Section 1

Overview of Sleep Medicine
Impact of sleep disorders on society

CONCEPTUAL OVERVIEW

Approximately 50–70 million people in the United States are chronic sufferers from sleep disorders, who have impaired health and daily functioning issues as a result of those disorders. The societal economic impact of sleep disorders is estimated at $16 billion annually for health care expenses and $50 billion annually regarding lost productivity. Sleep disorders are considered to be one of the most common health problems, and yet it has been demonstrated that between 82 and 98% of adults with sleep-related breathing disorders (SRBD) are undiagnosed.

Sleep disorders can no longer be thought of in simple terms as having a poor night’s sleep. There are currently a large number of different sleep disorders that may affect one’s quality of life. In addition, there is a difference between the sleep state and the wake state. Sleep is not simply an altered state of consciousness, that is merely a difference of being asleep or being awake.

Sleep is a totally separate behavioral and physiological state that is unique and well documented, and it is defined as “a reversible behavioral state of perpetual disengagement from and unresponsiveness to the environment.” As such, sleep is composed of a combination of rapid eye movement (REM) and nonrapid eye movement (NREM) associated with well-defined and variable brain activity. Sleep disruption and the specifically recognized sleep disorders not only may have a major impact on an individual’s well-being, health status, and quality of life, but may also render significant consequences on the various areas of public health, such as...
accidents, mortality, morbidity, work and other daily performance, cognitive function, and utilization of health care.

**EPIDEMIOLOGY OF SLEEP DISORDERS**

Epidemiology is the study of the geographic distribution and the risk factors of a particular disease, and, in particular, how that disease impacts the health status of different and varying populations. Relative to sleep disorders, the origin and onset of a specific sleep disorder are often multifactorial. As such, it is essential for there to be an epidemiological awareness of both normal and abnormal sleep and wake patterns. The ultimate goal of this greater appreciation of sleep disorder epidemiology is the improvement in people’s health as well as a foundation for preventative medicine and public health.

The eventual outcome of these early epidemiologic studies of normal and abnormal sleep patterns resulted in the publication of the *International Classification of Sleep Disorders* that has since been revised into its current second edition (ICSD-2). The ICSD-2 is the evidence-based standard for the classification, terminology, and diagnostic criteria of sleep disorders. Currently, the most common sleep disorders on the basis of epidemiologic studies are the following:

1. Insomnia
2. Sleep-related breathing disorders (SRBD)
3. Restless legs syndrome (RLS)

The general onset of sleep disorders as well as their progression is, to some degree, dependent on age, the presentation of being at risk for health-related consequences, and trauma. In many instances, these disorders may appear as a health issue and perhaps even some type of emotional or psychological condition. Also, the presentation of the particular health issue is sometimes not first recognized or diagnosed as maybe having an association with a sleep disorder. As an example, SRBD patients may seek treatment and utilize more health care resources for cardiovascular disease (e.g., hypertension) prior to the recognition of the SRBD as being the possible underlying cause (Figure 1.1).

In addition to the overall statistics of the portion of a population that suffers from the general label of sleep disorders, the prevalence of these disorders are often referenced to the epidemiologic studies pertaining to each of the classifications recognized in the ICSD-2. Thus, the actual distribution of a specific sleep disorder is variable and dependent on the study that is being referenced.

Relative to the three most common sleep disorders, a 1993 study is the most frequently cited reference relative to SRBD. In this study of 602 people, it was determined that 24% of men and 9% of women are at risk for SRBD, and it also demonstrated that 4% of men and 2% of women met the
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Selection Factors

Figure 1.1 Clinical recognition and diagnosis of sleep apnea. The proportion of all cases of sleep apnea is represented by the iceberg, with clinically diagnosed cases shown in the tip of the iceberg. Clinically recognized sleep apnea represents 85% of the total prevalence of sleep apnea cases that would be candidates for treatment. CVD, cerebrovascular disease; SES, socioeconomic status. '?' and '?' indicate that these particular “selection factors” are not as well known as “comorbidity” relative to the recognition and diagnosis of sleep apnea. (Young T. Rationale, design, and findings from the Wisconsin Sleep Cohort Study. Sleep Med Clin, 2009; 4(1):39. Reprinted with permission.)

criteria for SRBD, who also have daytime hypersomnolence or excessive daytime sleepiness. The correlate to this is a study that indicated 93% of females and 82% of males with moderate-to-severe SRBD are undiagnosed, and 98% of females and 90% of males who have less severe sleep apnea are undiagnosed. A more recent study demonstrated that a minimum of 12–18 million people in the United States are affected by untreated SRBD.

For insomnia, the prevalence may vary on the basis of the study, but, in general, it appears to be approximately 33% of the population. The percentage will vary on the basis of the defined criteria that may exist as a result of the specific study parameters.

