MANAGEMENT OF A HOLISTIC SLEEP HEALTHCARE IN SELECTED MALAYSIAN HOSPITALS

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ABSTRACT

Sleep apnea is an under-recognized public health issue and is underdiagnosed in Malaysia. The awareness of sleep disorders is slowly increasing in Malaysia, but the availability of sleep centres remains critically low. A holistic approach to managing sleep healthcare patients is needed to bridge the knowledge gap. Obstructive Sleep Apnea (OSA) remains underdiagnosed and undertreated. OSA does not kill the individual but can cause fatal cardiovascular-related complications such as high blood pressure and stroke. OSA amplifies the risk of multiple health conditions associated with increased morbidity and mortality. There could potentially be more OSA patients in Malaysia based on the 7.1% prevalence of clinically suspected OSA in Malaysia. Practical Information Technology will lead to immediate patient care and outcomes improvement. Big data analytics allow business and clinical models to transform into innovative and efficient care delivery. The low cost of wearables that can detect sleep information is a favourable tool for investigating the sleep architectures of individuals. As of today, the data of sleep diagnostics, sleep therapy and wearables are stored independently and do not interact with each other. The idea of integrating data from sleep diagnostics, sleep therapy and wearables has never been explored nor implemented in Malaysian hospitals. In addition, it has yet to be investigated on the feasibility of the integrated data in improving clinicians' management of sleep health patients holistically. The other problem identified is, sleep medicine knowledge is generally low among medical students and clinicians. Lack of education and training in sleep medicine has resulted in a culture of clinicians with minimal knowledge about sleep disorders. There is a need for a multidisciplinary approach to managing OSA patients. There is a need for clinicians from different specialities to treat the multiple medical conditions that the patient may have. The use of a single platform with integrated sleep data could potentially drive knowledge sharing and knowledge transfer among clinicians. This study employed qualitative research with a focus on phenomenon approach. Interview research technique is adopted for this study. The data analysis revealed that 86% of sleep clinicians agreed that multidisciplinary collaboration is a good practice. The sleep clinicians interviewed for this article agreed that data pooled together would allow them to understand better how they manage their sleep health patients with comorbid diseases plus allowing them to examine undetected correlations and trends between specific variables of interest. Data analytics would provide insights that would improve patient care and assist sleep clinicians in increasing patient awareness. The sleep health patients interviewed unanimously agreed that their sleep health issue has adversely affected their capacity to carry out everyday responsibilities because of their persistent daytime somnolence, poor energy, and insomnia. With the integrated data, the sleep clinicians agreed that they would be able to manage their sleep health patients more holistically. It also enhances the multidisciplinary collaboration among clinicians to look beyond the OSA condition alone, filling the knowledge gap in sleep medicine and allowing a team-based holistic approach to the patient’s condition with diverse expertise in diagnostic and therapeutic techniques challenges.

APPROVAL

This is to certify that this thesis conforms to acceptable standards of scholarly presentation and is fully adequate, in quality and scope, for the fulfilment of the requirements for the degree of Doctor of Business Administration

The student has been supervised by: **Associate Professor Dr. Sheila Cheng**

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DECLARATION

I hereby declare that the thesis submitted in fulfilment of the DBA degree is my own work and that all contributions from any other persons or sources are properly and duly cited. I further declare that the material has not been submitted, either in whole or in part, for a degree at this or any other university. In making this declaration, I understand and acknowledge any breaches in this declaration constitute academic misconduct, which may result in my expulsion from the programme and/or exclusion from the award of the degree.

