

1 **COMMERCIAL DRIVER PERSPECTIVES ON OBSTRUCTIVE SLEEP APNEA**

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2 **ABSTRACT**  
3 As a result of H.R. 3095, referred to as the “Sleep Apnea Bill,” the Federal Motor Carrier Safety  
4 Administration (FMCSA) is required to undertake a formal rulemaking process prior to  
5 implementing sleep disorder regulations, in particular focusing on obstructive sleep apnea  
6 (OSA). In its Advanced Notice of Proposed Rulemaking (ANPRM), FMCSA asked stakeholders  
7 to provide input on commercial driver experiences with sleep apnea screening and treatment. The  
8 American Transportation Research Institute (ATRI) conducted a survey for drivers who have  
9 been tested for OSA, collecting data from over 400 commercial drivers.

10       Of the drivers surveyed, 64 percent would require treatment for medical certification. The  
11 primary treatment regimen for drivers diagnosed with OSA in this sample was use of a  
12 continuous positive airway pressure (CPAP) device to manage their OSA (94%). The prevalence  
13 of CPAP treatment was also observed in driver respondents with mild OSA – a level of severity  
14 not currently requiring treatment per prior FMCSA guidelines. Ninety-one percent of drivers  
15 with mild OSA reported treating their OSA with CPAP therapy. Drivers in this sample with mild  
16 OSA often did not experience improved sleep from CPAP treatment, most frequently reporting  
17 no change in sleep or worse sleep. Conversely, drivers with moderate-to-severe OSA were likely  
18 to report experiencing improvements in sleep, and some other health conditions, after starting  
19 CPAP therapy. Drivers reported paying an average of \$1,220 for a sleep study, a significant cost  
20 relative to a driver’s average weekly income, \$835.

## 1 BACKGROUND

2 Obstructive sleep apnea (OSA) is a disorder wherein throat muscles relax intermittently,  
3 blocking the airway and causing breathing cessation during sleep. OSA is classified by the  
4 Federal Motor Carrier Administration (FMCSA) as a respiratory disorder, and is addressed in 49  
5 CFR 391.41(b)5 – the physical qualifications for drivers. Currently, certified medical examiner  
6 (CME) sleep study referrals are based primarily on a CME’s discretion (1). H.R. 3095, referred  
7 to as the “Sleep Apnea Bill,” was signed into law in 2013, requiring FMCSA to go through a  
8 formal rulemaking process prior to implementing sleep disorder regulations with a focus on  
9 OSA.

10 The impetus for OSA rulemaking is the potential safety risks of untreated OSA. In the  
11 general population, numerous studies have shown that untreated OSA increases a crash risk (2).  
12 Several studies focusing on the relationship between untreated OSA and crash risk in commercial  
13 motor vehicle (CMV) drivers have been conducted, with mixed results (3, 4, 5, 6). The most  
14 recent study on the crash risk associated with untreated OSA, using drivers from one fleet, found  
15 a 5-fold increase in preventable, Department of Transportation (DOT) reportable (a crash  
16 involving at least one fatality, injury, or vehicle requiring tow resulting from disabling damages  
17 in crash) crashes in CMV drivers who were nonadherent to their OSA treatment. CMV drivers  
18 partially adherent to their treatment did not have a statistically significant increase in crash risk.

19 The most recent estimate of OSA prevalence among CMV drivers found that 10.5  
20 percent had moderate-to-severe OSA (7). The characteristics of CMV drivers as a group likely  
21 may contribute to the higher risk of OSA observed in this population. Obesity, increased ages,  
22 and male gender all increase OSA risk (8). CMV drivers are predominately male (94%) (9).  
23 CMV drivers aged 45 to 54 years represented the largest cohort of the commercial driver  
24 population in 2013 and had a median age of 46.5 years, more than 42.4 years of the U.S.  
25 workforce as a whole (10). Estimates of obesity in the CMV driver population range from 40 to  
26 50 percent (8). While the impact of untreated OSA on crash risk and the prevalence of OSA in  
27 CMV drivers have been investigated, the impact of OSA screening and treatment on CMV  
28 drivers has not been addressed.