The epidemiology of RLS is estimated to be between 2.5 and 10% of the general population. Many of the studies have limitations because of misdiagnoses as well as patients who may not seek medical care. With improved criteria for making a diagnosis, the recognition of RLS may actually result in an increased prevalence.

Narcolepsy is another sleep disorder that has been studied epidemiologically. At the present time, its prevalence is between 25 and 50 per 100,000 population, which is a prevalence similar to multiple sclerosis.
RISK FACTORS

There are a multitude of risk factors that may impact the onset as well as the progression of a specific sleep disorder. The risk factors may be different for each disorder, and there may also be overlapping risk factors that apply to a number of different sleep disorders. In general, the demands of modern-day life have impacted the quality of one’s sleep as well as the required amounts that are deemed appropriate. In addition, the disruption of an individual’s sleep can impact other family members, roommates, or one’s bed partner. As an example, the results of a study pertaining to SRBD demonstrated that the snoring of one person significantly impacted the sleep of the bed partner to the point that the affected person had symptoms that were worse than those of the snorer. The risk factors frequently associated with the three most common sleep disorders are listed in Table 1.1.

HEALTH CONSEQUENCES AND COSTS

The impact of sleep disorders on one’s health can be evident in a wide range of adverse health consequences, including but not limited to hypertension, cardiovascular diseases, metabolic disorders such as diabetes, gastric disorders such as gastroesophageal reflux disease, respiratory disorders such as asthma, emotional and psychological disorders, and increased mortality rates. The heightened awareness that assorted health issues potentially may arise as a result of sleep disorders is improving. Similarly, an illness or health problem may conversely impact one’s sleep.

The increased risks for cardiovascular disease and elevated blood pressure associated with SRBD are well-documented. The largest and frequently cited investigation, the Sleep Heart Health Study, took place between 1995 and 1998 as a cohort study with more than 6,000 people enrolled as participants. This study found that obstructive sleep apnea (OSA) along with other SRBD are risk factors for cardiovascular disease, which is inclusive of myocardial infarction and stroke. A variety of proposed mechanisms indicate that OSA and cardiovascular disease are related, and elevated blood pressure is the more common one.

Insomnia, which is the inability to fall asleep or to maintain sleep, is often associated with emotional, psychological, or depressive disorders. In addition, it can be associated with painful conditions as well as other health issues. As a sleep disorder, insomnia is the most common and may occur in conjunction with other sleep disorders such as OSA and RLS. Everyone may have insomnia at some point in their life.

Alteration in metabolic and endocrine functions is also associated with SRBD, the most prevalent of which is type 2 diabetes. It has been found
that snoring alone increases the risk for type 2 diabetes independent of any other risk factors.  

Health issues that impact sleep are also recognized. Classically, among these are painful conditions, increased stress, and depression. These most often lead to insomnia and a decrease in sleep time and sleep quality, and, in many instances, an associated increased time in bed.

Although sleep disorders may potentially increase the risk for a multitude of health problems, it is not an absolute that a given sleep disorder will lead to any one specific health problem. The important issue is to recognize that these health problems may have an underlying sleep disorder as a contributing factor in the development or progression of a health issue. The more common health conditions associated with sleep disorders are listed in Table 1.2.
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**Table 1.2** Common health issues possibly associated with a sleep disorder.

<table>
<thead>
<tr>
<th>Painful conditions</th>
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<tr>
<td>Headaches</td>
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<tr>
<td>Arthritis</td>
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<tr>
<td>Fibromyalgia</td>
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<tr>
<td>Anxiety or depression</td>
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<td>Stress</td>
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<td>Hyperthyroidism</td>
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<td>Pregnancy</td>
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<td>Gastroesophageal reflux disease</td>
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<tr>
<td>Medications</td>
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<tr>
<td>Cardiovascular disease</td>
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<tr>
<td>Hypertension</td>
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</table>

There are also associations of sleep disorders with impairments in performance relative to attention and reaction time, which could have significant impact in occupational settings. One study demonstrated that about 20% of serious injuries from motor vehicle accidents are related to driver sleepiness and not alcohol-related. Other studies have indicated the equivalence of driving when sleepy as when driving under the influence of alcohol.

A report by the National Sleep Foundation (NSF) indicated that (1) 60% of adult drivers stated that they have driven a vehicle during the past 12 months while feeling drowsy and (2) 37% self-reported that they fell asleep while driving at least 1–2 days/month. The NSF report included an estimate by the National Highway Traffic Safety Administration that vehicular crashes related to driver fatigue result in a minimum estimation of $12.5 billion of monetary losses to the economy. Fiscal impact on society could be higher since there is no physical test to attribute these crashes to sleepiness.

