A CORPORATE DRIVEN SLEEP APNEA DETECTION AND TREATMENT PROGRAM: RESULTS AND CHALLENGES

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Summary/Abstract: Sleep disordered breathing (SDB), including sleep apnea, is very prevalent in commercial drivers and contributes significantly to higher healthcare and liability costs. Without a mandated screening program, driver and physician recognition of this condition remains low. Our corporate supported recognition and treatment program for SDB utilizes an objective screening tool that yields a positive predictive value of 91%. Of those continuous positive airway pressure (CPAP) treated drivers successfully contacted, one month or longer treatment compliance is 91% with high subjective rating scores. In 348 SDB drivers, CPAP intervention resulted in a 47.8% ($p<.0001$) reduction in per member per month (PMPM) health care spending. There was a 73% reduction in preventable driving accidents in a subgroup of 225 full-time CPAP-treated drivers. The driver retention rate in CPAP treated individuals was 2.29 times greater than the 2004 global corporate driver retention rate. On-going corporate measures that facilitate testing and treatment of drivers with SDB are described. These activities are proving both clinically and financially beneficial for a major commercial carrier.

Sleep disordered breathing (SDB) is associated with excessive daytime fatigue and diminished vigilance. Kryger et al (2005) estimates that sleep disordered breathing (SDB) affects around 4% of U.S. adults between the ages of 40 and 65. Pack, Dinges, and Maislin (2002) found the prevalence of this condition much higher in commercial drivers, approaching 28%. With the FMCSA's calculation of between 6 and 7 million truck and bus drivers in the U.S. (Gunnels, 2005), a conservative estimate of commercial drivers with SDB exceeds 600,000 individuals. The higher prevalence of sleep disordered breathing in truck drivers is likely related to the higher predominance of males to females (9:1) as well as the high frequency of obesity in that group, as cited in Hartenbaum (2003). Studies have shown that drivers with SDB have from 2 to 15 times more frequent motor vehicle accidents compared to unaffected drivers (Aldrich, 1989; Stoohs, et al, 1994; Horstmann, et al, 2000; Howard, et al, 2004). Large truck crashes are expensive, according to a FMCSA study (1999). Beyond the immeasurable cost of loss of life and permanent injury, the average cost per large truck crash involving a fatality in 1999 was \$3.54 million, and involving an injury was \$217,005. Additionally, it is becoming increasingly evident from multiple studies reviewed by Young, Peppard, and Gottlieb (2002) that untreated SDB is associated with higher risks for cardiovascular and cerebrovascular events. Mortality rates in untreated SDB have been shown to be higher in a paper recently published by Campos-Rodriquez, et al (2005), and this excess mortality was mainly from cardiovascular disease. Since cardiovascular disease, hypertension, and diabetes represent three of the most costly health expenditures in the commercial trucker population, efforts to mitigate these diseases should provide significant health care cost savings. Treatment of SDB, usually with CPAP, will result in fewer motor vehicle injuries. Vorona and Ware (2002) summarized several studies showing a marked reduction in the frequency of crashes in patients receiving CPAP therapy for their SDB.

There is a clear and pressing need to identify commercial drivers with SDB because effective treatment of this disorder results in reduced accident rates comparable to drivers without this condition, as previously cited in Vorona and Ware (2002). Health costs might also be positively affected by such a strategy. Although sleep apnea has not yet been specifically listed in the Federal Motor Carrier Safety Regulations, Section 391.41(b)(5)(8) considers a commercial driver physically qualified if he/she " Has no established medical history or clinical diagnosis of a respiratory dysfunction likely to interfere with his/her ability to control and drive a commercial motor vehicle safely…." Indeed, the recently revised FMCSA Medical Examination Report for Commercial Driver Fitness Determination now includes a specific question regarding "Sleep disorders, pauses in breathing while asleep, daytime sleepiness, loud snoring." Unfortunately, many affected individuals are unaware of their condition or they may consciously conceal or deny symptoms attributable to this disorder. According to Gunnels (2005), "There are medical gaps that FMCSA does not address, such as guidance for commercial motor vehicle operators with sleep disorders…." Surprisingly, Young, et al (1997) estimates that only 10% of adults with SDB have been diagnosed and Reuveni, et al (2004) states that only 10% of physicians inquire about sleep apnea related symptoms. Quoting Gunnels (2005), "The FMCSA…encourage[s] motor carriers and physicians to have higher medical standards." DOT-certified physicians and trucking companies are in need of reliable tools facilitating the identification of drivers with SDB.

