

CHAPTER I

INTRODUCTION

This chapter presents a comprehensive background of ambulatory wireless electrocardiography (ECG) monitoring devices and its relevance to patient care today. This section also includes an explanation of the importance of undertaking a research to explore the accuracy of wireless ECG monitoring. The specific research questions that this study aims to answer are likewise included in this chapter. In addition, this chapter details the benefits of this study for patients, healthcare providers, the healthcare system, and other researchers.

1.1 Background

Continuous ECG monitoring is a method of recording an individual's ECG for prolonged periods, usually 24 to 48 hours (Chou, 2008). ECG monitoring is commonly used in different nursing practice settings such as intensive coronary units, critical care units, operating theaters and post-anesthesia care units (Francis, 2016). Continuous ECG monitoring is useful in detecting ischemic changes and arrhythmias. It is usually prescribed when a patient has experienced symptoms related to alterations in myocardial electrical conduction secondary to a variety of causes (Passanisi, 2006).

Ambulatory wireless ECG monitoring is becoming increasingly important in both home care and clinical settings for early detection of cardiovascular diseases, prevention of cardiovascular disease complications and prompt detection of symptomatic signs in patients experiencing acute crisis conditions (Miao, Cheng,

He, Qingyun, & Li, 2015). Examples of ambulatory wireless ECG monitoring include 24-hour Holter monitors, daily transtelephonic (TT) ECG devices and patch ECG monitors (PEM). The Holter monitor was first introduced in the late 1940s. This device is commonly used for investigating patients in the ambulatory setting with suspected arrhythmias. Although the Holter monitor has been an essential technology in detecting arrhythmias, one in four patients were found to be unable to activate their event recorder during a symptomatic period. It is noteworthy that a majority of clinically significant arrhythmias are asymptomatic. Early identification and prompt treatment of asymptomatic arrhythmias are crucial to mortality and morbidity reduction (Barrett et al, 2014). Another type of wireless ECG monitoring device, the daily transtelephonic (TT) ECG, is useful for patients who require short-term evaluation of arrhythmias. The patient is required to wear the transtelephonic ECG daily for a period of one week. Patch ECG monitors (PEM), on the other hand, are divided into two categories: one that only functions as a recording device and another type that is capable of recording and transmitting ECG tracings. PEM is indicated for use in patients who may be asymptomatic or who may suffer from transient symptoms such as palpitations, dizziness, light-headedness, pre-syncope and syncope, shortness of breath, anxiety and fatigue. PEMs' ability to record ECG data for extended time periods allow clinicians to better detect and diagnose arrhythmias (Lobodzinski & Laks, 2012).

Ambulatory wireless ECG monitoring that are used nowadays commonly require wireless communication such as Bluetooth and Wireless Fidelity (Wi-Fi). Recent advances in mobile systems technology have made it possible to continuously record ECG data outside the laboratory and clinical settings. The trend towards using mobile devices, such as smartphones, for ECG assessment allows more prompt

detection of electrocardiographic changes and convenient collection of data into an internet-based database (Natarajan, et al., 2015).

In addition, the widespread availability of smartphones with powerful computing capability and high-speed data access via WiFi allows real-time transmission of results from the ECG sensor to the healthcare service provider (Miao, Cheng, He, Qingyun, & Li, 2015). Thus, wireless ECG monitors that utilize WiFi or Bluetooth allows patients to be monitored remotely outside the hospital settings (Al-Saud, Mahmuddin, & Mohamed, 2012).

One disadvantage of the wireless ECG sensors, however, is the fact that it does not provide ECG rhythm strips and thus could not be used for distinct rhythm analysis (Steinberg et al., 2019). Some physicians believe that the lack of rhythm strips negatively affects the accuracy of the results derived from wireless ECG monitors (Elgendi, Eskofier, Dokos, & Abbott, 2014).

Given the significant number of researches conducted to examine the accuracy of wireless ECG monitoring, this research was conducted to review and synthesize the results of previous research studies on the accuracy of wireless ECG monitoring specifically in out-patient settings.

1.2 Statement of Problem

According to World Health Organization (2012), 7.4 million people die from heart diseases worldwide. In the United States, 840,768 deaths reported in 2016 were caused by cardiovascular diseases. The annual cost of cardiovascular disease treatment between the years 2014 and 2015 was estimated at 351.2 billion US dollars. (Benjamin, et al., 2019).

