



In an Age of Constant Activity, the Solution to Improving the Nation's Health May Lie in Helping it Sleep Better

What Benefits Do Patients Experience in Treating their Obstructive Sleep Apnea?

Executive Summary	3
Frost & Sullivan's Interest in OSA	3
How is OSA Diagnosed?	4
What is the Prevalence of OSA?	4
Barriers to Diagnosing & Treating OSA	5
The Economic Burden of Undiagnosed & Untreated OSA.....	6
Impact of Treating OSA – Quality of Sleep	6
Impact of Treating OSA – Quality of Life (QOL).....	8
Impact of Treating OSA – Comorbidities.....	8
Impact of Treating OSA – Mental Health & Substance Abuse.....	11
Impact of Treating OSA – Occupational Productivity.....	12
Impact of Treating OSA – Accidents & Distractions	13
Conclusion.....	13
What Can You Do?	14

EXECUTIVE SUMMARY

Imagine a condition that affects millions of Americans, robbing them of their health, happiness and financial well-being. It would be prevalent in 12% of the adult population, and 80% of the time remain undiagnosed. A condition such as this would have patient advocacy and support groups, national awareness days, and large-scale government initiatives. Obstructive sleep apnea (OSA), a serious and life-threatening sleep illness that is largely undiagnosed and untreated, fits this particular profile.

Impacting almost 30 million Americans, OSA is defined by the American Academy of Sleep Medicine (AASM) as a sleep-related breathing disorder that involves a decrease or cessation in airflow during sleep despite an ongoing effort to breathe.² Approximately 5.9 million U.S. adults are diagnosed with OSA, but another 23.5 million remain undiagnosed¹¹. Direct economic costs include costs associated with comorbidities such as high blood pressure, diabetes, heart disease, stroke, motor vehicle or workplace accidents, and compensating behaviors such as the abuse of sleeping pills, tobacco, and alcohol. Indirect economic costs include decreased productivity at work, reduced quality of life, and stress on interpersonal relationships. In a companion paper, Frost & Sullivan estimated the total annual economic impact on the United States of undiagnosed OSA to be approximately \$149.6 billion at a cost of \$6,366 per individual. In comparison, average annual costs for the diagnosis and treatment of OSA were less than half that at only \$2,105 per person.

Figure 1 - Definition of Obstructive Sleep Apnea by Severity of Apnea-Hypopnea Index (AHI)

Apnea-Hypopnea Index (AHI) ²	
Mild	AHI of 5-15
Moderate	AHI of 15.1-30
Severe	AHI >30

FROST & SULLIVAN'S INTEREST IN OSA

Frost & Sullivan has been tracking the sleep medicine industry for the past decade, monitoring and contributing to the growing research of OSA. In such an established industry, we have focused our interest on the intersection of economics and new clinical research. The AASM commissioned Frost & Sullivan to further investigate the experience of OSA patients before and after treatment for the condition. While much has been reported on the clinical etiology, pathophysiology and consequences of the condition in the scientific literature, little research exists about how patients themselves view the transformative impact of OSA treatment. For the purpose of this paper, Frost & Sullivan created an online survey for over 506 U.S. adults that are currently being treated for OSA. In addition, our research team reviewed more than 100 leading studies on the impact of the condition on everything from heart attack risk to employee absenteeism.



