An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence

Christine Brunnick

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'An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence'

By

Christine Brunnick

A thesis submitted in fulfilment of the requirements of:

Master of Business

Department of Continuing Education

Cork Institute of Technology

Research Supervisor: Dr. Angela Wright

23rd August 2019
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23rd August 2019
Declaration of Academic Honesty

Title: An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence.

Name: Christine Brunnick

Student No: R00013582

Supervisor: Dr. Angela Wright

Declaration:
I hereby declare that this Research Thesis is solely my own work. Where work is not my own it is referenced accordingly. This work has not been submitted for any other academic award at this or any other institution.

Signed: ____________________________  Date: 30/01/2019

Christine Brunnick
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Dedication

To Shane,

For his love, his advice, his patience, and his faith,

Because he always understood
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Abstract

The prevalence of Obstructive Sleep Apnea (OSA) is increasing. As the prevalence of OSA increases, as does the need for the condition to be treated effectively to reduce several risk factors which increase both mortality and morbidity rates. Continuous Positive Airway Pressure (CPAP) therapy is easily recognised as the most effective treatment for OSA. Despite the recognised benefits of CPAP therapy, adherence rates reported worldwide remain suboptimal. A transitional change within the Irish healthcare system means that private medical device companies will provide CPAP devices in specific contractual regions throughout Ireland. This change presents challenges and opportunities for policymakers. This research aims to highlight any challenges or opportunities that must be considered by relevant policymakers before awarding any contractual tenders within the Irish marketplace.

This research was conducted to investigate the impact of nursing support and the financial implications associated with CPAP adherence in Cork, Ireland. A concurrent mixed-method triangulation approach was applied to answer the research question. Three individual pieces of data were collected. These individual pieces include a quantitative internal desk research, followed by quantitative CPAP data collection and analysis, and concluding with 9 face to face semi-structured interviews. The internal desk research was conducted so that a triangulation approach could be applied to the study. The desk research included 100 patients split evenly into a private patient group and a public patient group. The data was presented in a quantitative format using Microsoft Excel. The quantitative data was collected from the 9 participants CPAP devices and analysed using Microsoft Excel. The qualitative interviews were conducted concurrently to the quantitative research. The qualitative strand provides the researcher with objective data relating to CPAP therapy and adherence rates in public and private patient groups. In comparison, the qualitative data produced subjective data, including insightful patient opinions, experiences, and behaviours relating to CPAP therapy and adherence rates in public and private patient groups.

One of the concepts that emerged from the research findings is that OSA is more prevalent in males. The desk research identified that 70% of participants were male. This finding was further supported by the quantitative research, which revealed that 78% of participants were male. Another key theme that emerged is that 78% of interviewees reported that CPAP therapy is effective at reducing the subjective symptoms associated with OSA. Interestingly, only one interviewee claimed to have no significant reduction or elimination of subjective symptoms. Furthermore, this interviewee was the only participant who did not adhere to therapy for the minimum amount of required hours. Surprisingly, 78% of interviewees described the prescribed CPAP pressure as good, and the empirical research reveals that air pressure was not associated with poor adherence to CPAP therapy.

This research will be of interest to relevant policymakers within the private medical device industry and the Irish healthcare system as it provides a unique insight into CPAP adherence rates in Cork, Ireland. The study can act as a guide for future research in a national context.
Chapter 1.0: Introduction

*I love sleep. My life has the tendency to fall apart when I’m awake, you know?*

(Ernest Hemingway)

1.1 Introduction

This study investigates the impact of nursing support and the financial implications associated with Continuous Positive Airway Pressure (CPAP) adherence in Cork, Ireland. In the Irish healthcare system, the diagnosis of Obstructive Sleep Apnea (OSA) is financed by public funds and is not funded by private health insurers (Tan et al., 2018:504). Conversely, CPAP therapy is funded for some, but not all patients through a means-tested state funding scheme such as the medical card scheme. In Ireland, private health insurance does not cover the costs associated with CPAP therapy due to the prescription status associated with the therapy. While some patients meet the criteria for state funding, a majority of patients do not, and therefore, these patients incur the high costs associated with either renting or purchasing a CPAP device. CPAP therapy is easily recognised as the most efficacious treatment for OSA.

There is an overwhelming amount of literature documenting the positive impact of CPAP therapy on both subjective and objective symptoms experienced by OSA suffers. The level of mortality and morbidity rates are significantly reduced in patients who adhere to CPAP therapy, but despite the benefits associated with CPAP therapy, adherence to therapy can be poor.

This research study is a mixed-method triangulation approach to investigate the impact of nursing support and the financial implications associated with CPAP adherence in Cork, Ireland. The study has implemented a mixed-method triangulation approach to examine factors relating to CPAP adherence. The next period of transition for CPAP therapy within Ireland’s healthcare policy is associated with contractual tenders correlating with individual private medical device companies who can provide a standardised service to all patients on CPAP therapy. Consequently, this research adopts a mixed-method triangulation approach to explore the adherence rates in Cork, and to examine patient’s attitudes and opinions relating to CPAP therapy. Understanding these issues is critical as it allows policymakers to gain a deeper understanding of the overall CPAP adherence rates, opinions and attitudes of patients on CPAP therapy, in the Cork region, in addition to providing a foundation for developing an evidence-based policy for CPAP therapy.

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This study integrates three strands of primary research, including a desk research, qualitative research, complimented and conducted in parallel with the quantitative research, with the study bearing a longitudinal element. This approach allowed the researcher to maximise resources at her disposal to achieve an extensive examination of the topic. Ultimately, it will never be possible to have all patients diagnosed with OSA sufficiently adherent on CPAP therapy. Achieving the balance between CPAP users, CPAP providers, and healthcare policymakers is an immense challenge. The researcher aims to provide a study which can bring a multifaceted perspective to CPAP adherence rates in Cork and add to the existing knowledge base surrounding CPAP therapy.

1.2 Background to Research in Sleep Medicine

Research in sleep medicine over the last decades has involved a broad variety of sleep disorders in both men and women (Theorell-Haglow et al., 2018:28). Sleep is experimentally measured by a combination of behavioural observation and electroencephalographic (EEG) signatures (Barone et al., 2019:3). It can be argued that sleep patterns, habits, and problems vary based on country and culture (Khazaie et al., 2018:1). Sleep has varied over time and place owing to differences in its structure, length, distribution, and ecology (Ekirch, 2018:515). Sleep deprivation notably disrupts the circadian rhythm, which further supports the detrimental effects of sleep deprivation on health (Liu et al., 2018:7). Sleep and wakefulness are the yin and yang of our life (Kwon et al., 2018:134). Loss of this balance due to pathological sleep conditions can lead to perturbations of physiological systems essential to maintaining health (Kwon et al., 2018:134). Sleep deprivation impairs the consolidation of learned tasks into long-term memories and has profound effects on neural mechanisms of synaptic plasticity (Barone et al., 2019:1). Sleep has a well-defined and developmentally regulated architecture that grossly manifests as cycling between well-defined physiological states (Barone et al., 2019:3). Caldwell et al., (2019:276) outline that as many as 70 million Americans are affected by a sleep disorder, and many remain undiagnosed and untreated.

1.2.1 Sleep Defined

Over the past two decades, historians, joined by anthropologists, sociologists, and literary critics, have discovered the scholarly importance of sleep (Ekirch, 2018:515). Sleep is one of the most ubiquitous, mysterious, and developmentally regulated animal behaviours (Barone et al., 2019:1). Sleep is a biological necessity like food and water, and unlike breathing,
obtaining sufficient sleep requires individuals to engage in volitional behaviours affected not only by personal choices but also by societal demands (Caldwell et al., 2019:273). One-third of our life is spent sleeping; therefore, the study of sleep is a critical factor that directly affects our lives (Ghasemzadeh et al., 2019:523; Zhang et al., 2019:600; Ward et al., 2017:371). Sleep issues and sleep medicine has experienced rapid growth worldwide as both a field of clinical study and practice (Ekirch, 2018:515; Zhang et al., 2019:600). Sleep is a complex behaviour that has been studied extensively, yet it is still not fully understood how it affects the entire brain and body (Barone et al., 2019:6; Troyinkov et al., 2018:201). Humans typically cycle between three major behavioural states: wakefulness, Rapid Eye Movement (REM) sleep and Non-REM (NREM) sleep, with additional stages of NREM sleep (Herice et al., 2019:78). The homeostatic drive for sleep is primarily a function of the amount of sleep recently obtained as well as the amount of time that has elapsed between the end of the last sleep period and the beginning of the next sleep period (Caldwell et al., 2019:273). Indoor environment, mental state, body condition, and circadian rhythm are recognised as having an impact on human sleep (Zhang et al., 2019:600). No unifying molecular or cellular correlation of the dormant state fully encapsulates all of the neural and behavioural ramifications of sleep and sleep loss (Barone et al., 2019:6). An undeniable fact is that the sleep pattern changes with aging, by increasing sleep duration while reducing latency (Curran et al., 2019:158; Khazaie et al., 2018:1). Khazaie et al., (2018:1) report that generally, the mechanism for the initiation and continuation of sleep has different patterns from infancy to adulthood with a reverse relationship between sleep efficiency and aging. Sun et al., (2019:112) suggest that sleep undergoes robust and predictable changes with age, reflected in both overall sleep architecture and electroencephalogram (EEG) oscillations/waveforms.

The failure to obtain the required 7 - 9 hours of sleep per day impairs optimal performance and the ability to recover efficiently (Caldwell et al., 2019:273; Troyinkov et al., 2018:201). The natural physiological need for sleep is driven by circadian rhythms which allow organisms to anticipate daily changes in their environment (Curran et al., 2019:158; Marshansky et al., 2017:234). An active state with a dynamic physiological process (Kwon et al., 2018:134). The circadian clock governs 24-hour oscillations in sleep/wake cycles, gene expression, and physiology and is a fundamental organising principle of cellular function throughout the body (Barone et al., 2019:3).
By definition, sleep is a reversible state characterised by various degrees of sensory unresponsiveness and behavioural inactivity (Alfonsi et al., 2019:12; Barone et al., 2019:2). Sleep is homeostatic in that the drive to sleep is dependent on the length of previous wakefulness (Barone et al., 2019:3). Most adults fall asleep within 20 – 30 minutes and may sleep for 6 – 9 hours (Marshansky et al., 2018:234). Akay et al., (2019:1) support Marshansky et al., (2018) noting that there is a biological need for 6 - 9 hours of sleep per night. For instance, individuals may sacrifice sleep to acquire further education or training to increase their earning potential (Akay et al., 2019:2). Scarcely a biological constant, it has been influenced by numerous circumstances, not least cultural attitudes and technology (Ekirch, 2018:515). Factors that influence sleep behaviours include individual genetics, knowledge, beliefs, and attitudes about sleep, health and disease, and many other variables (Caldwell et al., 2019:273). The optimisation of sleep is beneficial to human well-being and is an essential indicator of well-being and overall health (Ghasemzadeh et al., 2019:523; Liu et al., 2018:8).

Even though the exact mechanisms as to why we need sleep remains largely unknown, the importance of sleep, both in terms of duration and quality, for several biological, psychological, and socio-economic reasons is well documented (Akay et al., 2019:1; Matricciani et al., 2018:339). Aside from emotional regulation, converging evidence suggests that sleep is directly implicated in all stages of emotional memory formation (Djonlagic et al., 2015:697; Tempesta et al., 2018:190). Sleep disorders are a common health problem worldwide (Yetkin et al., 2018:71). Troynikov et al., (2019) note that sleep plays a key role in healing and recovery as growth hormones released during sleep are thought to stimulate and boost the immune system, assisting tissue growth and recovery from injury, which is an important part of the recuperation process. Furthermore, Hein et al., (2018:1) suggest that sleep plays an important role in cognitive functioning. Sleep deprivation has detrimental effects on human health and performance that include reduced cognitive performance and psychomotor skills, impairment of mood, heightened fatigue, reduced time to exhaustion and decreased vigour, with resultant loss of power during performance of tasks and physical activities (Caldwell et al., 2019:278; Troynikov et al., 2018:201).

1.2.2 Rapid Eye Movement Sleep Defined

Sleep is subdivided into two major sub-states: Non-Rapid Eye Movement (NREM) sleep and Rapid Eye-Movement (REM) sleep (Barone et al., 2019:3; Marshanksy et al., 2018:234). REM
sleep or paradoxical sleep is characterised as an elusive behavioural state with a high degree of cortical activity that resembles the waking state (Barone et al., 2019:3; Herice et al., 2019:77). Even though REM sleep was only identified as a distinct behavioural state in the early 1950s, considerable progress has been made in understanding its mechanisms and functions, with most of this headway being made within the past decade (Peever et al., 2017:1244). REM sleep-regulating circuits are widespread throughout the brainstem and the hypothalamus and involve a range of neurotransmitters and neuropeptides (Herice et al., 2019:78). REM sleep is associated with vivid dreaming, rapid eye movement, muscle atonia, and other body homeostatic signatures (Herice et al., 2019:78). Peever et al., (2017:1244) indicates that theta activity during REM sleep is critical for facilitating motor learning; it remains unknown how or why theta activity promotes memory-related plasticity. Although REM sleep appears important for certain types of learning and memory, it remains virtually unknown how REM sleep facilitates plasticity and learning (Peever et al., 2017:1244). Tempesta et al., (2018:192) support the notion that sleep is critical for the formation of episodic memories, including emotionally-balanced information throughout all the stages of sleep. Both sleep state and circadian rhythm have important influences on the Autonomic Nervous System (ANS) modulation, playing an important role in cardiac electrophysiology and arrhythmogenesis (Kwon et al., 2018:134). While sleep has generally been considered a protective state, there is increasing recognition that disorders such as Obstructive Sleep Apnea (OSA) can have an unfavourable impact on cardiovascular physiology by disrupting normally balanced ANS activity and causing intermittent hypoxemia and acute hemodynamic changes (Kwon et al., 2018:134). OSA has been associated with a wide range of medical consequences, including cardiovascular disease (Pataka et al., 2018:4).

1.2.3 Obstructive Sleep Apnea Defined

Obstructive Sleep Apnea (OSA) is one of the most prevalent sleep disorders and is characterised by repeated cessations of breathing during sleep (Yetkin et al., 2018:71). Sleep, which under normal physiological conditions should ensure regeneration of the body through the parasympathetic system, is disturbed by recurrent hypoxia, respiratory acidosis, and awakenings which lead to the dominance of the sympathetic system (Urbanik et al., 2018:9). OSA results from the collapse of the upper airway due to the reduced tone of the extrinsic tongue and pharyngeal dilator muscles secondary to diminished neuromuscular drive during
sleep (Whyte et al., 2018:176). The airway is ordinarily kept patent by a balance between the opening force of dilator muscle activity and initial size of the airway and the collapsing force of negative intraluminal pressure and the external mass around the neck (Manuel et al., 2016:336). In the case of an individual with OSA, the tongue falls backward, the pharynx contracts, and obstruction of the airway occurs (Whyte et al., 2018:176). The site at which the obstruction occurs varies: usually, the posterior aspect of the tongue comes to rest on the posterior pharyngeal wall (Manuel et al., 2016:336). There is conclusive evidence that a narrow and elongated upper airway demonstrated by imaging correlates strongly with airway collapse and apnoeic episodes during sleep (Whyte et al., 2018:185).

In patients with OSA, the pharyngeal airway is usually small and, on average, more compliant, than in healthy individuals (Manuel et al., 2016:336). This obstruction results in the cessation of breathing (apnea) secondary to upper airway collapse further resulting in hypoxia and hypercapnia (Whyte et al., 2018:176). Apneas have traditionally been defined as a cessation of airflow and their severity is calculated according to the number of events per hour (Manuel et al., 2016:336). Severe OSA can be defined as having an Apnea-Hypopnea Index (AHI) of more than 35/hour throughout the night, and regular sleep as having an AHI of less than 5/hour (Manuel et al., 2016:336). When the airway reopens, hyperventilation occurs, and there is a correction of the blood gases to normal (Whyte et al., 2018:176). The physiological response is increased ventilatory effort and sympathetic overactivity, leading to the restoration of muscular tone and arousal from sleep (Whyte et al., 2018:176). Untreated OSA is associated with symptoms such as excessive daytime sleepiness as well as several adverse health outcomes, including hypertension and vascular disease, impaired cognition, and mood, an increased risk of motor vehicle accidents and increased mortality (Swieca et al., 2017:48). OSA is treated with CPAP, which is the standard form of care (Jennum et al., 2017:62).

1.2.4 Continuous Positive Airway Pressure

The treatment modality for OSA is CPAP therapy with the treatment being recognised as the gold standard and the first choice for most patients with OSA (Yetkin et al., 2018:71). This device maintains airway patency during the night, eliminating breathing pauses in OSA patients (Zhang et al., 2019:52). While CPAP increases sleeping and daily energy expenditure, the potential benefits of long-term adherence are not only reduced subjective symptoms and improved quality of life but potentially reduced cardiovascular morbidity and mortality.
(Ghosh et al., 2013:940; Shechter et al., 2015:620). Despite the potential benefits of therapy, CPAP adherence remains a significant challenge in the treatment of OSA patients (Wohlgemuth et al., 2015:336). The underlying mechanism as to why only some patients respond to the treatment is poorly understood (Zhang et al., 2019:52). Various interventions have been shown to improve long-term compliance and improving adherence is a crucial priority; however, it is a significant challenge faced by CPAP users (Ghosh et al., 2013:940; Wohlgemuth et al., 2015:336).

1.3 Research Justification
Currently, healthcare policy relating to the supply of CPAP medical devices from private companies in Ireland is changing. Presently the marketplace is saturated with multiple private companies providing CPAP devices with varying levels of support ranging from technician to nursing combined with varying costs associated with the therapy. The introduction of contractual tenders within the Irish healthcare system for the supply of CPAP devices from private companies will undoubtedly change the outlook of the marketplace. Successful companies will be chosen to supply and support designated geographical regions as outlined by healthcare policymakers. While the healthcare system burdens the cost for some patients, private patients must burden the financial cost themselves. It is essential to review the adherence rates in Ireland and to examine if nursing support impacts on adherence rates and if there are financial implications associated with CPAP adherence. Gulati et al., (2017:5) report that if CPAP treatment is not free for all patients within the health care system then cost may become a dominant factor in poor adherence. Tan et al., (2018:503) suggest that the cost of CPAP is a highly motivating factor for patients to undergo and become adherent to treatment. After conducting an extensive review of the literature, the researcher was unable to identify any significant articles which address CPAP cost and the implications it may have on CPAP adherence in Ireland. This research is justified due to the lack of literature examining the impact of nursing support and the financial implications of CPAP therapy on adherence. The research method integrates multiple strands of primary research to provide greater credence to the findings. The researcher envisages that the findings from the research can guide future policy and practice concerning CPAP therapy in Ireland.

As a patient support nurse employed in the private medical device industry in Ireland, the researcher has a significant interest in OSA and CPAP therapy. Since commencing in the
position of Patient Support Nurse (PSN) in 2015, the researcher has witnessed varying types of patients who accept CPAP as a treatment, decline CPAP as a treatment or abandon CPAP therapy. The two-tier healthcare system in Ireland provides a unique opening or barrier to CPAP therapy as a treatment. As private health insurers do not cover the costs associated with therapy, many patients burden the cost themselves. Conversely, public patients have their device funded through the state medical card scheme. In practice, the researcher has seen public patients with suboptimal adherence rates, abandoning therapy, or rejecting therapy, even though it is provided free of charge. In addition, the researcher has witnessed private paying patients with reduced adherence rates, abandoning therapy, and even a poor uptake of therapy in this group, which may be associated with the cost of treatment. Gentina et al., (2019:60) outline that supports for patients on CPAP therapy had no significant influence on adherence rates. The empirical research seeks to investigate CPAP user’s attitudes and opinions to CPAP therapy, financial implications, nursing support, and any factors which may influence CPAP adherence.

1.4 The Research Question
The main focus of the study is to examine two key factors which may impact on CPAP adherence rates in Cork, Ireland. Following some consideration and a review of existing literature, the ensuing topic and research question emerged as a relevant area of interest in this field, at this time:

An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence.

1.5 Research Aim and Objectives
This section presents the aim and objectives of the research.

1.5.1 Research Aim
This research has the following aim:
To examine in detail the impact of nursing support and the financial implications associated with CPAP adherence rates in Cork, Ireland.

1.5.2 Research Objectives
This research has the following objectives:
➢ To perform a desk research from an internal database within BOC Homecare on Continuous Positive Airway Pressure (CPAP) adherence data gathered from existing patients in the Cork region only and to examine and analyse the quantitative data collected.

➢ To analyse the opinions and attitudes of patients towards their prescribed CPAP therapy.

➢ To collect and interpret data relating to CPAP adherence rates in Cork, Ireland.

➢ To explore the needs, sources of support, and experiences of people who are prescribed CPAP therapy.

➢ To triangulate the data collected and analyse 2 sample patient groups.

**Group 1** – This group will consist of 5 OSA patients who have been prescribed CPAP therapy. This group will be actively engaged with via an educational support framework, as dictated by a client-specific sleep tender framework. Group 1 will consist of public patients. The medical card scheme will fund the cost of this group's CPAP device.

**Group 2** – This group will consist of 4 OSA patients who have been prescribed CPAP therapy. This group will receive support using an existing internal BOC Homecare framework. Group 2 will consist entirely of private patients who must finance their CPAP therapy.

➢ To investigate if there is a discrepancy in adherence rates between patients who must privately finance their CPAP device with limited nursing support and those patients whose device is funded by the state and receive additional nursing support.

### 1.6 Research Focus

Chapter 1.0 introduces the area of study. The background into research in sleep medicine and the definitions of sleep are discussed. In addition, the chapter briefly discusses OSA and CPAP therapy. The justification for the research is outlined to provide the reader with additional context for the chosen area of study. This section is followed by a description of the research aim and objectives. Chapter 1.0 concludes with an overview of the thesis structure.

In chapter 2.0, the literature is presented. This chapter examines and presents the relevant literature pertaining to the field of study. The literature review explores the literature that
has been previously published on OSA, risk factors for OSA, diagnosis of OSA, CPAP therapy, CPAP adherence rates, and financial implications associated with CPAP adherence. The literature also examines the outcomes of CPAP therapy.

Chapter 3.0 presents the research methodology that guided the research approach. The researcher chose an exploratory concurrent mixed-method triangulation approach for the study. The chapter presents the research philosophy, an overview of research methodologies, the methodology for the chosen research field, the research design, secondary and primary data collection, and analysis. The chapter presents the three individual components of the mixed-method triangulation approach, comprising of the internal desk research, qualitative interviews, quantitative CPAP data analytics, and reflective practice. The chapter discusses the essential ethical considerations provided holistically by the researcher throughout the entire research process. The chapter concludes with a note on the limitations of the research.

Chapter 4.0 presents the main findings of the study. This section includes the data collected and presented from the desk research incorporating tables. This piece is followed by the quantitative CPAP data, further incorporating tables, and concludes with the qualitative data obtained from the 9 face to face semi-structured interviews.

Chapter 5.0 concludes with a discussion of the main findings from chapter 4.0 and links them with the relevant literature presented in chapter 2.0. The chapter presents clear discussions around the key themes emerging from the study and provides the foundation for the recommendations emerging from the study. The recommendations provide a basis for future policy and practice in the field of study. The researcher identifies the areas which require future research to be conducted. The chapter concludes with a summary of the research.
Chapter 2.0: Literature Review

The amount of sleep required by the average person is five minutes more.

(Wilson Mizener)

2.1 Introduction

The purpose of this chapter is to provide the reader with an overview of the literature pertaining to Obstructive Sleep Apnea (OSA) and Continuous Positive Airway Pressure (CPAP) therapy. The researcher has reviewed academic journals relating to this topic. The research topic has become increasingly popular as the prevalence of OSA has increased in recent years. As the prevalence of OSA has increased, literature in the area has become multifaceted and intricate. All consulted literature contained gaps relating to various issues within the research area. There were areas of the literature which were scant. Such areas include research on nursing support and the financial implications associated with CPAP adherence in Ireland.

2.2 Obstructive Sleep Apnea

Obstructive Sleep Apnea-Hypopnea Syndrome (OSAHS) is a common chronic but underdiagnosed medical condition which is gaining in importance (Chiu et al., 2017:58; Garza-Garibay et al., 2017:155; Ramos et al., 2016:22). Diagnosis and treatment of Obstructive Sleep Apnea (OSA) syndrome are essential as it is a recognised morbidity and mortality risk factor (Patak et al., 2018:2; Wickwire et al., 2019:2). OSA is the most common and most severe manifestation on the spectrum of Sleep Disordered Breathing (SDB), affecting millions of people (Garza-Garibay et al., 2017:156; Whyte et al., 2018:176). The condition is characterised by recurrent episodes of breathing cessation due to complete or partial obstruction of the upper airway and is associated with oxyhaemoglobin desaturations, sleep fragmentation and sympathetic over-activity (Amin, 2016:765; Borel et al., 2018:91; Chiu et al., 2017:58; Dohi et al., 2019:89; Huang et al., 2016:715; Manuel et al., 2016:336; Mason et al., 2018:2694; McKinney et al., 2015:196; Rezaeitalab et al., 2014:205; Shah et al., 2016:71; Tan et al., 2016:66; Tan et al., 2018:501; Theorell-Haglow et al., 2018:29; Urbanik et al., 2019:8; Ward et al., 2017:371; Westlake et al., 2016:71). OSA is associated with coronary artery disease, cardiovascular disease, cerebrovascular morbidity, hypertension, insulin resistance and traffic accidents, resulting in deterioration of quality of life and increased mortality in these patients (Banghoej et al., 2017:156; Dohi et al., 2019:92; McKinney et al., 2015:196; Migueis et al., 2016:224; Ramos et al., 2016:22; Tan et al., 2018:501; Tonkin et al., 2018:768; Shah et al., 2016:71).
OSA is usually more severe in REM sleep because the loss of muscle tone in REM sleep affects the upper airway muscles, and the arousal threshold is higher (Manuel et al., 2016:336). The recurrent upper airway obstruction leads to an intermittent disturbance in gas exchange preventing airflow into the lungs (hypoxia), and an increased inspiratory activity is required to overcome the obstruction, resulting in awakenings from sleep and impacting on the quality of sleep achieved (Carlucci et al., 2019:57; Manuel et al., 2016:336; Migueis et al., 2016:224; Tonkin et al., 2018:767; Urbanik et al., 2019:8,11; Venn, 2014:229). Sleep becomes fragmented as the cycle repeats (Whyte et al., 2018:176). The condition forces a person to stop breathing during sleep frequently and is associated with cyclic heart variability (Urbanik et al., 2019:11; Whyte et al., 2018:176). Caldwell et al., (2019:277) argue that the greater the sleep disturbance, the greater the extent of adverse effects. Lechner et al., (2019:252) report that 8.7% of men and 5.6% of women state that they stop breathing at night at least three times per week.

2.3 Epidemiology

Kerkhof (2017:233) report a SDB prevalence of 7.1%, 8.8% in men and 5.6% in women. Worldwide, OSA is the most common medical disorder of sleep, affecting approximately 4% of middle-aged individuals (Venn, 2014:229). Around 2% - 4% of people in developed populations have OSAHS (Tonkin et al., 2018:767). Venn (2014:229) state that OSA affects 4% - 5% of middle-aged men and 2% - 4% of middle-aged women. Kerkhof, (2017:238) contradict Venn (2014) outlining that general population-based studies have found that the prevalence of OSA ranged from 3% - 8% in adult men and 2% - 3% in adult women. Vicente-Herrero et al., (2017:545) suggest that current estimations vary depending on age with 10% of moderate to severe cases in males aged 30 - 49 years; 17% in males 50 - 70 years; 3% in females aged 30 - 49 years and 9% in older females. Shah et al., (2016:73) report a male to female ratio of 3.3:1, revealing a male preponderance. Similarly, Gulati et al., (2017:4) found a male to female ratio of 3.4:1. Theorell-Haglow et al., (2018:29) contradict Shah et al., (2016) and Gulati et al., (2017:4) and suggest instead that there is consistent evidence that OSA is more common in men than women in the general population with a male-to-female ratio of approximately 1.5:1. Choudhury et al., (2019:47) report that there is statistically significant and independent risk factors associated with the prevalence of OSA.
An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence

2.3.1 Risk Factors

In adults, the prevalence of snoring and OSA increases with age, reaching a peak at 40 - 60 years (Manuel et al., 2016:336). OSA is at one end of the SDB spectrum that includes snoring, snoring-induced arousals, and upper airway resistance syndrome (Manuel et al., 2016:336). Typically in OSA, there is a history of worsening snoring over the preceding few years, often causing patients and partners to sleep separately (Venn, 2014:229). Whyte et al., (2018:185) maintain that in severe OSA affecting middle-aged to elderly patients, most commonly males; the degree of airway narrowing and elongation, and therefore collapsibility, is proportional to the severity of the disease. Lechner et al., (2019:252) support Whyte (2018) stating that the number of men with breathing pauses is significantly higher than women. Lechner et al., (2019:252) convey that 38% of men and 30.4% of women snore at least three nights per week with the association of both snoring and breathing pauses reported by 5.56% of both males and females. An increase in Body Mass Index (BMI) was associated with a higher likelihood of snoring; for each 1 unit increase in the BMI, the risk of snoring increased by a factor of 1.05 (Lechner et al., 2019:253). The reason for the difference is not fully known, but different patterns of fat deposition and responsiveness to inspiratory loading are thought to contribute (Manuel et al., 2016:336).

Obesity, age, and male gender are the most important risk factors for this syndrome (Rezaeitalab et al., 2014:205). Physical associations with OSA include being male, a collar size of 17 inches or greater, a broad tongue base, and often some degree of retrognathia (Venn, 2014:229). Garza-Garibay et al., (2017:155) concur with Rezaeitalab et al., (2014) noting that the most significant risk factors of OSA are advanced age, male gender, obesity, and high blood pressure. Banghoej et al., (2017:159) support Garza-Garibay et al., (2017) reporting that age is a well-known risk factor for OSA, especially between ages 43 - 61 years. Borel et al., (2018:92) concurs with Garza-Garibay et al., (2017) and Banghoej et al., (2017) stating that male gender, increased age, and obesity were factors associated with OSA. Tonkin et al., (2018:767) further supports Banghoej et al., (2017), Borel et al., (2018) and Garza-Garibay et al., (2017) outlining that OSA is more common in those who are obese, with 20% of men with a BMI >30 kg/m2 being diagnosed with OSAHS. Lechner et al., (2019:253) further supports Banghoej et al., (2017), Borel et al., (2018), Garza-Garibay et al., (2017) and Tonkin et al., (2018) suggesting that both snoring and OSA are associated with the male sex, age, marital status, significant alcohol intake, obesity and specific comorbidities including hypertension.
Manuel et al., (2016:337) argue that all risk factors are worsened by alcohol consumption and smoking. Shah et al., (2016:71) report that the pathophysiology of OSA has evolved over the last few decades as population-based studies revealed an unexpectedly high prevalence of the condition (Shah et al., 2016:71).

2.4 Pathophysiology

OSA is a repetitive obstruction of the upper airway during sleep that causes a substantial reduction or cessation of airflow despite breathing efforts, arterial hypoxemia, and often leads to a reduced quality of sleep (Garza-Garibay et al., 2017:155; Venn, 2014:229). These repeated collapses have four main consequences: desaturation-reoxygenation sequences; transitory episodes of hypercapnia; increased respiratory effort; and micro awakenings that end the respiratory event (Borel et al., 2018:91). An et al., (2019:52) report that multiple risk factors contribute to the disorder in different proportions through varied pathogenesis among patients. Airway narrowing most commonly occurs at the level between the hard palate and the larynx, where the airway is composed of numerous muscles and soft tissue with no rigid or bony support (Eckert, 2018:48; Tonkin et al., 2018:767). The patency of the upper airway is dependent on the tone of the dilator and constrictor muscles innervating its wall (Whyte et al., 2018:179). The main pharyngeal dilators are the muscles of the tongue, especially the genioglossus, which are responsible for the patency of the airway during sleep and wakefulness (Rojas et al., 2018:638; Tonkin et al., 2018:767; Whyte et al., 2018:179).

Deposition of fat in the tongue base in obese patients causes inflammation and decreases the number and efficiency of the genioglossus muscle fibres (Whyte et al., 2018:179). During sleep, there is a decrease in the neuromuscular drive to the pharyngeal dilator muscles, the narrowed upper airway collapses, leading to apnea, the airway re-opens, and respiration recommences, then the cycle repeats itself, leading to multiple arousals and fragmentation of sleep (Whyte et al., 2018:179).