29

## 30 METHODOLOGY

31 ATRI developed two surveys on OSA – one for CMV drivers who have completed a sleep study  
32 (polysomnography), a diagnostic tool used to confirm an individual has OSA, and another survey  
33 for drivers who have not completed a sleep study. The surveys were initially distributed at the  
34 2016 Mid-America Trucking Show (MATS), held March 31 – April 2, 2016 in Louisville,  
35 Kentucky. Following MATS, the surveys were available online through ATRI’s website  
36 ([www.atri-online.org](http://www.atri-online.org)) from April 14, 2016 until May 9, 2016. In total, 822 drivers completed  
37 one of the two surveys.

38 The present paper details the results of the survey distributed to drivers who have had a  
39 sleep study. A total of 408 surveys were completed. The survey asked drivers for information  
40 relating to their sleep study, the costs of OSA diagnosis and treatment, and treatment efficacy.

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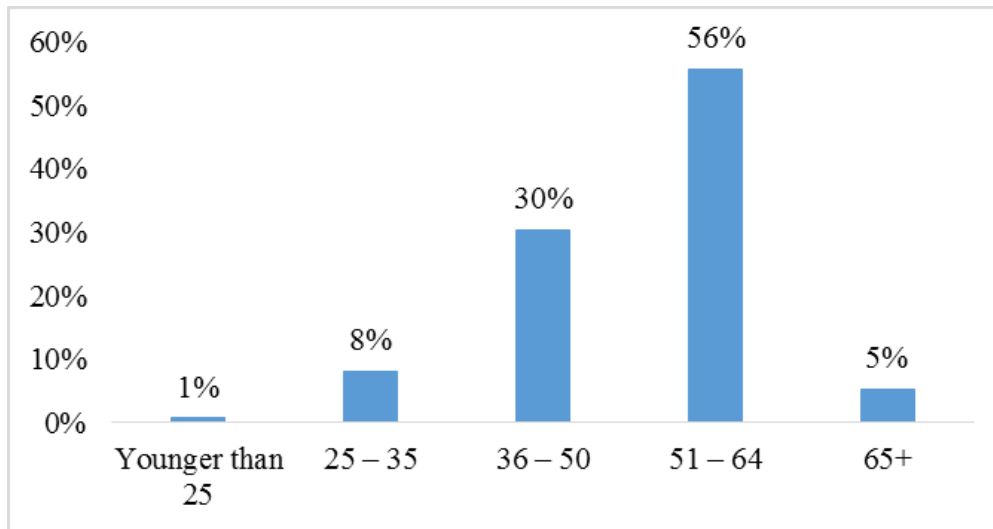
## 42 RESULTS

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### 44 *Driver Demographics*

45 First, respondents were asked about their age (Figure 1). Respondent age was heavily skewed  
46 toward ages greater than 50, which reflects both the increased risk of OSA as age increases and  
47 the age composition of CMV drivers (8, 10, 11, 12). Women comprised nine percent of the

1 sample, and men the remaining 91 percent. This sample overrepresents women relative to the  
 2 industry at large, where women comprise 6 percent of the driver population (9).  
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6 **FIGURE 1 Driver Age**

7 The operating status of survey respondents consisted of 73 percent employee drivers, 9 percent  
 8 Owner-Operators (O-O) with their own authority, and 18 percent Independent Contractors (I-C)  
 9 or O-O leased to a motor carrier.

10

#### 11 *Sleep Study Referral Experience*

12 A majority of drivers (53%) in this sample were referred to a sleep study by their primary care  
 13 physician, followed by CME referral (28%). When a driver was referred to a sleep study by an  
 14 individual other than their primary care physician or a CME (19%), drivers reported being self-  
 15 referred, or referred by a family member, another physician, or based on a company-specific  
 16 OSA policy.