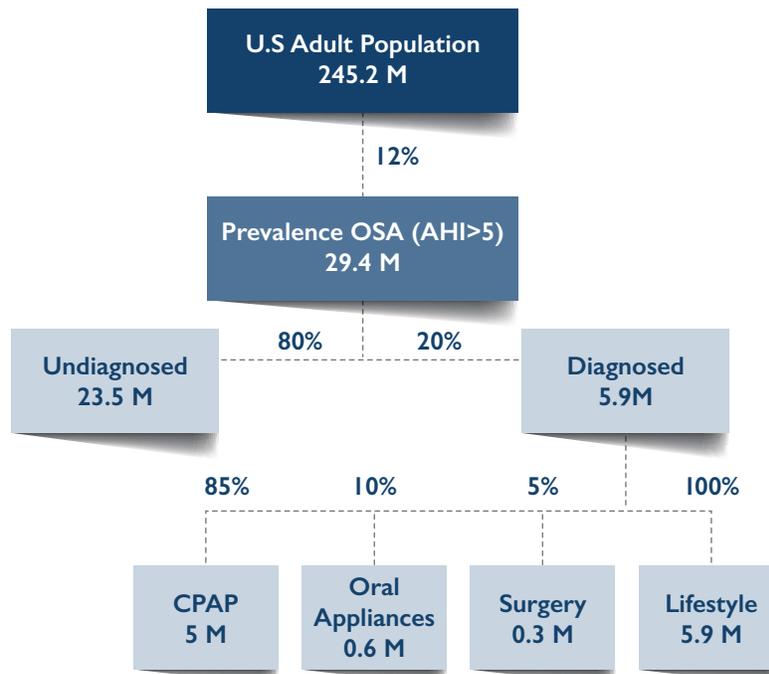
HOW IS OSA DIAGNOSED?

OSA is most commonly diagnosed with a polysomnogram, which can be performed in a sleep center laboratory or with home sleep apnea testing. Risk factors associated with OSA include obesity, wide neck circumference, aging, familial history, and facial or upper airway abnormalities. Treatment options include continuous positive airway pressure (CPAP), oral appliances, surgery, and lifestyle changes. OSA severity is measured by three categories in the apnea-hypopnea index (AHI), which averages the number of times an individual partially or completely stops breathing per hour of sleep² (Figure 1).

WHAT IS THE PREVALENCE OF OSA?

The prevalence of OSA is estimated to be 12% of the U.S. adult population totaling 29.4 million people, of which nearly 80% are currently undiagnosed (Figure 2).¹¹ OSA incidence and prevalence is closely related to rising obesity rates and an aging population, with men at higher risk. According to our 506-person survey, 3% of respondents were 18-29 years old, 15% were 30-49 years old, 56% were 50-69 years old, and 26% were 70-89 years old. The high number of respondents aged 50-69 years old corresponds to the data, which shows the average age of diagnosis and treatment is 53 years old.

Figure 2 - Prevalence and Treatment of Obstructive Sleep Apnea (OSA) in the U.S. Adult Population (2016)



Obstructive sleep apnea is more prevalent in individuals who are older, male, a minority race, menopausal, have a high body mass index, large neck circumference, craniofacial abnormalities, and those with health behaviors such as smoking and alcohol use.¹² Frost & Sullivan's survey respondents were skewed slightly toward the Caucasian ethnicity, but this aligns with current research that suggests racial disparities in terms of access to care and treatment for OSA. This provides supporting evidence about who in the country is actually receiving treatment for OSA versus what researchers know about the epidemiology of the condition within the broader population.

BARRIERS TO DIAGNOSING & TREATING OSA

Barriers to diagnosing and treating OSA include general public and physician awareness of the symptoms and severity of the condition. Patients may not be aware of their snoring or consider fatigue a condition worth mentioning. Of the 12% of respondents who raised the issue of OSA to the physician, 70% said it was because they were disturbing their bed partner. Lack of primary care physician (PCP) education on the urgency of diagnosis and treatment may be another reason patients are not asked about the quality or duration of their sleep. Primary care physicians are the first line of defense for OSA diagnosis as 55.5% of all physician office visits are at the PCP.⁷ With only 30% of respondents attributing PCPs to warning them to their risk of sleep apnea, it is easier to understand how 23.5 million Americans remain undiagnosed. Dr. Timothy Morgenthaler, patient safety officer at the Mayo Clinic, explains, “Many patients are dismissive of symptoms of sleepiness; it is accepted as the norm. Patients and providers need to acknowledge that OSA is a serious chronic disease just like hypertension and heart disease, and it needs to be managed.”