The severity of OSA is described by the number of apnea and hypopnea events per hour during sleep, also known as the apnea-hypopnea index (AHI) (Westlake et al., 2016:71). To meet the criteria for the diagnosis of OSA, complete obstruction of the airway (apnea) should occur repeatedly during sleep for periods greater than 10 seconds, whereas hypopnea (partial obstruction) refers to a decrease in respiratory airflow of >30% combined with the presence of continued movement of the diaphragm (Respiratory Disturbance Index (RDI)), leading to a
reduction of more than 4% in arterial oxygen saturation (SaO2) from the baseline Oxygen Desaturation Index (ODI) (Borel et al., 2018:92; Huang et al., 2016:716; Ramos et al., 2016:23; Venn, 2014:230; Xia et al., 2018:11). The severity of OSA is often expressed as the average number of apneic or hypopneic events per hour of polysomnographically recorded sleep which is calculated to obtain the Apnea-Hypopnea Index (AHI) (Brostrom et al., 2013:173; Huang et al., 2016:716). The condition is considered mild if the AHI is 5 - 14.9 events/per hour, moderate if 15 - 29.9 events/per hour and severe if >30 events/per hour. The worst cases may have up to 60 AHI per hour giving 400 - 500 episodes in a sleep period of 8 hours, with each dip in oxygen saturation as low as 60% (Venn, 2014:230). Eckert (2018) supports Venn (2014), reporting that in extreme cases, more than 100 breathing disturbances per hour of sleep can occur with respiratory events transiently increasing carbon dioxide levels and reducing oxygenation. Identification of Sleep Apnea-Hypopnea Syndrome (SAHS) is crucial, since its correction contributes to improved control of associated comorbidities, quality of life and the mortality it provokes (Ramos et al., 2016:23). Manuel et al., (2016:339) note that there is increasing evidence that higher baseline AHI is a reliable and independent predictor of all-cause mortality over several years of monitoring. The severity of intermittent nocturnal hypoxemia is the main determining factor and predictor of cardiovascular and metabolic complications (Borel et al., 2018:94). Amin (2016:765) notes the intermittent hypoxia and the arousal response are likely the main pathophysiologic factors associated with oscillation of systemic and pulmonary arterial blood pressures, heart rate, and cardiac function. Palma et al., (2014) report that the clinical features of OSA vary among patients depending on clinical, respiratory and autonomic features.

2.5 Clinical Features
OSA is suspected from the history recounted by both the patient and their bed partner (Tonkin et al., 2018:767). A history should be obtained from a bed partner concerning the presence of apneas at night and the level of symptoms during the day which are often both unknown and downplayed by the sufferer (Manuel et al., 2016:337). The classic triad of OSAHS symptoms include snoring, and apneas which are witnessed by other people and Excessive Daytime Sleepiness (EDS) (Garza-Garibay et al., 2017:155; McKinney et al., 2015:196; Ramos et al., 2016:23). EDS due to repeated micro-awakenings and arousals is a significant determinant of OSA and is the primary measure related to a more inferior quality.
of life (Borel et al., 2018:94; Manuel et al., 2016:336). EDS is considered severe if it significantly disrupts a person's social and professional life and affects everyday activities such as eating, driving and spending time with family (Borel et al., 2018:94; Manuel et al., 2016:336). The degree of EDS varies significantly between individuals for a given severity of OSA, and indeed, some individuals do not manifest sleepiness (Manuel et al., 2016:337).

Rezaeitalab et al., (2014:206) report that snoring (66.3%) is the most frequent symptom in patients suffering from OSA, followed by anxiety (53.9%), then choking (47.2%) and then depression (46.1%). Manuel et al., (2016:337) and Huang et al., (2016:715) contradict Rezaeitalab et al., (2014) claiming that EDS is the principal symptom of OSA. Alternatively, Shah et al., (2016:73) defines snoring as the principal symptom with EDS present in some but not in a majority of patients. Rezaeitalab et al., (2014:206) outline that despite the low prevalence of headaches and nightmares as symptoms of OSAS, they represented a significant share of the chief complaints of OSAS. Clinical features which must be assessed in all patients with suspected OSA at a general level include; obesity (BMI > 30 kg/m2), neck circumference > 42 cm; anatomical issues such as retrognathia, micrognathia, abnormal position of the palate; tonsillar hypertrophy, septal deviation, turbinate hypertrophy, nasal polyps (Ramos et al., 2016:23). OSAS is an anatomical and functional abnormality resulting from the partial or total neuromuscular collapse of the upper airways during sleep, mainly with negative pressures during inspiration (Migueis et al., 2016:224). Other measures to consider are a visual assessment for acromegaly, and neurological and respiratory examination if indicated by suspected neuromuscular or respiratory disorders (Manuel et al., 2016:338).

2.5.1 Obesity

OSA is common, and the incidence is increasing, principally due to a worldwide rise in obesity (Whyte et al., 2018:176). Obesity is a leading cause of OSA, together with an increased cardiovascular risk as well as metabolic associations such as insulin resistance, and dyslipidaemias all of which are associated with OSA and vascular morbidity (Manuel et al., 2016:336; Vicente-Herrero et al., 2017:549). The association of obesity with OSA is particularly intriguing, as obesity has been implicated both as a cause and a consequence of OSA (Lechner et al., 2019:250). As the severity of obesity and Body Mass Index (BMI) increases, so does the severity of AHI, owing to obstructions developing in the upper airway (Rezaeitalab et al., 2016:208; Whyte et al., 2018:185). In obesity, deposition of fatty tissue
around the airway causes compression and pharyngeal narrowing of the airway during sleep when muscle tone is reduced (Eckert, 2018:46; Manuel et al., 2016:337). Deposition of fat in the tongue related to obesity impairs the function of the genioglossus, making inferior oropharyngeal obstruction more likely during sleep as muscle tone falls (Whyte et al., 2018:182). Obesity is the most common factor leading to OSA with the accumulation of fat around the abdomen also reducing lung volume and increasing the risk for OSA (Eckert, 2018:46; Manuel et al., 2016:337). It is this increase in the rate of obesity and OSA in the population which are contributing to increasing rates of both hypertension and diabetes (Lechner et al., 2019:253). Ramos et al., (2016:24) recommends losing 10% of body weight as a cure for OSA in obese patients, because it reduces AHI and improves symptoms (Ramos et al., 2016:24). Thapa et al., (2015) highlight that patients with OSA who are non-obese may have craniofacial anatomical abnormalities which is the significant cause of their airway obstruction.

2.5.2 Anatomical

Multilevel obstruction is common in OSA patients (An et al., 2019:52). Airway obstruction may arise from several discrete anatomical factors such as a small lower jaw often referred to micrognathia or posteriorly positioned lower jaw often referred to as retrognathia (Borel et al., 2018:91; Manuel et al., 2016:337; Venn, 2014:229). The use of a torch to examine the oropharynx for ‘crowding’ provides a visual assessment of whether there is a high tongue base, a narrow pharyngeal anterior-posterior diameter or the presence of tonsillar enlargement (Manuel et al., 2016:338; Venn, 2014:231). An increase in the bulk of soft-tissues and decrease in size of the maxillofacial skeleton are the anatomical causes of constriction of the upper airway, which increase the extra-luminal pressure and the tendency for the pharynx to narrow and collapse (Garza-Garibay et al., 2017:155; Whyte et al., 2018:178). The increase in extra-luminal pressure is more likely to occur if there is a pre-existing narrowing of the upper airway secondary to excess surrounding soft-tissue, or if the maxillofacial skeleton is small decreasing the available space (Whyte et al., 2018:176). Eckert (2018:46) support Whyte et al., (2018) stating that there is no doubt that a crowded, narrow, or inherently collapsible upper airway is the key cause of OSA.

Apneas are more likely to occur when obesity, retrognathia, or a supine posture is present (Manuel et al., 2016:336). Multiple soft-tissue structures abut or partially surround the
oropharynx and, when enlarged, can also contribute to static airway narrowing (Whyte et al., 2018:181). Ear, Nose, and Throat (ENT) disorders like deviated nasal septum, inferior turbinate hypertrophy, allergic rhinitis, tonsillar hypertrophy are more common in patients with OSA than in simple snorers and have an impact on the pathophysiology of OSA and its treatment modality (Shah et al., 2016:74). Swelling of the turbinates and polyps due to rhinitis is present in 58% of patients with OSA; nasal decongestion treatment is mandatory and can resolve snoring and improve, but not cure, OSA (Whyte et al., 2018:181). Migueis et al., (2016:230) state that nasal obstruction was not associated with AHI, indicating no improvement in OSA with nasal resistance reduction. An et al., (2019:55) contradict Migueis et al., (2016) by demonstrating that AHI in the supine position was significantly lowered after improving nasal breathing with the administration of a nasal decongestion. Furthermore, An et al., (2019:52) argue that there was an inconsistent improvement in the AHI of OSA patients after nasal surgery. According to Ogilvie et al., (2018:36) despite the type of clinical features associated, OSA increases the risk of cardiovascular disease and other risk factors.

2.6 Risks Factors Associated with OSA
Sleep is a vital physiological function, and insufficient sleep due to sleep deprivation, sleep restriction and sleep disruption has been linked to numerous adverse mental and physical health outcomes (Caldwell et al., 2019:277). As the population suffering from OSA increases, there is a need for faster and less time-consuming diagnosis and treatment (Pataka et al., 2018:2). The diagnosis is not always easy since it can go unnoticed or does not get the appropriate importance (Garza-Garibay et al., 2017:156). Sleep apnea is a vital diagnosis for physicians because of its strong association with the most debilitating medical conditions, including hypertension, cardiovascular disease, coronary artery disease, insulin-resistance diabetes, depression, and sleepiness-related accidents (Farghaly et al., 2016:251; Kwon et al., 2018:134).

In adults, OSA coincides with aggravated cardiac problems and diabetes (Marshansky et al., 2018:236). Hypoxia and hypercapnia from apnoeic episodes and sympathetic overactivity from arousals lead to endothelial dysfunction, increased coagulability, and inflammation in multiple organs (Whyte et al., 2018:179). The dominance of the sympathetic nervous system in sleep apnea leads to the development of cardiovascular disability in terms of morbidity and mortality, irrespective of other major cardiovascular risk factors (Jennum et al., 2017:64;
Urbanik et al., 2019:11). Physiologically, there is evidence that cyclical alterations in arterial oxygen saturation caused by OSA lead to hypoxia/reperfusion injury (Venn, 2014:229). These cyclical alterations cause the excessive release of oxygen radicals, which outstrips the ability of naturally occurring intracellular anti-oxidants with consequent lipid peroxidation in the cell membrane resulting in cellular and endothelial damage resulting in atheroma formation (Venn, 2014:229). This endothelial dysfunction is a precursor of both atherosclerosis and arterial hypertension and can already be detected in OSA patients who do not have clinically overt cardiovascular disease (Dohi et al., 2019:92; Manuel et al., 2016:337). OSA accelerates atherosclerosis through the effect of hypertension and other mechanisms such as insulin resistance, diabetes, and dyslipidaemia (Amin, 2016:768). The recurrent night-time hypoxemia from OSA can lead to several cardiovascular complications, including arterial and pulmonary hypertension, cor-pulmonale, and an increased incidence of heart disease and cerebrovascular events (Venn, 2014:230). Tonkin et al., (2018:768) report that 50% of OSA patients have coexisting hypertension. Vincente-Herrero et al., (2017:549) and Xia et al., (2018:11) state that OSA is considered to be the most common cause of secondary hypertension. In addition, Xia et al., (2018:17) identify that the risk of essential hypertension is increased as the AHI increases. OSA affects 83% of patients with resistant arterial hypertension, defined as uncontrolled arterial pressure, despite improvements in diet and exercise and the administration of thiazide diuretics (Borel et al., 2018:95). Huang et al., (2016:718) report that the prevalence of hyperglycemia and hypertension was higher in patients who reported EDS as a symptom.

Obesity, hypertension and metabolic syndrome, while commonly associated with OSA, are also considered risk factors for Atrial Fibrillation (AF), and thus are major confounding factors on the causal pathway between OSA and cardiovascular diseases including AF (Kwon et al., 2018:139). In addition, Arikawa et al., (2016:435) claim that AF tended to be more prevalent in patients with OSA. Gastro-oesophageal reflux is also common in OSA patients and may lead to sudden awaking with choking and dyspnoea (Venn, 2014:231). Early detection, control, and treatment of OSA are essential because they reduce secondary conditions and save health resources from the silent or preclinical stages of disease (Vincente-Herrero et al., 2017:545). The use of a brief and precise screening tool can assist general practitioners, surgeons, or sleep specialists in the early detection of OSA (Chiu et al., 2017:58). Various screening tools,
2.7 Diagnostic Sleep Questionnaires

Healthcare systems invest a significant amount of money into the creation of sleep units in hospitals to evaluate sleep (Ibanez et al., 2018:90). One of the most important methods for assessing sleep are sleep questionnaires (Ibanez et al., 2018:90). Common symptoms occurring in more than 60% of OSA sufferers include loud snoring, EDS, choking or shortness of breath sensations during sleep, restless sleep, unrefreshing sleep, changes in personality and nocturia (Manuel et al., 2016:337). EDS is a symptom that is difficult to measure given that it is highly prevalent in the general population and does not necessarily mean that the patient has OSA (Ramos et al., 2016:23). Accurately estimating the level of EDS is important, both to understand the factors associated with the level of EDS and to estimate the health and social consequences (Kendzerska et al., 2014:321). Sleepiness is a complex phenomenon and depends on a balance between sleep and alertness mechanisms (Baiardi et al., 2018:188). OSA patients may be asymptomatic or minimally symptomatic or may have a misperception of their symptoms (Pataka et al., 2018:4). Baiardi et al., (2018:188) report that accurate evaluation is essential in commercial drivers who may intentionally underscore their questionnaire responses because of a threat to their driving licence and consequently, their employment. Standardised screening tools such as the Epworth Sleepiness Scale (ESS), STOP-BANG, and the Berlin questionnaire have been developed to quickly and conveniently identify patients who may be at risk for OSA (Bazemore et al., 2018:1). The main criticism regarding sleep questionnaires is that they are subjective, which can impact on their reliability and accuracy, compared to objective methods such as polysomnography (PSG) (Ibanez et al., 2018:90; Pataka et al., 2018:4).

One of the tools for measuring EDS is the Epworth Sleepiness Scale (ESS), which rates the possibility of the patient falling asleep in different daily circumstances on a scale of 0 – 24 (Ramos et al., 2016:23). Kendzerska et al., (2014:329) report questions surrounding the unidimensional approach of the ESS scale, particularly for items that may occur infrequently or that represent situations where there is a very low probability of falling asleep. The STOP-BANG questionnaire is used to predict the risk of OSA as high or low, based on answers to
questions related to snoring, tiredness, witnessed apneas and blood pressure (Manuel et al., 2016:338). Chiu et al., (2017:65) suggest that sleep specialists can use the STOP-BANG questionnaire to conduct patient interviews for the early diagnosis of OSA in clinical settings, particularly in settings which have limited resources. Tan et al., (2016:68) reported a moderate sensitivity of 66.2% and 69.2% for the STOP-BANG to detect moderate to severe OSA. Mason et al., (2018:2697) argue that the STOP-BANG questionnaire had limited diagnostic accuracy in both detecting and identifying patients at high risk of sleep apnea. Questionnaires are often the first cost-effective diagnostic test used in primary care, and they provide a general measure of the subjective quality of sleep (Baiardi et al., 2018:188; Ibanez et al., 2018:91).

2.8 Diagnostic Investigations

OSA is significantly underdiagnosed in the general population, due to lack of awareness and an insidious presentation (Ramos et al., 2016:22; Tan et al., 2016:66; Whyte et al., 2018:176). It is well known that polysomnography is the most reliable and golden diagnostic standard in the assessment of the AHI parameter in sleep apnea (Bazemore et al., 2018:1; Chiu et al., 2017:58; Garza-Garibay et al., 2017:155; Ibanez et al., 2018:94; Mason et al., 2018:2695; Ramos et al., 2016:23; Urbanik et al., 2019:12). In addition to the electroencephalogram, nowadays, the electrocardiogram (ECG), respiratory activity by measuring flow or respiratory effort, electrooculogram (EOG) and limb muscle activity are recorded during a regular PSG (Ibanez et al., 2018:91; Rolink et al., 2019:78). The high expense, relative inaccessibility, time consumption and the need for staff with appropriate qualifications are an obstacle to conducting a PSG in comparison to overnight oximetry (Chiu et al., 2017:58; Mason et al., 2018:2695; Ramos et al., 2016:23).

2.8.1 Overnight Oximetry

Overnight oximetry is commonly used as a screening tool as it is universally available and relatively cheap (Tonkin et al., 2018:768). Overnight oximetry recording is simple, however, the oximetry must be interpreted with the history due to the absence of snoring, a dipping pattern of oximetry can be caused by Central Sleep Apnea (CSA) rather than OSA, and a low baseline oxygen saturation can be caused by nocturnal hypoventilation rather than OSA (Manuel et al., 2016:338). Overnight oximetry measures heart rate and oxygen saturation to quantify the frequency of oxygen desaturation (Tonkin et al., 2018:768). The 4% Oxygen
Desaturation Index (ODI) is used to quantify severity measuring the number of times per hour the oxygen saturation falls by 4% or more (Tonkin *et al.*, 2018:768).

### 2.8.2 Overnight Sleep Study

The key mechanism of investigation is a diagnostic sleep study which can be performed in a sleep laboratory or at home and can take several forms (Manuel *et al.*, 2016:338). A limited sleep study which can be performed in a sleep laboratory or at home measures oronasal airflow, chest and abdominal movement to detect apnoeas and hypopneas, snore indices, pulse oximetry and electromyography (EMG) can also be included to look for periodic limb movements (Tonkin *et al.*, 2018:768).

Polysomnography (PSG) is the most reliable and the recommended gold standard for the diagnosis of OSA (Ramos *et al.*, 2016:24; Santos de Andrade *et al.*, 2014:658). PSG methods are extremely precise and can distinguish between the sleep phases (Ibanez *et al.*, 2018:91). The difference between the wake stage and any sleeping stage during a sleep study is essential for restorative sleep and sleep quality with any increased counts of wake stages or arousals acting as indicators for a sleep or breathing disorder, resulting in bad sleep quality (Rolink *et al.*, 2019:79).

The minimal availability of this exclusive technology and the high costs of polysomnography significantly limit diagnostic possibilities (Bazemore *et al.*, 2018:1; Ibanez *et al.*, 2018:91; Ramos *et al.*, 2016:23; Urbanik *et al.*, 2019:9). The electroencephalogram (EEG) signal measures the brains electrical activities (Ghasemzadeh *et al.*, 2019:523; Urbanik *et al.*, 2019:10). The PSG continuously registers EEG, electrooculogram (EOG), mental and anterior tibial electromyography (EMG) and electrocardiogram parameters, snoring, body position, pulse oximetry, nasobucal airflow and thoracoabdominal bands (Ramos *et al.*, 2016:24; Urbanik *et al.*, 2019:10). Respiratory effort is recorded with an induction plethysmography belt attached to the chest and abdomen, and respiration flow is measured with a thermistor under the nostrils (Rolink *et al.*, 2019:78).

Determining sleep stages is originally performed via the acquisition of the electrical activity of the brain using electroencephalography during the night, which is a complex measurement task (Rolink *et al.*, 2019:78). The PSG must be performed at night time with a registration time lasting at least 6.5 hours and with a minimum of 3 hours of sleep (Ramos *et al.*, 2016:24).
Although a full PSG is indicated for the diagnosis of narcolepsy and some parasomnias, it offers no advantage in the diagnosis of OSA and is considerably more complex, expensive and time-consuming (Manuel et al., 2016:338). Aside from the possible faulty application of the electrodes, the EEG acquisition is very sensitive to environmental factors, electrical noise, body movements and would disturb regular sleep since the wearing of the electrodes, and cables is not very comfortable (Rolink et al., 2019:78). For this reason, when investigating OSA, most centres now accept that limited sleep studies including oximetry recording, noise recordings and markers of arousal during sleep are optimal (Manuel et al., 2016:338).

2.9 Sleep Hygiene
Good sleep quality is a well-recognised predictor of physical and mental health, wellness, and overall vitality (Ohayon et al., 2017:1). Nam et al., (2018:259) indicate that sleep is influenced not only by individual factors but also by one’s physical and social environment. Caldwell et al., (2019:276) supports Nam et al., (2018) stating that sleep habits including poor sleep environments, inconsistent sleep/wake timing, sleep-disrupting associations between the bedroom and non-sleep behaviours, as well as engagement in arousal-producing activities in proximity to bedtime often create sleep initiation and maintenance difficulties (Caldwell et al., 2019:276).

Sleep quality represents a complex phenomenon (Al-Kandari et al., 2017:342). Although the term “sleep quality” is widely used by researchers, clinicians, and the public, this expression lacks definitional consensus (Ohayon et al., 2017:1). Sleep quality is affected by sleep hygiene, a term that refers to a set of rules that promote better sleep (Al-Kandari et al., 2017:342). To date, no consistent guidance is available from the scientific community regarding what constitutes normal or optimal, healthy sleep, and good sleep quality (Ohayon et al., 2017:1). Sleep hygiene is one of the known and validated behavioural sleep medicine treatments, which are non-pharmacological interventions for sleep disorders (Al-Kandari et al., 2017:343).

Ramos et al., (2016:24) recommend that the patient always goes to bed at the same time, as much as possible, avoid heavy meals and caffeinated products in the evening, and for at least 2 hours before bedtime, avoid watching TV or mobile phone use before sleep. AL-Kandari et al., (2017:343) support Ramos et al., (2016) outlining that the principles of sleep hygiene include avoiding strenuous activity within a short time before bed, avoiding caffeinated products within 4 hours of bedtime and avoiding naps during the day. Lechner et al.,
reveal a significant association between daytime drowsiness and owning a smartphone. Daytime blue light exposure tends to exert positive effects on night-time sleep, whereas evening exposure exerts adverse effects (Caldwell et al., 2019:277). Lechner et al., (2019:254) stress that public health agencies must take the initiative to increase public awareness on blue light emission through technological devices such as mobile phones in order to improve sleep hygiene. Nam et al., (2018:259) argue that it is an individual’s sleep-related beliefs and attitudes which contribute to their sleep behaviours.

2.10 Continuous Positive Airway Pressure
Sleep-disordered breathing is widely underdiagnosed and considering the adverse health effects caused by untreated OSA, this highlights an urgent need for policymakers to increase efforts addressing this problem (Lecher et al., 2019:256). A delay in diagnosis and treatment of patients with OSA has been partially attributed to the nature of this syndrome, as snoring and nocturnal respiratory pauses may not attract appropriate attention of sufferers (Chiu et al., 2017:58; Rezaeitalab et al., 2014:206). It is estimated that 15% - 20% of the population has moderate/severe risk of OSA which is not diagnosed or treated (Eckert, 2018:45; Vicente-Herrero et al., 2017:549). OSA requires attention and care throughout the patient’s lifetime (Garza-Garibay et al., 2017:155). OSA is a common disease associated with severe metabolic, cardiovascular, and neurocognitive sequelae and if left untreated, may lead to cognitive dysfunction, diminished work performance resulting in lack of promotion, loss of employment or work-related accidents and a diminished health-related quality of life (Garza-Garibay et al., 2017:155; Lechner et al., 2019:250; Manuel et al., 2016:337; McKinney et al., 2015:196; Pataka et al., 2018:4; Rojas et al., 2018:638). Furthermore, Djonlagic et al., (2015:697) and Manuel et al., (2016:337) note the link between OSA and motor vehicle accidents or the risk of an accident whilst operating machinery and thus, if left untreated, pose a significant risk to not only themselves but to other road users. Borel et al., (2018:98) support Djonlagic et al., (2015) and Manuel et al., (2016) stating that OSA increases the risk of road traffic accidents.

Effective treatment of OSA is an important goal due to the impact of OSA on quality of life, and the known cardiovascular and neurocognitive consequences of this common chronic disease (Cistulli et al., 2019:114). CPAP remains the gold standard for the treatment of OSA and is known to be the most efficacious treatment with millions of people worldwide benefitting from CPAP therapy (Carlucci et al., 2019:57; Catala et al., 2016:462; Cistulli et al.,
Patients undergoing CPAP treatment have healthier and more productive lives, improved quality of life and EDS and are less exposed to cardiovascular risks and accidents (Baratta et al., 2018:67; Pelosi et al., 2017:443). The main aims of treatment are to improve EDS and concentration, improve sleep quality, and return the AHI to typical values (Tonkin et al., 2018:768). Bhat et al., (2018:84) support Baratta et al., (2018) and Tonkin et al., (2018) suggesting that if patients are adherent to treatment and achieve an adequately controlled residual AHI, CPAP therapy can improve subjective EDS, fatigue, and depression in patients with OSA. Goyal et al., (2017:1393) report a decline in the ESS and maintain that the change in sleepiness after using CPAP has a significant effect on adherence. Pelosi et al., (2017:443) support Goyal et al., (2017) stating that the positive impact of CPAP in reducing sleepiness was confirmed by significantly higher values in the ESS in maladaptive patients. It is currently unclear whether treatment should, because of the potential cardiovascular benefits, be extended to include individuals with mild OSA or those with any level of OSA who are asymptomatic (Manuel et al., 2016:338). Amin (2016:768) argue that newly diagnosed OSA patients should be encouraged to commence CPAP therapy not just to relieve EDS but also due to its cardio-protective effects. The importance of CPAP adherence is emphasised by the doubling of the mortality rate in non-adherent patients (Palm et al., 2018:88).

Commencing CPAP treatment is usually a qualitative decision and involves deciding first whether the symptoms are bad enough to consider therapy, and second, whether there is sufficient evidence in the sleep study of upper airway narrowing leading to sleep fragmentation, which can account for those symptoms (Manuel et al., 2016:338). CPAP therapy involves the patient wearing either a nasal or oro-nasal breathing mask or interface attached to a source of positive pressure (Borel et al., 2018:96; Eckert, 2018:46; Whyte et al., 2018:184). The main parameter is the apnea-hypopnea index (AHI), which indicates the number of apnea and hypopnea events per hour of sleep (Santos de Andrade et al., 2014:659). Conducting treatment with CPAP in patients with an AHI of ≥ 5 and who have symptoms of associated cardiovascular disorders is recommended (Ramos et al., 2016:24).
Borel et al., (2018:96) maintain that CPAP is especially suitable for patients with severe OSA (AHI > 30 events/per hour). The mechanism action of CPAP therapy is similar to a pneumatic valve that increases the intraluminal pressure of the upper airway, preventing both static and dynamic collapse by moving the soft palate anteriorly thus, preventing pharyngeal collapse (Ramos et al., 2016:24; Santos de Andrade et al., 2014:659; Tan et al., 2018:502; Venn, 2014:232; Whyte et al., 2018:184). The rise in intraluminal pressure of the airway produced by CPAP therapy overcomes the rise in extra-luminal pressure tending to collapse the airway as the tone of the pharyngeal dilators falls during sleep (Inoue et al., 2019:556; Whyte et al., 2018:184). While the prescribed pressure should be high enough to overcome the pharyngeal collapse, it should not be so high as to reach the lower airway and raise the functional residual capacity, because this itself disrupts sleep due to discomfort (Inoue et al., 2019:556; Venn, 2014:232). As a general rule, the optimal individualised treatment strategy should be established for each patient with OSA, based on disease severity, comorbidities, and patient response (Paulitsch et al., 2019:33). Another aspect to consider when using CPAP is identifying the appropriate pressure level to eliminate apneas and hypopneas, snoring, asynchronies, arousals, and desaturation, thus improving sleep architecture (Ramos et al., 2016:25). Once treatment with CPAP has been established, it is important to inform the patient on how the device functions, device troubleshooting, the benefits derived from its use and of any side effects that may occur to decrease early treatment termination (Brostrom et al., 2013:182; Ramos et al., 2016:24).

2.10.1 Auto-Adjusting Positive Airway Pressure Devices

CPAP is best initiated in hospital for one night under supervision while the correct level of airway pressures measured in centimetres of water (cmH2O) is set for the individual, although there are now machines that detect reduced airflow and adjust the pressure automatically (Venn, 2014:232). Auto-adjusting Positive Airway Pressure (APAP) devices adjust pressure by using feedback control from patterns of pressure, flow, or other signals recorded during treatment (Bachour et al., 2007:704). Given the complexity of APAP engineering, each manufacturer designs its solution to detect disturbed breathing events and potential artefacts selectively and to define a strategy for adaptation of nasal pressure (Isetta et al., 2015:2). A fixed pressure can be assessed either as part of a PSG, or by using an APAP device for a week and deriving an average, or as an algorithm-derived pressure (Manuel et al., 2016:339). The best technique for an appropriate adjustment of pressure is the use of a complete PSG, which
assesses the accuracy of all respiratory and neurological phenomena (Ramos et al., 2016:25). Manuel et al., (2016:339) reveal that patients using auto-set CPAP, used the device for only 11 minutes longer on average than patients using fixed CPAP. Ken Lee et al., (2017:61) found that 92% of patients were using auto-titrating CPAP therapy, and no difference in compliance was found between fixed and APAP users.

2.10.2 Side Effects from CPAP Therapy

There are no serious side effects of CPAP treatment, but minor side effects may decrease compliance and benefit (Venn, 2014:232). The only absolute contraindication to the use of CPAP is the presence of a fistula of cerebrospinal fluid (Ramos et al., 2016:24). Side effects usually appear during the first week of use, but most of them are temporary and minor and respond well to local measures, which is why it is important to closely monitor the patient in the first few months after initiation of treatment (Ramos et al., 2016:25). Nasal resistance is common and may result in more frequent oral breathing with loss of pharyngeal pressure, causing airflow entering through the nose to escape through the mouth resulting in patients awakening with sore and dry throats (An et al., 2019:55; Shah et al., 2016:73; Venn, 2014:232).

Nasal complaints are associated with decreased CPAP adherence (Inoue et al., 2019:549). The most common side effects are congestion and nasal obstruction, pharyngeal dryness, skin irritation, noise, conjunctivitis, epistaxis, aerophagia, insomnia, difficulty exhaling or choking sensation (Ramos et al., 2016:25). Of these, inflammation of the nasal mucosa from the pressurised airflow often leads to symptoms of rhinitis and nasal blockage that become apparent after a period of treatment and is sometimes a reason for reduced adherence (Gulati et al., 2017:2; Venn, 2014:232). CPAP may induce nasal drying, congestion, rhinorrhea, sinusitis, and allergic reaction to the materials in the mask (Baratta et al., 2018:67). Shah et al., (2016:73) note that the presence of a blocked nose can interfere with CPAP acceptance and compliance, leading to the need for a higher pressure that can be uncomfortable for patients. Patients with nasal complications should be identified and adequately treated before CPAP therapy initiation (Inoue et al., 2019:555). Nasal blockage can be treated with topical steroid sprays but responds better to humidification of the pressurised airflow, the humidifier often being an integral part of the machine design (Venn, 2014:232).

To improve adherence to treatment, a heated humidifier device could be connected, which reduces dryness and the feeling of cold air (Ramos et al., 2016:25). Palm et al., (2018:85) recognise that the use of a humidifier at the initiation of CPAP treatment was strongly associated with high adherence to therapy. Lanza et al., (2018:99) found that nasal irritation in a majority of patients was overcome by adjusting the humidifier. Inoue et al., (2019:556) supports Lanza et al., (2018), Palm et al., (2018), Ramos et al., (2016) and Venn (2014) by recommending the use of humidifiers as an intervention for improving CPAP adherence. An et al., (2019:55) supports Venn (2014) and Inoue (2019) indicating that both subjective and objective sleep quality, as well as oxygen saturation level, AHI in both REM and non-REM sleep periods improved after nasal decongestion. Ken Lee et al., (2017:61) contradict Ramos et al., (2016) and Venn (2014) suggesting instead that humidification, nasal complications and mask related side effects were not shown to affect CPAP adherence.

Other issues stemming from CPAP therapy include noise emission from the device disturbing the sleep of the partner or patient, discomfort from the mask, and feelings of claustrophobia (Venn, 2014:232). Edmonds et al., (2016:9) claim that patients with claustrophobia are at risk for CPAP non-adherence and therefore interventions are needed to effectively reduce this treatment-related barrier and potentially improve CPAP adherence in the adult OSA population. Shapiro et al., (2017:82) highlight that if the side effects of CPAP therapy and psychosocial factors are not resolved early, they may interfere with CPAP becoming a positive experience and may impact on the development of habitual CPAP use. Ward et al., (2017:377) support Shapiro et al., (2017) stating that positive experiences from the use of CPAP reinforced beliefs about the health benefits of using the therapy. Therapy acceptance and adherence depends on patient characteristics, additionally equipment-related factors are crucial in determining CPAP adherence, with low adherence to treatment reducing the potential for benefits (Isetta et al., 2015:2; Zampogna et al., 2019:95). Brostrom et al., (2013:182) argue that at one end of the behaviour continuum are patients who are motivated by external regulations, such as patients using CPAP simply because they have been told by someone in authority to do so, and at the other end are behaviours that are intrinsically
motivated and performed for their own sake. Palm et al., (2018:88) identified patient characteristics as a factor which is impossible to influence when starting CPAP therapy.

