (Lin et al., 2016). It aims to reduce the risk of skin irritation as well as washable and reusable electrodes. This system has a high reliability and can be used in everyday activities. In addition, the hardware is very flexible and easy to use. Other research supports this research which states that technological advances in the use of wireless sensor networks and networking technologies result in healthcare applications that make a person's life easy and comfortable. The tools used are small, portable, and easy to use unlimited by time and place. In addition, relatively affordable and convenient prices are used by patients and reduce the workload of health workers (J & Buvana, 2015; Lou et al., 2013; Parihar et al., 2017).

Lack of use of community-based ECG monitoring system ie data base sent from the sensor node will be influenced by external factors such as wet electrode, topography area, etc. In addition, it may cause delays in the data transmission process due to disturbance in the area or location of the patient or in the magnet-

ic area (Chaudhary, 2014). Community-based ECG monitoring system for patients with cardiovascular disease is very possible to be applied in Indonesia because ECG monitoring system is portable, convenient and relatively affordable. Application of a community-based ECG monitoring system will reduce mortality and improve the quality of life of people with heart disease.

The limitation of this writing is that this manuscript is only done with non-systematic literature review so that the search strategy, completeness and time range covered are varied and do not have the literature review protocol.

CONCLUSION

ECG monitoring system in patients with heart disease is done using hardware supported wireless system is helping patients and health workers to control and monitor the condition of patients through changes in cardiac activity recorded with the help of dry electrodes contained in the hardware in the form of a flexible and unobtrusive ECG vest patient. Use of this system is very helpful in providing health services to patients in everyday life as well as those who are critical because this system sends the patient ECG change alarm and shows the location of the patient through google map so the patient location is easy to know. The use of this system is very affordable and the data displayed related to real patient condition, as well as patient data security is assured. Lack of a community-based ECG monitoring system that allows for the delay in the data transmission process even though the incident is very small and the data sensor can be influenced by external factors. This ECG monitoring system is very likely to be applied in Indonesia so it will help in reducing the death rate of patients with heart disease who are not getting medical treatment.

RECOMMENDATION

Recommendations in the development of a community-based ECG monitoring system can be directly linked to health workers or health facilities located within the patient's environment, especially for nurses to monitor the patient's condition remotely and provide nursing interventions through available communication making it easier to control patient behavior including diet, and physical activity, as well as reducing the workload of nurses in health services.

REFERENCES

- Aminian, M. (2013a). A Hospital Healthcare Monitoring System Using Wireless Sensor Networks. *Journal of Health & Medical Informatics*, 4(2), 4–9. <https://doi.org/10.4172/2157-7420.1000121>
- Aminian, M. (2013b). A Hospital Healthcare Monitoring System Using Wireless Sensor Networks. *Journal of Health & Medical Informatics*, 4(2), 30–33. <https://doi.org/10.4172/2157-7420.1000121>
- Chaudhary, D. (2014). Design challenges of wireless sensor network and impact on healthcare applications. *International Journal of Latest Research in Science and Technology*, 3(2), 110–114.
- Departeman Kesehatan Republik Indonesia. (2015). *Profil Kesehatan Indonesia*.
- Desmukh. (2013). Wi-Fi based vital signs monitoring and tracking system for medical parameters. *International Journal of Engineering Trends and Technology*, 4(May), 1935–1938.
- Gogate, U., Marathe, M., Mourya, J., & Mohan, N. (2017). Android based health monitoring system for cardiac patients. *International Research Journal of Engineering and Technology (IRJET)*, 1628–1634.
- Hashim, N. M. Z., Anuar, M. R., Jaafar, A., Aziz, M. Z. A. A., Salleh, A., & Ja, A. S. (2014). Graphical user interface for wireless patient monitoring system using zigbee communication. *ARPN Journal of Engineering and Applied Science*, 9(9), 1554–1558.
- J, L. R. M., & Buvana, M. (2015). A Survey : Security Issues and Design Challenges in Healthcare Monitoring System using Wireless Sensor Network. *International Journal of Innovative Research in Science Engineering and Technology*, 4(1), 10758–10765. <https://doi.org/10.15680/IJIRSET.2015.0411058>
- Lavanya, M. (2014). Reliable transmission protocol for GSM and HTTP Basedon wireless patient monitoring. *International Journal of Advance Engineering and Research Development*, 1(12), 196–204.
- Lin, B.-S., Wong, A. M., & Tseng, K. C. (2016). Community-Based ECG monitoring system for patients with cardiovascular diseases. *Journal of Medical Systems*, 40(4), 80. <https://doi.org/10.1007/s10916-016-0442-4>
- Liu, Y.-D., Liu, Y.-C., Chen, P.-Y., & Liang, S.-F. (2014). A portable wireless system for real-time electrocardiographic monitoring. *IJER*, 4–7.
- Lou, D., Chen, X., Zhao, Z., Xuan, Y., Xu, Z., Jin, H., ... Fang, Z. (2013). A wireless health monitoring system based on android operating system. *IERI Procedia*, 4(December), 208–215. <https://doi.org/10.1016/j.ieri.2013.11.030>
- Miane Afasneh, Sanati-Mehrziy Ali, Paymen Sanati-Mehrzi, S.-M. R. (2013). Application of wireless sensor networks in health care system. *Proceedings of the 120th ASEE Conference & Exposition June 23-26*.
- Parihar, V. R., Tonge, A. Y., & Ganorkar, P. D. (2017). Heartbeat and temperature monitoring system for remote patients using arduino. *International Journal of Advance Engineering Research and Science*, 6495(5), 55–58.
- Patil, A. B. C. (2017). An IoT based health care and patient monitoring system to predict medical treatment using data mining techniques: Survey. *IJARCCCE*, 6(3), 24–26. <https://doi.org/10.17148/IJARCCCE.2017.6306>
- Patil, S. R., Gawade, D. R., & Divekar, S. N. (2015). Remote wireless patient monitoring system 1. *International Journal of Electronics & Communication Technology*, 6(1).
- Riskesdas. (2007). *Riset Kesehatan Dasar*, 1–384. <https://doi.org/10.1016/j.riskesdas.2007.12.001> Desember 2013
- Riskesdas. (2013). *Riset Kesehatan Dasar*.
- Saputro, M. A., Widasari, E. R., & Fitriyah, H. (2017). Implementasi sistem monitoring detak jantung dan suhu tubuh manusia secara wireless. *Jurnal Pengembangan Teknologi Informasi Dan Ilmu Komputer*, 1(2).
- WHO. (2014). The probability of dying between ages 30 and 70 years from the 4 main NCDs is 11% ., 2014.
- WHO | World Heart Day 2017. (2017). Who. Retrieved from http://www.who.int/cardiovascular_diseases/world-heart-day-2017/en/