As patients undergo follow-up appointments as well as customized titration and calibration as necessary, their PAP experience almost always improves. Nearly 40% of respondents scheduled an appointment after one month of being warned about the risks of sleep apnea, while another 40% waited two to four months before receiving a sleep test and official diagnosis. Treatment options, in order of most commonly prescribed to survey respondents, include CPAP, changing sleeping position, non-surgical weight loss, oral appliances, and surgery for weight loss. The majority of individuals are prescribed CPAP treatment, and while clinically successful, patient compliance rates average around 60%. According to Frost & Sullivan estimates, 85% of CPAP patients consistently wear the device an average of 6.3 hours each night and have had continued treatment for approximately 7.4 years.

Innovative patient follow-up models and engagement programs, such as telemedicine, that increase communication have the potential to increase current compliance rates. If these programs could target the millions of OSA patients who are currently undiagnosed and untreated, the result could save the United States billions of dollars each year.

THE ECONOMIC BURDEN OF UNDIAGNOSED & UNTREATED OSA

The economic burden of undiagnosed and untreated OSA costs the U.S. billions of dollars each year. Treating OSA requires an upfront investment and costs can vary depending on whether an individual receives home sleep apnea testing or in-center polysomnography, but Frost & Sullivan's research shows that aggressively diagnosing and treating the condition can save patients, employers and the healthcare system significant amounts of money.

The patient survey found the largest opportunities for cost savings lie in improving health outcomes for the most common OSA patient comorbidities. A large portion of patients report OSA treatment helps improve those conditions, reduce healthcare utilization and medication, and improve quality of life. Survey respondents also reported a decreased use of alcohol, cigarettes, and sleeping pills following OSA treatment. Frost & Sullivan's research indicated that patients reported 1.8 fewer workplace absences and 1.2 hours of increased productivity per day after treating their OSA. By showing up for work physically and mentally, patients are earning more and employers are generating more productivity per employee.

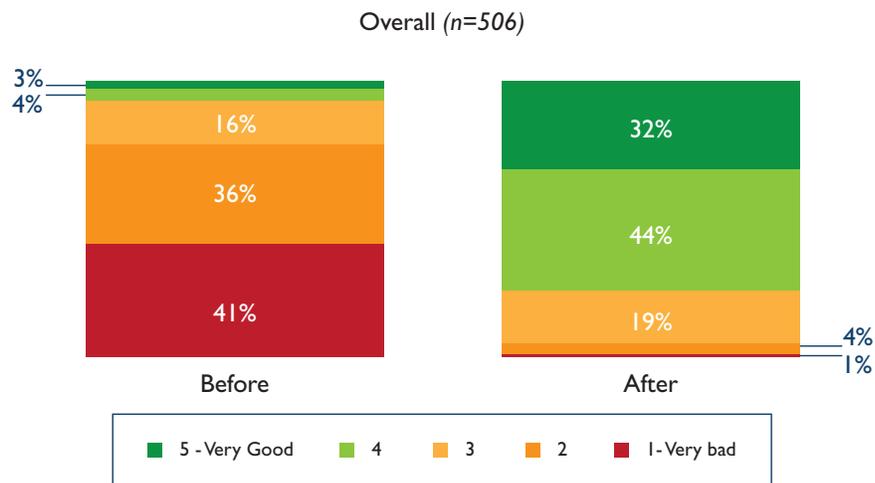
While many respondents reported very positive improvements following treatment, on average they were willing to spend only \$51 per month out-of-pocket on sleep apnea treatment. More than three-quarters of respondents agreed that OSA treatment was worth the costs; however, a third of respondents were unwilling to spend anything out of pocket for treatment. This action reflects a broader problem in the U.S. third-party payment model, where patients are disconnected from the true cost-benefit dynamics of their care.