2.10.3 Adherence to CPAP Therapy
It is not sufficient to prescribe CPAP therapy and consider the patient to be treated as many factors are influencing CPAP adherence, both medical and non-medical (Cistulli et al., 2019:115). OSA requires a patient to use the device as a long-term treatment, and such chronic care necessitates cost-effective interventions (Carlucci et al., 2019:58; Cistulli et al., 2019:115; Kang, 2016:2). Effective use of CPAP is vital to reduce the economic burden of OSA and associated comorbidities, at both the healthcare system and individual levels (Carlucci et al., 2019:58; Cistulli et al., 2019:114; Wickwire et al., 2019:2; Wimms et al., 2016:5). Pelosi et al., (2017:443) report that the awareness of OSA and its implications seems to play a key role in compliance with CPAP. Rezaeitalab et al., (2019:208) support Pelosi et al., (2017) reporting that a lack of public information regarding the importance of sleep apnea was a factor related to poor adherence. Eckert (2018:46) and Shah et al., (2016:71) argue that despite the recent advances in diagnosis and increased public awareness a substantial proportion of people who are diagnosed with OSA refuse even to try CPAP therapy or do not seek formal diagnosis and treatment due to a lack of enthusiasm for CPAP therapy. Rezaie et al., (2018:1301) encourage disseminating information about the importance of treating sleep disorders, including OSA, via public health initiatives which may significantly improve cultural awareness and acceptance of sleep-related interventions. Ken Lee et al., (2017:60) report a 42% rejection rate of CPAP therapy upfront. In addition, Ken Lee et al., (2017:62) maintain that 15.8% of the patients rejected therapy upfront as they did not see the need for treatment and may not have been fully aware prior to their sleep study of the implications of a diagnosis of OSA, including the need for long term CPAP therapy. Conversely, Tan et al., (2018:504) convey an upfront rejection rate of CPAP after the diagnostic sleep study as 38.4% of patients. Palm et al., (2018:88) convey that female gender, and coexisting hypertension were identified as risk factors for discontinuation of CPAP therapy while increased age was associated with CPAP adherence.

Long-term CPAP adherence is effective in abolishing the symptoms of OSA, treating hypertension and reducing morbidity and mortality but adherence rates are far from being ideal (Lanza et al., 2018:96; Whyte et al., 2018:184). Patients with symptomatic OSA accept
treatment better than those who have no symptoms (Ramos et al., 2016:25). CPAP is a nightly long-term treatment that will control OSA only when used, if it is stopped, OSA will return, although there may be a couple of nights before symptoms return fully to baseline levels (Manuel et al., 2016:339). Ward et al., (2017:376) highlight the importance of taking the time to persevere with using CPAP. Pelosi et al., (2017:440) described CPAP as an easy to use and highly effective treatment. CPAP data has many benefits including the ability to provide objective data on patient’s CPAP adherence and residual sleep-disordered breathing, a way to engage patients in increasing their CPAP usage and allowing CPAP providers and physicians to intervene earlier if patients are having difficulties or are not adhering to treatment by monitoring through wireless technology (Swieca et al., 2017:55). Uematsu et al., (2016:345) note that the long-term adherence rate for CPAP therapy is between 70% and 80%. Colelli et al., (2018:2) claim that adherence to CPAP therapy is typically low. Gentina et al., (2019:57) support Colelli et al., (2018) claiming that adherence to CPAP remains an issue for a significant percentage of OSA patients. Kuklisova et al., (2017) highlight a primary failure of CPAP in 23% of OSA patients. Inoue et al., (2019:554) state that the initial adherence to CPAP therapy in patients, with OSA, had a significant influence on long-term adherence. Similarly, Tan et al., (2018:506) outline that initial patterns of CPAP adherence at 1 month is predictive of long-term adherence. Alternatively, Gentina et al., (2019:60) outline that in couples with a poor relationship, CPAP withdrawal frequently occurs in the first months after CPAP initiation.

Adherence to treatment is one of the major inconveniences of CPAP and according to Ramos et al., (2016:25) the level of compliance is between 50% and 80%, although this may be over-estimated since it has been demonstrated that fewer than 50% of patients use CPAP at least 4 – 5 hours per day. Jacobsen et al., (2017:6) contradict Ramos et al., (2016:25) and suggest an adherence rate of 78% after a median follow-up time of 3 years, 81% after 5 years and 70% after 10 years. Gulati et al., (2017:4) indicate that 89.8% of patients were still using their CPAP after 6 months with a strong correlation between the early compliance measured as hours of use at first follow up, 6 weeks and 6 months, additionally device data reported a median adherence of 6 hours per night. Tan et al., (2018:503) report an adherence rate of 78.5% at 1 year. Alternatively, Zhang et al., (2019:58) report that the non-adherence rate of CPAP therapy is approximately 50%. Tonkin et al., (2018:768) argue that CPAP adherence is influenced by the support available and the severity of symptoms, with non-adherence
estimated at 29% - 83%. Gentina et al., (2019:60) contradict Tonkin et al., (2018) and suggest instead that neither emotional support nor collaboration was significantly associated with CPAP adherence. Tan et al., (2018:503) contradict Tonkin et al., (2018) and instead suggest that a possible reason for a high adherence rate is the high cost of CPAP which has to be paid out of pocket as a highly motivating factor for patients to undergo treatment. Jacobsen et al., (2017:7) note that patients with the most severe OSA have a superior adherence to CPAP therapy. Palm et al., (2018) and Jacobsen et al., (2017) further support Ken Lee et al., (2017:60) who demonstrate that patients with more severe OSA had better CPAP adherence. Baratta et al., (2018) and Palm et al., (2018) support Jacobsen et al., (2017) and Ken Lee et al., (2017) highlighting that compliance was higher in patients with more severe OSAS, where half of those with AHI > 30 events/hour were good adherers to CPAP treatment.

Adherence is recorded in hours of usage by a meter built into the device, and at least 4 hours of use per night is necessary for a reduction in EDS as evaluated by pre and post-treatment ESS (Venn, 2014:232). Wohlgemuth et al., (2015:336) contradict Venn (2014) stating that this benchmark, however, has not been found to necessarily promote maximum health and functional beneficial treatment outcomes. Ramos et al., (2016:25) contradict Venn (2014) stating that to gain an improvement in symptoms, the device should be used for at least approximately 3.5 hours per night. Borel et al., (2018:96) and Tan et al., (2018:502) contradict Ramos et al., (2016) and support Venn (2014) claiming that patients with OSA need to use CPAP for at least 4 hours per night to experience a reduction in daytime somnolence and neurocognitive function, and to reduce the risk of developing cardiovascular and metabolic comorbidities. An average CPAP use of fewer than 4 hours per night was considered sub-optimal (Gulati et al., 2017:3). The compliance is checked by dividing the number of hours for which the machine has been used by the number of nights it has been available, to give a figure for hours used per night (Manuel et al., 2016:340).

Unfortunately, poor adherence behaviour in CPAP therapy reduces its effectiveness and thereby limits beneficial outcomes despite efforts to improve devices and patient education (Baratta et al., 2018:67; Carlucci et al., 2019:57; Inoue et al., 2019:549; Kang, 2016:1; Pelosi et al., 2017:440; Tan et al., 2018:502). When a patient who has been initiated on CPAP then withdraws from therapy, the investment taken to test and treat the patient, including physician visits and CPAP equipment, is lost (Wimms et al., 2016:5). A considerable fraction
of patients decline CPAP very quickly, even before having tried the most common interventions to optimise compliance (Barrata et al., 2018:67; Jacobsen et al., 2017:8). Ken Lee et al., (2017:61) state that 70% of patients with significant OSA in whom CPAP therapy is indicated are not on effective treatment. Rezaie et al., (2018:1302) report that 5 patients in their study who never used their CPAP cited the device as intolerable, however, given that these individuals never actually used their CPAP, it may be psychological variables which influenced the perception of tolerability. Gentina et al., (2019:59) demonstrated that a partner’s involvement and the quality of the couple’s relationship significantly impact on CPAP adherence, in association with the perception of improvement with therapy.

There are many reasons patients do not tolerate CPAP, including the difficulty of dealing with the equipment and complaints of noise, mask discomfort, claustrophobia, oral/nasal irritation and dryness, respiratory difficulty, insomnia and no effect of treatment/no improvement in symptoms, patient characteristics and psychological factors and sexual functioning (Baratta et al., 2018:67; Manuel et al., 2016:340; Rezaie et al., 2018:1303; Tan et al., 2018:502; Uematsu et al., 2016:339). Oral breathing due to nasal congestion or habitual mouth breathing may be associated with decreased adherence to CPAP therapy (Inoue et al., 2019:549). Uematsu et al., (2016:347) assert that the cause of nocturnal awakening during CPAP utilisation is unclear, except in cases of nasal obstruction during sleep, pressure intolerance, and mask leaks, which can be easily managed to improve adherence. Integration of practical and behavioural aspects might influence learning and an intrinsically motivated behaviour increasing CPAP adherence (Brostrom et al., 2013:182). Kang (2016:3) support Brostrom et al., (2013:182) noting that non-adherence can be regarded as a behavioural issue that must be addressed in order to treat OSA optimally. Wohlgemuth et al., (2015:341) support Brostrom et al., (2013) suggesting that the type of intervention required to improve adherence depends on the type of CPAP user. Ken Lee et al., (2017:58) argue that socio-environmental background, education and psychological factors such as risk perception of disease and treatment outcome expectancies are increasingly recognised as more significant determinants of CPAP acceptance and long-term adherence. Colelli et al., (2018:5) contradict Kang (2016) and Ken Lee (2017) by reporting that patients who stated they did not feel tired, fatigued or sleepy during the day were more likely to adhere to CPAP therapy.
Poor treatment adherence is a significant concern and has been proposed as a main reason for the lack of effectiveness of CPAP on survival and cardiovascular outcomes in patients with OSA (Paulitsch et al., 2019:32). According to Uematsu et al., (2016:3) air pressure discomfort was a predictor for poor adherence, whereas respiratory difficulties were predictors for treatment discontinuation. Non-adherence brings no benefit or relief from symptoms, but every clinic has its group of such patients (Venn, 2014:232). Good adherence predictors include self-referral due to EDS as opposed to referral due to snoring and pressure from partners, a patent nasal airway and, most importantly, relief of daytime sleep on CPAP with an improved quality of life (Venn, 2014:232). Gulati et al., (2017:1) argue that compliance with CPAP treatment for OSA is not reliably predicted by the severity of symptoms or physiological variables. Ken Lee et al., (2017:61) report that EDS was identified as a predictor of adherence. Conversely, May et al., (2018:572) report that the frequency of CPAP use was the strongest predictor of adherence, alongside increasing age. Baratta et al., (2018:67) support Venn (2014) stating that the balance between symptom severity pre-treatment and symptom relief with CPAP treatment is among the strongest predictor of CPAP compliance. In addition, Baratta et al., (2018) maintain that no single factor has been consistently identified as predictive of long-term adherence.

Patients frequently stop using CPAP because of discomfort, mainly associated with local side effects directly related to the mask (Lanza et al., 2018:94). Finding a compatible interface can influence the efficacy of and adherence to CPAP treatment in patients with A (Santos de Andrade et al., 2014:665; Wimms et al., 2016:1). The choice of a suitable mask is vital to achieving CPAP adherence with nasal masks being most common, but these must be adapted to the needs of the patient with the mask fitting properly to prevent leakage (Ramos et al., 2016:24). Lanza et al., (2018:94) estimates that up to 50% of patients using CPAP experience at least one mask-related side effect. Furthermore, Lanza et al., (2018:99) maintain that patients with nasal masks complained significantly more than patients with nasal pillows about skin breakdown, marks on the face, swollen eyes, discomfort. Zampogna et al., (2019:98) contradicts Lanza et al., (2018) outlining that the use of a nasal mask is associated with better adherence. A well-fitting, comfortable mask keeps patients who are at the point of withdrawing from therapy adherent to CPAP therapy and can influence long-term adherence (Lanza et al., 2018:94; Wimms et al., 2016: Nasal pillows
constitute an alternative to nasal masks and have benefits over nasal masks due to their smaller size and less obtrusive nature in the treatment of OSA, and ensure adherence to treatment 1 year after therapy initiation (Lanza et al., 2018:96; Santos de Andrade et al., 2014:665; Wimms et al., 2016:5). Uematsu et al., (2016:347) report issues such as taking the mask off unconsciously, predicted poor adherence, which may be related to the sense of incongruity in the CPAP air pressure. Santos de Andrade et al., (2014:665) maintain that patients using oronasal masks must be monitored because the risks of CPAP treatment failure, non-adherence, and discontinuation are higher compared with those who use nasal masks.

A strategy of frequent evaluation and educational intervention may be useful especially in the early years of therapy to promote CPAP adherence (Carlucci et al., 2019:57; Zampogna et al., 2019:99). Patients may benefit from frequent counselling regarding the importance of therapy continuation or repeated consultation to maximise the effectiveness or perceived effectiveness of continued treatment (Uematsu et al., 2016:347). Brostrom et al., (2013:182) suggest that small tutorial groups of 4 - 8 patients can be a cost-effective approach to increase emotional, instrumental, informational, and appraisal support. Pelosi et al., (2017:443) recommend education and motivational components to influence CPAP adherence. Visits in the first few weeks should assess the clinical evolution, verifying the improvement of EDS and sleep, quality of life with the ESS (Ramos et al., 2016:25). Patients may welcome being put in touch with a support group who can give useful, practical advice about travel, new equipment, and overcoming problems (Manuel et al., 2016:340). Gulati et al., (2017:2) suggest that it would be most helpful if clinicians could identify the patients who are likely to fail to comply well with treatment before it is initiated, to focus interventions at the start of treatment in those likely to need extra support. Catala et al., (2016:469) support Gulati et al., (2017) recommending that improved therapeutic compliance can be achieved by placing an emphasis on patient education and the control of side effects. Given that OSA is a chronic disorder associated with considerable morbidity and mortality, it is imperative to optimise adherence to CPAP therapy (Cistulli et al., 2019:115). Zampogna et al., (2019:99) advocate a need for the early detection of patients at risk of poor adherence or drop out.

2.11 Assessing Outcomes of Treatment

Resolution of symptoms is assessed by direct questioning (Manuel et al., 2016:339). Current evidence is insufficient to recommend for or against the use of CPAP to improve survival or
prevent major cardiovascular events in patients with OSA (Paulitsch et al., 2019:33). Despite improvements in symptoms, participants reported a perception that CPAP use is stigmatising (Ward et al., 2017:376). CPAP adherence was associated with an overall improvement in the quality of life, health status and a greater perceived benefit from using CPAP (Diaz-Abad et al., 2014:4). Djonlagic et al., (2015:701) failed to demonstrate normalised levels of depression and anxiety as a result of CPAP therapy and unfortunately, there is no trial data to indicate that the treatment of OSA and reduction of AHI improve clinical outcomes (Manuel et al., 2016:340). Although the most noticeable effect of CPAP is to reduce daytime sleepiness, physiological benefits also occur (Venn, 2014:232). Patients with OSA often report significant subjective improvements after using CPAP for the first time, including feeling more rested and improved sleep quality (Djonlagic et al., 2015:698). Ken Lee et al., (2017:61) maintain that those who slept better or felt better after using CPAP demonstrated better adherence. CPAP therapy significantly improved sleep metrics (AHI and ESS score) and mental-component quality of life scores in patients with OSA and CVD (Paulitsch et al., 2019:32). Symptoms show a continued improvement throughout the first 6 months and then plateau (Manuel et al., 2016:339). Paulitsch et al., (2019:33) contradicts Manuel et al., (2016) noting that CPAP therapy is effective in improving sleep outcomes and mental-component quality of life scores, but not in reducing blood pressure or improving physical-component quality of life scores in patients with OSA and CVD.

There is accumulating evidence from human studies that untreated OSA causes increased oxidative stress and proinflammatory responses and that effective CPAP therapy can reverse these abnormalities (Dohi et al., 2019:92; Manuel et al., 2016:337). Amin (2016:767) found that in a group of 40 symptomatic patients newly diagnosed with severe OSA, CPAP treatment resulted in a significant reduction in carotid artery intima-media thickness compared to those who had preferred conservative treatment. Hypertensive patients treated with CPAP show a beneficial reduction in both systolic and diastolic blood pressure, the effect of which appears to increase with time (Venn, 2014:233). Shah et al., (2016:71) supports Venn (2014) stating that the treatment of OSA decreases blood pressure and modifies the cardiovascular risk associated with the condition. Baratta et al., (2018:67) support Shah et al., (2016) and Venn (2014) stating that CPAP decreases sympathetic neural activity and blood pressure. Paulitsch et al., (2019:32) contradicts Baratta et al., (2018), Shah et al., (2016) and Venn (2014) and
suggests instead that randomised trials showed no statistically significant effects of CPAP therapy, neither all-cause mortality, cardiovascular mortality, stroke, myocardial infarction nor any major cardiovascular event in adult patients with OSA and cardiovascular disease. Goyal et al., (2017:1393) failed to identify any relationship between hypertension or any comorbidity associated with OSA. Paulitsch et al., (2019:32) failed to demonstrate the significant effects of CPAP on either systolic or diastolic blood pressure in these patients. On the other hand, Paulitsch et al., (2019:32) demonstrated that CPAP therapy was associated with an average increase of 4% in left ventricular ejection fraction in patients with OSA and heart failure. Deng et al., (2018:5) note that OSA promotes recurrence of arrhythmia in patients after Atrial Fibrillation ablation. Furthermore, Deng et al., (2018:8) report that there was 17.59% of cases of recurrent AF in patients with OSA on account of not receiving CPAP after catheter ablation.

Jacobsen et al., (2017:7) believe that both AHI and daytime sleepiness were independently associated with CPAP adherence. Palm et al., (2018:90) maintain that patients with severe and symptomatic OSA had a greater chance of improving clinically as a result of CPAP treatment and are, therefore, more motivated to continue with therapy. Uematsu et al., (2016:347) claim that a lack of symptomatic improvement was a subjective predictor for non-adherence. It remains unclear why, despite adequate compliance, about 10% of patients remain excessively sleepy by day (Venn, 2014:232). Similarly, Palm et al., (2018:90) noted that 12% of those patients who were fully adherent continued to experience a residual EDS at follow up. Zhang et al., (2018:52) support Venn (2014) outlining that the issue of why some patients remain somnolent with persistent CPAP adherence remains unclear. Bhat et al., (2018:87) argue that patients with severe OSA should continue with CPAP therapy even in the absence of significant perceived improvements in daytime somnolence, fatigue, or mood, as improvements in vigilance do not necessarily match subjective measures, especially in view of safety concerns relating to commercial drivers and operators of heavy machinery. Until further robust evidence is available, it seems more prudent to follow current guidelines recommending the use of CPAP in patients with moderate to severe OSA, especially those with EDS, given the well-established effects on sleep outcomes, potential cardiovascular benefits, cost-benefits, and lack of serious side effects of such a therapy (Paulitsch et al., 2019:33).
2.12 Financial Factors Relating to CPAP

Inadequate sleep creates substantial and non-negligible economic costs to both society and the individual (Akay et al., 2019:1). Cost-effectiveness studies of CPAP therapy in OSA estimate whether the cost of CPAP treatment is compensated by improved symptoms and quality of life (Catala et al., 2016:462). Little is known about the effect of financial incentives on CPAP acceptance (Tarasiuk et al., 2012:2). To date, there have been few studies looking at the role of socio-economic status in acceptance and compliance with CPAP treatment in patients with OSAHS (Gulati et al., 2017:5). Diaz-Abad et al., (2014:4) report that socio-economic status did not turn out to be a determinant regarding CPAP adherence. Conversely, Gulati et al., (2017:5) report that only 21.8% of individuals with a low income accepted and purchased CPAP compared to 51.4% from average and 75.6% from higher-income groups. CPAP acceptance, as measured 4 - 6 weeks post-education, was significantly greater in patients from a higher income level (Diaz-Abad et al., 2014:5). Gulati et al., (2017:7) outline that socio-economic status, education level, ESS, and ODI did not predict excellent or poor compliers.

Tarasiuk et al., (2012:6) note that only 4.8% of patients refused treatment claiming that cost was a substantial factor determining their decision. A significant proportion of patients never used CPAP due to economic reasons, suggesting that reduced cost, increased insurance coverage, and subsidisation may be the most effective step to increase acceptance (Rezaie et al., 2018:1303). The state or private health insurers do not usually cover CPAP machines, and patients must pay for the devices and interfaces out-of-pocket (Ken Lee et al., 2017:58). The high cost of CPAP acts as a barrier to the uptake of CPAP therapy after the diagnosis of OSA (Tan et al., 2018:504). Gulati et al., (2017:5) report that 29% of those who declined CPAP cited cost as the reason. Goyal et al., (2017:1393) support Gulati et al., (2017) highlighting that resistance to CPAP was due to financial constraints with 54.5% of patients reporting it as the most important reason for not being able to purchase a CPAP device. The inability to purchase a CPAP device was reported by 55.3% of patients who specified that high unit cost and limited insurance coverage were major factors in opting out of CPAP treatment (Rezaie et al., 2018:1301). Tarasiuk et al., (2012:5) found that financial incentive was associated with a greater likelihood of CPAP acceptance.
Increases in healthcare spending due to continuous improvements in the diagnosis and treatment of such a prevalent disease are foreseeable in years to come, but these may be compensated in the long-term by a reduction in cardiovascular complications and increased work productivity (Catala et al., 2016:462). Wickwire et al., (2019:10) support Catala et al., (2016) reporting that CPAP was associated with favourable economic outcomes, including increased cost-effectiveness, reduced health care use, and improved workplace productivity and reduced days missed from work. Proper CPAP compliance reduces cardiovascular risk and is less expensive and more effective strategy than not using CPAP (Catala et al., 2016:469). Tarasiuk et al., (2012:5) suggest that a financial incentive should be applied to encourage CPAP acceptance. Wickwire et al., (2019:12) report that cost-effectiveness is closely linked to the clinical effectiveness of OSA treatment; thus, the economic benefit of CPAP is directly related to CPAP adherence. CPAP treatment in patients with moderate-severe OSA improves quality of life, reduces healthcare costs, and is cost-effective after the second year (Catala et al., 2016:469). Patel et al., (2016:35) support Catala et al., (2016) stating that CPAP for the treatment of OSA is a cost-effective intervention.

2.13 Conclusion
This chapter provided an extensive review of the literature pertaining to OSA, CPAP therapy and adherence. The chapter highlights the multifaceted and intricate nature of the field of study. Although the researcher limited the article search to ensure clarity around the literature reviewed, the fractured field of study and overlap between the area of research presented a significant challenge to the researcher.

The literature indicates that OSA is the most common and most severe manifestation of SDB worldwide, with a prevalence of 3% - 8% in adult men and 2% - 3% in adult women. The recurrent obstruction or partial obstruction of the upper airway results in hypoxia, sleep fragmentation, and sympathetic overactivity. The average number of airway collapses are referred to as the AHI. The higher the AHI, the more severe the OSA. The condition is associated with increased mortality and morbidity risks through its association with coronary artery disease, hypertension, cerebrovascular accident, reduced quality of life, and increased risk of road traffic accidents. The significant risk factors associated with OSA include obesity, age, and male gender.
The classic clinical symptoms of OSA include snoring, apneas, and EDS. Obesity is the leading cause of OSA with the increase in BMI, leading to an increasing AHI. A reduction of 10% of body weight can lead to a reduction in AHI. Anatomical causes are the next leading cause for OSA including issues such as retrognathia, micrognathia, tonsillar hypertrophy, nasal obstruction, deviated nasal septum, inferior turbinates hypertrophy, and allergic rhinitis.

Diagnostic investigations for OSA begin with a subjective assessment such as the ESS which measures an individual’s level of residual daytime tiredness. Overnight oximetry is used as a screening tool for OSA but does not provide the detailed information provided by either a limited sleep study or a PSG. The cost and limited resources related to the PSG mean that most sleep clinic accept the limited overnight sleep study. The significant difference between the two studies is that the PSG measures brain activity, whereas the limited study does not.

CPAP therapy is the gold standard treatment for OSA and is known to be the most efficacious OSA treatment. The device acts as a pneumatic splint for the airway through the positive generated pressure. CPAP therapy provides numerous potential benefits to individuals who are prescribed the therapy. These benefits include but are not limited to the reduction or elimination of snoring, EDS, reduction of AHI, increased energy, and improved quality of life.

Despite the potential benefits of CPAP therapy, adherence rates remain low. Low adherence rates are due to several issues including but not limited to mask issues, lack of subjective improvements, nasal irritation, the cost associated with CPAP, poor public awareness and a general lack of enthusiasm for the therapy. A staggering 10% - 12% of individuals despite consistent adherence to therapy continue to suffer from subjective symptoms. While it is a controversial issue, some academics suggest that CPAP can reduce hypertension and reduces the cardiovascular risks associated with OSA.

The research showed that cost-benefit analyses had been conducted to review the potential of CPAP as a treatment to prevent related co-morbidities. The economic benefit of CPAP is directly related to CPAP adherence in the long-term by reducing cardiovascular complications and increased work productivity. The literature has shown conflicting evidence relating to cost as a barrier to CPAP therapy.
Chapter 3.0: Methodology

A good laugh and a long sleep are the best cures in the doctor's book.

(Irish Proverb)

3.1 Introduction

In this chapter, the researcher presents the research methodology of the thesis. The chapter outlines the research philosophy, the research methodologies, the methodology for the research question, secondary data, the research design, primary data collection, the research sample, data analysis, reflective practice, and the reliability and validity of the research design. The chapter outlines both the limitations and ethical considerations of the research. The chapter concludes with a brief discussion on the limitations of the research study.

3.2 Research Philosophy

Research is about asking and beginning to answer questions, seeking knowledge and understanding of the world and its processes, testing assumptions and beliefs based on enquiry methods, questioning and hypotheses or assumptions that must be questioned and tested (Wisker, 2008:51). Quality in research is about using the most appropriate approach for investigating research problems and about researchers adopting a systematic, rigorous and transparent approach for exploring, discovering, confirming and understanding (Gerrish et al., 2010:129). It is the research question or hypotheses, which governs the type of methodology that is used (Flamez et al., 2017:124). Methodology leads the researcher to ask certain research questions and prioritise what questions and issues are most important to the study (Hesse-Biber, 2010:14). The basic premise of the comprehensive approach is that the methodology provides the theoretical perspective that links a research problem with a particular method or methods (Hesse-Biber, 2010:11). The methodology is the rationale and the philosophical assumptions underlying a particular study rather than a collection of methods, though the methodology leads to and informs the methods (Wisker, 2008:67). A methodology has a more philosophical meaning, and usually refers to the approach or paradigm that underpins the research (Blaxter et al., 2010:59).

3.2.1 Research Paradigms

Research methodology springs, to some extent, from the way we see the world, as well as the subject area in which we are working and the specific research area and question on which we are working (Wisker, 2008:65). Paradigm refers to the overarching perspective or worldview guiding an investigation (Gerrish et al., 2010:331). There are five research
paradigms, including positivist and post-positivist, interpretive, critical, and postmodern (Blaxter et al., 2010:61). The two main perspectives, often placed in opposition to each other, are the interpretivist/constructivist (qualitative) paradigm and the positivist (quantitative) paradigm (Gerrish et al., 2010:331). Both paradigms are common in social research which forms the foundation of this research study (Blaxter et al., 2010:61). The continuum of beliefs that underpin and inform the chosen methodologies, and therefore the methods and interpretations of data, ranges from perceiving the world to be fixed and knowable (positivism) or constructed (constructivism) (Wisker, 2008:68). Methodologies are derived from the researcher’s ontology and in turn, lead to perspective philosophies on the nature of epistemology (Hesse-Biber, 2010:11). Epistemology is knowledge, most particularly of how different disciplines construct, interpret, and represent knowledge in the world (Wisker, 2008:68).

3.2.2 Positivism
Positivistic research methodologists believe that the world is essentially knowable, consists of knowable facts, and if questions are asked the right way, with the right research method, with the right experiment performed, that facts and truths will be discovered (Wisker, 2008:65). Positivism holds the central belief that an objective reality exists that is independent of any individual’s subjective experience (Hesse-Biber, 2010:14). Positivistic research methodology tends to be found most appropriately in the sciences (Wisker, 2008:65).

3.2.3 Post – Positivism
Post-positivism maintains the same set of basic beliefs as positivism however, post-positivists argue that one can only know social reality imperfectly, probabilistically and only partially objective accounts of the world can be produced, for all methods are flawed (Blaxter et al., 2010:61; Denzin et al., 2005:27). If an individual believes that the world is indefinable, interpreted, shifting in meaning based on who, when and why anyone carries out and adds the meaning, then the individual will be undertaking post-positivistic research (Wisker, 2008:66). Philosophically, quantitative research is underpinned by positivism and truths emerge from what can be observed, measured, and can be studied as objects (Gerrish et al., 2010:130).
3.2.4 Interpretivism/Constructivism
Humans construct knowledge and meaning from experience and relationships between things, people, and events (Wisker, 2008:69). Within this paradigm, it is acknowledged that there may be multiple views of reality, that knowledge is not value-free, and that subjectivity is part of enquiry (Griensven, 2014:370). Qualitative research originates from constructivism, which is the idea that groups construct knowledge for one another and that there are as many realities as there are social constructions (McLaughlin et al., 2016:717). Constructivists contest the claim that statistical power constitutes greater truth value, while positivists question the value of research which does not meet their criteria for scientific rigour (Griensven, 2014:370). This approach reduces the distance between the researcher and participant and provides depth about contexts, values, opinions, and behaviours that are often missing in quantitative research (McLaughlin et al., 2016:717). Qualitative research fits neatly within an interpretivist tradition which is based on assumptions that in order to make sense of the world, human behaviour should be interpreted by taking account of interactions between people (Gerrish et al., 2010:130).

3.3 Research Methodologies
Researchers within and across disciplines can hold a range of different methodologies that frame their methods practice (Hesse-Biber, 2010:14). Different kinds of research approaches produce different kinds of knowledge about the phenomena under study (Blaxter et al., 2010:59). Researchers need to consider and choose one or more methodologies for their scholarly endeavours based on what they intend to study (Chu et al., 2017:284). The terms quantitative and qualitative refer to types of data, and by extension to research methods and methodologies which acquire, process and report on these types of data (Griensven et al., 2014:367). A methodological perspective is not inherently quantitative or qualitative for example, those who practice more positivistic methodology traditionally seen as quantitative can use qualitative as well as quantitative methods and vice versa (Hesse-Biber, 2010:11).

3.3.1 Quantitative
A quantitative positivistic approach is built on a primarily deductive mode of knowledge building that relies on "theory testing," and privileges value neutrality and objectivity over subjectively derived knowledge (Hesse-Biber, 2010:14). Quantitative research originates from positivism, which is the idea that a single reality or truth can be discovered through the objective study of numeric data and variables (McLaughlin et al., 2016:716). A quantitative
approach takes a confirmatory approach and is used to confirm or disconfirm hypotheses, whereas a qualitative approach is exploratory (Taguchi, 2018:27). Quantitative research approaches are particularly well suited for measuring the magnitude and frequency of variables, assessing relationships and differences across groups and time, and testing theories (Plano Clark, 2019:107). The use of such a scientific method reduces the risk of data contamination from the researcher’s subjectivity.

Quantitative research is designed to empirically identify the presence and magnitude of differences between individuals and groups of individuals (Cunningham et al., 2013:525). In contrast, qualitative research approaches are particularly well suited for describing real-life contexts, interpreting the meaning of phenomena, and generating theories (Plano Clark, 2019:107). Quantitative data and analyses use surveys, experiments, and statistical analysis of data (Hesse-Biber, 2010:14). While quantitative data may be useful in this research piece, quantitative data alone will not provide the depth and richness of data necessary to fully understand CPAP adherence (McLaughlin et al., 2016:715). Although this research question can be answered by using a quantitative approach, there are further questions that require the researcher to describe contextualised outcomes, to identify relationships and explain the mechanisms behind those relationships (Plano Clark, 2019:107).

3.3.2 Qualitative
Educational researchers have widely adopted a qualitative research strategy to improve the quality of their empirical studies (Liu, 2016:129). Qualitative methodologies are a particularly sensitive means of capturing the lived experiences of groups and individuals (Hesse-Biber, 2010:17). A qualitative approach helps understand multiple elements in a system (Taguchi, 2018:27). Qualitative research methods are used when the researcher is interested in better understanding a particular topic from the perspective of participants (Rosenthal, 2016:510). The benefit of using a qualitative approach is the approach’s open-ended, exploratory stance in which researchers commit to gaining an understanding of reasons behind a phenomenon, rather than proving or disproving a hypothesis (Taguchi, 2018:25). The value of qualitative research methodologies is increasingly being recognised within health services research as it offers insights into the question of “why” people engage in particular actions or behaviours (Rosenthal, 2016:509).
Qualitative research is typically inductive, with the theory being derived from the data rather than being predetermined and verified by the researcher (Griensven et al., 2014:367). Unlike a predictive approach using linear analysis of pre-selected variables, qualitative research can deal with a more significant number of elements that emerge in the data and use them as evidence toward interpreting observed changes (Taguchi, 2018:25). There are several methodologies in qualitative research, including observations, in-depth interviews, and focus groups that may be used to collect data (Rosenthal, 2016:510). Data from interviews, observations, and field notes are rich, yielding abundant information about learners' behaviour, views, and thoughts and is situated in a naturalistic context, adding to ecological validity (Taguchi, 2018:26). Qualitative data typically consists of material that is difficult to quantify, such as interview transcripts, observations of non-verbal communication, drawings, or film (Griensven et al., 2014:367). Qualitative data may not be amenable to systematic comparisons or hypothesis testing and may fail to generate the type of statistical feedback required by experiential inform practice (McLaughlin et al., 2016:716). While it is possible to make a quantitative analysis of qualitative information, this researcher risks losing the meaning and depth contained in the data (Griensven et al., 2014:367).