17 Following referral to a sleep study, most drivers (88%) did not get a second opinion on  
 18 whether a sleep study was needed. Drivers primarily took in-lab sleep studies (85%) with a  
 19 small number completing home sleep studies (15%).  
 20

#### 21 *Out-of-Pocket Sleep Study Costs*

22 Next, drivers were asked about out-of-pocket sleep study costs. In this sample:

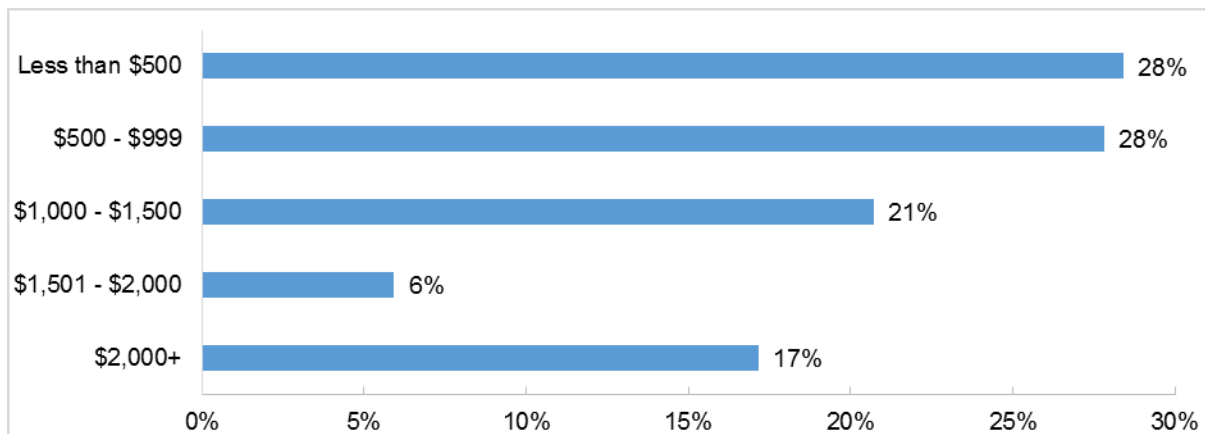
- 23 • 53 percent of drivers paid out-of-pocket costs;
- 24 • 40 percent of drivers did not pay any out-of-pocket costs; and
- 25 • 7 percent of drivers did not know if they paid any out-of-pocket costs.

26

27 Those drivers who indicated bearing some or all of the cost of the sleep study were asked to  
 28 provide a specific amount paid; 169 drivers provided data on the out-of-pocket costs for their  
 29 sleep study (Figure 2). On average, drivers in this data collection paid \$1,220 out-of-pocket for a  
 30 sleep study. The median out-of-pocket cost was \$800 and there was a significant range in  
 31 reported out-of-pocket costs of over \$6,000. The significant impact of sleep study costs on  
 32 commercial drivers is apparent when considered in relation to the national median truck driver

1 wage - \$805 per week (13). The impact of the high costs on drivers could be mitigated with more  
 2 widespread use of lower cost screening options such as home sleep studies.

3 The variation in driver out-of-pocket costs can be attributed to numerous factors,  
 4 including whether or not drivers have insurance, and for drivers with insurance, whether or not  
 5 their insurance covered sleep study costs, whether they had already exceeded their health  
 6 insurance deductible, and whether the driver completed an at-home or in-lab sleep study. The  
 7 individual effects of each of these factors was not investigated due to the relatively small number  
 8 of drivers that specified how much they paid out-of-pocket.