IMPACT OF TREATING OSA – QUALITY OF SLEEP

Understanding the impact OSA has on quality of sleep can be difficult as many individuals have been living with daytime drowsiness and fatigue for such an extended period of time it has become their new baseline. Kevin Potts, vice president of Union Pacific Railroad Employees Health System (UPREHS), which has implemented an aggressive OSA management program with its employees, said, “It can be difficult to explain to people that treatment will make them feel better if they do not have the context to remember or recognize good quality sleep.” Overall quality of sleep was perceived to be “good” or “very good” for an estimated 7% of respondents before treatment, but this number significantly shot up to 76% once treatment began (Figure 3). While new and mid-term user groups both saw substantial improvements, the most positive impact was seen in long-term users who have been treating the condition for over 10 years.

Figure 3- Patients Treating their OSA Reporting Significantly Better Sleep Quality Afterward



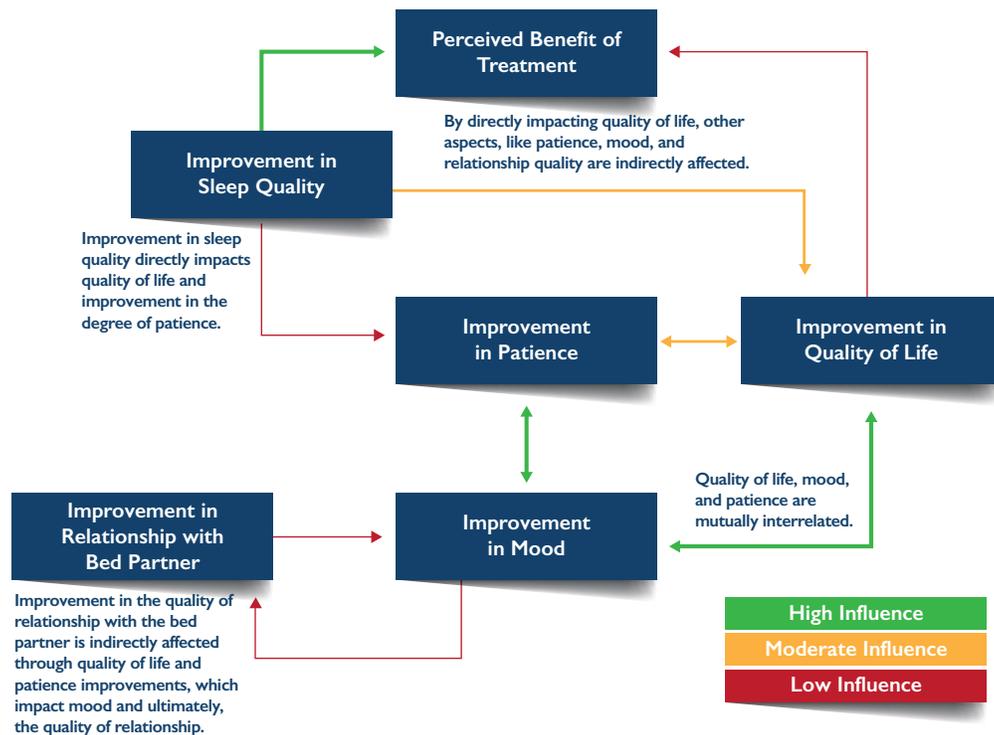
Perceived quality of sleep was further segmented across respondents with and without various comorbidities. Respondents with no existing comorbidities were the most satisfied group with a 75% increase in sleep quality after beginning treatment.



IMPACT OF TREATING OSA – QUALITY OF LIFE (QOL)

According to the patient survey, improvements in sleep quality significantly impacts multiple aspects of QOL, which includes patience, mood, and relationship quality in a positive manner. The percentage of respondents stating their QOL was “good” or “very good” nearly tripled from 26% to 76% after beginning OSA treatment. Correspondingly, satisfaction with the respondent’s interpersonal relationships, mood and patience doubled. Improvement in sleep quality significantly impacts a patient’s QOL and, indirectly, specific aspects of QOL such as patience, sleep quality, bed partner relationships, and mood (Figure 4). Heather Miller, program manager for the Clinical Best Practices team at health insurance company Humana, discussed the importance of consumer health: “We look at our members holistically; we are trying to improve quality of life and general well-being, and sleep is a large component of that. It is important to create awareness around commonly undiagnosed conditions like OSA.”