3.3.3 Mixed-Method

The mixed-method approach purposefully combines both quantitative and qualitative techniques, enabling a multi-faceted understanding of the research phenomena (Chiang-Hanisko et al., 2016:1). In a mixed-method study, the qualitative and quantitative arms often run either sequentially or concurrently (Griensven et al., 2014:368). Researchers engaging in mixed-methods can establish a complete understanding of an issue, triangulate findings, develop a complementary picture, identify trends, and validate results (McLaughlin et al., 2016:715). Mixed-method research allows researchers the opportunity to draw on the full repertoire of methods and methodologies found within a researcher's toolbox to generate new knowledge and insights in response to their research question (Plano Clark, 2019:107). The use of qualitative and quantitative methods in studying the same phenomenon has received significant attention among scholars and researchers with some researchers claiming it should become a third research method in addition to qualitative and quantitative research methods (Hussein, 2009:2). A mixed-method approach appeals to this nurse researcher because it offers an approach for broadening the understanding that captures multi-faceted dimensions of CPAP therapy and adherence rates (Chiang-Hanisko et al.,
2016:1). There are potentially a limitless number of reasons why research on human learning and motivation might benefit from mixing methods which can contribute new insights about the full range of topics, populations, settings, and contexts of interest to the field (Plano Clark, 2019:110).

While mixed-method research has great potential for addressing complex research questions, it is a challenging research approach because researchers must creatively and logically design and implement the combination of methods in ways that allow them to generate meaningful and defensible conclusions (Plano Clark, 2019:107). There are long-standing arguments in some research fields that mixing methods is not feasible because the two paradigms are incommensurate and that the underpinning view on the nature of reality and truth is different in each paradigm (Gerrish et al., 2010:333). Mixed-method research is about using quantitative and qualitative methods systematically in a way that they reinforce each other's results and interpretations (Taguchi, 2018:27). One of the most fiercely debated issues in mixed-method research, both within the field and outside it, concerns the combination of theoretical positions or paradigms associated with qualitative and quantitative research (Griensven et al., 2014:370). The qualitative paradigm sees reality as constructed by the complex set of meanings people attribute to their experiences, and there can be multiple truths, whereas the quantitative paradigm holds that reality is a known fixed point that can be objectively measured (Gerrish et al., 2010:333). If quantitative and qualitative data are not interacting in any particular way, it is not a mixed-method approach (Taguchi, 2018:27). To effectively integrate mixed-methods is still the fundamental issue faced by researchers using mixed-methods (Plano Clark, 2019:106). The researcher aims to triangulate both qualitative and quantitative methods for this research. A mixed-method approach can produce stronger inferences because of the data triangulation embedded in the design, which can assist the researcher in achieving a comprehensive understanding of a complex phenomenon (Taguchi, 2018:27). Furthermore, it may help this researcher to find something in quantitative data and something different in the qualitative analysis (Taguchi, 2018:27). If the quantitative/qualitative inferences present a contrasting pattern, there is a natural tendency to pose the next research question, constructing a direction for further study (Chiang-Hanisko et al., 2016:4).
3.3.4 Triangulation

Methodological triangulation is when methods either from within the same paradigm or across paradigms are used to study the same phenomena (Gerrish et al., 2010:334). Triangulation is a combination of two or more methodological approaches, theoretical perspectives, data sources, investigators, and analysis methods to study the same phenomenon (Hussein, 2009:3). Quantitative and qualitative data in a triangulated format can shed light on the complexity of pragmatic development in which multiple factors are interconnected and jointly influence the developmental trajectories as they change (Taguchi, 2018:31). Triangulation can increase the credibility of scientific knowledge by improving both internal consistency and generalisability by combining both quantitative and qualitative methods in the same study (Hussein, 2009:10). Triangulation is used to confirm suggested findings, but it can also be used to determine the completeness of data (Heale et al., 2013:1).

To conduct methodological triangulation, researchers need to identify and observe the consistency and adequacy of the two methods, positivistic and phenomenological regarding the research questions, data collection, methods of analysis and conclusions (Ostlund et al., 2011:382). During triangulation, both quantitative and qualitative data are collected either concurrently or sequentially (Taguchi, 2018:27). Analytical approaches used in mixed-methods studies differ based on of the sequence in which the components occur, and the emphasis is given to each (Ostlund et al., 2011:369). Triangulation is implemented to add depth and richness; however, triangulation assumes that the data from two distinct research methods are comparable and may or may not be of equal weight in the research inquiry (Heale et al., 2013:1).

3.4 Methodology for this Research Question

After a comprehensive review of the research methodologies available, the researcher adopted an exploratory concurrent mixed-method triangulation approach for the thesis. The rationale for implementing this classical type of method combination is due to the own definition of triangulation; and different stages where triangulation can occur in the research process (Hussein, 2009:2). Triangulation allows the researcher to expand available toolkits to include different approaches to collect, analyse, and apply quantitative and qualitative data as a means to strengthen the research and broaden the impact (McLaughlin et al., 2016:719). This research will be triangulated using the empirical quantitative and qualitative data.
collected and triangulated with the third piece of empirical research known as a desk research.

3.5 Secondary Data Collection

3.5.1 Literature Review

A research student's first exposure to the literature usually involves finding and reviewing multiple papers to identify an idea to serve as the basis of their thesis (Fernandez, 2019:1). A literature review is essential because it enables the researcher to work at a high conceptual level with other people's work, and how to see one's own contributions to knowledge and meaning (Wisker, 2008:171). The task of reviewing the literature is influenced by the type of literature review being undertaken, the relative maturity and cohesiveness of the literature relative to the topic of interest, and by the norms of the particular discipline the author is working within (Fernandez, 2019:2). The researcher conducted a critical review of the literature on OSA, CPAP therapy and CPAP adherence. The researcher made a conscious effort to focus on the specific research objectives in a broad emerging topic with strands of knowledge buried in disparate areas (Fernandez, 2019:2).

The researcher adopted a comprehensive systematic review of the literature. Fernandez (2019:4) notes that keywords help researchers select terms and phrases that can be used to retrieve relevant articles, books, and reports from databases. The keyword strategy was embraced and is presented in table 1, which highlights the core themes: CPAP adherence, nursing support in CPAP therapy, financial implications associated with CPAP adherence.

<table>
<thead>
<tr>
<th>Key Themes</th>
<th>The impact of Financial and Nursing Support on CPAP Adherence</th>
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<tbody>
<tr>
<td>CPAP Adherence</td>
<td>Nursing Support in CPAP</td>
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<tr>
<td>Adherence</td>
<td>Education</td>
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<td>Compliance</td>
<td>Support</td>
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<td>Influencing Factors</td>
<td>Public Awareness</td>
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<tr>
<td>CPAP Issues</td>
<td>Patient Care</td>
</tr>
</tbody>
</table>

Table 1. Key Word Strategy

The literature review was performed continuously throughout the thesis. The literature review formally commenced in September 2017 and continued to July 2019. Literature which was published after this date has not been included in this report. All literature was sourced from Cork Institute of Technology, including the online journal database portfolio (e.g. Science Direct and Ebsco-Host); ebook services (e.g. ebook central) and available internet sources.
3.6 The Research Design

Critical aspects of research include implementing an appropriate research design, collecting useful and accurate data, using the right analysis tools, and interpreting the results correctly (McLaughlin et al., 2016:717). There are many ways of thinking about, and categorising, the wide variety of methods available for designing, carrying out and analysing the results of research (Blaxter et al., 2010:59). The term method can be understood to relate principally to the tools of data collection or analysis: techniques such as questionnaires and interviews (Blaxter et al., 2010:59). For these reasons, the researcher required the distinct advantages of quantitative and qualitative methods and chose to employ both approaches to conduct a mixed-method triangulation study (McLaughlin et al., 2016:716). During the design of the study, the researcher found that quantitative data could supplement the qualitative data and could be triangulated with a larger sample from a desk research to provide a more in-depth insight into the topic and potentially further support the findings (McLaughlin et al., 2016:717). Complementarity allows the researcher to gain a fuller understanding of the research problem and to clarify a given research result (Hesse-Biber, 2010:4). This research is grounded in a qualitative and quantitative methodology using the process of triangulation to study a specific area in CPAP adherence (Mikalef et al., 2019:270). The researcher identifies that CPAP adherence is a complex area which may benefit from a mixed-methods approach that enables triangulation of statistical findings with important contextual and value-based themes (McLaughlin et al., 2016:719). The researcher has applied this approach to the study to incorporate multiple research methods to collect the data (Moon, 2019:103).

3.7 Primary Data Collection

3.7.1 Desk Research

Desk research consists of those research processes which do not necessitate going into the field and consists, literally, of those things which can be done while sitting at a desk (Blaxter et al., 2010:62). The researcher chose to implement a desk research in the field of study since small samples may be unable to detect a statistical difference (McLaughlin et al., 2016:719). The criteria for the desk research included a split ratio of public patients to private patients. Patients had previously been diagnosed with OSA and had been commenced on CPAP. Participants were chosen at random from an internal database to ensure an equal representation of the variables in the research. Participants were recruited from the Cork region only and represented 20% of the Cork CPAP patient demographic. To avoid bias,
patients were recruited from an internal database using a seven-digit account number. Account numbers were used to ensure compliance with current General Data Protection Regulations (GDPR) legislation and to maintain participant anonymity. A copy of the company Task Description Data Privacy Responsible Person under the Global Data Privacy Guideline (GDPG) and the Global Data Transfer Guideline (GDTG) is located in appendix 1 and 2 respectively. Patients were recruited across several different Cork-based hospital groups and Respiratory Consultants to provide broad, unbiased samples. As the patients were chosen at random, the age group ranged from 21 years - 86 years. Participants included in the desk research varied in the severity of OSA, ranging from mild to severe.

The objective of the desk research was to investigate the variables in CPAP adherence in both public patients and private patients. For the research question, the most reasonable starting point of the study was to conduct an internal desk research. The main advantage of performing internal desk research is that it involves all internal and existing organisational resources. Internal resources allowed the researcher to access pertinent patient data, including CPAP adherence rates, the severity of OSA, and geographical location in both a practical and efficient manner. The desk research will act as a cross-referencing tool to further validate the mixed-method approach to the research question. The variables investigated and analysed as part of this study are presented in Chapter 4.0: 4.2.

3.7.2 Quantitative Design
The quantitative data collection was designed in parallel with the qualitative data collection. 10 patients who had a diagnosis of OSA and were referred for CPAP therapy were recruited to participate. Written consent and a participant information document were provided to participants, a template of which is located in appendix 3 and 4 respectively. Participants were allowed to ask questions regarding the nature of the study. Initially, 10 participants consented to the study; however, 1 participant withdrew their consent. Therefore 9 participants were included in the study. CPAP devices objectively record usage data, which provides the researcher with a unique opportunity to monitor adherence (Cistulli et al., 2019:114). Data was collected and analysed from the CPAP devices following a specific timeline for the study. A debriefing form will be posted to the 9 participants on the completion of the research. A copy of this form is located in appendix 5.
The patient timeline was dependent on two factors based on the research question. The research question is to investigate the impact of nursing support and the financial implications associated with CPAP adherence in the Cork Region. Participants were divided into a split ratio of 5 public patients and 5 private patients. The participant who withdrew consent from the study was originally part of the private patient group; thus, the participating groups were 5 public patients and 4 private patients. In Ireland, the healthcare system is referred to as a two-tiered system. This means that participants of the public group had CPAP treatment provided for free. These public patients are entitled to state funding for all healthcare-related costs, including prescriptions. State funding is dependent on the level of income of the individual. If their income level is below the threshold then a medical card is issued and funded by the state. An individual who earns higher than the threshold, does not qualify for the medical card scheme. These individuals must either arrange private health insurance or must pay for medical costs and prescriptions if they do not have insurance. Patients who opt for health insurance must burden the CPAP cost themselves as health insurers do not cover these devices in Ireland.

3.7.2.1 Research Sample
Sampling is a necessary aspect of all social research, as by definition it is not possible, except in exceptional and limited circumstances, to carry out a census that collects data from the total population (Gerrish et al., 2010:143). Sampling designs comprise the selection of sampling schemes purposive and random accompanied by the selection of sample size, subsample size, or group size per approach, and these designs have multifaceted implications (Collins et al., 2013:86). Participants were recruited at random as they were referred for CPAP education from multiple sleep physicians and sleep clinics. Participants met with a Patient Support Nurse (Researcher) who provided a formal education session on CPAP therapy. These sessions were provided in a multitude of environments, including the researcher’s place of work, hospital-based education for in-patients and patient’s homes. These sessions were 1 hour in duration, and education on the use and functionality of the CPAP device was provided. In addition, the rationale for the requirement of CPAP therapy and device maintenance was outlined during this session. Participants were provided with opportunities to ask questions about the CPAP device and to engage in a hands-on approach to facilitate learning.
3.7.2.2 Research Data Collection

The CPAP device records pertinent information relating to OSA and monitors the impact of treatment. The following parameters were recorded, collected and analysed: Participant Age; Gender; Average Adherence Time in Hours; Mask Leak Percentage; Adherence Percentage; Percentage of days where CPAP was used for greater than 4 hours; Participant AHI and 90% Percentile pressure. The data was collected using the appropriate software assigned to the specific CPAP device manufacturer. For this study, the Fisher&Paykel InfoWeb software platform and Encorepro software were used to collect device recordings. The data was analysed and presented using Microsoft Excel and presented in Chapter 4.0:4.3. Findings and recommendations from the data analysis are presented in Chapter 5.0.

A specific timeline was implemented for each group of patients. Both groups received a 1 hour long education session on CPAP. During the education session, patients were educated on the rationale, benefits, and possible side effects of CPAP (Ken Lee et al., 2017:58). All patients were fitted with the most suitable interface. All patients were provided with information leaflets, and troubleshooting tips were provided (Ken Lee et al., 2017:58). Group 1 was the public patient group, who bear no cost for their CPAP device as the medical card scheme funds it. These participants received a weekly phone call from the researcher to report any related side effects or issues with their CPAP. Phone call support was provided so that participants could discuss any issues or questions relating to the therapy. On week 4, these patients met with the researcher, where the interview was conducted, and quantitative data was collected from the CPAP device. Group 2 was the private patient group who burden the cost of the CPAP device every month. These participants received one support phone call on week 2. On week 6, these patients met the researcher, where the interview was conducted, and the quantitative data was collected from the CPAP device. The specific patient timeline for each patient group is located below in tables 2 and 3.

<table>
<thead>
<tr>
<th>Participant No.</th>
<th>Install Date</th>
<th>Week 2 - Phone Call 1</th>
<th>Week 6 - Interview</th>
<th>Debriefing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A</td>
<td>12/04/2019</td>
<td>26/04/2019</td>
<td>24/05/2019</td>
<td>10/08/2019</td>
</tr>
<tr>
<td>2B</td>
<td>16/04/2019</td>
<td>30/04/2019</td>
<td>28/05/2019</td>
<td>10/08/2019</td>
</tr>
<tr>
<td>2D</td>
<td>24/04/2019</td>
<td>08/05/2019</td>
<td>05/06/2019</td>
<td>10/08/2019</td>
</tr>
<tr>
<td>2E</td>
<td>29/04/2019</td>
<td>13/05/2019</td>
<td>01/06/2019</td>
<td>10/08/2019</td>
</tr>
</tbody>
</table>

Table 2. Private Patient Interaction Timeline
### Table 3. Public Patient Interaction Timeline

<table>
<thead>
<tr>
<th>Participant No.</th>
<th>Install Date</th>
<th>Phone Call 1</th>
<th>Phone Call 2</th>
<th>Phone Call 3</th>
<th>Week 4 - Interview</th>
<th>Debriefing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>12/04/2019</td>
<td>19/04/2019</td>
<td>26/04/2019</td>
<td>03/05/2019</td>
<td>10/05/2019</td>
<td>10/08/2019</td>
</tr>
<tr>
<td>1B</td>
<td>23/04/2019</td>
<td>30/04/2019</td>
<td>07/05/2019</td>
<td>14/05/2019</td>
<td>21/05/2019</td>
<td>10/08/2019</td>
</tr>
<tr>
<td>1C</td>
<td>24/04/2019</td>
<td>01/05/2019</td>
<td>08/05/2019</td>
<td>15/05/2019</td>
<td>22/05/2019</td>
<td>10/08/2019</td>
</tr>
<tr>
<td>1D</td>
<td>29/04/2019</td>
<td>07/05/2019</td>
<td>14/05/2019</td>
<td>21/05/2019</td>
<td>28/05/2019</td>
<td>10/08/2019</td>
</tr>
<tr>
<td>1E</td>
<td>08/05/2019</td>
<td>15/05/2019</td>
<td>22/05/2019</td>
<td>29/05/2019</td>
<td>05/06/2019</td>
<td>10/08/2019</td>
</tr>
</tbody>
</table>

#### 3.7.3 Qualitative Design

The qualitative research was conducted in parallel with the quantitative data collection. The process followed has previously been described in section 3.7.2. The primary source of data collection for the qualitative research was semi-structured interviews. These interviews included 9 participants, during which their attitudes, beliefs, and opinions were sought regarding their experience with CPAP therapy, nursing support provided and financial implications associated with CPAP adherence (Mikalef et al., 2019:267). An interview is a data collection technique where individual participants are asked questions relating to the specific research question (Chu et al., 2017:289). Interview research methods involve capturing individual’s opinions, feelings, and practice, their experience, and the kind of atmosphere and the context in which they act and respond (Wisker, 2008). The researcher chose to apply a semi-structured approach due to the flexibility that it affords to the interviewer. The choice of interview as a data collection method afforded the researcher the ability to collect detailed, rich data relating to emotions, feelings, insider experiences and privileged insights within the field of study (Wisker, 2008). Qualitative interviewing has today become a key method in the human and social sciences and in many other corners of the scientific landscape from education to the health sciences (Brinkmann, 2014:277).

#### 3.7.3.1 Research Data Collection

Compared to structured interviews, the semi-structured approach allowed the researcher to make better use of the knowledge-producing potentials of dialogues by allowing far greater leeway for following up on whatever angles are deemed important by the interviewee (Brinkman, 2014:277). The researcher developed an interview guide to ensure that the aim and objectives of the thesis which are outlined in chapter 1.0 were met. To ensure consistency, the guide entails a thematic dimension that consists of broad questions related to the research question and a dynamic dimension with specific questions that contribute to
a natural conversation in an everyday language during the interview (Pederson et al., 2016:631). This interview guide was developed based on the outcome of the secondary research in Chapter 2.0 and the questions arising from the researcher’s familiarity with the topic grounded in the researcher’s previous experiences and pre-understandings as well as conceptual and theoretical knowledge about the topic (Pederson et al., 2016:631). To focus the interview guide further, the specific research question was incorporated. Dr. Wright (Research Supervisor) reviewed the interview guide, and the necessary adjustments were made. The medical language used in the interview questions was amended as recommended by Dr. Wright. As the researcher is from a healthcare background, it was difficult to implement clear, concise English that participants would understand in the interview guide. Questions were redesigned from the perspective of the interviewees partaking in the research process to provide questions which used everyday language (Pederson et al., 2016:633). The interview guide was comprised of 10 questions. The interview opened with general questions based on CPAP, followed by questions focussing on nursing support and the financial implications associated with CPAP adherence. The interview guide is located in appendix 6. The analysis of these findings is located in Chapter 4.0, and the findings are presented in Chapter 5.0. All interviews were recorded, and the recordings were transcribed using a software package called Sonix. All transcriptions are available upon request from the researcher.

3.8 Research Data Analysis
The data analysis technique, as one of the two components for research methods, is normally categorised as qualitative and quantitative at the top level (Chu et al., 2017:292). The weighting, or priority, of the qualitative and quantitative data in a mixed-method study is dependent upon various factors including; the aims of the study and whether the purpose is, for example, to contextualise quantitative data using qualitative data or to use qualitative data to inform a larger quantitative approach such as a survey (Ostlund et al., 2011:372). Utilising several methods within a research design is termed triangulation, a term which has more traditionally been coined to refer to procedures used in surveying in order to pinpoint a particular geographic position by taking reference measurements from three or more points (Gerrish et al., 2010:138).

Data triangulation also referred to as data sources triangulation, depicts the use of multiple data sources in the same study for validation purposes (Hussein, 2009:3). The points of the
triangle represent theoretical propositions and empirical findings from qualitative and quantitative data while the sides of the triangle represent the logical relationships between these propositions and findings (Ostlund et al., 2011:371). This notion of convergence underpins the meaning of triangulation in the research context in that it refers to a process of adopting two or more methods in order to corroborate the findings from one method with the other and with this process of crosschecking, it is intended by the researcher that the confidence in the entire study will be enhanced (Gerrish et al., 2010:335). In addition to validation purposes, analysis triangulation can be described further as the use of more than two methods of data analysis in qualitative and quantitative paradigms within the same study for both validation and completeness purposes (Hussein, 2009:4). The nature and use of the triangle depends upon the outcome from the analysis, whether that be convergent, where qualitative and quantitative findings lead to the same conclusion; complementary, where qualitative and quantitative results can be used to supplement each other or; divergent, where the combination of qualitative and quantitative results provides different (and at times contradictory) findings (Ostlund et al., 2011:371). This empirical research applies both a convergent and complementary approach which is demonstrated in the findings in chapter 5.0.

Quantitative and qualitative analyses, research objectives and applications overlap, and the decision of which of the two methods to apply depends not only on the nature and volume of data that is to be collected, but also the actual type of data and the resources at hand (Victor, 2019:1). If qualitative and quantitative data are not integrated during data collection or analysis, the findings may be integrated at the stage of interpretation and conclusion (Ostlund et al., 2011:381). Connecting analyses are procedures for linking the results of one method to the collection and analysis of data representing the other method (Plano Clark, 2019:110). Statistical inference is the process of drawing conclusions about populations of interest (Sebastiao et al., 2018:367). Joint displays are visuals in the form of tables, matrices, or figures that explicitly relate quantitative and qualitative information (Plano Clark, 2019:110). The use of statistics in clinical research helps identify relevant patterns in patient characteristics, health services, and outcomes to provide the framework for recommendations (Sebastiao et al., 2018:367). The researcher has implemented both
arithmetic statistics and descriptive statistics to analyse the data collected. All of which are presented in Chapter 4.0.

3.8.1 Integration
Mixed-method research, where quantitative and qualitative methods are combined, is increasingly recognised as valuable because it can potentially capitalise on the respective strengths of quantitative and qualitative approaches (Ostlund et al., 2011:369). Mixed-method designs differ in terms of the ordering of the quantitative and qualitative components, which fundamentally changes the inherent logic of the combination and the kinds of conclusions that are drawn from the use of mixed-methods (Plano Clark, 2019:108).

Integration is the explicit conversation between or interrelating of the quantitative and qualitative components of a mixed-method study (Plano Clark, 2019:108). By seeking to integrate different methodologies, mixed-method researchers place themselves at the centre of the paradigm debate as not only do they acknowledge that quantitative as well as qualitative approaches have a valuable contribution to make to research, they actively seek to utilise and integrate both (Griensven, 2014:370). This strength is understandable, considering that mixed-method is a combination of two methods that follow different philosophical and methodological orientations (Taguchi, 2018:27). The unique potential of mixed-method research comes from the effective integration of quantitative and qualitative perspectives, methodologies, data sources, and data analyses (Plano Clark, 2019:108). Through data integration, mixed-method can respond to research questions in a more meaningful manner than either quantitative or qualitative method alone can do (Taguchi, 2018:27). Due to the centrality of integration in mixed-method research, there is increasing attention on researchers implementing rigorous integration of the quantitative and qualitative components within their mixed-method studies (Plano Clark, 2019:108).

3.9 Reflective Practice
Reflection is a form of mental processing, like a form of thinking, which we may use to fulfil a purpose or to achieve some anticipated outcome (Moon, 2013:192). Mantzourani et al., (2019:1) contradict Moon (2013) stating that whilst the terms of reflection and reflective practice have been equated to a spectrum of activities, no consistent definition has been followed. Reflective practice is the ability to learn from experiences and to understand and develop form practice through reflection (Barbagallo, 2019:160). Paterson et al., (2013:133)
suggest that reflection is a critical part of learning from experience and is important in
developing and maintaining competency across a practice lifetime. Barbagallo (2019:160)
note that reflective practice in nursing is a vital competency that permits learning and
continued professional development. Reflection is not just thinking or going back over an
event in the mind (Paterson et al., 2013:133). Mantzourani et al., (2019:1) suggest that there
are a number of models and tools which healthcare workers can draw upon to facilitate the
reflection of their professional practice. Moon (2013:194) report that such structures can be
helpful at the beginning of reflection but should be dispensed with as soon as possible. The
Gibbs cycle (figure 1) is a structured, easy to follow model that guides the process of
reflecting, consisting of cue questions, based on key concepts, and provides a checklist for
learners to work through, answering and considering the cue as they progress (Husebo et al.,
2015:369). The researcher comes from a clinical background and has completed a Gibbs
reflective cycle to guide and broaden the learning environment. The Gibbs Cycle provides a
deeper understanding and incorporation of learning into knowledge and future practice for
the researcher (Husebo et al., 2015:374). This Gibbs Cycle is located in appendix 7.

Figure 1. Gibbs Reflective Cycle

Source. University of Hull (2019)

3.10 Reliability and Validity

Validity, reliability, and objectivity are generally used as criteria for determining the quality of
quantitative research (McLaughlin et al., 2016:718). In quantitative research, reliability and
validity of measures, sample size, choice of appropriate statistics to use, underlying assumptions for the statistical procedures, calculation of effect sizes, and appropriate reporting of findings are important considerations (Taguchi, 2018:31). Validity reflects the extent to which a measure actually represents what it claims to measure, reliability concerns the degree to which a finding is stable and consistent, and objectivity indicates the extent to which the instrument being used is resistant to influence from the beliefs and biases of researchers (McLaughlin et al., 2016:718). In qualitative research involving the researcher’s subjective observation, coding and segmentation of naturalistic data, sufficient descriptions of participant sampling, the researcher’s role, and data analysis process are critical (Taguchi, 2018:31). While objectivity remains an ideal, there is increased use of qualitative techniques in order to ‘check’ the validity of findings (Blaxter et al., 2010:61).

Mixed-method combine quantitative and qualitative approaches; therefore, researchers have to be mindful about meeting rigorous standards on both sides (Taguchi, 2018:31). Triangulation is generally considered to promote a more comprehensive understanding of the phenomenon under study and to enhance the rigour of a research study (Heale et al., 2013:1). In the early practice of mixed-method research, researchers primarily used mixed-method for cross-validation purposes, meaning that inferences are drawn from converging quantitative and qualitative data (Taguchi, 2018:27). Researchers use triangulation for validating quantitative research instruments when the research phenomenon under investigation has little theoretical underpinnings (Hussein, 2009:5). A further caution required with triangulation is that while the corroboration process might suggest a greater air of validity or confidence in the findings, it is vital to examine how the methods have been applied in every study (Gerrish et al., 2010:335).

The researcher ensured that the data collected in the mixed-method research was valid and reliable by incorporating a larger sample in the desk research to triangulate the findings. The use of quantitative data allowed the researcher to validate the qualitative findings from the interviews. The method of triangulation provided this researcher with a more comprehensive picture of the research variables and enhanced the study’s rigor through a collection of data from multiple sources (Moon, 2019:104). The interview questions were carefully designed to ensure reliability. The interview questions were reviewed and amended to avoid medical jargon and to ensure reliable responses were gathered from all participants.
3.11 Ethical Considerations

Historically, researchers undertaking research that involved human subjects relating to medical or health procedures would, as they still do, be expected to seek formal ethical approval for their work (Wisker, 2008:86). The Nuremberg Code contained guidelines for consent or discontinuation of studies and advised on the balance between risks and benefits, however, most of these rules were concerned with experimental research (Holloway et al., 2016:52). The 10 main principles of the code are summarised in table 4 (Jarmusik, 2019).

<table>
<thead>
<tr>
<th>10 Principles of The Nuremberg Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Voluntary consent is essential</td>
</tr>
<tr>
<td>2. The results of any experiment must be for the greater good of society</td>
</tr>
<tr>
<td>3. Human experiments should be based on previous animal experimentation</td>
</tr>
<tr>
<td>4. Experiments should be conducted by avoiding physical/mental suffering and injury</td>
</tr>
<tr>
<td>5. No experiments should be conducted if it is believed to cause death/disability</td>
</tr>
<tr>
<td>6. The risks should never exceed the benefits</td>
</tr>
<tr>
<td>7. Adequate facilities should be used to protect subjects</td>
</tr>
<tr>
<td>8. Experiments should be conducted only by qualified scientists</td>
</tr>
<tr>
<td>9. Subjects should be able to end their participation at any time</td>
</tr>
<tr>
<td>10. The scientist in charge must be prepared to terminate the experiment when injury, disability, or death is likely to occur</td>
</tr>
</tbody>
</table>

Table 4. Summary of Nuremberg Code (Jarmusik, 2019)

Universities have codes of practice, and most now have ethics committees who oversee ethical approval (Wisker, 2008:88). A Cork Institute of Technology Ethics Application Form was provided by Dr. Wright (research supervisor). This ethics application form was completed and returned to the Research Ethics Committee (REC) and Office of the Registrar and Vice President of Academic Affairs and is located in appendix 8. Both the REC and Office of the Registrar and Vice President of Academic Affairs approved the ethical application and granted permission for the study to be conducted. The approval letter is located in appendix 9. Ethical approval was sought from the researcher’s employer. A BOC clinical audit project support form was submitted to the Clinical Governance Chair. This form is located in appendix 10. The Clinical Governance Chair granted ethical approval.

The researcher addressed the following ethical considerations throughout the research: voluntary informed consent; permission to collect data; process data; data storage; data disposal; participant anonymity; participant briefing; debriefing; and consent for future publishing of findings. Sensitive information collected from participants including name;
address; DOB; eircode; contact number; medical card number; and CPAP prescription. Participant anonymity was maintained throughout by utilising an alphanumeric code for each participant. Desk research patients remained anonymous by using a 7-digit account number.

3.11.1 Informed Consent

Voluntary informed consent is the hallmark of all research involving human participants (Cunningham et al., 2013:36). Informed, voluntary consent means that research participants are fully informed about the research and give their voluntary agreement to take part in it with neither implicit or explicit pressure from researchers nor any inducement (Holloway et al., 2016:57). The participants must understand that they are free to withdraw from the study at any time and for any reason without penalty (Cunningham et al., 2013:36). The process of informed consent is located within the principle of respect for autonomy, and this principle demands that participation is voluntary and that informants are aware not only of the potential benefits of the research for the population but also of the personal and individual risks they take (Holloway et al., 2016:58). Participants then must be informed throughout about the voluntary nature of participation in research and about the possibility of withdrawing at any stage and this should be shown in the written consent form required in health research (Holloway et al., 2016:58). To ensure voluntary informed consent was obtained, the researcher developed a participant information document. This document is located in appendix 4. This document was provided to the participant before the consent form. Participants were allowed to ask questions regarding the study before written consent was obtained. Completed consent forms are available upon request.

3.11.2 Privacy, Confidentiality, and General Data Protection Regulations (GDPR)

Researchers must respect the privacy of the research participants which is closely linked to confidentiality, with confidentiality in healthcare generally recognised as underpinning the patient, practitioner, researcher relationship (Holloway et al., 2016:54). The health sciences researcher must be concerned about the confidentiality of all parties included in the research project, including the people being studied, the organisation that has commissioned the research, and any third party that may be involved in the project (Cunningham et al., 2013:35). There is a subtle difference between confidential and anonymous, but in both cases, when the researcher reports the data, the reader will not be able to determine how individuals performed or responded in the study (Cunningham et al., 2013:39; Holloway et al., 2016:60). In research where words and ideas from participants are used, full
confidentiality cannot be promised, especially as qualitative research contains quotes from the interview data (Holloway et al., 2016:60). Technically, confidentiality means that the researcher does not reveal how participants acted in the study and instead may use a unique but meaningless number to identify each of the participants (Cunningham et al., 2013:39).

The researcher applied alphanumeric coding to label all participants to ensure that anonymity was maintained throughout the study. Participants were labelled in the following way to maintain anonymity: 1A, 1B, 1C, 1D, 1E, 1F, 2A, 2B, 2C, 2D, 2E, 2F. The use of a numeric 7-digit account number was used to maintain anonymity in the desk research participants.

Data security is a pertinent issue relating to the risk of participating in a study (Flamez et al., 2017:135). Tapes, notes, and transcriptions are essential tools for the qualitative researcher, they must be kept secure, and names must not be located near the tapes (Holloway et al., 2016:59). If data is stored electronically, it may be important to store encrypted data and keep the data on separate devices that remain secure (Flamez et al., 2017:135). The collection, processing, storage, and disposal of all data collected is in line with current European General Data Protection Regulations (GDPR) Legislation. This complies with internal GDPR policies within BOC Homecare, requiring a username and password to log on to the internal network. This is followed by a two-factor authentication method using RSA Secure ID and Pulse Secure. A Firewall system is in place to prevent unauthorised access to the network.