In 2008, it was estimated that 17.3 million deaths in Indonesia were caused by

cardiovascular diseases (InfoDATIN, 2014). Survey Sample Registration System (2014) further shows that 12.9% of the total deaths in Indonesia were caused by coronary heart diseases. The number of deaths from cardiovascular diseases in Indonesia rose to 625,050 in 2016, comprising 35% of the total deaths that year. In terms of financing, the Health Social Security Administration (BPJS) identified cardiovascular diseases as among the leading cause of increase in the cost of hospitalization in the country (Ministry of Health Republic of Indonesia, 2018). BPJS reported that the highest hospital expenditure was for percutaneous cardiovascular procedures which amounted to 137 million rupiah, followed by heart valve procedures without cardiac catheterization at 138 million rupiah (Indonesia Hospital Associations, 2020).

Care outcomes for patients suffering from cardiovascular diseases is significantly improved with early detection and prompt treatment. The golden period, which is the maximum critical time to treat the patient before permanent damage to the heart happens, plays a critical role in preventing mortality from cardiovascular diseases. ECG monitoring is an essential component of early detection and prompt treatment of potentially fatal cardiovascular changes. One of the causes of mortality in patients with cardiac diseases is unmonitored heart condition during activity that leads to failure in the treatment of ischemia during the golden period (Hendrata, Arifin, & Hikmah, 2016).

At present, ECG monitoring are commonly done in the hospital or clinic setting. Thus, patients are required to visit a hospital or clinic to have their ECG monitored. This process requires patient's time and monetary resources that lead some patients to forego monitoring until they experience signs and symptoms. Delay in the detection of ischemic changes in its early stages result to critical complications and

even death. Wireless ECG monitoring allows health professionals to monitor changes in the patient's cardiac rhythm even when they are in their homes. This lessens the burden for patients because they are not required to visit a hospital or clinic for ECG monitoring. The availability of wireless monitoring improves patient care outcomes by enhancing compliance and early detection (Hendrata, Arifin, & Hikmah, 2016). Thus, this research was conducted to review and synthesize existing literature on the accuracy of wireless ECG monitoring.

1.3 Statement of Purpose

This integrative review of literature aimed to synthesize the findings of open-access published researches on the accuracy of wireless ECG monitoring. Specifically, this study focused on exploring the accuracy of wireless ECG monitoring in detecting arrhythmias and ischemic changes in the heart.

1.4 Research Questions

This research aimed to answer the questions (1) "How accurate is wireless ECG monitoring in detecting abnormal cardiac rhythms in out-patient settings?" and (2) "What factors affect the accuracy of wireless ECG monitors in out-patient settings?"

1.5 The Benefits of the Study

1.5.1 Patients

Ambulatory wireless ECG monitoring is important in providing holistic care for patients with cardiovascular diseases. Patients diagnosed with cardiovascular disease may experience anxiety. Studies have found that having an ambulatory wireless ECG monitor enhances patients' sense of security regarding their health. Patients stated that they feel safe in a case a cardiac event occurs when they are attached to an ambulatory wireless ECG monitor (Haberman et al., 2015; Lortz,

Varnavas, Weissenberger, Erbel, & Reinsch, 2016).

Overall patient care outcomes can be enhanced holistically through devices, such as ambulatory wireless ECG monitors, that would allow more prompt, efficient and cost-effective care. Aside from its physiological and financial benefits, this technology also improves the emotional wellbeing of patients while causing very minimal discomfort or limitations to patients' mobility.

1.5.2 Healthcare professionals

A strong evidence-base is important to aid health professionals perform their functions in a manner that is safe and effective. Understanding the effectiveness of ambulatory wireless ECG monitoring can aid healthcare professionals in their decision to utilize this technology in the context of their overall patient care goals. The result of this study can serve as a basis for clinical decisions for healthcare professionals in their attempt to improve quality of care for patients at risk of arrhythmias and ischemic changes in the heart.

1.5.3 Healthcare systems

It is important to conduct studies that examine the effectiveness of patient monitoring in non-hospital settings. Establishing an evidence base for the effectiveness of ambulatory wireless ECG monitoring devices that allow health professionals to monitor patients in non-hospital settings can contribute to the development of policies that will promote the use of such devices. Furthermore, wireless ECG monitoring can potentially reduce the number of patients in the hospital; thus, allowing hospitals to cater to more acute cases that require hospital-based care. Early detection of arrhythmias and ischemic changes in the heart will also allow prompt intervention and lessen the need for long term hospital stay for patients. These advantages can be translated to improvement in the allocation of

healthcare system resources and decreased burden to the healthcare workers.

1.5.4 Researchers

New technologies in the healthcare setting are continuously being improved and developed to provide better quality of care for patients. Every year, research on technologies are also being conducted to examine their safety and effectiveness. This study is expected to contribute as an additional reference for other researchers who will be conducting research studies related to ambulatory wireless ECG monitoring devices. Furthermore, this study can be a source of valuable information that can contribute to future innovations of ambulatory wireless ECG monitoring devices to improve the care for patients with cardiac diseases in general

