Chapter 6

mHealth:
Sleeping Disorders Diagnosis

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ABSTRACT

The increasing computing power of mobile electronic devices coupled with advances in sensing and wireless technology have paved the way for mobile health (mHealth) to play a major and innovative role in the health sector. This chapter discusses the use of mHealth in the monitoring and diagnosis of sleep-related diseases with a particular emphasis on sleep apnea since it is considered to be one of the most prevalent disorders. Apnea symptoms and the physiological signals associated with it are described with an overview of the current sensing technology used to capture and record these signals. The chapter continues to discuss the integration of sensors with today's mobile devices to offer mHealth platforms that allow for the monitoring, diagnosis and management of sleep apnea. We conclude by discussing the current limitations of the mHealth technology and discuss possible future enhancements.

INTRODUCTION

Mobile Health or mHealth is the use of mobile and wireless devices such as smartphones, tablets, and other patient monitoring devices to support various medical and health practices. mHealth has the potential to turn mobile devices into personal labs that continuously assess a person’s physiology, behavior, social context, and environment exposure (Kumar, 2013).

mHealth based techniques have been applied in different domains of the health sector. In recent years, some novel approaches (where there were serious attempts to maximize the benefits offered by this new paradigm shift in healthcare delivery) are reported in the literature. Examples of such efforts include the use of mHealth and related technologies in assessing and promoting physical activity (O’Reilly, 2013). Smartphones integrated cameras coupled with an intelligent system running on the mobile are used in the skin disease analysis (Bourouis, 2013). mHealth intervention techniques are successfully utilized in enhancing the physical activity of patients with cardiovascular disease (Carter, 2013). Phippard (2012) examined the use of mobile phones as tools to support and advance HIV/AIDS work in sub-Saharan
Africa. An overview of smartphones’ use in behavioral healthcare and the options available to integrate this technology into real life clinical practice is provided in (Luxton et al.). Brian and Ben-Zeev (2014) examined the integration and utilization of mobile technologies into the diagnosis and treatment of mental disorders in the Asian region. mHealth techniques proved to offer valuable opportunities in service delivery for the mentally ill in parts of India (Jain, 2015). mHealth methods are recently used to identify patterns of high-risk illicit drug use in a study of drug users in Baltimore, Maryland (Linas, 2015). Recently, IBM has collaborated with Telecom companies in Africa to populate an Ebola disease-mapping system; mHealth based strategies are then used as educational tools during the Ebola epidemic to spread awareness.

Sleeping disorders play a significant role in individual activities during the daytime, and can lead to complications that make the patient suffers from other diseases. Estimates indicate that approximately 70 million Americans experience some form of sleep disorder (Abidi, 2015). mHealth oriented intervention with the aim of diagnosing and improving sleeping patterns of individuals has been an open and active area of research with some related mobile applications developed in recent areas. A case in point is the recent announcement of ‘Johns Hopkins Center for Sleep’ the use of a mobile application in a pilot study to assess its feasibility in alleviating the anxiety of many Americans who suffer from sleep-related issues (Motti, 2015). One of the most common and prevalent sleep disorders is Obstructive Sleep Apnea (OSA); according to the World Health Organization, around 100 million people worldwide have OSA (Alqassim, 2012). In this chapter, we discuss the role of the mHealth innovations as it relates to OSA. We will first provide a brief overview of OSA then proceed to discuss the application of mobile technology for managing and diagnosing OSA, and conclude by highlighting current limitations and pointing out possible future directions. Throughout the chapter the terms apnea and OSA are used interchangeably.

BACKGROUND

Obstructive Sleep Apnea (OSA)

OSA is a sleeping disorder characterized by the repetitive reduction of airflow during sleep where air is physically blocked from flowing into lungs intermittently. A phase of apnea is accompanied by an initial decrease in heart rate and a drop in oxygen saturation after a few seconds. This phase is followed by an awakening signal of the central nervous system and is characterized by arousal, short-term EEG activation, acceleration of the heart rate, heavy breathing, as well as an increase in blood oxygen saturation (Hoffmann, 2011).

The National Sleep Foundation concluded that for adults to function in a healthy and productive manner, they should have seven to eight sleeping hours every night. Frequent obstructions of airflow during this period have a considerable influence on the performance of humans during the daytime. OSA may cause excessive sleepiness, non-restorative sleep, high blood pressure, diminished neurocognitive performance, cardiovascular diseases, memory loss problems, erectile dysfunction, personality changes, and depression. Besides daytime tiredness, OSA patients may also experience job impairment and automobile accidents (Ancoli-Israel, 2003; Al-Mardini, 2014).

The current approach to diagnosing OSA is attended overnight polysomnogram or PSG. It is the golden standard for OSA diagnosis but considered to be involved, time-consuming and costly in time and hospital use. During a PSG session, sleep is examined under laboratory conditions with the goal of
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