Data will be destroyed as specified by the relevant internal BOC Homecare Policy and current EU legislation. The Linde Group task description data privacy responsible person and The Linde Group Global Data Privacy Guideline documents are located in appendix 1 and 2 respectively.

3.12 Limitations
A limitation is any aspect that hinders a study and its findings (Moura, 2017). As expected, the current research has its limitations, including time constraints, impact limitations, research design limitations, sample limitations, and relevant literature limitations.

A single individual has under taken this current study, the research was self-funded, and the researcher was in full-time employment. Time constraints were a fundamental limitation of the research due to the specific submission deadline and the limited amount of time to undertake the research. An important factor associated with the area of study is that CPAP adherence can lessen over time. Therefore, due to the time constraints, long-term adherence
An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence

at 6 months, 12 months, or 18 months were not measured. On this basis, it is difficult to examine such a multifaceted field of study and to draw significant conclusions in the area. Despite this time constraint, the researcher envisages that the research findings can impact critical policymakers in the field of study.

Integrating qualitative and quantitative research can optimise the strengths and address the limitations of each approach and provides a practical alternative to two distinct paradigms (McLaughlin et al., 2016:717). Despite the mixed-method triangulation approach, there were limitations associated with the design of the study. The qualitative data collected in the interviews was collected from the individual who provided their initial education session on CPAP therapy. This existing rapport may have influenced interviewees to provide biased responses when questions surrounding nursing support were discussed. An unknown nurse educator may have resulted in different responses being provided regarding the questions based on nursing support provided.

Another limitation experienced by the researcher was concerning the sample size of the qualitative data collection. The initial number of participants recruited were a split ratio of 5 private patients and 5 public patients. Unfortunately, 1 private patient requested to withdraw their consent. This individual could not be replaced due to the time required for patients to be on CPAP therapy in order to participate in the study. The loss of a participant may have negatively influenced the results of the study. Interestingly, the desk research supported the findings of the qualitative and quantitative data despite the mixed-method ratio of 5:4.

An impact limitation associated with the study is the strong regional focus of the research (Sheen et al., 2019). Time and resource constraints restricted the sample size in the desk research and the mixed-method data collection. This limited the researcher's ability to draw population-based generalisations from the findings. Merging the desk research and the mixed-method data in a triangulation based study allowed the researcher to draw more accurate conclusions. The research was focused explicitly in Cork, Ireland. The research has the potential to be conducted at a national level, increasing the sample size, and generating results that may show population generalisations within the field of study.

The final limitation associated with the study is that this research question, to the researcher's knowledge, was the first of its kind. Literature was scant in the area examining the financial
implications on CPAP adherence, so the research articles addressing the research question were limited.

Regardless of the limitations of the study, the researcher strived to maximise the available resources. The goal was to expand the existing knowledge with a comprehensive and well-researched study in an intricate topic of research.

3.13 Conclusion
This chapter outlined and presented the research methodologies which were implemented by the researcher to answer the research question. Chapter 4.0 presents the findings of the research.
Chapter 4.0: Research Findings and Analysis

Laugh and the world laughs with you, snore and you sleep alone.

(Anthony Burgess)

4.1 Introduction
This chapter presents the data gathered throughout the entire research process. This chapter is divided into three parts. Section one will present the data collected from the internal desk research. Section two of the chapter will present the quantitative empirical data gathered from the participants CPAP device, as explained in chapter 3.0. The final section will present the qualitative empirical data gathered from the 9 face to face semi-structured interviews with the participating patients.

4.2 Desk Research Analysis
As part of the initial primary research, an internal desk audit was conducted as outlined in chapter 3.0. The purpose of the internal desk research was to serve as a cross-referencing tool for the quantitative and qualitative data collected. As previously described in Chapter 3.0 section 3.7.1, the desk research gathered data from an internal database, which stores current patient information collected from CPAP devices. The analysis undertaken includes a review of 20% of the OSA patients based in the Cork region and their adherence to CPAP therapy. The detailed data collected is located in appendix 11. A summary of the results are presented in the following tables.

4.2.1 Demographics
Participants were divided into public (n=50, 50%) and private (n=50, 50%) patient categories and the ratio of male (n=70, 70%) to female (n=30, 30%) participants is presented in table 5. The inequality between male and female participants will be discussed in Chapter 5.0.

<table>
<thead>
<tr>
<th>Participant Gender</th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>34</td>
<td>36</td>
</tr>
<tr>
<td>Female</td>
<td>16</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 5. Participant Gender

Participant age varied from 21 years to 82 years due to the random sample selection of patients. This data is presented in table 6.

<table>
<thead>
<tr>
<th>Participant Age Range</th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youngest Overall Participant</td>
<td>21</td>
<td>31</td>
</tr>
</tbody>
</table>
The participants mean age was divided into three separate categories, comprising mean age overall, mean male age, and mean female age. The mean overall age for the public group (n=50, 50%) was 58 years, and the mean overall age for the private group (n=50, 50%) was 53 years. Findings reveal that in terms of age, a majority of participants are middle-aged. These findings are presented in table 7.

### Table 6. Participant Age Range

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youngest Overall Participant</td>
<td>82</td>
<td>70</td>
</tr>
<tr>
<td>Oldest Male Participant</td>
<td>82</td>
<td>70</td>
</tr>
<tr>
<td>Youngest Female Participant</td>
<td>21</td>
<td>35</td>
</tr>
<tr>
<td>Oldest Female Participant</td>
<td>76</td>
<td>69</td>
</tr>
</tbody>
</table>

**Table 7. Mean Participant Age**

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age Overall</td>
<td>58</td>
<td>53</td>
</tr>
<tr>
<td>Mean Male Age</td>
<td>60</td>
<td>53</td>
</tr>
<tr>
<td>Mean Female Age</td>
<td>53</td>
<td>53</td>
</tr>
</tbody>
</table>

**4.2.2 CPAP Adherence**

The participant’s average adherence to CPAP therapy was rounded in hours and is presented in table 8. This research reveals that private patients (n=50, 50%) are more adherent to CPAP therapy by 0.75 of an hour than the public group. Private female participants were more adherent to CPAP therapy by 0.5 of an hour than the public participants.

### Table 8. Average Adherence Time in hrs (Rounded)

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Patients</td>
<td>5.25hrs</td>
<td>6.00hrs</td>
</tr>
<tr>
<td>Male</td>
<td>5.25hrs</td>
<td>6.00hrs</td>
</tr>
<tr>
<td>Female</td>
<td>5.25hrs</td>
<td>5.75hrs</td>
</tr>
</tbody>
</table>

**Table 9. CPAP Adherence**

CPAP adherence measures how adherent patients are to their CPAP therapy, with the aim of achieving a clinical benefit and relief from OSA symptoms. CPAP adherence is measured in percentage. This study has found that private paying patients (n=50, 50%) are more complaint with CPAP therapy than public patients with a mean adherence rate of 84%. This is presented in table 9.
Participants who use CPAP therapy for greater than 4 hours receive a clinical benefit and relief from their symptoms of OSA. This study has found that 70% of private patients use their CPAP for greater than 4 hours, which is the recommended number of hours required to gain a clinical improvement in symptoms. Conversely, only 56% of public patients use their CPAP for greater than 4 hours. These findings are presented in table 10.

### Table 10. % Days CPAP Used > 4 Hours

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Overall Patients</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Lowest Overall Patients</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Average Overall Patients</td>
<td>56%</td>
<td>70%</td>
</tr>
<tr>
<td>Highest Male</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Lowest Male</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Average Male</td>
<td>58%</td>
<td>70%</td>
</tr>
<tr>
<td>Highest Female</td>
<td>100%</td>
<td>98%</td>
</tr>
<tr>
<td>Lowest Female</td>
<td>3%</td>
<td>21%</td>
</tr>
<tr>
<td>Average Female</td>
<td>52%</td>
<td>71%</td>
</tr>
</tbody>
</table>

4.2.3 Mask Leak Percentage

Participant’s percentage of leak from their CPAP mask is presented in table 11. Mask leak is an important measurement to ensure correct mask fit, correct mask placement, and correct CPAP usage. If the mask leak is very high, then the therapeutic nature of the therapy may be compromised. This study has identified that private patients (n=50, 50%) have a minimal amount of mask leak measured at 3%.

### Table 11. Mask Leak %

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Overall</td>
<td>8%</td>
<td>3%</td>
</tr>
</tbody>
</table>

4.2.4 Participant AHI

Participant AHI is a clinical indicator used to measure the therapeutic effectiveness of CPAP therapy. Table 12 presents the highest, lowest and average male and female AHI.
### Participant AHI

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Overall Patients</td>
<td>14.8</td>
<td>4.7</td>
</tr>
<tr>
<td>Lowest Overall Patients</td>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>Highest Male</td>
<td>14.8</td>
<td>2.8</td>
</tr>
<tr>
<td>Lowest Male</td>
<td>0</td>
<td>0.7</td>
</tr>
<tr>
<td>Average Male</td>
<td>5.6</td>
<td>5</td>
</tr>
<tr>
<td>Highest Female</td>
<td>10.6</td>
<td>10.1</td>
</tr>
<tr>
<td>Lowest Female</td>
<td>0.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Average Female</td>
<td>4.1</td>
<td>3.7</td>
</tr>
</tbody>
</table>

*Table 12. Participant AHI*

#### 4.2.5 90% Percentile Pressure (cmH20)

The 90% percentile pressure provides the specific air pressure required to ensure and maintain airway patency during sleep. The average 90% percentile pressure overall in the public group (n=50, 50%) was 10.2 cmH20 and the average overall in the private group (n=50, 50%) was 11.1 cmH20. These findings are represented in Table 13.

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Overall Patients</td>
<td>17.0</td>
<td>16.0</td>
</tr>
<tr>
<td>Lowest Overall Patients</td>
<td>0.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Average Overall Patients</td>
<td>10.2</td>
<td>11.1</td>
</tr>
<tr>
<td>Highest Male</td>
<td>17.0</td>
<td>16.0</td>
</tr>
<tr>
<td>Lowest Male</td>
<td>0.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Average Male</td>
<td>10.6</td>
<td>11.3</td>
</tr>
<tr>
<td>Highest Female</td>
<td>16.0</td>
<td>16.0</td>
</tr>
<tr>
<td>Lowest Female</td>
<td>5.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Average Female</td>
<td>9.3</td>
<td>10.6</td>
</tr>
</tbody>
</table>

*Table 13. 90% Pressure (cmH20)*

#### 4.3 Quantitative Analysis

This section presents the findings and analysis of the empirical quantitative data gathered to meet the objectives of the study outlined in chapter 1.0. The quantitative data was collected from the 9 participants CPAP devices in parallel with the interview stage. In total, 9 participants were included in this quantitative piece. The purpose of the quantitative research was to collect data so that a triangulation method could be applied to the research question. The quantitative data provides valuable objective insights into participant’s actual adherence to CPAP therapy.

Christine Brunnick (R00013582) 66
4.3.1 Summary of Data Gathered

Table 14 provides an overview of the empirical quantitative data collected from the participant’s CPAP devices. Data relating to several variables were collected, such as gender, age, age range, average adherence in hours, percentage of days where CPAP was used greater than 4 hours, adherence percentage, mask leak percentage, participant AHI and 90% percentile pressure. This empirical data allows for a comparative analysis to evaluate the desk research, the quantitative data and the qualitative data.

<table>
<thead>
<tr>
<th>Category</th>
<th>Data Gathered from CPAP Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>- Age</td>
</tr>
<tr>
<td></td>
<td>- Gender</td>
</tr>
<tr>
<td></td>
<td>- Age Range</td>
</tr>
<tr>
<td>CPAP Adherence</td>
<td>- Average adherence to CPAP therapy in hours</td>
</tr>
<tr>
<td></td>
<td>- Percentage of days CPAP is used greater than four hours as minimum recommended number of hours</td>
</tr>
<tr>
<td></td>
<td>- Adherence to CPAP therapy as a percentage</td>
</tr>
<tr>
<td>Mask Leak</td>
<td>- Percentage of mask leak whilst on CPAP treatment</td>
</tr>
<tr>
<td>Participant AHI</td>
<td>- Apnea Hypopnea Index (AHI) of participant whilst on CPAP therapy</td>
</tr>
<tr>
<td>CPAP Pressure</td>
<td>- Ninety percentile pressure of the CPAP device</td>
</tr>
</tbody>
</table>

Table 14. Summary of Quantitative Data Gathered

4.3.2 Demographics

The majority of participants were male (n=7, 78%). The remaining 22% of participants were female (n=2). This is presented in table 15. In total, 56% of participants were categorised in the public patient group, and 44% were classified in the private patient group.

<table>
<thead>
<tr>
<th>Participant Gender</th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 15. Participant Gender

The mean overall age of the public participants (n=5, 56%) was 54 years, whereas the mean overall age of the private participants (n=4, 44%) was 60 years. The mean age of female participants (n=2, 22%) in both the public and private groups was identical at 45 years. Conversely, there was a more significant difference in the mean age of the male participants in the public and private categories with their mean ages recorded as 57 (n=4, 57%) and 64 (n=3, 43%) years respectively. This is presented in table 16.
An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence

The participant's age range varied across both the public and private groups (n=9, 100%). The youngest age recorded was 45 years. The oldest age recorded was 70 years. The participant age range is presented in table 17.

<table>
<thead>
<tr>
<th>Participant Age Range</th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youngest Overall Participant</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Oldest Overall Participant</td>
<td>62</td>
<td>70</td>
</tr>
<tr>
<td>Youngest Male Participant</td>
<td>47</td>
<td>61</td>
</tr>
<tr>
<td>Oldest Male Participant</td>
<td>62</td>
<td>70</td>
</tr>
<tr>
<td>Youngest Female Participant</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Oldest Female Participant</td>
<td>45</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 17. Participant Age Range

In total, 8 participants (89%) from the overall study were middle aged. All of the public participants (n=5, 56%) were middle aged whereas 75% (n=3) of the private participants were middle aged.

4.3.3 CPAP Adherence

Adherence to CPAP therapy is measured using a variety of metrics, including average adherence time in hours. The overall average adherence time for public participants (n=5, 56%) was 6 hours. The female participant (n=1, 11%) in the public group showed an average adherence time of 6.75 hours. The remaining male participants in the public group (n=4, 44%) had an adherence time of 5.75 hours. Conversely, the overall average adherence time for all private participants (n=4, 44%) was significantly higher than the public group with an average adherence time of 7.25 hours. Both male (n=3, 75%) and female (n=1, 25%) participants in the private group had an average adherence time of 7.25 hours. This research shows that patients who fund their CPAP privately are more adherent to their CPAP therapy. This is represented in table 18.
An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence

### Table 18. Average Adherence Time in hrs ( Rounded)

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Patients</td>
<td>6.00</td>
<td>7.25</td>
</tr>
<tr>
<td>Male</td>
<td>5.75</td>
<td>7.25</td>
</tr>
<tr>
<td>Female</td>
<td>6.75</td>
<td>7.25</td>
</tr>
</tbody>
</table>

The percentage of days where the CPAP was used for greater than 4 hours is how the minimum recommended number of hours is recorded. This variable highlights patients who are adherent to CPAP for a sufficient number of hours so as to achieve a clinical improvement in their symptoms of OSA. The highest overall percentage of days CPAP was used for greater than 4 hours in both the public (n=5, 56%) and private (n=4, 44%) patient groups was 100%. The lowest percentage of adherence recorded was in the public group (n=5, 56%), which reported a percentage adherence of 23% by a male participant. Conversely, the overall average percentage of days the CPAP was used for greater than 4 hours was 67% for the public group (n=5, 56%) and 88% in the private group (n=4, 44%). This research shows that the group of private patient group who fund their CPAP device are more adherent to CPAP for greater than the 4 hours of recommended wear time. These findings are illustrated in table 19.

### Table 19. % Days CPAP Used > 4 Hours

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Overall Patients</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Lowest Overall Patients</td>
<td>23%</td>
<td>58%</td>
</tr>
<tr>
<td>Average Overall Patients</td>
<td>67%</td>
<td>88%</td>
</tr>
<tr>
<td>Highest Male</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Lowest Male</td>
<td>23%</td>
<td>93%</td>
</tr>
<tr>
<td>Average Male</td>
<td>67%</td>
<td>98%</td>
</tr>
<tr>
<td>Highest Female</td>
<td>68%</td>
<td>58%</td>
</tr>
<tr>
<td>Lowest Female</td>
<td>68%</td>
<td>58%</td>
</tr>
<tr>
<td>Average Female</td>
<td>68%</td>
<td>58%</td>
</tr>
</tbody>
</table>

Table 20 presents participant’s adherence to CPAP therapy as a percentage. The mean rate of adherence in the private group (n=4, 44%) was 100%. The public group (n=5, 56%) had a mean adherence rate of 82%. The mean adherence rate is lower than that of the private group because the lowest adherence percentage was recorded at 63% in the public group (n=5, 56%).
An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence

<table>
<thead>
<tr>
<th>Adherence Percentage</th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Rate</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Lowest Rate</td>
<td>63%</td>
<td>100%</td>
</tr>
<tr>
<td>Mean Rate</td>
<td>82%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 20. Adherence Percentage

4.3.4 Mask Leak Percentage
It is essential that the percentage of mask leak is monitored on CPAP adherence reports, as a poorly fitting mask can be a reason that patients abandon their therapy. Percentage mask leak can negatively impact on the reduction of AHI despite good adherence. The percentage of mask leak was within acceptable ranges with the average mask leak at 8% in the public group and 6% in the private group. These findings are presented in table 21.

<table>
<thead>
<tr>
<th>Mask Leak %</th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Overall</td>
<td>8%</td>
<td>6%</td>
</tr>
</tbody>
</table>

Table 21. Mask Leak %

4.3.5 Participant AHI
The measurement of AHI is essential in determining the impact of CPAP on maintaining a patent airway. A therapeutic AHI should result in patients gaining relief from the subjective symptoms associated with OSA. The public participants (n=5, 56%) showed an average overall AHI of 3.4. The highest overall AHI in the public group (n=5, 56%) was measured at 7.8. This elevated AHI can be linked to the lower adherence percentage previously highlighted. The highest overall AHI in the private group (n=4, 44%) was measured at 7.1, which can be linked to individual mask leak percentage. The average overall AHI in the private group (n=4, 44%) was 3.6. This study reveals that CPAP therapy can reduce the AHI to within the therapeutic range required to reduce or eliminate the symptoms of OSA. This is presented in table 22.

<table>
<thead>
<tr>
<th>Participant AHI</th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Overall Patients</td>
<td>7.8</td>
<td>7.1</td>
</tr>
<tr>
<td>Lowest Overall Patients</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>Average Overall Patients</td>
<td>3.4</td>
<td>3.6</td>
</tr>
<tr>
<td>Highest Male</td>
<td>7.8</td>
<td>7.1</td>
</tr>
<tr>
<td>Lowest Male</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>Average Male</td>
<td>3.5</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Table 22. Participant AHI

Christine Brunnick (R00013582)
Table 22. Participants AHI

<table>
<thead>
<tr>
<th></th>
<th>Highest Female</th>
<th>Lowest Female</th>
<th>Average Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.1</td>
<td>3.1</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>2.4</td>
<td>2.4</td>
<td>2.4</td>
</tr>
</tbody>
</table>

4.3.6 90% Percentile Pressure (cmH20)

The 90% percentile pressure provides the specific air pressure required to ensure and maintain airway patency during sleep. The average 90% percentile pressure overall in the public group (n=5, 56%) was 7.8 cmH20 and the average overall in the private group (n=4, 44%) was 11.1 cmH20. These findings are represented in Table 23.

<table>
<thead>
<tr>
<th>90% Pressure (cmH20)</th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Overall Patients</td>
<td>13.5</td>
<td>14.4</td>
</tr>
<tr>
<td>Lowest Overall Patients</td>
<td>5.0</td>
<td>7.0</td>
</tr>
<tr>
<td>Average Overall Patients</td>
<td>7.8</td>
<td>11.1</td>
</tr>
<tr>
<td>Highest Male</td>
<td>7.3</td>
<td>12.0</td>
</tr>
<tr>
<td>Lowest Male</td>
<td>5.0</td>
<td>7.0</td>
</tr>
<tr>
<td>Average Male</td>
<td>6.3</td>
<td>10.0</td>
</tr>
<tr>
<td>Highest Female</td>
<td>13.5</td>
<td>14.4</td>
</tr>
<tr>
<td>Lowest Female</td>
<td>13.5</td>
<td>14.4</td>
</tr>
<tr>
<td>Average Female</td>
<td>13.5</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Table 23. 90% Pressure (cmH20)

4.4 Qualitative Analysis

This section of the chapter presents the outcomes from the 9 semi-structured interviews with a ratio of 5 public and 4 private patients. The interviews were carried out between May and June 2019. The purpose of the interviews was to gain patient insight and opinions on CPAP therapy, CPAP adherence, nursing support and the financial implications associated with CPAP therapy. The qualitative data collected and presented in this chapter include direct quotations from interviewees who for this study and the ethical constraints of the research must remain anonymous.

4.4.1 CPAP Therapy

This theme examines how patients have tolerated their CPAP therapy since they received their initial education session on how to maintain and use the CPAP device. This research has investigated independent subjective opinions from participants since the commencement of CPAP therapy. This study has found that CPAP therapy provides an immediate benefit to CPAP users by eliminating snoring, increasing energy levels, elimination of headaches, improvement in mood, and improved sleep for bed partners. The first contributor

Christine Brunnick (R00013582)
acknowledges that CPAP therapy has had a positive impact and has completely changed their life:

I got on very well. I am sleeping at night. I am not snoring. My partner is sleeping at night. I have more energy by day. I am not tired. I am going walking. I am not as depressed as I used to be because I am sleeping, and I am happy in myself by day now. It is just after changing my life. It is only a couple of weeks, but my life is completely different from what it used to be.

[1A, Public Patient].

The following contributor acknowledges that the CPAP device has reduced their level of fatigue:

I am very happy with the CPAP. It has helped me an awful lot. Since I am on it, I do not feel half as tired on the CPAP.

[1D, Public Patient].

The next participant outlines that they noticed a significant improvement in both day time somnolence and energy levels as a result of using CPAP therapy:

I got on very well with the CPAP. I have no problems with tiredness during the day. I feel I have way more energy, and I feel like I am benefitting greatly from it.

[1E, Public Patient].

The next participant notes that while they experienced minor issues initially with the CPAP therapy they acknowledge when they do not wear the CPAP device that their daytime somnolence is increased and their headaches return:

It has been good but just a few hiccups that we have had on the way. Other than that, I know the nights that I do not use the CPAP. One of the hiccups would be that I have a dry mouth and that the mask would be full of moisture. The other one would be when I do not use it, I would be exhausted the following day, and I know that I have not used it. I would have a headache, and I would be very tired.

[1C, Public Patient].

The next contributor explains that they are removing the CPAP therapy subconsciously during their sleep:
I got on fine, but my problem is that I am throwing it off at some point in the night unknown to myself.

[1B, Public Patient].

The next participant outlines that they noticed a significant improvement in both day time somnolence and energy levels from using the CPAP therapy:

I got on very well with the CPAP. I have no problems with tiredness during the day. I feel I have way more energy and I feel like I am benefitting greatly from it.

[1E, Public Patient].

According to another participant, within two days of commencing the CPAP therapy, there was a significant improvement in energy levels and the elimination of headaches:

I used to have headaches all the time. I Google'd it a bit to see what could be causing headaches and sleep apnea came up. When I was diagnosed with it, I met yourself, and we went through the CPAP. Within two or three days, I had way more energy. Secondly, I have had no more headaches since I started CPAP. There have been two nights that I forgot to put on the mask. These are the only two nights that I have had the headaches between two and four in the morning. For me, no headaches, a good night's sleep, way more energy, and losing weight is a win-win.

[2E, Private Patient].

The next contributor maintains they adapted well to their CPAP device:

I got on fine with it. Very well. I got on grand so far anyway.

[2B, Private Patient].

The next participant outlines that the CPAP device did not inconvenience them in any way, and has become part of their bedtime routine with no issues such as claustrophobia:

I have had no problems. It did not affect me or inconvenience me in any way. I put it on the Saturday night as I did not get around to opening it or taking it out of the bag the first night. Once I got sorted setting it up, it has just become part of my routine, and I have had no problem with it. The mask is not affecting me so far as it is not causing me any claustrophobia or annoyance. In no way am I discomforted by it or unhappy with it.

[2A, Private Patient].
This participant acknowledges that adopting CPAP therapy has improved sleep quality, their concentration at work, and allowed their bed partner to sleep:

I am very happy with it. I am getting better sleep, and I am more attentive on my job because I am not tired. My wife is happy, and I am very happy. She is getting sleep too.

[2D, Private Patient].

4.4.2 Participant Hours of Sleep with CPAP Device

This research has revealed that 89% of participants wore their CPAP for the recommended number of hours advised in the initial education session to gain symptom relief. This participant reveals that the CPAP was used between 6 and 7 hours per night:

I am getting between 6 and 6.5 hours of sleep every night. Some days more some days less. However, that is not the machine that is me. If I wake, I take off the machine because I do not sleep once I wake. I am getting a sound sleep definitely between 6 and 7 hours.

[1A, Public Patient].

The next participant outlines that the use of the CPAP varies from 5.5 hours to 8 hours but that regardless of when they remove the CPAP, they feel more refreshed on awakening:

I start it around 11 o’clock, and I will work away until around 7, or I might work away until half 4. I find that when I take the CPAP machine off after finishing, I feel a lot fresher, and I feel it is a lot easier to manage my day.

[1D, Public Patient].

Similar to the previous participants, this contributor uses the CPAP for greater than the recommended number of hours:

Between 6 and 7 hours.

[1C, Public Patient].

In contrast to previous contributors, this participant has used the CPAP device for less than the recommended hours:

I would get an average of 3 hours.

[1B, Public Patient].

Another contributor outlines that CPAP usage was higher than the recommended hours:
Between 7 and 8 hours.

[1E, Public Patient].

The next participant concurs with the previous contributor with CPAP usage at 7 to 8 hours per night:

7 to 8 hours a night. Around that anyway.

[2B, Private Patient].

The next contributor highlights poor sleep hygiene and bedtime routine as a reason for varied CPAP usage:

Sometimes I think it is because my bed habits are so bad and sometimes, I have to get up early. I would like to have a better routine for sleep, and I would like to have a minimum of 8 hours and preferably 9 hours per night. When I am in bed, I am sleeping, and I have never been in bed sleeping without it since I got it. So if my hours sometimes seem short, it is because I went to bed late and got up early.

[2A, Private Patient].

The next participant outlines the average hours they get on various nights, which fluctuate between 5 and 7 hours:

On average most nights, I would say I get between 5 and 7 hours most nights.

[2E, Private Patient].

The next contributor concludes that CPAP usage varies depending on the time they go to bed with an average of 7 hours per night:

I am getting on average 7 hours, but it has gone to 9 and a half. It depends on what time I go to bed. The minimum hours would be 6 and a half hours, and the maximum would be 9 and a half hours.

[2D, Private Patient].

4.4.3 CPAP Air Pressure

This study has uncovered that all participants found CPAP air pressure easy to tolerate and has revealed that no participant highlighted negative issues relating to the CPAP air pressure. This research highlights positive responses from all participants relating to CPAP air pressure.
Two contributors identified that the CPAP air pressure is significant in maintaining airway patency; thus, treating their OSA. This contributor notes that CPAP air pressure is good and identifies that the pressure of air is essential as it maintains airway patency:

I find it very good. Once it goes on and I put the mask on my nose, I do not feel anything. I know that the pressure is there, but it does not affect me once I am going off to sleep. I have no problem with the pressure, and I know it is keeping my airway opened and that is what it is all about.

[1A, Public Patient].

The next participant concurs with the previous patient by suggesting that the air pressure is easily tolerated and further identifies that the pressure of air is maintaining airway patency:

The CPAP pressure overall is very good. The one thing about it is that it is very good for opening the airway, which is what it is there to help.

[1D, Public Patient].

The next contributor acknowledges that the CPAP air pressure is good and even depicts it as barely noticeable when using the CPAP:

Overall good. Yes, it is very good. To be fair, I do not even know it is on. To be fair you do not notice it, well I do not anyway.

[1C, Public Patient].

The next participant describes the CPAP air pressure as enjoyable:

Perfect. Most enjoyable.

[1B, Public Patient].

Another contributor notes that the CPAP air pressure caused a few issues initially, but these issues were overcome with the perseverance of CPAP therapy:

I find that very good. It does not bother me what so ever. I have no problems with it. At first, I did, but I just persevered and got used to it.

[1E, Public Patient].

Another participant described the CPAP air pressure as fine and had no problem tolerating it:

Fine. I managed it, no bother.
An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence

The following contributor maintains that the CPAP air pressure is perfect and that they are unable to sleep without their CPAP device now:

*Perfect. I feel now like I actually cannot sleep without it.*

[2E, Private Patient].

A further participant proclaims that they had no problem with the CPAP air pressure:

*Fine. No problem.*

[2A, Private Patient].

This participant explains that during the night if the CPAP is removed, the air pressure can flow at a higher rate, but after a few seconds, it reduces down to a normal flow. Furthermore, this contributor describes the CPAP air pressure as perfect:

*If I take it off in the middle of the night, there is a gush of air there for a few seconds. It goes back down to the normal flow. Before I put it on, I hold it in my hand and turn it on and leave the excess air come out until it stops. The pressure is perfect; I find it great. No pressure on me.*

[2D, Private Patient].

4.4.4 Mask Fitting

Findings reveal that in terms of mask fitting, participants experienced different issues. While most participants claim that perseverance is key in getting used to the mask, some participants had genuine mask issues. The first contributor acknowledges that the CPAP mask fits perfectly and neatly with no air leaking; they barely notice that the mask is in place:

*It is perfect. The fitting is absolutely perfect. The straps go on the back of my head. The mask just fits onto my nose nice and neatly. There is no air escaping from it. I find that once I put the headpiece on, I do not even realise it is there. It is very comfortable.*

[1A, Public Patient].

The next contributor outlines how easy it is to put on the mask and highlights how it can cause some anxiety in the latter stages of commencing CPAP therapy:

*The mask is very well managed. It is very simple. It is like putting on a helmet, and all you have to do is bring two clips straight forward. All you have to do is automatically*
press the button, and you will see the screen changing, and then you manage away for the night. Like you might feel after maybe ten minutes/fifteen minutes a little bit anxious, but if you settle down and relax, you will work away grand with it.

[1D, Public Patient].

The next participant identifies some common issues, including facial dryness and excessive moisture inside the full face mask:

The mask. It is just you know it is dry here (points to face). It is just the mask, but it is a full mask. It is got to do with the moisture. When it is in place it is fine as in when it goes on my face, but then it is moving and it does not stay in place, and then if I tighten it, it marks my face.

[1C, Public Patient].

Another contributor indicates that they had no problem with the mask or fitting the mask:

Excellent. Yeah. No problem what so ever.

[1B, Public Patient].

This participant noted that the mask was uncomfortable to start with, but due to the benefit from the CPAP therapy they persevered:

Again at the start it was unusual and a little bit uncomfortable, but I am benefitting from it, so I persevered with it.

[1E, Public Patient].

This contributor outlines how they are getting used to wearing a mask and how they developed their routine when putting on their CPAP mask:

I mean, I am getting used to it. No problem at all. No, bother at all. Actually, you told me to put the mask on my mouth first, but I actually put the harness over my head then mask over my mouth. That is the way I do that. I have my own routine, and that is it exactly.

[2B, Private Patient].

This participant reports that the mask fit is good a majority of the time but notes that some nights they wake with a sweaty face. According to this participant, it does not impact on their ability to return to sleep:
Quite good most of the time. Sometimes I wake up at around five am in the morning, and it is a little bit sweaty maybe, but I just turn it off, wipe my face and then put it back on again, and I am out like a light within two minutes.

[2E, Private Patient].

This contributor admits that there was no issue with the mask; however, due to skin irritation, this mask was replaced. This contributor believes that this may have been due to inexperience with mask placement:

I had no problem with the first one. Except that it made my nose sore and that did concern me slightly because it was going to stay sore and it probably was fine. Maybe that is because of inexperience. With the leaks, I think I am getting the hang of this one. The only thing that happened was that it put pressure on my nose. It did not cause redness, but the nose is getting acclimatised.

[2A, Private Patient].

Mask fit is not an issue with this next contributor, but they do not like the mask to be overly tight on their face. They state that mask leak is within the acceptable parameters as they routinely monitor the mask leak of their own accord:

I find it okay. I do not have it too tight because I do not want it squeezing in on top of me. I am finding it, ok. My leakage on the mask is certainly within limits.

[2D, Private Patient].