Studies have also demonstrated the association of sleep-related fatigue and work-related injuries and fatalities. Workers who were identified as highly fatigued had a 70% greater chance of being involved in occupation-related accidents than were workers identified with low fatigue. Another study demonstrated that workers with insomnia had a greater chance for injuries related to their occupations than workers who were identified as having good sleep. Also, workers with disturbed sleep had twice as much chance of dying in a work-related accident than those who did not have sleep disturbance.

Because of the increased risk for the development of health problems with sleep disorders, there may be an associated increase in health care costs as well. The presence of a sleep disorder may drive up the cost of health care in general, and it has been estimated that untreated sleep apnea may add $16 billion in medical costs annually in the United States.
However, at the present time, it is unclear what the actual savings in medical costs are with the management of OSA. In a study of 31 patients diagnosed with cardiovascular disease and OSA, there was a reduction in the need for hospitalization related to the cardiovascular illness when the apnea was adequately managed. An association between the severity of the sleep disorder and increased health care expenditures is possible.

The costs of health care are increased by the lack of attention to the specific sleep disorder. A 1998 study demonstrated that 10 years prior to the actual diagnosis of OSA, the patients who were eventually diagnosed with OSA had incurred nearly double the costs for health care and had additional hospitalizations when compared to the matched controls. As such, in many instances the sleep disorder actually precedes the onset of the specific health issue or consequence. If the sleep disorder is not discovered, then the attention to the related health issue takes precedent. This may then lead to an increase in expenditures for various testing, imaging, physician visits, hospitalization, and medication or prescription usage.

Along with the health issues that may arise, there is also an impact on one’s quality of life. Studies that assessed parameters regarding quality of life demonstrated that patients with a sleep disorder feel that their quality of life is poorer than those without OSA. When the OSA is improved with treatment, both the patient and the bed partner experience an improvement in their quality of life.

THE ROLE OF THE DENTIST

As it relates to the recognition of health issues, the role of the dentist as well as the auxiliary staff is becoming more apparent. No longer is the dentist solely relegated to only the management of dental structures and dental-related conditions. An example is the association between periodontal disease and cardiovascular disease.

Many decades ago, the dentist’s role in the overall health care of the patient was initiated by performing blood pressure screenings. Patients often saw their dentist more frequently than they saw a physician, which led to the discovery of many patients who were at risk for hypertension and yet were unaware of its existence. A commentary in the *Journal of the American Dental Association* (JADA) called for an increase in the education of the dentist in biological and medical sciences. This commentary directly referenced medical topics possibly related to the dentist that appeared in JADA from 2004 to 2006, including diabetes, heart disease, cardiovascular diseases, and OSA. Another commentary noted the potential for the dentist to inform patients about possible risk factors for cardiovascular disease. When considering the association between SRBD and cardiovascular disease, the dentist as well as the auxiliary staff are well-poised to assist patients with their overall health.
Table 1.3  The role of the dentist.

<table>
<thead>
<tr>
<th>Action</th>
<th>Indirect approach</th>
<th>Direct approach</th>
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<tr>
<td>Advise patient of potential sleep disorder</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Obtain blood pressure and review medical history</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Refer for further evaluation: to primary care physician or sleep specialist</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Refer for sleep study</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Based on diagnosis, actively involved with treatment</td>
<td>No</td>
<td>Yes</td>
</tr>
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The role of the dentist can potentially take on one of two roles (Table 1.3). The first, referred to as the *indirect approach*, is simply the recognition of the potential existence of a sleep disorder that may be impacting the patient’s health status, and the patient is subsequently advised of the situation and referred for definitive evaluation and care. The second, referred to as the *direct approach*, is when a sleep disorder is recognized and, if appropriate, the patient is referred for more comprehensive evaluation and care. This testing often involves the primary care physician and/or sleep specialist, and the care, when deemed applicable, may also include the dentist. The dental treatment typically involves the use of an oral appliance for the management of OSA. The dentist may also be involved for treatment of a painful orofacial condition that is impacting the patient’s sleep.

Regardless of the role that the dentist assumes, the initial action needs to start with the recognition of the patient who may be at risk for a health problem or who may have a health problem that may have a sleep disorder as an underlying or contributing factor.

**CONCLUSION**

The dentist now has an ever-increasing role in the recognition of a patient who may be at risk for a sleep disorder. Epidemiologic data support the increasing awareness of the relationship of sleep disorders and other health issues. Clinical treatment and decision making now emphasize sound evidence based on documentation that relies on well-researched epidemiologic studies to assist in determining the coexistence of a sleep disorder, which in turn is impacting the health of a patient.

**REFERENCES**

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