Figure 4-Study Found Strong Statistical Connections Between OSA Treatment and Sleep Quality, Quality of Life, and Improvement in Patience and Mood



IMPACT OF TREATING OSA – COMORBIDITIES

In order of decreasing prevalence, the most common conditions reported in the patient survey were high blood pressure, mental health problems, insomnia, asthma or breathing problems, diabetes, and heart disease. Out of 506 respondents, only 70 individuals did not have any of the comorbidities described above.

Approximately one in three adults in the U.S. have hypertension, with an estimated \$46 billion spent each year on related medical services, pharmaceuticals and absenteeism.^{9,10} It is not surprising that among all comorbidities measured in the patient survey, hypertension is the most prevalent condition, affecting 60% of respondents. After

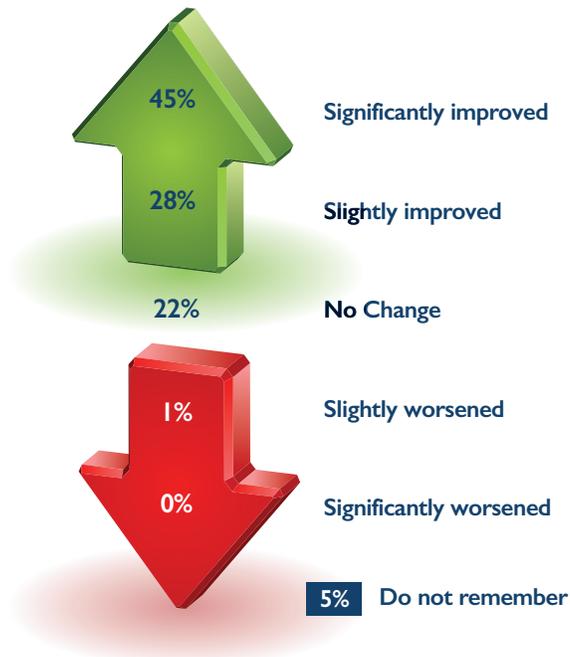
one year of treatment, 41% of patients surveyed reported an improvement in their blood pressure readings, understood as a decrease of their BP scores from where they were prior to treatment to a level now closer to the targets set by their physician. In addition, 17% reported a decrease in medication and another 3% were able to completely stop taking hypertension medication all together, saving hundreds of dollars in co-pays (Figure 5).

Figure 5-Patients with Hypertension Report OSA Treatment Significantly Improves Blood Pressure



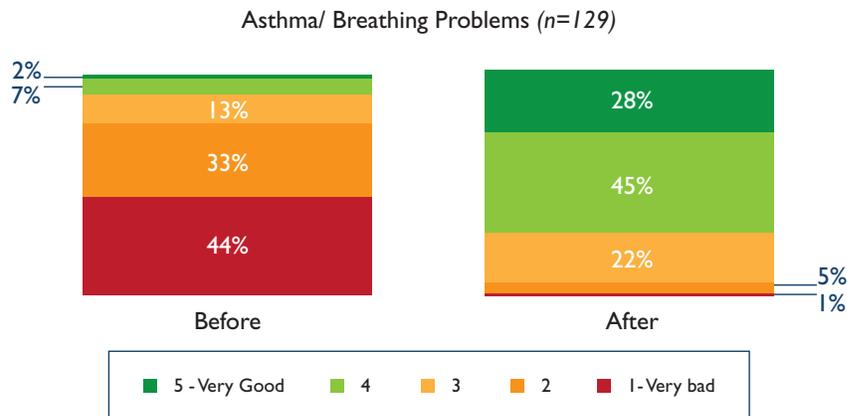
Individuals with insomnia reported an eight-fold improvement in good quality sleep (8% to 65%) and a 54% decrease in respondents who reported “very bad” quality of sleep. Overall, 73% of respondents reported improved sleep quality one year post-treatment. The percentage of respondents reporting life-threatening and serious insomnia declined from 47% to 11% (Figure 6).