A purpose of our study is to examine if a reduction in preventable accidents can be achieved in the commercial trucker population with appropriate treatment of SDB. An additional goal of this study is to examine how employer health costs are affected by a concerted effort to identify and treat SDB in their drivers. This paper describes the utility of a simple screening tool used to identify commercial drivers who may have SDB. Of those commercial drivers identified with and receiving treatment for SDB, this paper also reports their intermediate term CPAP treatment compliance and corporate retention rates.

METHODS

Corporate Measures Facilitating Diagnosis and Treatment

Schneider National Inc (SNI) has recognized SDB with financial backing since 1998. A SNI employed driver referred for SDB testing and physician consultation incurs no out of pocket expenses. Since the late 1990's, the Occupational Health Department at SNI has noticed a trend in their driver population where the risk of SDB and the co-morbidities associated with SDB were evident in 1 out of 3 drivers. This discovery led to an increased effort by the Occupational Health Department to begin a formal process of symptom recognition and SDB education throughout the organization.

Educating a mobile workforce has its own set of challenges. The nurses work to identify every available internal resource to assist them in this regard. Training engineers have become an effective first-line screen of new drivers. From the classroom to riding in the cabs beside these novice drivers, symptoms of sleepiness and diminished vigilance are readily observed. Disease Management vendors handling cardiac disease, diabetes, and asthma are trained to monitor for symptoms of SDB. On site physical therapists at SNI's various operating centers are trained to identify drivers suspected of having SDB. Loss Prevention teams are similarly trained. Text messages are routinely sent to drivers in their trucks, reminding them to schedule a sleep study or a follow-up appointment. A monthly newsletter is sent to the driver's homes featuring articles on SDB (spousal recognition of symptoms is a key diagnostic aid). The medical interview required at the time of hire has modified its strategy to better identify the SDB candidate. Pharmaceutical claims data is reviewed for certain medications, including sleep aids and Modafinil, often triggering a sleep evaluation for those drivers. Successfully treated SDB drivers are interviewed and recorded for educational "drive-time tapes." These educational resources allow SDB-treated drivers to describe to their peers their renewed sense of energy, productivity, and improved sense of safety. Short-term disability waiting periods are waived for those undergoing diagnosis and treatment for SDB. Driver handbooks are updated to include SDB when addressing fatigue over the road.

Despite all of the previously mentioned initiatives, drivers' concern over possible loss of income and job security remained as significant impediments in implementing widespread driver cooperation. Measures were then developed addressing those concerns, including a two-day turnaround from diagnosis to treatment of SDB. A business relationship was formed between Precision Pulmonary Diagnostics, Inc. (PPD) and SNI whereby a sleep diagnosis/treatment facility located near a major SNI operating center was identified to deliver rapid turn-around times from diagnosis to treatment set-up – averaging 2 business days. This center was held to the highest medical and service standards. Using their operating center as a hub, SNI facilitates referral to this sleep facility through preferential route scheduling of drivers in need of testing. PPD also works with SNI in efforts to educate the DOT physicians contracted with SNI to perform driver certification exams. These efforts have included two mass educational mailings to all involved DOT physicians working with SNI, as well as face-to-face meetings with said physicians in the city where a participating SNI operating center is located. Through separate mailings to DOT physicians, SNI has "raised the bar" explicitly identifying what documentation they require of their contracted physicians.