4.4.5 Symptom Improvement on CPAP Therapy

This research has revealed that CPAP does improve several symptoms relating to OSA. It highlights that there are benefits to consistently wearing CPAP. According to, the following contributor they noticed an elimination of snoring and gasping for air during the night. Furthermore, this contributor acknowledges that their bed partner and other individuals noticed the improvement:

I might not notice a pile of symptoms, but I know by other members in the house (laughter) that my symptoms have improved dramatically because I was a very heavy snorer. I used to be waking up gasping for air, or else my partner was waking me because I was not breathing. Other people tell me that it is definitely working. I know it is working myself and I am thrilled with it. I am really thrilled with it. It is something that once I was told I had sleep apnea; I was actually glad that I had it because I was so bad at snoring and not breathing. If I was told at the time I did not have it; then nothing would be done. Then I was told I had it, I got the mask, and now I feel so much better. It is great for me. I am thrilled.

Christine Brunnick (R00013582)
The next participant was educated while an inpatient in a hospital and outlines the immediate benefits of CPAP therapy, including improved levels of fatigue and a reduction in dyspnea:

I do not feel as tired. I do not feel anyway caught for breath. I feel good since I am on it, I am only on it about a month. I only found out a month ago when I was in the hospital and then I found out that I was getting a machine to help me. I found out it is good. When I wore it the first night in the hospital, I found out it was great and then the following day when I came home I felt great. Now there is a bit of setting up in it, but you have it all set up and everything ready to go, change the water at night time. You put your water into it to get it going, and it will automatically work away.

The next participant concurs with the previous contributors reporting not only an improvement in their symptoms but that colleagues had noticed a difference in both their level of daytime fatigue and daytime somnolence. This contributor highlights how symptoms return when CPAP is not adhered to consistently:

I am not as tired. When I do use the machine, I am not as tired. When I do not use it, I am wrecked. Many people have noticed that when I do use it that I am fine the following day. You know I am wide awake all day and not looking to sleep at two pm in the day. I do want to use it, but then it is just the fact that I get nervous. Like this week now I have had a bad week because with the dry mouth. I just could not get my head around round using it. Then with dad and everything and it is just this week was a manic week. But other than that I do use it, and I want to use it, but then it is kind of like why do I need it? But I do use it, and now this week I am going to make a huge effort to use it every night. You know because I have to.

In contrast, another contributor reports no improvement in symptoms; however, the researcher must highlight that this participant is the only contributor who did not use the CPAP therapy for the minimum recommended number of hours:

Absolutely no improvement in symptoms but I am hoping. Well, I am very anxious to wear it so that I have these nice results.

Waking up refreshed, reduced daytime somnolence, and the elimination of headaches is why this next contributor recommends their CPAP therapy as a way of life:
I just notice I do not have any symptoms anymore. I do not sweat. I do not wake up sweating, and I am waking up more refreshed. No headaches. Daytime tiredness is improved. I find now since I started using it that it is just way of life now for me and you know in a short time I am wearing it I am so used to it now it is part of what I do. So I am very pleased with it and very happy with it.

[1E, Public Patient].

This next contributor concurs with the previous participant by recognising a reduction in snoring and feeling slightly more refreshed upon wakening but disputes any improvement in energy levels:

I suppose I am fresher; I am slightly fresher in the mornings. I used to cough up phlegm in the mornings, but that is not as bad as what it was. I am not snoring as much. I cannot see a major improvement in energy, not at the moment anyway. I am on it 6 weeks now.

[2B, Private Patient].

This participant declares that they could not live without the CPAP device due to symptom improvement. Furthermore, this participant reports increased energy levels, feeling refreshed in the morning, and the elimination of daytime somnolence:

I have way more energy which I did not have before. I used to need to go for a lie down for twenty minutes/half an hour between 4 and 5 pm every day before the CPAP. I would say I have only done this once since and that was just because we were calving cows and I was absolutely shattered. It had nothing to do with the CPAP. I was just exhausted. I have only done it once since the CPAP. I could not live without it. I completely benefit from it. I find now if I do not put it on going to bed, I am not going to get a good night’s sleep. I feel fresher in the morning when I get up after using it.

[2E, Private Patient].

Sleep hygiene is a high priority for the next contributor, revealing that an improved sleep routine could increase the benefits of CPAP therapy. Furthermore, this contributor maintains that they have a reduced level of fatigue, energy levels are improved, and they feel more refreshed upon awakening:

I do not tend to feel tired. I am out and about a lot. I am fairly active. Like driving or anything, I have no problem. I think it does make a difference. Energy levels are quite good. I think they are better. When I wake, I am more refreshed. I think if I got into a better sleeping and bed routine, it would also increase the benefits.

[2A, Private Patient].
This contributor concludes that snoring has reduced and that they have adapted quickly and easily to the CPAP therapy:

All I can tell you is that when I put on the mask, and I know that my brain registers that I have to breathe through my nose. So my mouth remains closed ninety percent of the time I am in bed. Before the treatment, my mouth was open ninety percent of the time. In the first couple of days, my wife was saying you have to keep your mouth closed. Eventually, everything fell into place. Now I do not snore. I might get the odd breath out through my mouth. When I do, I get a tip from my wife because it only happens when I am sleeping on my back. If I were sleeping on my side, that would not happen, but you have to adjust the mask then, pull the hose, and then you are on your side, and you are prone to leakage because you have pressure on the mask, but everything is falling into place. Now it takes maybe 2 months, but I think I have taken to it as a duck takes to the water, to be honest.

[2D, Private Patient].

4.4.6 Challenges Associated with CPAP

This study has revealed numerous challenges associated with CPAP therapy and various contributors. The findings highlight that some contributors have experienced no challenges, while others have experienced multiple issues. The initial contributor maintains that CPAP was easy, but admits that they have to reposition during sleep and worried initially if they would be able to tolerate wearing a mask at night:

No, it is all so easy. You put in your water put on your mask, and you go to sleep. Now, there was a couple of challenges at the start. Like I used always sleep on my tummy, but now I can sleep on my back or my side, and there is no problem. There was a little couple of challenges at the start with the mask and stuff, but that was only a couple of days before I got used to it. I put on my mask, and I turn on my machine, and I sleep for hours, and I have no problems. I was half afraid that it would not work for me. I worried if I would be able to get off my belly going to sleep because that is the way I have slept all my life. I questioned if I would be able to wear a mask, but I was, it just took a couple of days to get used to it. Once I got used to it, I had no problems.

[1A, Public Patient].

Another participant denied any challenges with their CPAP therapy:

No, not really.

[1B, Public Patient].
The next contributor maintains that there were no challenges with the CPAP device. Interestingly, this contributor who was educated as an inpatient suggests that individuals who are educated on CPAP at home should have supervision:

No, none. I found it strange to go on it, it was different, but I had the experience of it in the hospital for the nights I was there. I am on it and got used to it. It was fine to get used to it. If you did not use to it and you are after getting it at home, and you are setting it up at home on the first night I think you should be supervised. After that then you will find it ok and you can work on your own with it.

[1D, Public Patient].

Turning around in the bed, causing the tubing to fall and forgetting to fill the humidifier has caused challenges for this next contributor:

I did not find any challenges. The only thing is when I am turning around at night, and I have to lift all the tubing. You know the hose is going to fall off the bed if I turn. The duvet gets caught in it. I turn back to where I was. Some nights the other thing is I forget to bring down the white box. Then I have to boil the kettle. So then I am waiting for the water to cool and then it gets later and later because that has happened. I know it has been a few weeks, but it is still trying to get used to it and still trying to do everything. I know it takes like ten minutes not even ten minutes to do, but you know what I mean. Late at night, I am like ugh.

[1C, Public Patient].

Learning to tolerate the mask and learning to navigate getting in and out of bed attached to a hose and a mask was the only challenge experienced by the next participant:

No challenges. Just the only challenge was getting used to the mask and getting used to having the pipe trailing alongside me and stuff like that and getting in and out of bed. Wearing the mask in general but no challenges.

[1E, Public Patient].

In addition to the previous contributor, this participant concurs that it is a challenge to get used to the sensation of CPAP and that wearing the mask can cause claustrophobia but that it is a challenge that can be overcome:

Getting used to it was the hard thing. Now that I am used to it, I do not even think about it. Getting used to the mask over your face is a little bit claustrophobic at the start. It is nothing that cannot be overcome.

[2E, Private Patient].
While this next participant identifies no challenges associated with CPAP therapy, they do indicate that they would like to have overnight pulse oximetry to measure if CPAP therapy has improved their blood oxygen saturation levels:

No, not really. One thing I would like to do is I would like to get the monitor on my wrist again and see has the oxygen levels improved. That is what I'd be really interested in.

[2A, Private Patient].

The next participant reveals that they experience no challenges with their CPAP device:

Not really. I manage away fine with it.

[2B, Private Patient].

This participant highlights the challenge of knowing which way to exhale on a nasal mask which was resolved after 2 poor nights on the CPAP device. Furthermore, this participant overcame this challenge and reports that they could not go to bed without the CPAP device now:

Only the first couple of days because of my job you know with water. Water flows in one end and flows out the other end. So, the biggest problem I had was that I am breathing in through my nose and I thought that I was breathing back out into the same pipe and between the pressure of the machine and the pressure from my nose where is it all going to go too? I thought I had to breathe into my nose and expire from my mouth, and everything went wrong in the bed that night. I had to pull the whole thing off. That happened for the first 2 nights. Then I read the instructions and realised I breathe in and out of the one thing. That was one night, and I thought I would never get used to it. I find it A1. If I am honest about it, I do not think I could go to bed anywhere without that machine. I can't because I am just afraid now if I do not use it.

[2D, Private Patient].

4.4.7 Nursing Support

This study has found that the group of public patients felt that they received sufficient nursing support to get them started on CPAP therapy. This study revealed that despite less frequent telephone and nursing support, the private patient group was satisfied as a whole with the level of nursing support provided. This contributor from the public group reports that the initial education session was beneficial and acknowledged that the weekly telephone support was valuable:
The most beneficial support was coming here. Coming to the office. I found the support that I got here was excellent. I got a complete rundown on what to do with the machine. I went away thinking there is a lot of buttons and there is this and that, but once the correct person has shown you it is so easy and you get used to it. The support that I got here in the office was just second to none. I found the phone calls very beneficial because if I had anything to say I could ask or say that Christine would be ringing me on Friday and I can discuss it. I might think that something is not working right and you would be told that it is or that it is normal. So I found the phone calls very beneficial.

[1A, Public Patient].

The same contributor makes no suggestions for improving the level of nursing support provided as they report that the nursing support was good:

I could not give an awful lot of suggestions because my nursing support was just so good. I was shown everything. I can do anything with the machine now, and I do not see any problems. I do not think I can offer any suggestions here because I got all of my support.

[1A, Public Patient].

The next contributor from the public patient group concurs with the previous contributor maintaining that initial education session was the most useful piece of nursing support:

Well the way I put it is, she was very understanding when she came, she told me who she was and what her job was, and she told me what she was doing and she showed me how to set it up, she showed me how to manage it, she showed me what to do and if I found any problem with it in the hospital all I had to do was ring. I did not need to ring her since I came home, and I did not have to ring her since I was in the hospital. I think she gave me great advice on the machine and it is working out good for me.

[1D, Public Patient].

The same participant believes that public awareness regarding OSA and CPAP therapy is necessary. This participant believes that there should be an increase in the number of talks by nurses for patients who are undiagnosed to raise awareness:

For people who have severe sleep apnea, and they cannot justify driving their car because they are starting to fall asleep. I think in a way nursing support should be when people are being tested, there should be more nurses to talk about it. Even if there were talks about it in boardrooms talking about sleep apnea and CPAP treatment and explaining to people about the machine. I think that that would help out more people. More public awareness because there are probably truck drivers, probably car drivers and there are people who have it, and they do not know that they have it. If they find
themselves tired and they are losing sleep, then they should get themselves checked out by the doctor and get a test to see if you have OSA. If you have it, it is straightforward. It is not a very big machine that you would be wearing for days and nights. It is very simple to wear it when you are home at night for a few hours, and when you have it worn for the few hours, you find yourself feeling way better.

[1D, Public Patient].

The next participant from the public patient group highlights the importance of the weekly telephone support provided:

Oh excellent sure your only a phone call away from me. The weekly phone calls were excellent because I knew you were there for me if I had a problem.

[1B, Public Patient].

The same contributor made no suggestions to improve nursing support, claiming that they were happy with the nursing support provided:

No at present I am very happy with it.

[1B, Public Patient].

The next participant from the public patient group reports that the weekly telephone calls were advantageous as a method of nursing support:

I found the phone calls very good. I must say that I found the phone calls very good. There were days there where I was like what do I do, or how do I do it. I mean like when I was saying to you about the mask or the dry mouth, and you were able to say what it was and describe what it was and you helped out. No those phone calls are very useful and good.

[1C, Public Patient].

The same participant offers no suggestions for improving the nursing support provided:

No, it has been very good, been brilliant to be fair. I genuinely cannot say it has not. To be fair, you could pick the phone up anytime or a text. Sometimes if you were doing it with anyone else, you would be like answer the phone, but no you answered the phone.

[1C, Public Patient].

The following contributor from the public patient group believes that all of the nursing support provided, including initial education session and telephone support, was beneficial:
I found all the help was unbelievable. Great help and great support from the off from the first time I went about it. The nurse that calls, everything has just been brilliant fantastic. I could not ask for better. I found it all very beneficial. Everything was significantly explained to me. Masks were tried and fitted. Everything about it was good, and phone calls are good. If I have a problem, I can ring, and I find that very beneficial.

[1E, Public Patient].

The same contributor offered no suggestions for improving the nursing support provided:

No, I do not think so. I think everything is quite good.

[1E, Public Patient].

The first contributor from the private patient group acknowledges the initial education session as most beneficial:

I suppose the showing of the equipment and the cleaning of equipment. That was very good.

[2B, Private Patient].

The same contributor maintains that additional nursing support is not warranted:

Not really. What I'm doing now seems to be okay right here. I am getting on fine with it. I do not think I need more; the support is fine. What I got was very good.

[2B, Private Patient].

Another participant from the private patient group believes that telephone support is brilliant as it provides a backup if they encounter any problem:

Phone calls are brilliant and just the backup. Just the thought that I could ring. I can ring whenever I think of a problem. There has been no problem really with the level of support. It is a good backup I have here.

[2E, Private Patient].

The same participant outlines that they are happy with the service and offer no suggestions for improving the nursing support provided:

No, because I am happy with the service that I got. The mask is fitting perfectly, and my consultant said it seems to be fitting my face that there is no escape of air. So it is
good support, and I could not suggest anything better. The help I have got since the
start has been phenomenal and I have not looked back since really.

[2E, Private Patient].

This next contributor notes that the initial education session was good because it prepared
the contributor on how to use the CPAP device:

It was very beneficial, and your introductory session was very good because when I
went to set it up, you had prepared me. I thought your introduction was professional
and friendly, and I felt at ease with it. Moreover, may I compliment you on your
personality. That did make a difference. Your presentation was very good.

[2A, Private Patient].

The same contributor could not make any suggestion on how to improve nursing support,
stating that there was no shortcoming at all:

No because. I thought it was, to say adequate is probably an understatement. You
were ahead of the problem. In other words, your groundwork was good. I never in the
slightest felt at odds with the whole procedure. So, personally from my experience I
could not say that there was any shortcoming at all. I got the impression that if I
needed more support, it was there to be had. You never gave me the impression this is
it you have to look after yourself. I always felt that if there was a problem, you would
help.

[2A, Private Patient].

The final private patient group contributor highlights that their bed partner attended the
initial education session. Furthermore, this contributor acknowledges that telephone support
was beneficial for technical queries:

The support I got was from you. Maybe we spoke once or twice on the phone, but the
best thing I got was that I brought my wife in with me. What I missed, my wife did not
miss, and when you put the two together, you get a full report. If I wanted to know
something, I would ask my wife, or if I want to know something technical, I could ask
you. I have asked a couple of loose questions to you earlier, which you answered about
the liquid inside and how the level of water fluctuates. So that is the best support I have
gotten from the two women in my life at the moment. My wife and you. That is the
best support I have got, and I can ring you if I need something technical.

[2D, Private Patient].

The same participant suggests that first-class support would be provided if adherence reports
were emailed to each patient:

Christine Brunnick (R00013582)
No way, I think you have it well covered. The fact that you have my email address now, you can send all those types of reports so I can look at my chart to see how I am performing. That, to me, is first-class support.

[2D, Private Patient].

4.4.8 Financial Implications
This study has revealed that public patients whose CPAP devices were funded by the Irish Health System have used their CPAP due to the symptom relief achieved. This study has found that if funding was removed, 60% of the public patients would privately fund their CPAP device owing to symptom improvement. The study has revealed that the private patients who fund their CPAP device are adherent to therapy due to the relief of symptoms and that cost had no significant implication on CPAP adherence. The first public patient acknowledges that the medical card funds their CPAP, and this increases their CPAP adherence. Interestingly this contributor states that if the medical card were removed, they would privately fund the CPAP device:

I have no problem with it being covered by the medical card. It would increase my use anyway. The machine is second to none. It is the latest that's there. When I get it by the medical card, I will use it, and I will continue to use it, and I have no problems using it through the medical card. If I had to lose the medical card, it would not change anything. I would take it up myself.

[1A, Public Patient].

This next participant suggests that because the device is funded, they are being looked after. Furthermore, they believe that private patients are not being refused care but identify that they must privately fund the cost of the device:

No, I think naturally like in a way it is looking after people who have a medical card. For people who do not have a medical card at least, they are not being turned away. They can still hire the machine, pay per month for the machine, like insurance is there, and all the types of things are there to help.

[1D, Public Patient].

The same participant maintains that without the funding, fewer people would be hiring the CPAP device. In addition, this participant expresses that the medical card is helping to purchase the device and that they are paying for the device through the medical card:
Yes. That would make things very awkward. People would not be on it as much then. You will not see people hiring or taking machines from hospitals. The nurse is coming out and giving the machine, but you have to pay so much per month, and then if you have to buy it, you have to pay more. I think in a way, the medical card is helping people to buy it. Like I am on it, and I pay through the medical card for it, and I think it is a great invention. I tell you if I did not go into the hospital for the thing that’s wrong with me, I would not be here today to talk about it. I might not wake up at all. My wife would come into the bedroom in the morning, and she would put her hand over to wake me and I would not wake.

[1D, Public Patient].

The following public patient expresses fear as the fundamental motivational factor for using the CPAP device:

I just use it. I do use it because now that I know that I stopped breathing twenty times per hour, I am petrified that I will not wake up anymore. That is being honest. I would be saying to my husband can you hear me stopping breathing now and he says no. It has frightened me. I mean it has done to be fair.

[1C, Public Patient].

The previous contributor goes on to outline that regardless of funding, they would rent the CPAP device. The reduction in symptoms being noted as the main incentive for continuing with CPAP without public funding:

No, I would still do it. Yeah because I need it. I cannot go back, walking around like a zombie anymore. To be fair, that is what has been happening for months and months and months. I was walking around like a complete zombie. I have not been able to function. Even at work I could be so tired that I could go to sleep and sometimes when I would have a break at lunchtime if I were not going anywhere I had not anything to do at lunchtime, I would go into the car, and I would have a sleep. Then come home at 6pm and need to get stuff done and I cannot do it. That now has stopped, and the night that I do not use the machine, I know when I have not used it. They will know in work when I have not used my machine. They can even notice it. So I make myself use it. I know it is easy to get up at night and go to bed not even bother doing it, you know. However, I have to wear it.

[1C, Public Patient].

The following contributor maintains that the medical card increases their use of the CPAP device:

The medical card increases my use.
The next public patient revealed that even if the device was not funded by the medical card scheme that they would rent the device as they identified the CPAP as an essential part of their life:

I would have got the device to try either way even if there was no financial support. I could not find myself without it now at the minute. I could not do without it at the minute. I think that it is an important part of my life now to have it for my health. Of course, it was great to get it through the medical card system, and I hope it continues, but if it were not, I would have to come up with the finances some way. If I had to rent it privately, I could not stop. No, I could not imagine going back to what it was like before I had the machine and so I would have to rent it.

In the context of privately funding the CPAP device, this contributor states that cost had no significant influence on their adherence to CPAP as they recognise the therapy as a prescription medication:

It is not too bad. I suppose paying seventy, eighty euro a month or something. Well, I was told I have to use it. I had no choice that's what I picked up from my Doctor. This is the medication for sleep apnea. I have no other choice I have to use it. The cost has no significance over the use. If I have to go for it, I have to go for it. The same as you would for other medication or tablets. It is going to cost you so much per month. Well, I suppose it would be better if it were funded. I suppose I was told to use it because of my symptoms.

To mitigate the financial cost incurred by hiring an additional employee for their farm, the cost of the CPAP device bears little significance for this private patient contributor:

If I did not have the CPAP, I would have savage headaches. I would not have the energy to do my work above on the farm. It would cost us more to employ someone to be up the farm. So, for the sake of the money that I am spending on this once a month, it adds up for me personally. I cannot claim back on it because I am not a medical card holder and I do not think the health insurance I have will cover it either. So, for me, the way I look at it is we are not employing someone up in the yard because I have more energy to do the jobs up the yard. So that is the way I look at it.

I feel way better health-wise since I started using it, and as I said, I cannot sleep without it now. I look forward now to going to bed. Like going to sleep. Once I put on the mask, I am asleep within a minute. Before I got the CPAP, I used to snore an awful lot, and I could not lie on my left side or my back. Now I can lie whatever way I want, and it...
makes no difference. I can twist and turn. I used to get a pain in my shoulder on the right side because that was the side I always slept on, but now I can sleep.

[2E, Private Patient].

In addition, this contributor outlines that the benefit of paying for a CPAP is more valuable than not having a CPAP device. Furthermore, this contributor recommends that people use CPAP to gain symptom relief:

Definitely and I think anyone who does not use it and anyone who has it for free that do not use it is ridiculous because they do not realise the benefits they are missing out on. Physically and health-wise, it does for me. I am a lot healthier with it, so I do not mind paying it. As I said it kind of links in then that we do not have to pay a guy to be up in the yard because I can go up the yard. The benefits of paying for this it is a lot more than the payment of it.

[2E, Private Patient].

Quality of life, as opposed to the financial cost, is the priority for this next private patient contributor:

No, because it is a question of priority and quality of life and because I am physically active and mentally active, and I am still very active in farming, and I get great satisfaction out of it. Having a good quality of life and anything that helps that is important to me.

[2A, Private Patient].

The financial cost of CPAP equipment has no bearing for the same private patient contributor:

It would have no bearing.

[2A, Private Patient].

The final private contributor maintains that the cost of the CPAP is insignificant compared with the benefits of using the CPAP:

No. The cost of the machine is a hundred euros a month. Three euros a day or one bottle of beer per day, which is cheap, to give me a good medical report. It sounds like a lot of money, but if you break it down and put three euro into a jar every day, you would not miss it. I use it so that I can get out of the bed in the morning and it gives me a good appetite for a day’s work. Twelve months ago, I was to meet up with a bunch of lads on the bank of the river for the chit chat, but I was not able. Now I am trying to get back into it, and with this machine, I am heading in that direction. It will not happen overnight like it was twelve months, two years ago, but I will be back the
way I was in the near future. Once I have this machine on every night, and I am going to bed earlier now to get this sorted because I want to get a good night’s sleep. I want to get back to what I was before.

[2D, Private Patient].

If offered public funding for the CPAP device, this private respondent outlined how it would have no impact on adherence. In addition, this respondent claims that the management of symptoms is the most significant motivating factor for adhering to therapy:

Well, I would still use it; no snoring, more energy, and my wife is happy. When my wife is happy, everybody is happy. I can tell you anything free there is no respect for it. That is the most important thing. None whatsoever. You get it for nothing, and you have no respect for it. You know the cost does not worry me; I am just here to see how it will benefit me.

[2D, Private Patient].

4.4.9 Positives and Negatives Associated with CPAP Therapy
This research has identified multiple positives and some negatives associated with CPAP therapy. The following respondent noted only positive feedback, including improvement in the mood:

Well, there are a couple of positives that I found out in Dublin. A couple of weeks ago from people that met me, three months previous, they said you are looking so well, your perkier, your mood is better. You lost a couple of pounds, what is your story? So I had no problem telling them that I was on a sleep apnea machine and it is after changing me so much. I am walking, and they commented on how well I looked compared when I was meeting them for three months every week before that. Then I met them after three months, and they could not get over me and what has changed in me in the three months. It is the CPAP, and everything is looking well.

[1A, Public Patient].

The next respondent concurs with the previous participant and highlights only positive feedback:

I am happy out with it. I have no insults about it.

[1D, Public Patient].

Another respondent reports the mask is a negative associated with the therapy:

If I could manage the mask. Then I would be fine.
This contributor is unable to highlight either positive or negative feedback as they are only adapting to the therapy:

*Presently, no because I am only feeling my way at the moment so no.*

This participant reports that CPAP is effective and is worth using by highlighting the improvement in their AHI since the commencement of CPAP therapy:

*It works. It does work. It is something that you would not even think would help. You know I cannot even find the words now of what I am trying to say. I did notice the benefit I really did. I mean you go from AHI of 28 to 3. That is worth it.*

The next contributor notes only positive feedback as they report feeling good with family members noticing an improvement in them:

*I would have no negatives about it. I probably have only all positives, and as I said, my health has improved. I think my family will appreciate it as well, and they see the difference in me. I mean just overall, I feel really good.*

Another respondent states that although everything is going well that they must use it:

*Not really. No, everything is ok. I suppose I presume you have to use it and that is it.*

The pros far outweigh the negatives, states the next respondent who identifies specific positive feedback, which includes improved mood, health, and energy levels:

*The positives are that my mood is way better. My health is way better. I have more energy. I have no snoring, so my husband does not stay awake, and he gets some sleep. The only negative with it is getting used to the mask, and the odd night you would have a very sweaty face, but that is just because it is warm or you're hot. Other than that the pros far outweigh the negatives. The pros far outweigh the negatives for me.*
Interestingly this next participant offers no feedback other than that they must accept this treatment as a medical doctor has recommended the therapy:

*No, because I am not aware of alternatives, I accept what is available. To my knowledge, it is a medical doctor recommending it, so I go along with it as I am unaware of alternatives.*

[2A, Private Patient].

This contributor concludes that the only problem they have is the embarrassment of wearing it on a trip away with friends:

*I cannot find any problem with it so far. One may be like I will be traveling in September. There will be five single beds and five of us in a room all fishermen, and there is no way that I would share a room with the five of them with this machine on my face. The reason being is because I would be afraid that somebody would put it up on Facebook. So that is the only cloud over it. So I will take a room on my own. The lads would have a great laugh at this machine. I would be embarrassed if it went up on Facebook. A couple of my friends know I am on it, but they have never seen it and what they do not know will not trouble them.*

[2D, Private Patient].

4.4.10 Future Recommendations for CPAP Usage

This study has found that the first contributor recommends that they keep using CPAP and remain in contact with their CPAP support nurse:

*No, the only recommendation I have is that I keep using it, and I keep in contact with my nurse. It is working so well for me that I want to keep going.*

[1A, Public Patient].

It is a great invention, states the next respondent:

*No. I make out it is a great invention.*

[1D, Public Patient].

Another respondent acknowledges that they must use the CPAP consistently to remain symptom-free:

*You need to use it every day. I know going on holidays my family are going to be saying to me sure you do not need to be putting that on tonight, but I will be putting it on. It will be coming on holidays with us. So I will not be exhausted. You know there are still*
things I cannot do with the kids that I want to do. So I need to pull myself together and get on with it.

[1C, Public Patient].

It will take time to get used to CPAP, states the next participant:

*To impress that it will take time to get used to it.*

[1B, Private Patient].

This contributor encourages perseverance with therapy and describes it as a life-changer:

*I would encourage people to give it a try. Do not knock it on the first night or the first week or the first month but keep going and persevere with it. It is a life-changer. It definitely is.*

[1E, Public Patient].

Another participant is happy because the CPAP does what it is designed to do:

*Not really, I am happy out with it. It does the job.*

[2B, Private Patient].

The following contributor pleads with people to get tested for sleep apnea as they claim individuals are unaware of how dangerous the condition is:

*Well, I pushed my GP to get me tested for this. If someone has felt like they are tired all the time and just lethargic. Get yourself tested, and if you have it, you will not know yourself within a week a using CPAP. You really will not know yourself within a week. I did not believe when Dr. X said to me; you will notice some difference in three days. I did not believe him until I got the CPAP. This is what sleep is actually like. I had sleep apnea all my life, and I did not realise it. The fact is that I was stopping breathing every minute, basically or very shallow breathing. I did not realise how dangerous that was, and I do not think people realise how dangerous it is.*

[2E, Private Patient].

In addition, this contributor outlines the need for increased public awareness for the condition and acknowledges how dangerous it is to drive a car while untreated with CPAP therapy:

*There should be more public awareness because there are people I think out there who are working fierce long hours, stressed to the hilt, no energy and realise they do not*
have any energy. Just get yourself checked out. It is the first fee to get checked out. The most uncomfortable thing of the whole lot was getting the sleep study, but that was only one night. I mean, I used to drive, and I would have to pull in if I was going somewhere only ten miles up the road. I would have to pull in halfway. I could not drive ten miles and like that is just too dangerous. You cannot have that on your conscience. So that would be why I think anyone who is like that and feeling like that should get checked out. All this thing about pulling in and having your cup of tea and sleeping for fifteen minutes. You should go to the doctor. Just see if you have sleep apnea and if you do not, you do not. You might be tired. If you do, you will not know yourself, and you never have to stop for that cup of tea. You know you might save your life or someone else's life.

[2E, Private Patient].

Another participant recommends staying positive and adapting to therapy as a matter of priority:

Just think positive. I suppose I adapt. Maybe everybody does not do it as I do. My recent experiences with health services allow me to see the benefit. That is it. It is just a question of priority, being adaptable. I think it is a personal thing.

[2A, Private Patient].

This contributor concludes that there is not enough public awareness and indicates that the condition is more prevalent but is under-diagnosed:

It depends on the individual, but I would tell them to stick with it. It was only by pure chance that I found out about this on the riverbank. One man told me he snored and then I told him I snored. He told me he had a machine, then he told me what was wrong with me, and it just gathered from that. I talk a lot with my customers, and my company or customers of my company and people tell me my "father in law has that" and "my brother in law has that." This is going to gather momentum, and it is going to get busier and busier. There is not enough public awareness. That is one major problem with it. The only time I had heard about it was on the bank of the river. I think people suffer from it and they do not realise they have it.

[2D, Private Patient].

4.5 Conclusion
This chapter has outlined and presented the research findings and analysis of this study. Chapter 5.0 of the thesis will present the main findings, recommendations, and the conclusion for the research study.
Chapter 5.0: Main Findings, Recommendations and Conclusion

And if tonight my soul may find her peace in sleep, and sink in good oblivion, and in the morning wake like a new-opened flower then I have been dipped again in God, and new-created.

(D.H. Lawrence)

5.1 Introduction

This research was carried out to gain a more in-depth insight into CPAP adherence in the Cork region with a specific focus on the impact of nursing support and the financial implications on adherence rates in OSA patients. The researcher has identified number of emerging themes, and aims to provide a fresh perspective on what influences CPAP adherence in the Cork region. A mixed-method triangulation approach was utilised with an initial internal desk research, followed by a quantitative and qualitative research piece where 9 participants were interviewed and data collected from their CPAP devices. Initially, 10 participants were recruited and consented to partake in the research. Unfortunately, 1 participant withdrew their consent, so all data they provided has been removed from the research.