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12 **FIGURE 2 Out-of-Pocket Sleep Study Costs**

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14 One of the impacts on how much driver respondents paid out-of-pocket for sleep study costs is  
 15 insurance coverage of some or all of the sleep study costs. Health insurance assistance with sleep  
 16 study costs impacted driver out-of-pocket costs significantly – 61 percent of drivers with no  
 17 health care coverage of their sleep study incurred out-of-pocket costs exceeding \$1,000  
 18 compared to 32 percent of drivers whose health insurance did cover some portion of the sleep  
 19 study with costs exceeding \$1,000.

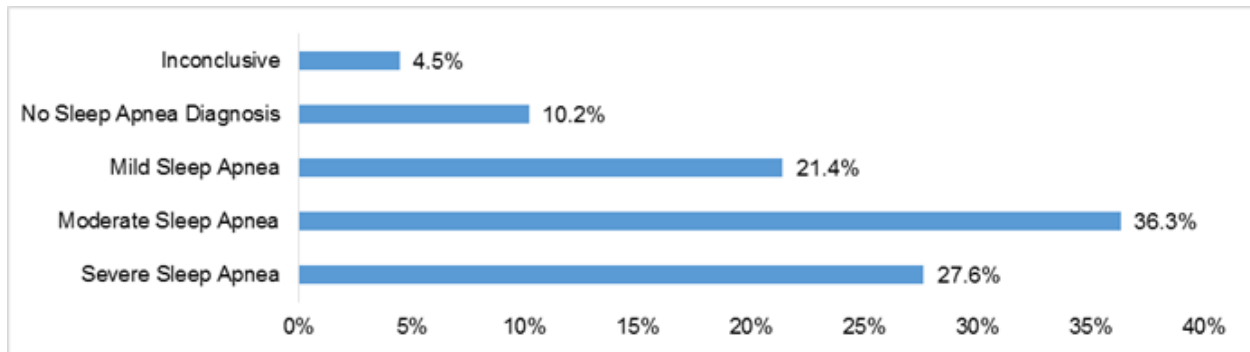
### 20 21 *OSA Diagnosis and Treatment*

22 The sleep study diagnoses of respondents are shown in Figure 3. The apnea hypopnea index  
 23 (AHI) is the number of times an individual stops breathing per hour of sleep and measures OSA  
 24 severity. A majority of respondents who reported participating in a sleep study (85%) were  
 25 diagnosed with OSA of varying severities. Drivers in this sample who have had a sleep study  
 26 may have exhibited multiple risk factors for OSA that led to the sleep study referral, therefore the  
 27 “prevalence” figures reported here are not representative of the truck driver population at large.

28 Additionally, driver respondents self-selected to participate, potentially introducing  
 29 some bias. Under current FMCSA guidelines, only those drivers diagnosed with moderate-to-  
 30 severe OSA would require treatment. In this sample of 408 drivers that completed a sleep study,  
 31 64 percent of drivers would require OSA treatment for medical certification, 36 percent would  
 32 not.

33 Of the 41 drivers who reported receiving a diagnosis of no sleep apnea, 28 percent  
 34 reported that they are still referred to sleep studies regularly. The most commonly reported  
 35 frequency of referral to another sleep study was every two years or every DOT physical.

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4 **FIGURE 3 Driver Sleep Study Diagnoses**

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6 Sleep study results, stratified by age, are shown in Table 2. Sleep study results for drivers 50  
7 years old or younger were more likely to indicate no OSA or inconclusive results (20%) relative  
8 to drivers aged 51 or older (10%). Sleep studies resulting in diagnoses of moderate-to-severe  
9 OSA occurred in 69 percent of drivers 51 years of age or older and 58 percent of drivers 50 years  
10 of age or younger, reflecting the increased risk of OSA as age increases (8). Again, these drivers  
11 likely exhibited OSA risk factors that led to their sleep study referral and self-selected to  
12 participate in this survey, so these figures are not reflective of the CMV driver population at  
13 large.