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LIST OF ABBREVIATIONS

AASM	**A**merican **A**cademy of **S**leep **M**edicine
AF	**A**trial **F**ibrillation
AHI	**A**pnea **H**ypopnea **I**ndex
APAP	**A**utomatic-titrating **P**ositive **A**irway **P**ressure
BMI	**B**ody **M**ass **I**ndex
BPAP	**B**i-level **P**ositive **A**irway **P**ressure
CAD	**C**oronary **A**rtery **D**isease
CBT-I	**C**ognitive **B**ehavioural **T**herapy for **I**nsomnia
CPAP	**C**ontinuous **P**ositive **A**irway **P**ressure
CSA	**C**entral **S**leep **A**pnea
CCSH	**C**ertification in **C**linical **S**leep **H**ealth
DBP	**D**iastolic **B**lood **P**ressure
DIMS	**D**ifficulty **I**nitiating and/or **M**aintaining **S**leep
EMR	**E**lectronic **M**edical **R**ecords
ENT	**E**ar, **N**ose and **T**hroat
ESRS	**E**uropean **S**leep **R**esearch **S**ociety
GP	**G**eneral **P**ractitioner
HPA	**H**ypothalamic-**P**ituitary-**A**drenal
ICSD-3	**I**nternational **C**lassification of **S**leep **D**isorders – **3**rd Edition
IoT	**I**nternet **o**f **T**hings
ISI	**I**nsomnia **S**everity **I**ndex
ISS	**I**nternational **S**leep **S**pecialist
MAD	**M**andibular **A**dvancement **D**evices
MBBS	**M**edicinae **B**accalaureus **B**accalaureus **C**hirurgiae (Bachelor of Medicine, Bachelor of Surgery)
MSA	**M**ixed **S**leep **A**pnea
OHS	**O**besity **H**ypoventilation **S**yndrome
OSA	**O**bstructive **S**leep **A**pnea
PAP	**P**ositive **A**irway **P**ressure
PCP	**P**rimary **C**are **P**hysician
PG	**P**oly**G**raph

PM	**P**ortable **M**onitors
PSG	**P**oly**S**omno**G**raphy
QoL	**Q**uality **o**f **L**ife
RPSGT	**R**egistered **P**oly**S**omno**G**raphy **T**echnologist
SBP	**S**ystolic **B**lood **P**ressure
SDB	**S**leep **D**isordered **B**reathing
SRDB	**S**leep-**R**elated **D**isordered **B**reathing
SS	**S**leep **S**pecialist
TRD	**T**ongue **R**etaining **D**evice
VAS	**V**isual **A**nalog **S**cale
WASM	**W**orld **A**ssociation of **S**leep **M**edicine
WSS	**W**orld **S**leep **S**ociety

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Sleep is the best meditation. That was what the 14th Dalai Lama, Tenzin Gyatso quoted to People Magazine back in September 1979. Sleep is vital in ensuring the human body is functioning optimally. Unfortunately, sleep disorder is an under-recognized public health issue and underdiagnosed in general practices (Ashraf et al., 2016 & Dixit et al., 2018). A person with sleep dysfunction has their cognitive and motor performance affected by decreased health status, poor mental health, low quality of life, and increased morbidity and mortality (Hassed et al., 2012).

The field of sleep medicine is still relatively new in Asia, and sleep research in Asia is still in its infancy stage. The Asian Sleep Research Society was founded in 1994, whereby Malaysia joined officially in the same year. A speaker from Malaysia, Dr Baharudin Abdullah, was present at the Asian Sleep Research Society Summit and Symposium held in Okinawa, Japan, together with other sleep societies from Asia. More activities and efforts were placed to alert populations and healthcare professionals about the worsening sleep problems in their respective countries (Cherasse, 2011).

In general, like in many other countries, sleep apnea is mainly diagnosed and treated by pulmonologists or respiratory physicians, while insomnia patients are diagnosed and treated by psychiatrists. The field of sleep medicine is vast, and some of these clinicians may not have comprehended well the basics of sleep disorders since there are only a limited number of sleep specialists (Cherasse, 2011). In addition, Ashraf et al. (2016) found no education on sleep and sleep disorders provided by

medical schools in countries like Malaysia, Indonesia and Vietnam. Therefore, there is a knowledge gap in identifying, diagnosing, and treating patients with sleep disorders. In Malaysia, sleep apnea is mainly diagnosed and treated by Ear, Nose and Throat (ENT) surgeons and Respiratory Physicians. There is an emergence of Neurologists, Cardiologists as well as Dentists in diagnosing and treating this group of patients. Each clinician has specialities in treating the patient's condition, as most of them will have other comorbid health conditions besides sleep disorders. Henceforth, sharing knowledge and management of the experience is vital in realizing a holistic approach to managing sleep healthcare patients.

Having said that, with all the effort poured into creating and raising awareness of sleep disorders, the demand for sleep-related medical services increased. Still, the availability of sleep centres remains critically low (Dixit et al., 2018). Although there is no official data on the availability of the number of sleep centres in Malaysia, it is estimated that there are about 50 sleep centres in Malaysia for a population of 32.6 million. Therefore, it is not surprising that patients will need to wait six months to 1 year to get a sleep diagnostics test. The long waiting period is supported by the evidence that in Hong Kong, patients will need to wait 3 to 12 months to get their sleep diagnostics test (Cherasse, 2011). The long waiting period is further confirmed in a multi-countries study involving Malaysia by Waseem et al. (2021).