In this chapter, the empirical findings of the research are triangulated. Through the implementation of independent quantitative and qualitative study components, the integration of analysis and the interpretation of this data allows the study to present holistic and comprehensive conclusions and recommendations (Plano Clark, 2019:108). This approach allows for the data to be integrated to provide multidimensional findings. The holistic and comprehensive conclusion will be discussed with a focus on the implications for future policy and practice in CPAP therapy. The key findings are presented in table 24.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Desk Research</th>
<th>Quantitative Data</th>
<th>Qualitative Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPAP Therapy</td>
<td>70% Male:30% Female, Mean age was middle age.</td>
<td>78% Male:22% Female, 89% were middle aged.</td>
<td>Reduced EDS, snoring, headaches. Increased energy, mood, more attentive at work. Bed partner happier, dry mouth, removing at night.</td>
</tr>
<tr>
<td>Participant Hours</td>
<td>Private patients more adherent by 0.75 hours, Adherence 84% in private group versus 74% public group, 70% of private</td>
<td>Private patients more adherent by 1.25 hours, Overall average percentage of days the CPAP was used for greater</td>
<td>Wear time varied by non-adherent at 3 hours to 8 hours. Sleep hygiene could be improved.</td>
</tr>
<tr>
<td>An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence</td>
<td></td>
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<tr>
<td><strong>patients use their CPAP for greater than 4 hours compared to 56% public patients.</strong></td>
<td><strong>than 4 hours was 67% for the public group and 88% in the private group.</strong></td>
<td><strong>Good, do not notice/feel it, opens the airway, persevered and got used to it, cannot sleep without it now.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>CPAP Air Pressure</strong></td>
<td><strong>90% pressure was 10.2 cmH20 in public group in 11.1 cmH20 in private group.</strong></td>
<td><strong>90% pressure was 7.8 cmH20 in private group and 11.1 cmH20 in public group.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Mask Fitting</strong></td>
<td><strong>Average 8% leak from mask in the public group versus 3% leak from private group.</strong></td>
<td><strong>Average mask leak at 8% in the public group and 6% in the private group.</strong></td>
<td><strong>Perfect, fits neatly, no leaks, do not realise it is on, simple to use, comfortable, anxious but persevered, dry skin, marks on face, sweaty, sore nose.</strong></td>
</tr>
<tr>
<td><strong>Symptom Improvement</strong></td>
<td><strong>Average AHI in Males 5-5.6, Average AHI in Females 3.7-4.1.</strong></td>
<td><strong>Average AHI in Males 3.5-4.0, Average AHI in Females 2.4-3.1.</strong></td>
<td><strong>Reduced EDS, snoring and gasping. Feel refreshed, no headaches, could not live without it, anxious to use, no improvement noticed.</strong></td>
</tr>
<tr>
<td><strong>Challenges with CPAP</strong></td>
<td></td>
<td></td>
<td><strong>Easy to use, no challenges, sleeping position, mask issues, trying to develop a routine, strange sensation at first to tolerate.</strong></td>
</tr>
<tr>
<td><strong>Nursing Support</strong></td>
<td></td>
<td></td>
<td><strong>Initial education was excellent, phone call support was very beneficial, increase public awareness, adequate support, email reports.</strong></td>
</tr>
<tr>
<td><strong>Financial Implications</strong></td>
<td></td>
<td></td>
<td><strong>Medical card increases adherence, would rent privately if medical card funding was removed, subjective symptom improvement encourages use rather than cost, regarded as a medication, told to wear it from a doctor, scared not to use it.</strong></td>
</tr>
<tr>
<td><strong>Positives &amp; Negatives</strong></td>
<td></td>
<td></td>
<td><strong>Reduced weight, improved mood and energy, health,</strong></td>
</tr>
</tbody>
</table>

Christine Brunnick (R00013582)
An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence

<table>
<thead>
<tr>
<th>Future Recommendations</th>
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<tbody>
<tr>
<td>reduction in AHI, happy with CPAP, prescribed so had to use it, no negatives, mask was a negative, stigma, pros outweigh the negatives.</td>
</tr>
</tbody>
</table>

Table 24. Summary of Key Findings

5.2 Review of the Main Findings
The main findings will examine the key themes from the interviews carried out with both public and private patients. The key themes will be summarised and presented. Statistical data gathered from the quantitative data will be presented. Fundamental themes will be discussed under the same headings adopted in Chapter 4.0:4.4.

5.2.1 CPAP Therapy
The following word cloud summarises, from the qualitative interviews, the main findings concerning the CPAP therapy theme.
Supporting Theorell-Haglow et al., (2018), this current study has found that OSA is more prevalent in males than females. This finding first emerged from the internal desk research, where 70% of participants were male, and 30% were female (Chapter 4.0:63). The findings from the empirical quantitative and qualitative data support Lechner et al., (2019), highlighting that 78% of participants are male and the remaining 22% are female. Supporting Tonkin et al., (2018), this study confirms that treatment with CPAP therapy can improve symptoms associated with OSA, with an overwhelming 78% of participants noting that CPAP therapy is effective at reducing subjective symptoms. "I am sleeping at night. I am not snoring. I have more energy by day. I am not tired..." (Chapter 4.0:72). In support of Lechner et al., (2019) and McKinney et al., (2015) this qualitative research has found that, if left untreated, OSA can lead to diminished work performance. One interviewee highlights the improvement in work performance since commencing CPAP therapy. "...I am more attentive on my job because I am not tired..." (Chapter 4:74).

Another key finding from this study supporting Manuel et al., (2016), and mentioned by 22% of interviewees is that CPAP therapy requires a consistent approach to be beneficial in the management of symptoms. "...when I do not use it, I would be exhausted the following day, I
would have a headache, and I would be very tired..., (Chapter 4.0:72). Manuel et al., (2016) is further supported by another participant who states, "...There have been two nights that I forgot to put on the mask. These are the only two nights that I have had the headaches...", (Chapter 4.0:73). In correlation with Uematsu et al., (2016), this present qualitative research found that 11% of interviewees reported removing the mask unconsciously during the night. "...I am throwing it off at some point in the night unknown to myself", (Chapter 4.0:73).

5.2.2 Participant Hours of Sleep with CPAP Device
The following word cloud summarises, from the qualitative interviews, the main findings concerning the Participant Hours of Sleep with CPAP Device theme.

Figure 3. Participant Hours of Sleep with CPAP Device Word Cloud

The current desk research supports Ramos et al., (2016), highlighting that 56% of public patients adhered to therapy for the recommended number of hours and 70% of private patients adhered to CPAP therapy (Chapter 4.0:65). The current quantitative research reinforces this finding with the public participant's adherence measuring at 67% and the private patient group at 88% (Chapter 4.0:69). Interestingly, it is only the empirical quantitative findings from the public patient group, which contradict Tonkin et al., (2018) who estimated non-adherence at 29% - 83%.
Another significant finding from the current qualitative research is that 89% of interviewees adhered to their CPAP therapy for longer than the minimum hours required to gain a sufficient improvement in their symptoms. "...I am getting a sound sleep definitely between 6 and 7 hours.", (Chapter 4.0:74). This current mixed-method triangulation study contradicts Colelli et al., (2018), as the overall adherence rate was 89% for the private group and 67% for the public group. This current finding from the quantitative and qualitative data support Tan et al., (2018) indicating that a possible reason for the higher adherence rate in the private group is due to the financial burden of CPAP on those individuals. The current qualitative research found that 33% of interviewees stated that they used their CPAP for between 6 - 7 hours "...between 6 and 7 hours..." (Chapter 4.0:74). Furthermore, 44% of interviewees reported using their CPAP for 7 - 8 hours "...7 to 8 hours a night..." (Chapter 4.0:75). This empirical finding contradicts Ramos et al., (2016) who suggests that fewer than 50% of patients use their CPAP for at least 4 – 5 hours per day. The empirical quantitative research supports Tan et al., (2018) reinforcing this finding with the average adherence time for public patients measured at 6 hours and the private group at 7.25 hours (Chapter 4.0:68). The new quantitative and qualitative research contradicts Ramos et al., (2016) reporting that 89% of participants used their CPAP for a period of greater than 5 hours each night. Interestingly, only one participant did not adhere to therapy for the recommended number of hours. "I would get on average 3 hours.", (Chapter 4.0:74). Another finding from the present qualitative research, reflecting Baratta et al., (2018), Carlucci et al., (2019), Gulati et al., (2017), Inoue et al., (2019), Kang, (2016), Pelosi et al., (2017), Tan et al., (2019), Venn, (2014), is that the same interviewee noticed no significant improvement in their subjective symptoms due to non-adherence. "Absolutely no improvement in symptoms but I am hoping...", (Chapter 4.0:80). In support of Caldwell et al., (2019), it was suggested by one interviewee that if they improved their sleep hygiene, their health would benefit positively. "Sometimes I think it is because my bed habits are so bad. I would like to have a better routine for sleep, and I would like to have a minimum of 8 hours and preferably 9 hours per night...", (Chapter 4.0:75).
5.2.3 CPAP Air Pressure

The following word cloud summarises, from the qualitative interviews, the main findings concerning the CPAP Air Pressure theme.

Figure 4. CPAP Air Pressure Theme Word Cloud

Supporting Isetta et al., (2015) and Venn (2014) all participants (100%) had a CPAP device which could detect reduced airflow, disturbed breathing events, and adjust to the required level of pressure automatically. The quantitative data found that the 90% percentile pressure of all participant’s CPAP device varied from 5.0cmh20 to 14.4cmh20 (Chapter 4.0:71). Interview participants unanimously (100%) acknowledged that CPAP air pressure was easy to tolerate and described it as barely noticeable while in place. "...To be fair, I do not even know it is on...", (Chapter 4.0:76). Concerning air pressure, 78% of interviewees reported that they considered the prescribed pressure as good with one interviewee reporting that they would be unable to sleep without the CPAP device. "...I feel now like I actually cannot sleep without it.", (Chapter 4.0:77). Both of these empirical findings support Inoue et al., (2019) and Venn, (2014), who suggest that while the prescribed pressure should be high enough to overcome the pharyngeal collapse, it should not be so high as to reach the lower airway and raise the...
functional residual capacity, because this itself disrupts sleep due to discomfort. Another compelling finding from this qualitative research supporting Ramos et al., (2016), Santos de Andrade et al., (2014), Tan et al., (2018), Venn, (2014), and Whyte et al., (2018) is that 22% of interviewees acknowledged that CPAP therapy was effective in maintaining their airway patency. "...The one thing about it is that it is very good for opening the airway which is what it is there to help.", (Chapter 4.0:76).

5.2.4 Mask Fitting
The following word cloud summarises, from the qualitative interviews, the main findings concerning the CPAP Air Pressure theme.

A significant finding from the present qualitative data, and in contrast to Lanza et al., (2018), is that circa 33% of interviewees reported a mask related side effect. "...It made my nose sore...Maybe that's because of inexperience", (Chapter 4.0:79). A further 55% of interviewees reported that the mask was perfect, comfortable or simple to use. "...It is perfect. The fitting is absolutely perfect...", (Chapter 4.0:77). This new qualitative finding supports Lanza et al., (2018) and Wimms et al., (2016) outlining that a well-fitting, comfortable mask can influence
long-term CPAP adherence. Supporting Ward et al., (2017) this study found that a further 22% of interviewees reported that although the mask felt unusual at the beginning, the benefits achieved from CPAP therapy encouraged them to persevere. "...Again, at the start it was unusual and a little bit uncomfortable but I'm benefitting from it so I persevered with it."
(Chapter 4.0:78).

The desk research revealed that the percentage of mask leakage was 8% for the public group and 3% for the private group (Chapter 4.0:65). The percentage of mask leak in the quantitative data was similar with an 8% mask leak in the public group and 6% in the private group (Chapter 4.0:70). These empirical findings support Ramos et al., (2016) who recommend a suitable mask, fitted properly to prevent leakage as a means to increase and maintain CPAP adherence. Interestingly, only one interviewee from the current qualitative data mentioned managing the leaks to achieve a comfortable fit with the mask. "...With the leaks I think I'm getting the hang of this one...", (Chapter 4.0:79). Furthermore, only one interviewee admitted to monitoring the percentage of mask leak. "...My leakage on the mask is certainly within the limits...", (Chapter 4.0:79).

5.2.5 Symptom Improvement on CPAP Therapy
The following word cloud summarises, from the qualitative interviews, the main findings concerning the Symptom Improvement on CPAP Therapy theme.
The internal desk research, the quantitative and qualitative research support Carlucci et al., (2019), Catala et al., (2016), Cistulli et al., (2019), Colelli et al., (2018), DelRosso et al., (2015), Eckert, (2018), Goyal et al., (2017), Inoue et al., (2019), Kang, (2016), Kuklisova et al., (2017), Lanza et al., (2018), Ramos et al., (2016), Rojas et al., (2018), Santos de Andrade et al., (2014), Tan et al., (2018), Venn, (2014), and Whyte et al., (2018) highlighting that CPAP remains the gold standard for the treatment of OSA and continues to be the most efficacious OSA treatment for patients benefitting from CPAP therapy. Supporting Manuel et al., (2016) and Huang et al., (2016) this empirical study found that 44% of interviewees experienced a reduction or elimination of excessive daytime tiredness since the commencement of their CPAP therapy. "...I am not as tired. When I do use the machine, I am not as tired. When I do not use it, I am wrecked...", (Chapter 4.0:80). Another finding from the current qualitative data is that 33% of interviewees reported that they felt more refreshed upon awakening. "...I feel fresher in the morning when I get up after using it.", (Chapter 4.0:81). This study contradicts Shah et al., (2014) maintaining that only 33% of interviewees reported an elimination or reduction in snoring. "...I am not snoring as much...", (Chapter 4.0:81). This new qualitative research contradicts Rezaetalalab et al., (2014) by reporting a mere 11% of interviewees noted an improvement in both witnessed apneas and headaches as a symptom.
of OSA. "...No headaches...", (Chapter 4.0:81). In line with Venn (2014), 22% of Interviewees reported an improvement in sudden awakening with choking and dyspnoea. "...I used to be waking up gasping for air or else my partner was waking me because I was not breathing...", (Chapter 4.0:79). The empirical research has revealed that one interviewee reported that they were not as depressed since initiating CPAP therapy. "...I am not as depressed as what I used to be because I am sleeping and I am happy in myself by day now...", (Chapter 4.0:72). Interestingly, this empirical finding contradicts Djonlagie et al., (2015) and Manuel et al., (2016) who maintain that CPAP therapy and the reduction of AHI does not normalise levels of depression and anxiety.

The internal desk research reveals that CPAP therapy is effective at returning the AHI to an acceptable therapeutic limit. The AHI limit ranged from an AHI of 3.7 – 5.6 in both the public and private groups (Chapter 4.0:66). The desk research further supports the empirical findings from the qualitative data and supports Tonkin et al., (2018) outlining that the main aims of treatment are to improve EDS and concentration, improve sleep quality and return the AHI to typical values. The new quantitative data reinforces the desk research and qualitative findings by showing a therapeutic AHI ranging from 2.4 - 4.0 (Chapter 4.0:70).

5.2.6 Challenges Associated with CPAP
The following word cloud summarises, from the qualitative interviews, the main findings concerning the Challenges Associated with CPAP theme.
In support of Manuel et al., (2016), Rezaie et al., (2018), Tan et al., (2018) and Uematsu et al., (2016) the qualitative data highlighted numerous challenges associated with CPAP therapy which can influence or impact on CPAP adherence. The new research has found that 44% of interviewees stated that getting accustomed to wearing the mask was a challenge initially. "...Getting used to it was the hard thing. Now that I am used to it I do not even think about it...", (Chapter 4.0:83). In support of Edmonds et al., (2016) and Venn (2014) the same participant highlights claustrophobia as a challenge associated with CPAP therapy; however, this participant argues that it is a challenge which can be overcome. "...Getting used to the mask over your face is a little bit claustrophobic at the start. It is nothing that cannot be overcome.", (Chapter 4.0:83). A further 33% of interviewees reported the need to adapt their sleeping position as a challenge associated with CPAP therapy. "...I worried if I would be able to get off my belly going to sleep because that is the way I have slept all my life...", (Chapter 4.0:82).

The empirical findings from this study support Inoue et al., (2019), Ramos, (2016) and Venn, (2014) as all patients had a humidifier supplied at the initial education session, which acted as an early intervention to improve adherence to CPAP. Interestingly, no participants
interviewed mentioned any nasal complications associated with CPAP. Furthermore, this study has found that 67% of interviewees claim that they experienced no challenges associated with their CPAP therapy. "...I did not find any challenges...", (Chapter 4.0:83). The present qualitative findings support Pelosi et al., (2017) with one interviewee denying any challenges and emphasising that CPAP was easy to use. "...No, it is all so easy...", (Chapter 4.0:82).

5.2.7 Nursing Support
The following word cloud summarises, from the qualitative interviews, the main findings concerning the Nursing Support theme.

Figure 8. Nursing Support Theme Word Cloud

The current qualitative research supports Brostrom et al., (2013) and Uematsu et al., (2016) as it states that 55% of interviewees felt they received the best nursing support at the initial education session including the care and maintenance of the CPAP device, device functions, device troubleshooting, the rationale for CPAP as a treatment and the importance and benefit of CPAP therapy. "...The support that I got here in the office was just second to none...", (Chapter 4.0:85). The current qualitative research supports Tonkin et al., (2018) with one participant identifying the introductory session as beneficial because they felt more prepared
for commencing their CPAP therapy. "...It was very beneficial, and your introductory session was very good because when I went to set it up, you had prepared me...", (Chapter 4.0:88).

The public patient group received weekly phone calls over the first month of therapy. The empirical qualitative data supports Manuel et al., (2016) noting that 80% of the public group found the phone call support beneficial, as it helped to encourage adherence to CPAP therapy through problem-solving and troubleshooting. "...The weekly phone calls were excellent because I knew you were there for me if I had a problem.", (Chapter 4.0:86). In contrast to the weekly phone calls that the public group received, 75% of the private patient group felt that one phone call on week 2 of the therapy commencing was beneficial. "...Phone calls are brilliant and just the backup. I can ring whenever I think of a problem...", (Chapter 4.0:87). The current qualitative research supports Carlucci et al., (2019) and Zampogna et al., (2019) reporting that regardless of the support strategy, frequency, and educational intervention timeline, both groups of patients benefitted from each support intervention provided. "...I do not think I need more; the support is fine. What I got was very good...", (Chapter 4.0:87).

This study has revealed that 67% of interviewees could not make any suggestions to the nursing support they were provided. This empirical finding supports Catala et al., (2016), who recommends emphasising patient education before CPAP therapy commences. The new qualitative data found that 67% of public patients and 33% of private patients could make no suggestions to improve nursing support, which was provided to them. "...No, because I am happy with the service that I got...", (Chapter 4.0:87). In support of Rezaeitalab et al., (2019) and Rezaie et al., (2018) one public patient made a recommendation for improving nursing support by suggesting that increased public awareness is warranted regarding OSA and CPAP therapy as a treatment. "...More public awareness because there are probably truck drivers, probably car drivers and there are people who have it, and they do not know that they have it...", (Chapter 4.0:85). There was only one suggestion for improving nursing support from a private patient who recommended that adherence reports be emailed to the patient directly. "...The fact that you have my email address now, you can send all those types of reports so I can look at my chart to see how I am performing...", (Chapter 4.0:89).
In the Irish healthcare system, the diagnosis of OSA and CPAP therapy is funded by the state for public patients, while private patient’s CPAP therapy is not (Tan et al., 2018). The desk research shows that private patients who self-funded their CPAP therapy have an adherence rate of 84%. In comparison, to the public patients whose device is funded by the state showing a lower adherence rate of 74% (Chapter 4.0:64). The desk research revealed that the private patient group showed an adherence percentage of days where the device was used for greater than 4 hours as being 70% (Chapter 4.0:65). In comparison the desk research revealed that the public group had an adherence percentage of days where the device was used for greater than 4 hours of 56% (Chapter 4.0:65). Both of these quantitative empirical findings contradict Rezaie et al., (2018) by demonstrating that state-funded CPAP adherence was lower than non-funded CPAP adherence, suggesting that a reduced cost, increased insurance coverage, and subsidisation is not the most effective step to increase CPAP adherence. Interestingly, this new quantitative and qualitative research supports Tarasiuk et al., (2012)
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suggesting that a financial incentive applied to the CPAP device encourages adherence. Supporting Ken Lee et al., (2017), private patients must fund CPAP devices and interfaces out-of-pocket. This current qualitative research supports Goyal et al., (2017) stating that 40% of public patients claim that the medical card increases their adherence to CPAP. "...The medical card increases my use.", (Chapter 4.0:90). In line with Gulati et al., (2017) and Rezaie et al., (2018) this study revealed that 20% of interviewees would not rent the device if state funding were lost, due to the high cost associated with the CPAP. "... People would not be on it as much then. You will not see people hiring or taking machines from the hospitals...", (Chapter 4.0:90). Interestingly, the current qualitative data disputes Goyal et al., (2017) reporting that 60% of interviewees would hire the device out-of-pocket if the medical card funding were removed. "...if I had to lose the medical card, it would not change anything. I would take it up myself.", (Chapter 4.0:89). This empirical qualitative research supports Baratta et al., (2018), Brostrom et al., (2013) and Venn (2014) with one interviewee highlighting that the cost of the CPAP device is insignificant and that their adherence to therapy is motivated by external regulations including the fact that CPAP therapy has a prescription status. "...Well, I was told I have to use it. I had no choice that’s what I picked up from my Doctor. The cost has no significance over the use, the same as you would for other medication or tablets...", (Chapter 4.0:91).

The findings from the empirical qualitative data contradict Goyal et al., (2017), Rezaie et al., (2018) and Tan et al., (2018) with 100% of the private patient group revealing that the benefits of CPAP therapy including improved symptoms and quality of life far outweigh the costs associated with the CPAP device. "...I am a lot healthier with it, so I do not mind paying it...", (Chapter 4.0:92). This current qualitative research supports Baratta et al., (2018) and Venn (2014) highlighting that symptom severity pre-treatment and symptom relief with CPAP treatment is the strongest predictor of CPAP adherence. In comparison to the public patient group, there were only 20% of interviewees who stated that they used CPAP because of the benefit. "...I have not been able to function. Even at work, I could be so tired that I could go to sleep...", (Chapter 4.0:90).

Interestingly, in support of Catala et al., (2016), Patel et al., (2016) and Wickwire et al., (2019) only one interviewee from the private patient group reported that using CPAP therapy provided a cost-effective benefit to their workplace. "...It would cost us more to employ
someone to be up the farm. We are not employing someone up in the yard because I have more energy to do the jobs up the yard...", (Chapter 4.0:91).

5.2.9 Positives and Negatives Associated with CPAP Therapy
The following word cloud summarises, from the qualitative interviews, the main findings concerning the Positives and Negatives Associated with CPAP Therapy theme.

The current qualitative data has found that 33% of interviewees reported that either family members, friends, or work colleagues commented that they noticed an improvement in the patient since commencing CPAP therapy. "...A couple of weeks ago from people that met me, three months previous, they said you are looking so well, your perkier, your mood is better...", (Chapter 4.0:93). In support of Diaz-Abad et al., (2014), this present study revealed that 33% of interviewees felt that using CPAP had a positive impact on their overall health. "...My health is way better...", (Chapter 4.0:94). The empirical qualitative research supports Diaz-Abad et al., (2014) and Djonlagic et al., (2015) outlining that 22% of interviews reported that they only experienced positive outcomes resulting from CPAP therapy. "...I would have no negatives about it. I probably have only all positives...", (Chapter 4.0:94). Interestingly, in support of
Venn (2014), only one interviewee reported that the elimination of snoring was a positive outcome because it no longer negatively impacted on their spouse's sleep. "...I have no snoring, so my husband does not stay awake, and he gets some sleep...", (Chapter 4.0:94). The empirical data reported that 22% of interviewees noted that they had neither positive or negative comments they associated with CPAP therapy. "...Presently no because I am only feeling my way at the moment so no.", (Chapter 4.0:94).

This current qualitative research has found that 33% of interviewees reported no negatives associated with CPAP therapy. "...I have no insults about it."., (Chapter 4.0:93). Interestingly, only 22% of interviewees reported the mask as a negative association of CPAP therapy. "...If I could manage the mask. Then I would be fine.", (Chapter 4.0:93). This empirical finding contradicts Lanza et al., (2018) who estimates that 50% of patients experience at least one mask-related side effect. Another finding from this current research which supports Ramos et al., (2016), Santos de Andrade et al., (2014) and Wimms et al., (2016) is that an overwhelming majority of interviewees (67%) reported that they had a comfortable, well-fitting mask which may have provided a positive influence on their CPAP adherence. "...I find that once I put the headpiece on, I do not even realise it is there. It is very comfortable...", (Chapter 4.0:77). Supporting Ward et al., (2017) this current qualitative research has found that 11% of interviewees reported that there is a stigmatisation surrounding CPAP therapy, especially when in the company of friends. "...The reason being is because I would be afraid that somebody would put it up on Facebook...", (Chapter 4.0:95).

5.2.10 Future Recommendations for CPAP Usage

The following word cloud summarises, from the qualitative interviews, the main findings concerning the Future Recommendations for CPAP Usage theme.
Encouragingly, this new qualitative data supports Ward et al., (2017) revealing that 67% of interviewees agree that they must persevere and keep using the CPAP therapy in order to become successful on the treatment. "...Do not knock it on the first night or the first week or the first month but keep going and persevere with it...", (Chapter 4.0:96). Surprisingly, the empirical qualitative data contradicts Uematsu et al., (2016) reporting that only one respondent recommended keeping in contact with the patient support nurse. "...the only recommendation I have is that I keep using it, and I keep in contact with my nurse...", (Chapter 4.0:95).

The empirical qualitative research found that 22% of interviewees recommend getting tested for OSA. "...Get yourself tested, and if you have it you will not know yourself within a week a using CPAP...," (Chapter 4.0:96). In line with Ramos et al., (2016), Rezaie et al., (2018), Tan et al., (2016), and Whyte et al., (2018) this current qualitative research has found that there is a need for more public awareness regarding OSA and CPAP therapy. According to 22% of interviewees, poor public awareness is an issue relating to OSA and CPAP therapy in Cork, Ireland. "...There should be more public awareness because people are working fierce long hours, stressed, no energy and realise they do not have any energy...," (Chapter 4.0:96).
Supporting Borel et al., (2018), Djonlagic et al., (2015) and Manuel et al., (2016) this current qualitative research reveals the link between OSA and motor vehicle accidents, with 22% of interviewees highlighting this issue. "...I used to drive, and I would have to pull in only ten miles up the road. I could not drive ten miles and like that is just too dangerous. You know you might save your life or someone else's life...", (Chapter 4.0:97). In support of Carlucci et al., (2019), Catala et al., (2016), Cistulli et al., (2019), Colelli et al., (2018), DelRosso et al., (2015), Eckert, (2018), Goyal et al., (2017), Inoue et al., (2019), Jennum et al., (2017), Kang, (2016), Kuklisova et al., (2017), Lanza et al., (2018), Ramos et al., (2016), Rojas et al., (2018), Santos de Andrade et al., (2014), Tan et al., (2018), Venn, (2014) and Whyte et al., (2018) this empirical research found that CPAP is effective at treating the symptoms of OSA. The current qualitative research revealed that 22% of interviewees recommend CPAP due to its effectiveness in treating symptoms. "...It is a life-changer. It definitely is...", (Chapter 4.0:96). This finding is supported by both the desk research and the quantitative research which reveal that the AHI is within a therapeutic range when CPAP therapy is utilised for the treatment of OSA (Chapter 4.0:66). In support of Baratta et al., (2018) another participant highlights that because the CPAP is working so well, it encourages them to continue with therapy. "... It is working so well for me that I want to keep going...", (Chapter 4.0:95).

5.3 Integrated Framework of the Key Empirical Findings
This current research study has revealed several empirical findings relating to individual’s attitudes, beliefs and opinions on CPAP therapy, CPAP adherence, nursing support and the financial implications associated with CPAP adherence and symptom management in OSA. This new research has provided unique insights into participant’s experiences with CPAP therapy. The mixed-method triangulation approach has provided the researcher with a comprehensive insight into CPAP adherence in the Cork region. A summary of the key findings is presented in an integrated framework in table 25.

<table>
<thead>
<tr>
<th>General Behaviour, Attitudes and Opinions on CPAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ OSA is more prevalent in men than women in the desk research (70%:30%).</td>
</tr>
<tr>
<td>➢ OSA is more prevalent in men than women as shown in the quantitative and qualitative empirical research (78%:22%).</td>
</tr>
<tr>
<td>➢ 33% of interviewees felt that using CPAP had a positive impact on their overall health.</td>
</tr>
</tbody>
</table>
67% of interviewees agree that they must persevere and keep using the CPAP therapy in order to become successful on the treatment.

11% of interviewees believe that there has been an improvement in their work performance since commencing CPAP therapy.

78% of interviewees reported that they considered the prescribed pressure as good.

22% of interviewees recommend getting tested for OSA if you have symptoms.

22% of interviewees highlight poor public awareness as an issue relating to OSA and CPAP therapy.

22% of interviewees recommend CPAP because it is effective at treating symptoms.

33% of interviewees reported that either family members, friends or work colleagues commented that they noticed an improvement in the patient since commencing CPAP therapy.

Interviewees report that treatment with CPAP therapy can improve a variety of symptoms associated with OSA.

33% of interviewees reported a mask related side effect.

44% of interviewees stated that getting accustomed to wearing the mask was a challenge initially.

67% of interviewees claim that they experienced no challenges associated with their CPAP therapy.

### CPAP Adherence

70% of private patients used their CPAP for greater than 4 hours whereas only 56% of public patients used their CPAP for greater than 4 hours in the desk research.

In the quantitative data the average adherence time for public participants was 6 hours.

The quantitative data showed that the average adherence time for private participants was significantly higher than the public group with an average adherence time of 7.25 hours.

The lowest percentage adherence (23%) recorded in the quantitative data was by a male participant in the public group.

Within the quantitative data, the overall average percentage of days the CPAP was used for greater than 4 hours was 67% for the public group and was higher in the private group (89%).

The quantitative data showed that the mean rate of adherence in the private group was 100%. The public group had a mean adherence rate of 82%.

89% of interviewees adhered to their CPAP therapy for longer than the minimum hours required to gain a sufficient improvement in their symptoms.

33% of interviewees said that they used their CPAP for between 6 - 7 hours and 44% of interviewees for 7 - 8 hours.

89% of interviewees used their CPAP for a period of greater than 5 hours each night.

Only one interviewee reported no significant improvement in their symptoms due to non-adherence.
### Financial Support and its Impact on CPAP Adherence

- Private self-funding patients were more adherent to CPAP therapy by 0.75 of an hour than the public group in the desk research.
- The quantitative data revealed that private patients who fund their CPAP device are more adherent to CPAP for greater than the 4 hours of recommended wear time in the quantitative research.
- The desk research found that privately paying patients are more adherent with CPAP therapy than public patients with a mean adherence rate of 84%.
- 20% of interviewees would not rent the device if state funding were lost, due to the high cost associated with the CPAP.
- 60% of interviewees would hire the device out-of-pocket if the medical card funding was removed.
- 100% of the private patient group revealed that the benefits of CPAP therapy, including improved symptoms and quality of life, far outweigh the costs associated with the CPAP device.
- One interviewee from the private patient group reported that using CPAP therapy provided a cost-effective benefit to their workplace.

### Nursing Support and its Impact on CPAP Adherence

- 55% of interviewees felt they received the best nursing support at the initial education session.
- 80% of interviewees in the public group found the phone call support beneficial, as it helped to encourage adherence to CPAP therapy through problem-solving and troubleshooting.
- 75% of the private patient interviewees felt that one phone call on week 2 of the therapy commencing was beneficial.
- 67% of interviewees could not make any suggestions to the nursing support they were provided.
- One public patient made a recommendation for improving nursing support by suggesting that increased public awareness is warranted regarding OSA and CPAP therapy as a treatment.
- One respondent recommended keeping in contact with the patient support nurse.

### Symptom Management on CPAP Therapy

- The average male AHI ranged between 5.0 - 5.6 for both groups in the desk research.
- The average female AHI ranged between 3.7 - 4.1 for both groups in the desk research.
- The quantitative data showed that an average male AHI ranged between 3.5 - 4.0 for both groups.
- The quantitative data showed that an average female AHI ranged between 2.4 - 3.1 for both groups.
- The quantitative data showed that CPAP is effective at lowering the AHI to reduce or eliminate the symptoms of OSA.
44% of interviewees experienced a reduction or elimination of excessive daytime tiredness since the commencement of their CPAP therapy.

33% of interviewees reported that they felt more refreshed upon awakening.

33% of interviewees reported an elimination or reduction in snoring.

22% of interviewees reported an improvement in sudden awakening with choking and dyspnœa.

22% of interviewees acknowledged that the CPAP was effective in maintaining their airway patency.

22% of interviewees reported that although the mask felt unusual at the beginning, the benefits achieved from CPAP therapy encouraged them to persevere.

Table 25. Integrated Framework of the Key Empirical Findings

5.4 Recommendations for Future Practice

This section presents the key recommendations for future practice in CPAP therapy and recommendations for future research originating from the empirical research.

5.4.1 Increasing Public Awareness

The first recommendation relates to increasing public awareness about OSA as a SDB condition, ensuring that there are consistent messages about the condition, its prevalence, and the risk factors in Ireland. The impact of the disease on individual’s health should be highlighted to patients as soon they are diagnosed with OSA. Patients must realise that OSA is associated with increased morbidity and mortality. The empirical research has shown that 22% of interviewees highlighted a lack of public awareness relating to OSA and CPAP therapy. Based on the empirical evidence, it is essential to raise public awareness and knowledge about OSA, the risks associated if left untreated and CPAP therapy. Awareness related to symptoms of OSA needs to be highlighted so that individuals can quickly identify and potentially self-refer to their local General Practitioner (GP) for evaluation and further specialist referral.

Increasing awareness of OSA and the risks associated can positively influence the reduction of healthcare costs resulting from co-morbidities from untreated or undiagnosed OSA. Based on the current research, it was recommended in the qualitative data that education sessions should be performed in places of work and hospitals to highlight awareness about OSA, symptoms associated, risks associated and the treatment required. This research suggests that a coordinated awareness campaign should be commenced across the public and private healthcare sector at a national level. A simple but effective recommendation is the use of a healthcare poster which can be distributed quickly to the public and private hospitals, specific
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sleep clinics, Out Patient Departments (OPD) and GP practices. A draft copy of the researchers proposed poster is included in appendix 12. This initiative can also be implemented across non-healthcare settings such as workplaces. This can be implemented across workplaces in all industry sectors; however, there should be a focus on implementation in sectors where undiagnosed OSA poses a significant safety risk, such as those where employees operate heavy machinery and are required to drive as part of their role.