14

15 **TABLE 2 Sleep Apnea Diagnoses by Age**

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Age	Inconclusive / No OSA Diagnosis	Mild OSA	Moderate OSA	Severe OSA
50 or Younger	20%	22%	29%	29%
51+	10%	21%	42%	27%

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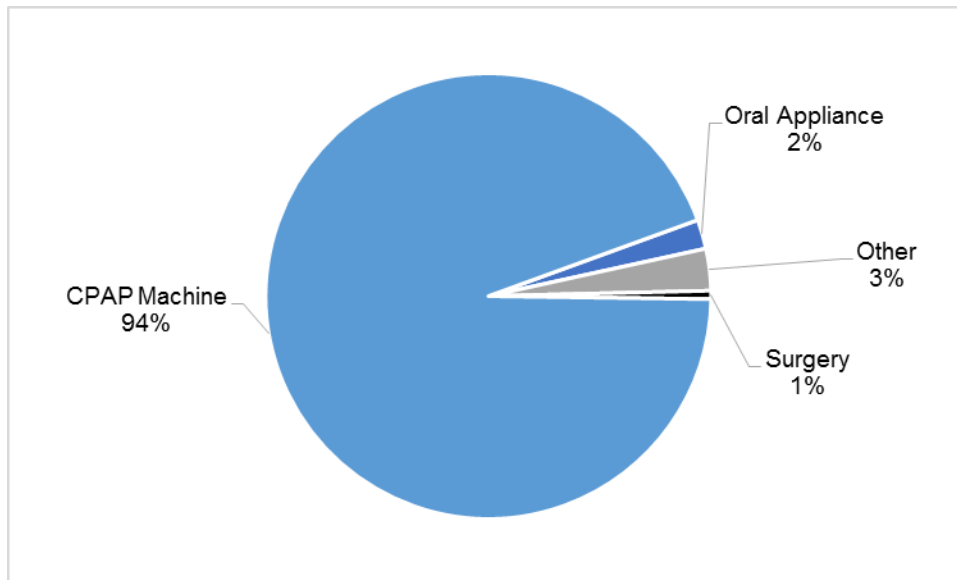
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23 Figure 4 displays the prescribed OSA treatments for survey respondents. The overwhelming  
24 majority of respondents (94 percent) were treated using CPAP machines, defined here to include  
25 all positive airway pressure devices (CPAP, APAP, VPAP, etc). The use of CPAP treatment is  
26 common in the trucking industry due to the ability of most CPAP machines to monitor treatment  
27 compliance. The “other” treatment responses that were specified typically indicated that the  
28 respondent had received multiple, different treatment types.

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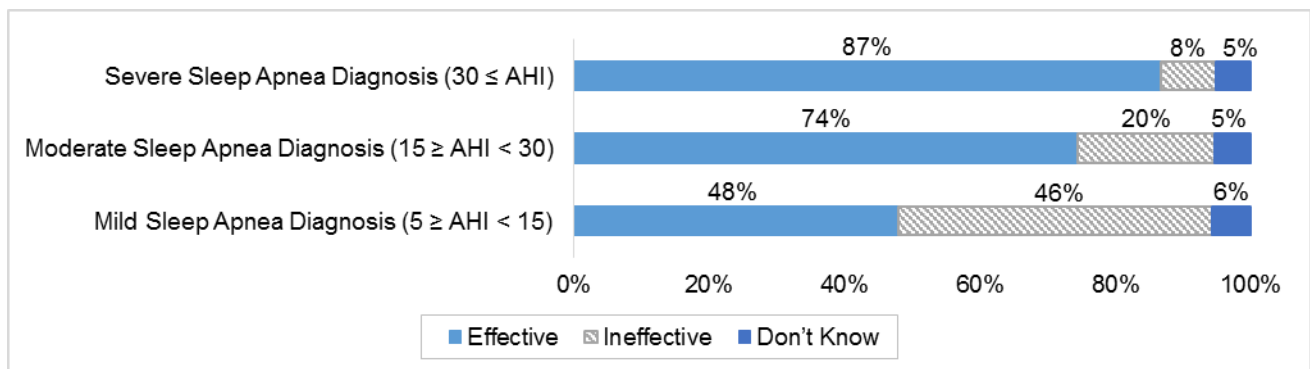