Screening Tool

Certain symptoms carry a near 100% accuracy in predicting a diagnosis of SDB and should prompt a sleep study, such as witnessed apnea by a bed-partner. Other symptoms, when volunteered by the driver or discovered through appropriate survey responses, justify testing for a sleep disorder. One example is daytime sleepiness, with or without a history of snoring. On the other hand, snoring alone may not be sufficient to warrant obtaining the more expensive polysomnography. Trucking companies require a valid and relatively inexpensive tool allowing identification of those individuals with a high likelihood of having SDB and therefore requiring polysomnography. Such an ideal screening tool should be sufficiently sensitive to pick up all truckers with clinically relevant SDB. The screening tool should incorporate relevant subjective response data useful in identifying high risk groups while not completely bound by a respondent's answers to *exclude* a high risk individual. This latter point is important because some drivers may try to conceal their symptoms of daytime sleepiness out of fear it may jeopardize their employment. Therefore a screening tool must also include reliable, objective data in formulating a prediction for sleep apnea in any given person. From a review of the available medical literature, we developed a simple screening tool to augment the aforementioned subjective responses of the drivers. This tool incorporates weighted values for body mass index (BMI), presence of hypertension, and presence or absence of heavy snoring. The tool also includes other objective criteria for a screener to consider in deciding whether or not to refer a driver for testing.

Accident Rate Analysis

Driver identification numbers in the sample of SDB data was analyzed along side of accident data matching the same driver numbers. A portion of SDB data was not usable due to a dual role of driver and shop mechanic or the original date of hire was not located due to rehiring of that driver. Of the 337 SDB employees analyzed in this report, 255 were deemed acceptable for analysis of accident rates, based on the exclusions mentioned above. Beginning with the driver's date of hire, all preventable accidents prior to treatment for SDB were tracked. A comparison was made looking at the number of drivers with preventable accidents both before and after SDB treatment.

Retention Rate Analysis

This was obtained by noting the percentage of CPAP-treated drivers diagnosed during the study period and still employed by SNI as of June 30, 2005. A comparison was made with the 2004 corporate-wide driver retention rate for SNI (actual numbers were deemed proprietary).

Health Care Analysis

This analysis identified drivers who received a CPAP machine and compared the rates of hospital admissions, emergency room (ER) visits, office visits, and outpatient (OP) visits as well as medical, drug, and total health care spending for these individuals in the periods before and after receiving CPAP intervention. The analysis involved merging claims files from multiple sources: medical claims from Cigna for 2003 and 2004 (provided by Schneider), pharmacy claims for the same time periods (obtained from Medco), and medical and pharmacy claims from Definity Health paid from January through June of 2005. This allowed for the creation of a continuous 30-month claims stream for Schneider from January of 2003 through June of 2005. In the absence of member-level eligibility data, all members were treated as continuously enrolled for the years in which they had claims paid. An alternative to this approach would have been to use the first and last dates for which each member had paid claims, but a check against Definity Health's eligibility data determined that this method underestimated eligibility far more than the assumption of continuous enrollment overestimated it. The study group was identified using a list of DME (Durable Medical Equipment) codes for the CPAP machine and related items among Schneider subscribers. An intervention date was then identified for each study group member by selecting the earliest service date from all claims with one of the appropriate DME codes. This allowed for the calculation of the number of months of enrollment for each member before and after the CPAP intervention. Utilization was identified from both data sources, with different identifiers used due to different fields in the data. Admissions were identified through the presence of an admission date in the Cigna data, and through revenue codes in the Definity Health data. ER visits were found through the use of place-of-service