This has led to an increasing number of sleep vendors offering home sleep testing services in Malaysia. This effectively increases the accessibility to sleep diagnostics as well as sleep therapy. However, this presents one massive problem for sleep physicians. There are different brands of sleep diagnostics and sleep therapy in

the market. Furthermore, all these data are stored independently. This makes knowledge sharing and collaboration hard amongst clinicians with other specialities.

The word *holistic* is defined as relating to the whole of something or the total system instead of just its parts (Cambridge Academic Content Dictionary, 2020). Therefore, a holistic approach to managing sleep healthcare patients is needed to bridge the knowledge gap in managing the patients. Plus, integrating data from sleep diagnostics, sleep therapy, and wearables further boosts the collaboration of clinicians with different specialities. This could potentially create a more patient-centric treatment approach and move closer to precision medicine in treating patients.

1.1.1 The common types of sleep disorder

Sleep is crucial to a person's health and well-being as well as to their survival. Unfortunately, in the current world and community, a large number of individuals do not follow appropriate sleep hygiene and do not get enough sleep. Among the benefits of sleep are that it helps reduce the risk of weight gain, reduces the risk of heart disease such as high blood pressure, avoids depression, and builds a more robust immune system (Fletcher, 2019). Unfortunately, there are five common sleep disorder types: insomnia, obstructive sleep apnea, Narcolepsy, Restless Legs Syndrome and REM Sleep Behaviour Disorder (Cho & Duffy, 2018; Brooks, 2017).

1.1.1.1 Insomnia

According to the American Sleep Association (ASA), insomnia is the most reported sleep disorder that affects as many as 50 to 70 million adults in the United States (Brooks, 2017). Insomnia is defined as a person having difficulty initiating or maintaining sleep. One common symptom of insomnia is that a person cannot fall asleep even when tired. Other insomnia symptoms include not getting enough sleep to

feel refreshed or fully recharged and often feeling exhausted when awake. There are two types of insomnia: transient and chronic (Palagini et al., 2020; Brooks, 2017).

Transient insomnia, also known as short-term insomnia, often arises after a traumatic or tense event. These events can come in the form of work stress, losing a loved one or going through a rough patch in a relationship issue. Transient insomnia could also happen if the person is working odd shifts or suffering jet lag (Brooks, 2017). As for chronic insomnia, the person is experiencing non-restorative sleep, having difficulty falling asleep and maintaining sleep for at least one month. During the daytime, they felt lethargic throughout the day. Some people that have chronic intermittent insomnia they would experience a sleeping pattern whereby there are a few nights of good sleep alternating with many nights of insomnia (Palagini et al., 2020; Brooks, 2017)

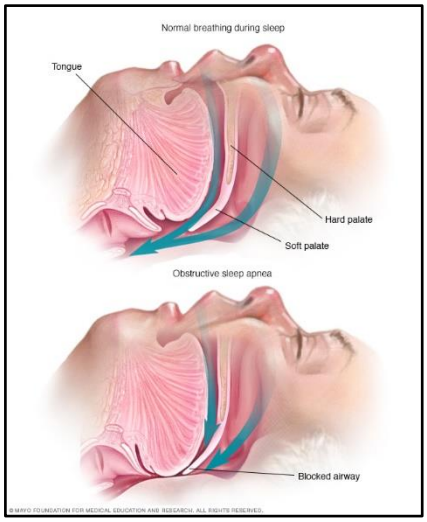
There are many causes of insomnia. The most common cause is poor sleep hygiene. The other reason is that the person has sleep-related breathing disorders such as Obstructive Sleep Apnea. The other reasons would include the medical conditions that the person has that affect their sleep, hormonal changes, circadian rhythm disorders, an odd sleep-wake schedule and limb movements during sleep (Palagini et al., 2020; Brooks, 2017).

1.1.1.2 Obstructive Sleep Apnea (OSA)

The most common sleep apnea is Obstructive Sleep Apnea. The other two types of sleep apnea are Central Sleep Apnea (CSA) and Mixed Sleep Apnea (MSA). Snoring affects 40% of men and 20% of women. It gets worse with age and with weight gain. Snoring is one of the most common symptoms of OSA and is reported by up to 94% of patients diagnosed with OSA (Alshaer et al., 2019). OSA is a prevalent sleep

problem that is unfortunately frequently overlooked. The risk factors include men, obese people, smokers, and people with upper airway inflammatory illnesses such as asthma and pharyngeal reflux (Asha'ari, 2015).