**FIGURE 4 Prescribed Treatments**

Respondents were asked whether they believe that the prescribed OSA treatment is effective. Due to the small number of individuals treating OSA with oral appliances, surgery, or another treatment, this analysis omits reporting the individual efficacy of each of treatment. Of respondents using CPAP machines, 72 percent found treatment effective, 21 percent did not find treatment effective, and 7 percent were not sure if treatment was effective. With almost a quarter of CPAP machine-treated drivers reporting that they believe their treatment is ineffective, treatment option flexibility will be an important component of any proposed rule.

Drivers treating their OSA with CPAP machines for more than one year were almost twice as likely to find their treatment effective (82%) than drivers who have been using CPAP treatment for less than one year (45%). The reason for this relationship is unknown; possible explanations could include drivers becoming accustomed to the CPAP treatment over time or certain drivers finding the treatment ineffective and quitting the CPAP treatment regimen.

The need for treatment flexibility is further demonstrated by the relationship between OSA severity and perceived treatment efficacy (Figure 5). Drivers with moderate and severe OSA in the ATRI sample were more likely to find their CPAP treatment effective (74% and 87% respectively) than drivers with mild OSA (48%).



## 1 **FIGURE 5 Driver-Reported PAP Treatment Efficacy by OSA Severity**

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3 The specific effects of CPAP treatment for respondents, stratified by OSA severity, are reported  
4 in Table 3. Generally, drivers experienced more positive effects of CPAP treatment the more  
5 severe their OSA diagnosis. Drivers diagnosed with severe OSA experienced largely positive  
6 effects from CPAP treatment, reporting increased amounts of sleep (71%), feeling better when  
7 they wake up (84%), and lower blood pressure (75%). Half of drivers with severe OSA also  
8 reported losing weight after treating their OSA with a CPAP device (50%). Positive effects of  
9 CPAP treatment were evident in drivers with moderate OSA, but less pronounced than the effects  
10 CPAP treatment had on drivers with severe OSA. Roughly half of drivers with moderate OSA  
11 experienced improvements in sleep, with 54 percent sleeping more and 75 percent feeling better  
12 when they wake up.

13 Conversely, many drivers with mild OSA did not experience improvements in sleep.  
14 Less than half of drivers in the sample with mild OSA reported sleeping more (32%) or feeling  
15 better when they woke up (44%). Often, the CPAP treatment had a negative effect on sleep for  
16 drivers with mild OSA – 26 percent did not feel better when they woke up and 43 percent  
17 reported that they slept less. Similarly, studies on CPAP treatment for mild OSA have found that  
18 while CPAP treatment reduces AHI, objective measures of sleepiness did not improve (14).

19 CPAP treatment was the dominant form of treatment prescribed to drivers in the ATRI  
20 sample with mild OSA (91%), even though no guidelines or regulations require the treatment of  
21 mild OSA in commercial drivers. Often, it is recommended that mild OSA be treated with  
22 conservative measures – sleeping on your side, quitting smoking and drinking alcohol, and  
23 losing weight (15, 16). However, conservative treatment options do not allow for compliance  
24 monitoring. The prevalence of CPAP treatment, which is more costly than the conservative  
25 treatment approach and often (in this sample) did not improve sleep in drivers with mild OSA  
26 suggests that treatment flexibility is paramount to any success that OSA regulations in  
27 commercial drivers will have on reducing fatigued driving.