Figure 6-Patients with Insomina Report OSA Treatment Significantly Improves Sleep Quality



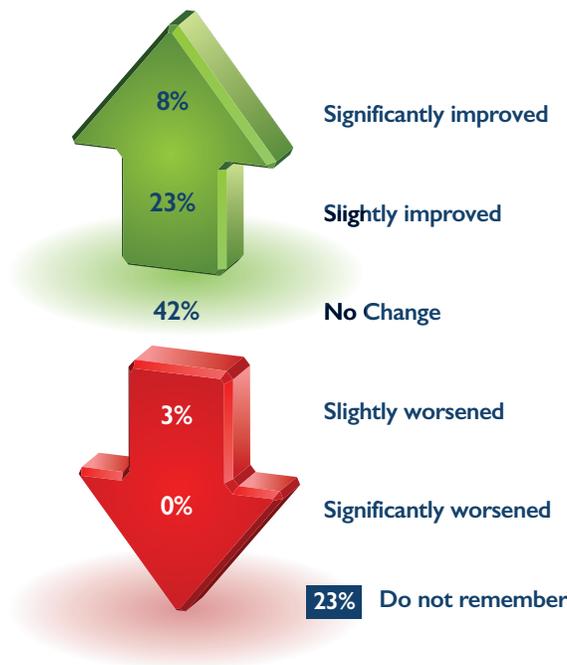
In a recent report published by the U.S. Centers for Disease Control (CDC), approximately 8% or 19 million U.S. adults reported having asthma.¹³ According to asthma and other breathing condition respondents, 54% reported improvement in breathing, a 70% increase in reporting symptoms as mild, and eight-fold increase in good quality sleep (9% to 73%) (Figure 7).

Figure 7-Patients with Asthma and Other Breathing Problems Reported Significantly Higher Quality Sleep After OSA Treatment



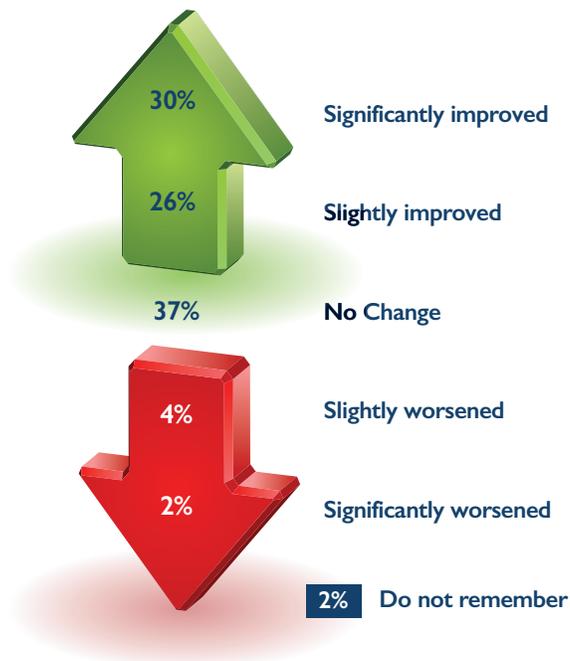
Diabetes affects approximately 29.1 million Americans, costing almost \$245 billion each year for the 21 million who are diagnosed.⁸ Survey respondents saw a 31% improvement in HbA1c and 14-fold increase in good quality sleep (5% to 72%). Equally important, diabetics with treated OSA reported nearly half the number of annual hospital visits. According to the CDC, Americans made 136.1 million visits to the emergency department in 2012. Various studies have emergency department visit costs ranging from \$800 to \$4,000, depending on the length of stay and treatment needed. One less visit to the emergency department for every individual with OSA and diabetes would offer substantial cost savings to both the patient and healthcare system (Figure 8).