Figure 1.1: Obstructive Sleep Apnea



Note. Adapted from "Obstructive sleep apneas," by Mayo Clinic Staff, 2019. Copyright 2019 by Mayo Foundation for Medical Education and Research.

OSA is prevalent among overweight adults who often snore, although this does not rule out OSA in healthy and skinny people who do not snore. OSA prevalence in adults is estimated to be around 25%, almost double the estimation of 45% in obese adults (Romero-Corral et al., 2010). This is supported by Kositanurit et al. (2018), who found that the prevalence of OSA in the bariatric surgery population was 85.7%. The airway muscles tend to relax and collapse while a person is asleep. During sleep, as the upper airway contracts, there is a partial airway occlusion. Typically, snoring is followed by a brief period of silence. The moment of silence occurs when a person experiences pauses in breathing while sleeping (Kim et al., 2019; Asha'ari, 2015). For example, Figure 1.1 demonstrates that when the muscles supporting the tongue and

soft palate collapse briefly, the airway becomes temporarily occluded, and breathing ceases. The individual's breathing is stopped until they are "awakened" to breathe again, at which point a loud choking sound is typically heard, the muscles recover their strength, and the upper airway is reopened.

Constant blockages and pauses in breathing during sleep effectively disrupt sleep, resulting in poor sleep quality over time. Without sufficient sleep, a person feels daily drowsiness, headaches in the early morning, a lack of focus and attention at work or school, and falling asleep while driving, which can result in automobile accidents, marital discord, and psychiatric diseases such as depression. OSA alone is not lethal but can lead to fatal cardiovascular consequences, including high blood pressure, stroke, and heart attack. These cardiovascular-related problems are the leading cause of mortality among OSA patients. (Tietjens et al., 2019; Asha'ari, 2015).

A research paper published in the European Respiratory Journal in 2005 indicated that those in their twenties with obstructive sleep apnea had a mortality risk ten times that of those in their fifties. In 2012, a research team from the International Islamic University Malaysia found that persons diagnosed with mild OSA were three times more likely to have a high blood pressure than normal individuals. The same study also found that those with severe OSA were eight times more likely to develop hypertension than healthy people (Asha'ari, 2015). The evidence from Rana et al. (2020) supported that OSA is a leading cause of secondary hypertension.

The authors of the same study also revealed that those with high blood pressure (hypertension) were three times more likely to have comorbid OSA than those without hypertension. Obesity was one of the most significant causes of OSA in the investigators' research population. It significantly contributes to cardiovascular

illnesses such as hypertension in the later stages (Asha'ari, 2015). This is supported by the works of Dixit et al. (2018)

1.1.2 Diagnosis and Treatment of Obstructive Sleep Apnea (OSA)

Obstructive sleep apnea (OSA) diagnosis begins with measuring blood pressure, pulse rate, and a cardiovascular and respiratory examination. The surgeon will then inspect the upper airway for blockages. This is usually referred to as a "scope," in which a soft fibre optic camera is introduced via the nostril and down the patient's throat. The doctor will then schedule a sleep diagnostic test to validate the diagnosis and severity of OSA. Several physiological measures, including blood flow, respiratory effort, pulse, and oxygen saturation, are recorded during the sleep diagnostic exam and administered while the subject is asleep. The sleep diagnostic test results will next be analysed to determine the Apnea-Hypopnea Index, which is the number of occurrences per hour (AHI). Table 1.1 illustrates the correlation between the incidence of AHI and its severity.

Table 1.1: AHI and Severity of OSA

Severity	Apnea-Hypopnea Index (AHI)
Normal	< 5 events
Mild	> 5 events and < 15 events
Moderate	> 15 events and < 30 events
Severe	> 30 events

Note. Adapted from "The impact of obstructive sleep apnea on non-alcoholic fatty liver disease in patients with severe obesity," by Benotti et al., 2016, *Obesity*, *24*(4), p.874. Copyright 2016 by John Wiley & Sons, Inc.

Patients with OSA have access to a variety of therapy choices. Various methods of therapy are offered based on the degree of severity. Typically, for patients diagnosed with mild OSA, physicians may recommend adopting a healthy lifestyle, engaging in

regular exercise, and losing weight, which is frequently adequate therapeutic strategies.