1 **TABLE 3 CPAP Treatment Effects by OSA Severity**  
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	OSA Severity	Agree	Disagree	Don't Know	No Change
<b>My blood pressure has decreased</b>	Mild OSA	0%	0%	14%	86%
	Moderate OSA	30%	0%	0%	70%
	Severe OSA	75%	0%	0%	25%
<b>Amount of sleep has increased</b>	Mild OSA	32%	43%	0%	25%
	Moderate OSA	54%	23%	1%	22%
	Severe OSA	71%	13%	2%	13%
<b>My weight has decreased</b>	Mild OSA	29%	0%	14%	57%
	Moderate OSA	50%	10%	0%	40%
	Severe OSA	50%	25%	0%	25%
<b>I feel better when I wake up</b>	Mild OSA	44%	26%	1%	28%
	Moderate OSA	75%	13%	0%	13%
	Severe OSA	84%	3%	1%	12%

3  
4 The survey also gathered information on OSA compliance review. Of drivers treating their OSA  
5 with CPAP machines in this sample, 75 percent are reviewed by their CME for treatment  
6 compliance and 27 percent are reviewed by their employer for treatment compliance. Over half  
7 of drivers (66%) using CPAP treatment reported that their carrier did not have restrictive idling  
8 policies that prevented them from powering their CPAP machines on the road. However, local  
9 idling laws may impose additional barriers to powering CPAP machines on the road.

10 Recently research on the potential crash safety risk associated with nonadherence to  
11 OSA treatment indicated that truck drivers who did not adhere (at all) to their prescribed  
12 treatment regimen were five times more likely to be involved in a preventable, DOT-reportable  
13 crash (5). However, in the ATRI sample, the number truck driver respondents with moderate-to-  
14 severe OSA who indicated that they were not adhering to their treatment regimen was six out of  
15 235 respondents, or 2.6 percent.

## 16 17 18 **CONCLUSIONS**

### 19 **CPAP Machines Are Not Effective For Treating All Drivers**

20 Almost a quarter of drivers treating their OSA with CPAP machines (21%) did not find their  
21 treatment effective. Additionally, drivers reported varying levels of CPAP treatment efficacy  
22 related to OSA severity, with CPAP treatment generally being more effective for more severe  
23 OSA. Most drivers with mild OSA in this sample treated their OSA with CPAP machines (91%).  
24 Less than half of drivers with mild OSA experienced improved sleep as a result of CPAP  
25 treatment, with only 32 percent reporting increased amounts of sleep and 44 percent reported  
26 feeling better when they woke up. Flexibility in OSA treatment options may reduce the number  
27 of OSA-affected drivers who find their treatment ineffective. Prescribed treatments should  
28 consider OSA severity.  
29

### 30 **Non-Adherence to Treatment Regimen**

31 While outside research may indicate higher crash risk associated with non-adherence to  
32

1 prescribed OSA treatment (partial adherence had no increased safety risk), the number of non-  
2 adherent drivers (2.6%) with moderate-to-severe OSA is relatively small according to the ATRI  
3 survey data (5).

4

#### 5 **Driver Sleep Study Costs Are Significant**

6 The cost of a sleep study, needed to diagnose a driver with OSA, in this sample is significant.  
7 The financial impact of sleep study costs on commercial drivers is illustrated by considering  
8 truck driver wages in relation to sleep study costs – average (\$1,220) sleep study costs as  
9 reported by drivers in the ATRI sample exceed the average weekly truck driver wages in 2015,  
10 \$835 (13). These costs are also extremely varied, depending on who pays the sleep study costs,  
11 what type of sleep study a driver takes, whether a driver is insured, whether a driver's insurance  
12 covers sleep studies, and how high a driver's deductible is. These costs may be mitigated by  
13 allowing drivers to take home sleep studies, which cost less than in-lab studies. Additionally, use  
14 of home sleep studies may reduce other costs that drivers incur to complete a sleep study, such as  
15 reducing the time a driver takes off work to complete a sleep study and potential travel to reach a  
16 sleep clinic.

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