Figure 8-Many Diabetic Patients Reported Improvement in HbA1C Levels After Treatment for OSA



Among respondents with heart disease which their physician believes puts them at increased risk of heart attack, 56% self-reported their risk for heart disease had improved one year after OSA treatment. Respondents also reported a three-fold decrease (56% to 17%) in life-threatening heart disease and a dramatic improvement in sleep quality. Prior to treatment, half of the population reported “very bad” sleep quality, with that number plummeting to only 3% after treatment. No respondents reported “very good” quality sleep before treatment, but that number improved to 26% after treatment (Figure 9).

Figure 9-Patients at Risk for Heart Disease Report Significant Improvements in Heart Disease Risk Profile After OSA Treatment

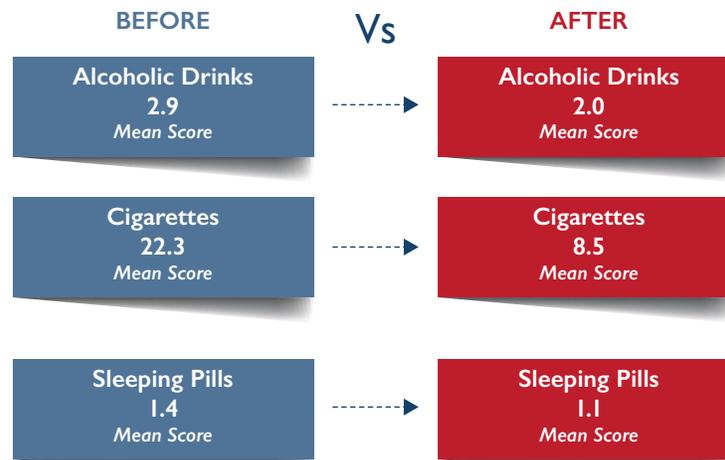


IMPACT OF TREATING OSA – MENTAL HEALTH & SUBSTANCE ABUSE

Mental health disorders affect nearly one in 17 adults in the U.S. and are the leading cause of disability in the country.¹⁴ The definition of mental health can be broad as it includes cognitive function, QOL, temperament, depression, energy levels, and sustaining interpersonal relationships. The second-most prevalent condition affecting 37% of OSA survey respondents is depression, anxiety, or other mental health problems. After one year of treatment, patients surveyed reported a 49% improvement in mental health, a halving in the number of individuals stating their mental health condition was life threatening (38% to 16%) and an 11-fold (6% to 71%) improvement in good quality sleep. OSA treatment affects not only the individual’s QOL, mood, and degree of patience, but also relationships with bed partners.

The abuse of alcohol, cigarettes and sleeping pills can be compensating behaviors for individuals seeking to cope with symptoms of OSA. After beginning treatment, respondents reduced their consumption of these substances and these results suggest the following: A 31% decrease in alcoholic beverage consumption would result in \$187.20 savings each year assuming \$4 per drink. A 62% reduction in cigarettes smoked would result in \$197.70 savings each year assuming \$0.28 per cigarette. Lastly, 21% fewer sleeping pills would result in \$31.20 savings per year assuming \$2 per pill (Figure 10). Reducing the use of depressives and stimulants not only saves money, but can improve overall health and well-being.

Figure 10- Patients Treating their OSA Report Significant Decreases in Cigarette, Alcohol and Sleeping Pill Consumption



IMPACT OF TREATING OSA – OCCUPATIONAL PRODUCTIVITY

Frost & Sullivan’s separate economic analysis indicated an increase in sleep duration of 1.7 hours per 24 hours in patients with OSA following initiation of CPAP. We have also shown increases in sleep quality following treatment with CPAP. Christopher Barnes, Ph.D., associate professor of management at the University of Washington, has produced multiple studies demonstrating that loss of sleep affects productivity.⁵ His research investigates the relationship between short sleep duration and poor sleep quality to the corresponding increase of workplace “cyberloafing,” poor decision making, decreased productivity, and the degree of likelihood that an individual will help a colleague. For the purpose of our patient survey, we chose to measure daytime productivity and absenteeism.