(POS) codes in the Cigna data, and POS codes or revenue codes in the Definity Health data. Office visits were identified using POS codes, and OP visits using minor service category and POS codes. To prepare the dataset for analysis, utilization and spending variables were assigned to a pre or post-intervention row for each member in the study group based upon dates of service. If the CPAP intervention occurred during an admission, the admission and its associated costs were assigned to the pre-intervention period; all other non-admission intervention costs fell into the post period. The Cigna and Definity Health values were then merged and summed, providing a single dataset broken down by pre and post-CPAP values for each member in the study group. In order to accommodate different lengths of enrollment for each member, the number of months of enrollment before and after the intervention were calculated and used as the denominator in PMPM measures of utilization and spending. Finally, members were removed who did not have at least one full month of enrollment before and after the CPAP intervention. The study group contains 348 members. Comparing pre and post-intervention values, summary statistics were gathered for all of the per member per month (PMPM) variables. T-tests were also run to test the statistical significance of the difference between mean pre and post-intervention values (95% confidence interval). Two tests were run, one which assumes equal variances in the pre and post-populations (pooled) and one which does not (Satterthwaite). Both tests produced identical t-values and levels of statistical significance, so only one value is reported in the results for each mean.

CPAP Compliance Data

A subset of CPAP-treated drivers available to PPD for contact was queried regarding their frequency of equipment usage, symptoms of daytime sleepiness, difficulty with CPAP therapy, and various subjective responses related to treatment success.

RESULTS

Screening Tool

Analysis of screening tool data is available from only one testing source (PPD). A total of 62 drivers were referred to this source for testing. Of those 62 individuals, data was incomplete for 5, leaving 57 drivers for this analysis. Of these 57, 49 are males and 8 are females. Because of the small number of females, they were not separately analyzed from the males. The sensitivity of our screening tool to detect SDB of any severity was 86% and remained at 86% if used to detect only moderate to severe SDB. The specificity was 43% in all SDB and only 24% in moderate to severe SDB. Overall, the accuracy was 80%. The positive predictive value was 91% in predicting the presence of any severity of SDB and fell to 72% for moderate and severe SDB. The negative predictive value was only 30% for all severity SDB and improved only to 40% in moderate and severe SDB. Twenty-five of the 57 drivers (44%) analyzed in this population had severe SDB with apnea/hyponea scores ranging from 34 to 112 events per hour of sleep.

Health Costs

The number of study group members analyzed by time period is shown below in Table 1:

Table 1: Number of Study Group Members Receiving CPAP Intervention by Time Period

	2003	2004	Jan-June 2005
Number of Members	3	257	88

Table 2 illustrates the breakdown of health care costs generated from enrolled members with SDB before and after CPAP intervention. Overall, there was a 47.8% reduction in health care costs after CPAP intervention ($p<.0001$). The mean values for admissions PMPM and outpatient visits PMPM are significantly less in the post-CPAP period than in the pre-CPAP period($p<.001$ and $p<.0001$, respectively). Medical spending also decreased significantly ($p<.0001$). There was a modest increase in prescription spending (mean difference of $32.84 per month), along with a 42.6% increase in PMPM office visits. After CPAP intervention, affected SDB patients experienced roughly one fourth as many hospital admissions and spent about one half the health care dollars compared with the period prior to intervention.

Table 2: Summary Statistics and T-Test Results for CPAP Intervention (n=348)

		Pre-Intervention	Post-Intervention	% Change
Admits PMPM	Mean	.0128	.0035	-72.7% **
	Std. Dev.	.0432	.0242	
ER Visits PMPM	Mean	.0224	.0238	6.3%
	Std. Dev.	.0676	.0666	
Office Visits PMPM	Mean	.7621	1.087	42.6% ***
	Std. Dev.	.7869	1.239	
OP Visits PMPM	Mean	.2663	.1245	-53.2% ***
	Std. Dev.	.3954	.2418	
Allowed Amount Medical PMPM	Mean	$807.58	$341.15	-57.8% ***
	Std. Dev.	$1,294.80	$553.59	
Allowed Amount Rx PMPM	Mean	$98.70	$131.54	33.3% *
	Std. Dev.	$154.40	$267.27	
Allowed Amount Total PMPM	Mean	$906.28	$472.69	-47.8% ***
	Std. Dev.	$1,320.45	$653.92	

*** $p < .05$ ** $p < .001$ *** $p < .0001$**

CPAP Compliance

Forty-six drivers diagnosed and treated for sleep apnea with CPAP for at least one month (range 1 to 9 month follow-up) have been contacted with 32 drivers responding (response rate of

69%). Of those drivers responding, 91% are using CPAP 6-7 nights per week. Most are very pleased with their treatment, giving a subjective average score of 7.5 and a mean score of 8.5 out of a possible 10.