5.4.2 Patient Advocates and Patient Testimonials
The second recommendation is to utilise patient advocates and patient testimonials to improve cultural awareness of CPAP therapy and to improve CPAP acceptance and adherence. A challenge associated with CPAP therapy is the lack of enthusiasm by some patients to engage with the therapy. A lack of knowledge regarding subjective symptom improvement is associated closely with the lack of interest in CPAP therapy. The empirical research found that 44% of participants experienced a reduction or elimination of EDS. A further 33% reported reduced snoring and feeling more refreshed upon waking. These empirical findings highlight the positive experiences of individual patients using CPAP therapy. These positive experiences can be converted to testimonials to highlight the real-life benefits of CPAP therapy for new patients. It is recommended that testimonials be gathered from patients and a library of testimonials be established on the BOC Homecare website. These testimonials can be provided to new patients to highlight how proper CPAP adherence can have a positive impact on their quality of life and overall health. Several positive testimonials which are supportive and realistic of CPAP therapy should be chosen and included in patient literature and information brochures. For further testimonials and real-life examples of the benefits of CPAP therapy, patients should be directed to the library of testimonials on the BOC Homecare website.

To support testimonials, several CPAP therapy advocates could be recruited from current CPAP patients. As reported in the empirical research in Chapter 4.0, one interviewee noted that they were highlighting to their customers that they should get tested for OSA and emphasised how beneficial CPAP therapy has been with subjective symptom improvement. The advocates would include patients with high adherence levels who have embraced CPAP therapy and reported a significant improvement in subjective symptoms, improved quality of life, and improved overall health. In conjunction with a patient support nurse, patient

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advocates should attend healthcare facilities and workplaces to provide awareness and information sessions on the importance of having symptoms investigated, receiving a diagnosis and the benefits of CPAP therapy. This recommendation will allow potential patients to receive clinical information from a CPAP provider and to get reliable information on the practical implications of CPAP therapy from the patient advocate.

5.4.3 Nursing Support
The third recommendation is aimed at both policymakers within the Irish healthcare system and private companies who provide CPAP devices. Policymakers should use this research to develop a new model of practice for CPAP adherence. Based on the empirical research, 55% of patients felt they received the most beneficial nursing support at the initial education session. Interestingly, 80% of public patients felt that weekly phone calls were beneficial, as it helped to encourage adherence through troubleshooting. While 80% of public patients agreed that the weekly phone calls were beneficial, 20% of public patients were non-adherent to therapy despite more frequent nursing support. While private patients had their CPAP for a greater period and had a reduced level of nursing support, these patients were more adherent than the public group. The empirical research reported that 75% of private patients acknowledged that one phone call was sufficient at week 2 of a 6 week period. The research has shown that the frequency of nursing support provided does not directly influence the level of CPAP adherence, as the private patient group received less frequent support yet reported higher adherence levels. Considering these findings, it is reasonable to assert that there is another more prevalent differentiating factor between the two groups, which influences the level of adherence. The empirical research has shown that the differentiating factor between the two groups is the financial implications of therapy for the patient. The private group bears a financial burden as they must self-finance their CPAP therapy.

Therefore, the researcher recommends that a new standardised model of practice for CPAP adherence is implemented as a national standard so that all patients receive adequate nursing support. This CPAP support and adherence follow up is reported directly back to the relevant teams in the respiratory clinics. A collaborative and supportive approach between the Irish healthcare system and private medical device companies is crucial to realising higher levels of CPAP adherence. This standardised model for practice is located in section 5.5. An earlier intervention allows for changes to be made to therapy in order to encourage CPAP adherence.

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These changes may include but are not limited to switching from CPAP to APAP, mask education, and mask trials. Increasing adherence to therapy provides a cost-benefit to the healthcare system by reducing risks which negatively impact on morbidity and mortality rates due to untreated OSA.

5.4.4 Financial Implications of CPAP Therapy on Adherence

The fourth recommendation is based on the financial implications for patients. The empirical research showed that private paying patients were more adherent in the desk research, quantitative, and qualitative research. One of the most exciting findings from this research was that 60% of the public patients stated that they would hire the device if the medical card funding were removed, due to the improvement in their subjective symptoms. Interestingly, 100% of the private group revealed that the benefits of therapy, including improvements in subjective symptoms and increased quality of life, far outweighed the cost associated with renting the CPAP device. This, coupled with the financial differential noted at the end of recommendation three, suggests that the patient bearing some financial responsibility for their CPAP therapy can impact positively on their adherence rate. In light of this, recommendation four is that a cost-sharing initiative be introduced for publicly funded patients. This researcher proposes two different models for consideration. These models are outlined below.

Model A – Flat rate monthly charge. Under this model, the patient would pay a fixed amount each month towards the cost of their CPAP therapy. This amount would be a nominal amount similar to the current prescription charge applicable to patients with a medical card. By introducing this charge, it encourages patients to increase their adherence levels as they now bear some of the cost.

Model B – Adherence based charge. Under this model, the patient would pay a percentage of the monthly cost of their CPAP therapy with the Irish health system funding the balance. The main difference between this model and model A is that the patient will have the opportunity to reduce their cost by increasing their adherence. If the patient exceeds an agreed adherence target each month, the percentage of the therapy cost that they pay will be reduced or waived. Adherence monitoring can be performed remotely monthly for the
first 6 months and quarterly after that. The patient’s monthly charge will be reviewed quarterly in conjunction with the adherence reports.

5.5 A Standardised Model of Practice for CPAP Adherence Nursing Support
Following an analysis of the results, the researcher has developed a standardised model of practice with nurse-led support for patients to monitor and improve CPAP adherence. As the empirical research has shown, 80% of patients found telephone support beneficial for troubleshooting CPAP queries and further CPAP education. The research showed that while nursing support was provided more frequently to public patients, this did not improve adherence to therapy. Private patients were more adherent, even though they received less nursing support. Subjective improvement in symptoms was highlighted as the most significant reason for adhering to CPAP therapy, despite the level of nursing support provided. The model for practice highlights this by providing a standardised model for patient support. This model incorporates the Respiratory team (Prescribing Physician and Clinical Nurse Specialist) by highlighting non-adherent patients at an early stage so that interventions can be implemented to improve CPAP adherence.
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Figure 12. A Standardised Model of Practice for CPAP Adherence Nursing Support

**DAY 1 – Education with Patient Support Nurse (PSN) (1 hour)**
Includes: Overview of OSA, overview of CPAP, possible side effects, trouble shooting, mask fitting

**WEEK 1 – Support phone call from PSN**
Check adherence, remotely download, phone support e.g. education & troubleshooting

**WEEK 2 – Support phone call from PSN**
Check adherence, remotely download, phone support e.g. education & troubleshooting

Non-Adherent Patient
 Requires additional support call

Week 3 – Support call from PSN
As per week 2

**WEEK 4 – Face to Face appointment with PSN**
Assess mask, re-educate patient, troubleshoot, discuss side effects (if any)

Non-Adherent Patient
Report to Respiratory Physician & team

Adherent Patient
Proceeds to week 4

Adherent Patient
Proceeds to week 12

**WEEK 12 – Support phone call from PSN**
Check adherence, remotely download, phone support e.g. re-education & troubleshooting

**WEEK 26 – Support phone call from PSN**
Check adherence, remotely download, phone support e.g. re-education & troubleshooting

**WEEK 52 – Face to Face visit with PSN (Repeated Annually)**
Check adherence, download, replace consumables, re-education & troubleshooting

Christine Brunnick (R00013582)
5.6 Recommendations for Future Research
The researcher recommends that the specific subject area investigated in this study should be expanded to ensure that the findings are representative of the entire Irish CPAP user population. A new qualitative study should focus on patient demographics, the prevalence of OSA, risk factors, subjective symptoms, and CPAP adherence at a national level within Ireland.

The researcher recommends that a further quantitative study should be carried out to investigate the socio-economic factors relating to the Irish CPAP user population and the potential impact that this has on the uptake of CPAP therapy and adherence.

The researcher believes that CPAP therapy and issues surrounding non-adherence in Ireland requires further investigation. The Irish healthcare system provides CPAP therapy free of charge to any patient who has met the criteria for a medical card. A qualitative study investigating non-adherence in this group of patients would provide beneficial information to policymakers within the Irish health system.

With the Irish health system funding CPAP devices to a large population of patients, a cost-benefit analysis study could provide valuable insight into the morbidity and mortality costs of non-adherence in Ireland. This information could help pave the way for future policymaking.

A qualitative study dedicated to investigating OSA and CPAP public awareness in Ireland, especially with the prevalence of the condition, would help to alleviate perceptions and to improve cultural awareness surrounding OSA diagnosis and CPAP therapy.

5.7 Conclusion and Final Comments
This research has evaluated the impact of nursing support and the financial implications associated with CPAP adherence in Cork, Ireland. The research adopted a unique mixed-method triangulation approach to achieve the aim and objectives set out in Chapter 1.0. The empirical research has revealed several key findings concerning CPAP adherence, patient's attitudes, and opinions regarding CPAP therapy, nursing support, and the financial implications associated with CPAP Adherence.

A profound review of the literature was conducted, with a specific focus on CPAP adherence, nursing support, and the financial implications associated with CPAP adherence. The literature revealed a topic which was comprised of multifaceted, complex, and intricate areas.
Interestingly, the financial implications and nursing support provided to CPAP patients did not appear to be investigated previously in Ireland, which highlighted a significant gap for the researcher. The introduction of contractual tenders within the Irish healthcare system for the supply of CPAP devices from private companies will undoubtedly change the outlook and the importance of patients using CPAP therapy and their adherence to reduce the risks associated with OSA in Ireland.

This current research study has revealed that OSA is more prevalent in males than females, with 78% of participants in the quantitative data recorded as male. The desk research supports the quantitative finding with a 70% male prevalence. The empirical research demonstrates that the prevalence of OSA increases with age. Both the desk review and the quantitative research support this finding by revealing that the mean ages of participants diagnosed with OSA and commenced on CPAP therapy as middle-aged.

In the context of CPAP treatment, the main findings from the research reveal an overwhelmingly positive experience associated with CPAP therapy. The empirical data demonstrates support from patients for CPAP therapy with 33% of interviewees reporting the positive impact CPAP therapy has had on their overall health. Improvement in work performance was highlighted, with 33% of interviewees reporting that family members, friends, or work colleagues noticed an improvement in the individuals since commencing CPAP. These findings appear to reduce the negative connotation associated with CPAP therapy. The findings demonstrate that 67% of interviewees claimed to have experienced no challenges with their CPAP therapy and an overwhelming 67% of participants recommended that users of CPAP should implement a consistent approach and persevere with treatment to realise the full potential and benefits of CPAP therapy.

The desk research, qualitative and quantitative research illustrate that CPAP adherence rates differentiated significantly between the public and private patients. The empirical research gathered in the quantitative data supported the desk research findings by demonstrating that private patients who self-fund the CPAP device were more adherent to therapy. The quantitative data revealed that private patients who used their CPAP for greater than 4 hours had a staggering adherence rate of 89%. In contrast, the quantitative data highlighted that public patients had a lower adherence rate of 67%. This finding was reinforced by the desk
research, which found that private patients who used their device for greater than 4 hours had an adherence rate of 70%. In contrast, only 56% of the public group in the desk research used their device for greater than 4 hours. The quantitative empirical research also highlights that private patients used the device for a greater number of hours with an average adherence time of 7.25 hours as opposed to 6 hours in the public group. The study finds that the majority of interviewees (89%) adhered to therapy for longer than the recommended minimum hours required to gain a sufficient improvement in their subjective symptoms.

The present study finds that a majority (55%) of interviewees felt that the most beneficial nursing support they received was at the initial 1-hour education session before commencing therapy. A staggering 80% of public patients in the qualitative data reported that weekly phone call support was beneficial, as it allowed for troubleshooting and problem-solving. In contrast, 75% of private patients felt that one phone call was beneficial and was an adequate level of nursing support. A key recommendation emerging from this study suggests that key policymakers should develop a standardised model of practice for CPAP adherence and nursing support provided to patients. A proposed model is located in section 5.5 of this paper.

An exciting finding emerging from this research reveals that an astonishing 60% of public patients stated that they would hire the device out-of-pocket if medical card funding were removed. This finding is the core foundation for a cost-sharing recommendation, which could be implemented by key policymakers to increase CPAP adherence and reduce related morbidity risk factors in the public patient group. This key finding is a result of the subjective symptom improvement noted by public patients, which is the reason they indicated they would be willing to self-fund the CPAP device. A noteworthy 44% of all interviewees reported that they benefitted from a reduction or elimination of EDS, 33% felt more refreshed upon waking, 33% reported a reduction or elimination in snoring and 22% reported an improvement in choking and dyspnoea. Another key finding in the private patient group revealed that the benefits of therapy including improved subjective symptoms and increased quality of life far outweighed the costs associated with CPAP, with one interviewee claiming that CPAP provided a cost-benefit to their place of work.

The empirical evidence produced in this study in conjunction with recommendations for policy and practice provides evidence-based research which can add new value to an
established knowledge base and introduce new findings into a multifaceted topic. The recommendations outlined in this thesis are aimed at key policymakers and private medical device companies who can work collaboratively to reduce the implications of non-adherence to CPAP therapy and promote CPAP as a beneficial treatment to reduce mortality and morbidity associated with untreated OSA in the Irish healthcare system. Furthermore, this collaboration and focus on increasing CPAP adherence in public patients can provide a financial benefit for the Irish healthcare system by reducing mortality and morbidity associated costs resulting from non-adherent patients. The key findings and recommendations presented provide both policymakers and private medical device companies with a broader understanding of patient behaviours and attitudes towards CPAP therapy concerning adherence, nursing support and the financial implications of therapy in Cork, Ireland.
References


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significant increase in the rates of sleep apnoea and obesity over the last 20 years - data from the UK sleep survey”. *Sleep Medicine*, 54, pp. 250-256.


### Glossary

<table>
<thead>
<tr>
<th>Acronym/Word</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ablation</td>
<td>Cardiac procedure to correct an irregular heart rhythm.</td>
</tr>
<tr>
<td>Aerophagia</td>
<td>Excessive air swallowing into the stomach resulting in bloating.</td>
</tr>
<tr>
<td>AF</td>
<td>Atrial Fibrillation is a specific type of irregular heart rhythm.</td>
</tr>
<tr>
<td>AHI</td>
<td>Apnea-Hypopnea Index</td>
</tr>
<tr>
<td>ANS</td>
<td>Autonomic Nervous System</td>
</tr>
<tr>
<td>APAP</td>
<td>Automatically Adjusting Positive Airway Pressure</td>
</tr>
<tr>
<td>Arrhythmias</td>
<td>An irregular heart rhythm.</td>
</tr>
<tr>
<td>Arrhythmogenesis</td>
<td>Producing a cardiac arrhythmia.</td>
</tr>
<tr>
<td>Atheroma Formation</td>
<td>Formation of plaque in blood vessels.</td>
</tr>
<tr>
<td>Atherosclerosis</td>
<td>The build-up of plaque leading to cholesterol.</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>Cardiovascular Disease</td>
<td>A disease involving the blood vessels of the heart.</td>
</tr>
<tr>
<td>Coagulability</td>
<td>The thickening of blood.</td>
</tr>
<tr>
<td>CSA</td>
<td>Central Sleep Apnea</td>
</tr>
<tr>
<td>CMH20</td>
<td>Centimetre of water. The measurement used for air pressure in CPAP therapy.</td>
</tr>
<tr>
<td>Coronary Artery Disease</td>
<td>Arteries that supply the blood to heart muscle become narrowed and hardened due to build-up of plaque.</td>
</tr>
<tr>
<td>CPAP</td>
<td>Continuous Positive Airway Pressure</td>
</tr>
<tr>
<td>Deviated Septum</td>
<td>Nasal bone and cartilage is crooked or uneven.</td>
</tr>
<tr>
<td>Dyslipidaemia</td>
<td>Elevated number of lipids in the blood</td>
</tr>
<tr>
<td>Dyspnoea</td>
<td>Laboured breathing</td>
</tr>
<tr>
<td>EDS</td>
<td>Excessive Daytime Sleepiness</td>
</tr>
<tr>
<td>EEG</td>
<td>Electroencephalogram</td>
</tr>
<tr>
<td>EMG</td>
<td>Electromyography</td>
</tr>
<tr>
<td>Endothelial</td>
<td>Cells that line the interior surface of blood vessels.</td>
</tr>
<tr>
<td>Endothelial Dysfunction</td>
<td>Damage to the vascular layer of cells in blood vessels.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>EOG</td>
<td>Electrooculogram</td>
</tr>
<tr>
<td>Epistaxis</td>
<td>Acute haemorrhage from the nose.</td>
</tr>
<tr>
<td>ESS</td>
<td>Epworth Sleepiness Scale</td>
</tr>
<tr>
<td>Hemodynamic</td>
<td>Blood flow and homeostatic mechanisms.</td>
</tr>
<tr>
<td>Hypercapnia</td>
<td>Reduced levels of carbon dioxide in the blood.</td>
</tr>
<tr>
<td>Hypertension</td>
<td>Elevated Blood Pressure</td>
</tr>
<tr>
<td>Hypoxemia</td>
<td>Abnormally low level of oxygen in the blood.</td>
</tr>
<tr>
<td>Hypoxia</td>
<td>Body deprived of adequate oxygen supply.</td>
</tr>
<tr>
<td>Insulin Resistance</td>
<td>Cells do not respond properly to the hormone insulin.</td>
</tr>
<tr>
<td>Lipid Peroxidation</td>
<td>Oxidation degradation of lipids resulting in cell damage.</td>
</tr>
<tr>
<td>Metabolic Syndrome</td>
<td>A cluster of conditions that together increase your risk of heart disease.</td>
</tr>
<tr>
<td>Muscle Atonia</td>
<td>Muscle weakness.</td>
</tr>
<tr>
<td>Neurotransmitters</td>
<td>Enable the transmission of chemicals across a chemical synapse.</td>
</tr>
<tr>
<td>Neuropeptides</td>
<td>Protein like molecules used by neurons to communicate with one another.</td>
</tr>
<tr>
<td>ODI</td>
<td>Oxygen Desaturation Index</td>
</tr>
<tr>
<td>OSA</td>
<td>Obstructive Sleep Apnea</td>
</tr>
<tr>
<td>OSAHS</td>
<td>Obstructive Sleep Apnea-Hypopnea Syndrome</td>
</tr>
<tr>
<td>Oxygen Radicals</td>
<td>Unstable molecule that contains oxygen.</td>
</tr>
<tr>
<td>PSG</td>
<td>Polysomnography</td>
</tr>
<tr>
<td>Plethysmography belt</td>
<td>Measures pulmonary ventilation by measuring the movement of the abdomen and chest wall.</td>
</tr>
<tr>
<td>RDI</td>
<td>Respiratory Disturbance Index</td>
</tr>
<tr>
<td>Reperfusion Injury</td>
<td>The tissues damage caused when reperfusion after a period of ischemia or lack of oxygen due to hypoxia.</td>
</tr>
<tr>
<td>Respiratory Acidosis</td>
<td>A condition that occurs when the lungs are unable to remove carbon dioxide.</td>
</tr>
<tr>
<td>Rhinitis</td>
<td>Swelling and inflammation of the mucous membrane of the nose.</td>
</tr>
<tr>
<td>SA</td>
<td>Sleep Apnea</td>
</tr>
<tr>
<td>SAHS</td>
<td>Sleep Apnea-Hypopnea Syndrome</td>
</tr>
<tr>
<td>SaO2</td>
<td>Arterial Oxygen Saturation</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SDB</td>
<td>Sleep Disordered Breathing</td>
</tr>
<tr>
<td>STOP-BANG</td>
<td>Tool to screen for OSA.</td>
</tr>
<tr>
<td>Sympathetic Nervous System</td>
<td>Part of the autonomic nervous system which activate the fight or flight response.</td>
</tr>
<tr>
<td>Sympathetic Overactivity</td>
<td>Increased activity of the nervous system manifesting in heart rate, increased blood pressure, increased respiration, increased sweating and hyperthermia.</td>
</tr>
<tr>
<td>Thiazide Diuretics</td>
<td>A drug used to treat elevated blood pressure.</td>
</tr>
<tr>
<td>Theta Activity</td>
<td>Stage one of sleep is characterised by these brain waves which are slow in frequency.</td>
</tr>
<tr>
<td>Tonsillar hypertrophy</td>
<td>Enlarged tonsils.</td>
</tr>
<tr>
<td>Turbinate hypertrophy</td>
<td>The tissue in the outside wall of the nose is too large which results in nasal obstruction.</td>
</tr>
</tbody>
</table>
Appendix 4
List of authorised subcontractors
List of all subcontractors appointed at the time the contract is concluded, including full address and description of the services rendered:

<table>
<thead>
<tr>
<th>Company name of the subcontractor with registered office</th>
<th>Subcontractor task (description of scope &amp; services)</th>
<th>Location where data is processed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 5
Individuals authorised to issue and receive instructions

Please complete if not already regulated by the main contract or if something different to the main contract should apply to instructions from a data protection perspective:

<table>
<thead>
<tr>
<th>Linde's person(s) who is/are authorised to issue instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last name, first name</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplier's person(s) who is/are authorised to receive instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last name, first name</td>
</tr>
<tr>
<td>Last name, first name</td>
</tr>
</tbody>
</table>
Appendix 3: Written Consent Form

Consent Form

I....................................................................... agree to participate in Christine Brunnick's research study on "The impact of financial and nursing support on CPAP adherence in Cork"

I have read the information provided about this research study, and the researcher has explained it to me.

I have had the opportunity to ask questions and as such understand the purpose and nature of the research study.

I understand that I will not benefit directly from participating in this research. I agree with my interview being audio-recorded and having my CPAP data collected. I understand that all the information I provide for this study will be treated confidentially. I understand that my identity will remain anonymous in any report regarding the results of this research.

I consent voluntarily to be a participant in this research study and understand my rights to withdraw at any time and to deny the use of my information at any time throughout this research process.

I understand that the purpose of this research is to fulfill the requirements for the CIT MBus Thesis. I consent for the data being collected to be used in future academic publications.

Signed............................................................... Date................../.............../................
Appendix 4: Participant Information Document

1. Research Project Title

The impact of nursing support and the financial implications on CPAP adherence in Cork.

2. Invitation

You have been invited to participate in this research project. It is vital that you understand why the research is being conducted and what it will involve. Please read the information provided carefully. Take your time to consider whether or not you wish to part-take.

3. What is the project's purpose?

The purpose of this research piece is to investigate the impact of nursing support and financial implications on CPAP adherence. The research is composed of a desk research piece based on a definitive sample size. Your participation in the study builds upon this information and will allow for comparisons to be reached.

4. Why have I been chosen?

You have been chosen at random to participate in this research. You have been picked to part take due to the diagnoses of Obstructive Sleep Apnea (OSA), and you have been prescribed Continuous Positive Airway Pressure (CPAP) by your Respiratory Consultant.

5. Do I have to take part?

Your participation in this study is voluntary, and you may opt out of the study at any given time. You have the opportunity to deny the use of your information at any time throughout this research process. Your anonymity will be maintained throughout the research, and if the research piece is published in the future, your anonymity will be preserved.

6. What is required if I take part?

Participation requirements are based on which sample group you are assigned.

Sample Group 1 (Public Patients) - The duration will range from March-August 2019. Initial education session will be one hour in length. One phone call per week for the first three weeks. Phone calls will range from 10 minutes to 20 minutes to assist with any queries or
troubleshooting issues. Week four will consist of a face to face visit which may last one hour. This visit will include a semi-structured interview on CPAP therapy and data will be collected from the CPAP device. There will be debriefing visit at the end of research collection. Post research collection the standard service for CPAP patients will continue from BOC Homecare.

Sample Group 2 (Private Patient) - The duration will range from March-August 2019. Initial face to face education session will be one hour in length. On week two there will be a phone call lasting 10 to 20 minutes to assist with any queries or troubleshooting issues. Week six will consist of a face to face visit which may last one hour. This visit will include a semi-structured interview on CPAP therapy and data will be collected from the CPAP device. There will be a debriefing visit at the end of the research collection. Post research collection, the standard service for CPAP patients will continue from BOC Homecare.

7. What are the possible benefits of taking part?

The benefits of the research will be to inform future practice in CPAP therapy and to contribute to the advancement of clinical practice. As a participant, it allows you (the patient) to take an active role and accountability in your CPAP treatment. This research may aid in improving your wellbeing and quality of life. It allows you to receive a high standard of healthcare and CPAP nursing support throughout the study.

8. Will my taking part in this project be kept confidential?

Anonymity will be maintained throughout the research and if the research piece is published. The collection, processing, storage and disposal of all data collected will be in line with European GDPR Legislation. Data will also comply with internal GDPR policies in BOC Homecare requiring a username and password to log on to the internal network. Access to the network will be by using a two-factor authentication method using RSA Secure ID. A Firewall system is also in place to prevent unauthorised access to the network. Data will be destroyed as indicated by relevant internal BOC Homecare Policy and current EU legislation. All transcripts and recordings will be destroyed on completion of the research. See attached GDPR documents.

9. What type of information will be collected for the research objectives?
The interview will ask questions based on your experience with CPAP. Your views and experience are a vital component of the research. Quantitative data will also be collected from your CPAP device to measure adherence to therapy.

10. What will happen to the results of the research project?

The results of this study will be submitted as part of a thesis in fulfilment of an MBus in CIT. All information is confidential, and you will not be identifiable in any future academic publications. You are entitled to receive a copy of the reports resulting from this research.

11. Who is organising the research?

Christine Brunnick (BOC Homecare Patient Support Nurse) in fulfilment of a Masters in CIT. Dr. Angela Wright will supervise the research.

12. Who has ethically reviewed the project?

The REC Committee chaired by Prof Kelly, CIT, and the registrar’s office has approved this research. The research has also been approved by Quentin Sayer the Clinical Governance Chair for BOC Homecare.

13. Contacts for further information

Christine Brunnick (BOC Patient Support Nurse)

Thank you for taking part in this research.
Appendix 5: Debriefing Form

Debriefing Form Template

Thank you for your participation in my research study. Your participation in this study is appreciated.

Purpose of the Study:
I previously informed you that the purpose and goal of the study was “to investigate the impact of nursing support and the financial implications on CPAP adherence in Cork”. From the research, I have found that subjective symptom improvement in comparison to nursing support is the primary determinant for improving CPAP adherence. The study also revealed that financial factors did influence adherence. The research reported that patients who self-funded their CPAP device demonstrated a higher adherence rate. Overall, both public and private patients reported that the primary motivation for CPAP adherence was the improvement in subjective symptoms.

As a Patient Support Nurse, I will continue to follow up and support all patients who remain on CPAP therapy as per BOC Homecare policy.

Confidentiality:
You may decide that you do not want your data used in this research. If you would like your data removed from the study and permanently deleted please contact me directly via the contact information provided at the bottom of this form. All of your data will be stored in line with current GDPR legislation.

Final Report:
If you would like to receive a copy of the final report of this study, or a summary of the findings when it is completed, please feel free to contact me directly.

Useful Contact Information:
If you have any further queries or concerns regarding this study please feel free to contact Christine Brunnick on [Redacted] or email me at [Redacted]

Please retain a copy of this form for your future reference. Once again, thank you for your participation in this study.
Appendix 6: Interview Guide

Interview Guide:

**Introduction & Confidentiality Statement**
Welcome and thank you for your time.

As you are aware the purpose of the interview is to gather your opinions on your CPAP therapy. The data gathered here today will be used in the fulfilment of my Masters in Business. The interview will be recorded and will be transcribed in order to interpret themes which may arise. You may stop the interview at any time. Your anonymity will be maintained and the responses to the interview questions will be maintain anonymous.

Do you agree to participate in the interview?

**General Overview of CPAP Therapy**
1. How did you get on with your CPAP since I gave it to you?
2. How many hours do you think you are sleeping with the CPAP device?
3. How did you find the CPAP air pressure overall?
4. How did you find the overall fitting of the mask?

**Symptom Management in CPAP Therapy**
1. Do you notice any changes in your symptoms since you started on your CPAP therapy? *For example;* Waking more or less at night, reduction or elimination of snoring, changes in you energy level, or improvement in daytime tiredness/fatigue, changes in mood or concentration.
2. How does this make you feel about CPAP therapy?

**Challenges Associated with CPAP Therapy**
1. Are there any challenges you experienced that you could outline? *For example;* dry mouth or nose, pressure leaking, skin irritation, bloating in the stomach.
2. How did you address these challenges?
3. How did these challenges make you feel about your CPAP therapy?

**Nursing Support**
1. In your view what type of nursing support did you find most and least beneficial? *For example;* Follow up phone calls, face to face follow up.
An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence

2. Are there any suggestions that you could give to the level of nursing support provided to you by your CPAP provider during your therapy to influence your usage?

Financial Implications of CPAP Therapy

1. **Private Patients** – In your view did the financial costs associated with therapy influence your usage to CPAP therapy?

2. Do you believe that if the cost of the device was funded, would you still use it as frequently?
   - In your view is there a link between the cost of the device and your usage?

1. **Public Patients** – Do you believe that the funding of the device by the medical card increases your use of it or decreases you use?
   - In your view would the removal of medical card funding influence your usage of CPAP therapy?

   *For example private rental of CPAP device.*

Closing Questions

1. Are there any positives or negatives that you would like to list in relation to your CPAP therapy?

2. Based on your experiences can you make any recommendations for the future usage of the device?

Is there anything that I have left out that you would like to mention?

Thank you very much for your time and for participating in this interview today.
Appendix 7: Gibbs Cycle

Gibbs Cycle

1. Description
The researcher applied for a Master in Business post-graduate programme. The researcher had to complete a thesis in fulfilment of this programme. The researcher works in a private clinical setting providing respiratory medical devices and O2 therapy. The researcher decided to conduct a thesis investigating the impact of nursing support and the financial implications on CPAP adherence in Cork, Ireland. A mixed-method triangulation approach was utilised. The researcher has been in the current job for 4 years. The researcher has vast experience in dealing with patients from two separate tiers within the health system in Ireland. Private patients must self-fund their CPAP device, whereas public patients have their device funded by the state. The researcher has witnessed various behaviours relating to CPAP adherence rates in Cork, Ireland. Some patients will use the device despite how it is funded, and some will not use the device despite the device being funded by the state. The researcher wishes to investigate if financial implications influence adherence rates. With contractual tenders being introduced, policymakers require a certain amount of support to be provided to patients. The researcher wished to investigate if nursing support has an influence if any on CPAP adherence rates.

2. Feelings
The researcher felt overwhelmed by the amount of work required to complete the thesis. The researcher felt unprepared for the amount of work and time that was required to complete the thesis. The range of emotions and feelings changed throughout the entire research process. At times during the research, the researcher felt stressed from the workload, but at other times felt motivated and the momentum continued throughout the thesis. The researcher worried that they would not be able to finish the thesis on time. Another stressor for the researcher was if the thesis would be considered a "good thesis" with an excellent mark to represent the work that was put into the thesis. The researcher was concerned about the level of English required for such an academic piece of writing.

During the first interview, the researcher was nervous regarding the process as it is an area in which the researcher lacked experience. After the first 2-3 interviews, the researcher gained more confidence and relaxed into the process. Fortnightly meetings with Dr. Wright provided
more confidence in the researcher’s ability to achieve the result. During the summer months, these meetings were missed, and the researcher lacked reassurance during these times.

3. Evaluation
The researcher enjoyed the learning process behind the thesis process. The choice of methodology allowed the researcher to gain an insight into a mixed-method triangulation approach. The researcher gained valuable information regarding the adherence rates in Cork, Ireland. The choice of research method allowed a valid and reliable study with specific patterns of adherence to be identified. Opinions and attitudes of patients provided the researcher with a unique perspective of what encourages patients to adhere to therapy. The findings of the research and the recommendations provided the researcher with a feeling of accomplishment as there are no other similar studies previously conducted in Ireland.

The researcher struggled with low energy, tiredness, and motivation at different times throughout the research process. Working full-time and trying to fulfil the requirements of the thesis was very demanding. The downside was that it was impossible to conduct more research into the field of study due to the time constraints of working full-time. Time was limited, and the field of study is extensive. Patient timeline and required number of weeks to be on CPAP therapy added to the time constraint.

4. Analysis
Overall, the thesis went well because of the support from Dr. Wright. The education sessions provided clarity and direction for the thesis. The time constraints are the most debilitating part of the thesis. It was a stressful period of the researcher’s life trying to balance working full-time with the thesis. The researcher believes that more time is required to conduct the research. The researcher chose an area which required a significant timeline. Patients required 6 weeks minimum of CPAP therapy before the primary data could be collected. This 6 week timeline limited the time frame significantly for the researcher.

5. Conclusion
The researcher learned that a thesis is time-consuming but satisfying when complete. The researcher now understands the entire research process required to conduct a thesis. The approach used allowed the researcher to experience first-hand, multiple strands of data collection and analysis. The findings from the research have provided unique findings and recommendations. The research can be used in future practice.
6. Action Plan

Improved coordination and time management skills throughout the research process would benefit the research in the future relating to the time limitations. The researcher would start collecting the primary data earlier in the process. The researcher would anticipate the length of time required to gain Ethical approval for the study. The researcher would have applied for ethical approval earlier in the process.
## Appendix 11: Detailed Findings of Desk Research Analysis

### Public Patient Group

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### An Investigation of the Impact of Nursing Support and the Financial Implications Associated with CPAP Adherence

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**Private Patient Group**

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