Before OSA treatment, respondents considered themselves fully awake, productive and contributing to their job approximately 6.1 hours each day. After beginning treatment for OSA, average productivity increased 1.2 hours each day for a total of six extra hours per week (Figure 11). The U.S. median net compensation was \$28,851.21 in 2014, meaning that increased productivity of 17.3% is equivalent to \$4,274.35 more labor output per employee treated.³ Employers can see the value of treatment through increased productivity and safety, while employees can realize it through promotions, bonuses, and increased job stability.

Figure 11-Improvement in Work Productivity After Treating for OSA

	Before Treatment	After Treatment	Difference
Number of Hours per Workday that are Fully Productive	6.9	8.1	+17.4%
Number of Days Absent	6.3	4.5	-40%

Absenteeism due to illness, disability, medical visits or feeling too tired to work accounted for 6.3 missed days of work per year before treatment. After treatment for OSA, absences were reduced 40% with an average of 4.5 days missed each year. The average hourly pay for a U.S. worker in the private sector as of December 2015 was \$25.24.⁴ With a 1.8-day reduction in workplace absences, that is equivalent to an additional \$363.46 (\$25.24 X 8 hrs per day X 1.8 days) in new earnings per year for hourly workers.

IMPACT OF TREATING OSA – ACCIDENTS & DISTRACTIONS

Accidents and distractions are not only dangerous, but extremely expensive. A commercial trucking accident can cost anywhere from \$304,500 to \$7 million depending on the size of the truck and injured parties.¹ A non-commercial accident can cost between \$237,000 and \$1.4 million as costs for property and vehicular damage, lost wages from absenteeism, and insurance and related medical expenses vary depending on the severity of the accident.⁶ While the prevalence of work- and car-related accidents due to drowsiness and/or sleep apnea is relatively unchanged in the respondent population before and after treatment, significant research indicates that treatment for commercial and non-commercial drivers can have a major impact on reducing the risk of crashes.



CONCLUSION

If the United States aggressively addressed the under treatment of OSA, the benefits described in this Frost & Sullivan survey would be applied to millions of residents, resulting in a truly transformational impact on our society. Payors and providers could expect a major drop in life-threatening conditions such as diabetes, heart disease and stroke. Employers would see a jump in productivity and performance. Patients and their families would enjoy a better quality of life, more enjoyable interpersonal relationships, and improved health. Recognizing the significant benefits that OSA treatment can deliver, what can we do to help the 20 million Americans who are not receiving them?

WHAT CAN YOU DO?

- Talk with your doctor about your own OSA risk level, and seek diagnosis and treatment as soon as possible. Make sure family members are likewise evaluated. Work with your team of sleep health professionals to find the treatment options that work best for you.
- If you are a healthcare provider or behavioral specialist, educate yourself on the indicators for OSA, as well as the available diagnostic and treatment options. OSA is life-threatening and contributes to the morbidity and mortality of other serious chronic conditions. It costs patients and payors money, and stands in the way of your patients having a happier, healthier and more productive life.

- For employers, government and insurance providers, take a closer look at the hidden costs that OSA has on your populations. Frost & Sullivan's research shows OSA treatment has measurable benefits soon after initiation, while at the same time helping to improve long-term health for patients.

As Dr. Nathaniel Watson, current AASM president, professor of neurology at the University of Washington in Seattle, co-director of the University of Washington Medicine Sleep Center and director of the Harborview Medical Center Sleep Clinic, states: "All things are touched by sleep; there is no other aspect of medicine that is like this. We need to change the narrative and current attitudes. Healthy sleep is a tool for a more effective you and more effective life."

Now is the time for all stakeholders in the U.S. healthcare system to commit themselves to making this vision a reality through more aggressive diagnosis and treatment programs and policies, improved education of providers and patients, and healthcare investments that reward prevention and cost-avoidance.

ENDNOTES

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