Surgical procedures may be suggested if the patient has mild to moderate symptoms or if the clinician detects any anatomic blockage in the airway. Additional treatment options for cases with mild to moderate OSA include using a tailored oral appliance. CPAP is the gold standard for treating OSA. In this instance, the patient sleeps while wearing a mask attached to the CPAP machine. People with mild and moderate OSA can use the CPAP machine, but it is advised for those with severe OSA.

1.1.3 Epidemiology of Obstructive Sleep Apnea (OSA) in Malaysia

OSA prevalence in the general population is estimated at 9% to 38% (Zhang et al., 2019). In the case of Malaysia, there are only limited studies carried out on the prevalence of OSA in Malaysia. In a study by Kamil et al. (2007), the prevalence of breathing pauses during sleep in the Malaysian population was 15.2%, and the prevalence of clinically suspected OSA in the Malaysian population was 7.1%. In the recent publication by Loo et al. (2020), the authors did a prevalence study of OSA in 226 bariatric patients that were seen and underwent bariatric surgery at the National University of Malaysia. In the study, the authors found that the overall sample prevalence of OSA was 80.5%.

According to data from the Department of Statistics Malaysia, on 15 July 2020, the population of Malaysia was around 32.7 million. Considering the prevalence of OSA in Malaysia, considering the limited available data, there are an estimated 2.32 million OSA patients in Malaysia. Therefore, there could potentially be more OSA patients in Malaysia, and the calculation based on the 7.1% prevalence of clinically

suspected OSA in Malaysia is merely looking at the estimated minimum number of OSA patients in Malaysia (Kamil et al., 2007).

Malaysia's sleep business is on a growth trajectory. Approximately eight sleep provider firms provide sleep diagnosis, therapy equipment, and home sleep testing services. According to the International Trade Administration (ITA) of the United States Department of Commerce (2019), as of December 2017, there were 144 public and 200 private hospitals in Malaysia. Currently, there are around 30 polysomnography sleep diagnostics systems in public hospitals and 20 in private hospitals in Malaysia, based on estimations and information received from the field. Consequently, there are around eight sleep provider companies in Malaysia, and it is anticipated that each of these firms has six home sleep testing equipment.

Only approximately a hundred pieces of sleep diagnostic equipment in Malaysia are available to serve 2.32 million patients. This represented tremendous potential and the country's untapped market. In addition, Malaysians are becoming increasingly conscious of sleep-breathing issues. Therefore, the number of sleep providers in the country has expanded by fifty percent over the previous decade. However, in Malaysia, physicians and hospitals confront several enduring challenges. First, the technology for sleep diagnostics is expensive to acquire. Second, they could not identify the appropriate individuals to run the system. Thirdly, when they choose home sleep testing services from sleep provider firms, the clinician and hospitals do not receive an update on their patient and are, in most cases, at the mercy of these companies to obtain information about their patient.

In the current landscape, only a handful of private and public hospitals in Malaysia are equipped with sleep diagnostics systems. On top of that, the waiting time

for a sleep diagnostics test in these hospitals varies from one to six months. This has prompted a tremendous rise in-home sleep testing services from sleep provider companies in the country. The real problem is that less than three companies in the country have certified and qualified sleep technologists to score the patient data and prepare high-quality and accurate reports for the clinicians. Most of these sleep provider companies that do not have in-house sleep technologists use the auto-scoring modules from the software to generate the report. While there are some doubts about the accuracy of these auto-generated reports, they could also potentially affect the treatment options for the patients.

On the therapeutic side, there is no uniformity in the follow-up of these patients because doctors and institutions use different suppliers for sleep therapy. Once patients are initiated on Positive Airway Pressure (PAP) therapy, more than fifty percent are lost due to dropouts or noncompliance with PAP treatment. The clinicians and hospitals do not know what happens to these patients until years later when they are readmitted for various medical issues.

There is currently no centralized platform in Malaysia capable of integrating all these data, notably, sleep diagnostic, sleep treatment, and wearables data, to provide hospitals with information on managing sleep health patients effectively. For instance, severe OSA patients may have comorbidities, including hypertension and Type 2 diabetes. Clinical research demonstrates that CPAP treatment for OSA patients reduces blood pressure (Sun et al., 2016). Without such insights gained from the data of the sleep treatment devices and wearables, it is impossible for the doctor that are currently treating the patient to alter the hypertension drugs for the patient. Given that the patient's blood pressure is more effectively controlled with CPAP therapy, this begs