Accident Rates

Of the drivers diagnosed and treated for SDB and eligible for analysis (see Methods section above for exclusion criteria), 75%, had incurred a preventable accident during this analysis. Of those drivers with accidents, 93% had their accident before treatment for SDB. Twenty-five percent incurred an accident after treatment for SDB. Of those drivers with accidents and diagnosed SDB, only 7% incurred an accident after treatment for SDB, but not before. Overall, the accident rate in these treated individuals dropped from 93% to 25%, or a 73% reduction.

Corporate Retention Rates

Extremely high driver turn-over is prevalent throughout the industry. Industry-wide norms in yearly retention rates are as low as 25%. Although SNI has asked that their yearly retention rates remain proprietary and not be reported, our survey found that SNI SDB-treated drivers had a 129% greater retention rate (odds ratio 2.29) compared to 2004 SNI global driver retention rates.

DISCUSSION

This is the first published report of a large commercial long-haul carrier employing a systematic program of screening, diagnosing, and treating its drivers for SDB. Indeed SNI, with its dedicated departments of Occupational Health and Loss Prevention, is employing its unique position to explore the utility of such programs. Successful implementation of these initiatives requires a commitment from management to expend the “hard dollar” costs of screening, testing, and educating its drivers regarding SDB. It has also proven necessary to educate and demand a higher standard than that which is currently mandated from the DOT physicians responsible for certifying commercial drivers as fit for duty. The hypothesized, and now proven, results of such initiatives are the larger “soft dollar” savings in health care expenditures, diminished liability risks from fewer accidents, and an improved retention rate of drivers who are generally pleased with the results of CPAP treatment of their condition.

Difficulties encountered in our initiative include a mobile work force, an industry-wide high driver turn-over rate, a continued need to educate the DOT examiner regarding SNI’s expectations from the DOT Physical Exam (SNI contracts with numerous DOT clinics across the country and turnover of office and physician staff becomes a factor as well), and the maintenance of the infrastructure and education within the SNI organization as it grows. While balancing the desire to have as many safe drivers on the road at all times, driver shortages and business needs exact pressures when drivers are pulled out of service for testing.

In developing our screening tool for SDB, it was important to provide an instrument sensitive enough to identify affected individuals utilizing easy to obtain objective criteria. Discovering commercial drivers afflicted with SDB presents a rather unique situation in medicine where subjective complaints suggesting this condition are often willfully denied and objective criteria for diagnosis require a relatively expensive sleep study. Several investigations looking at various screening strategies have relied heavily on subjective responses to help identify patients with SDB (Maislin, et al 1995; Chesson, et al 1997; Gurubhagavatula, et al 2004). Other reports have shown predictive associations between biochemical markers and the presence of SDB. Shamsuzzaman, et al (2002) found the level of C-reactive protein in the blood to correlate proportionally to the severity of obstructive sleep apnea. Dixon, Schachter, and O'Brien (2003) have found that fasting blood insulin levels and the level of glycosylated hemoglobin A_{1C} were predictive of the apnea/hypopnea index. Although these studies are promising in contributing to a potential objective screening tool for SDB, their utility, validity, and costs remain to be defined. Additionally, most reports of various screening tools, including ours, reflect models "developed from a population of patients referred to a sleep center for evaluation," according to Rowley, Aboussouan, and Badr (2000). These tools' utilities will be proven only after their broad application to large, randomly selected groups (coupled with polysomnography as the gold standard for diagnosis and exclusion) regardless of any *a priori* bias.

Our screening tool incorporates easy to obtain objective and subjective criteria which have been consistently shown in the literature to be predictive of SDB. These criteria incorporate BMI, presence of hypertension (Flemons, et al; 1994), and heavy snoring. It is our belief that most SDB individuals will admit to a history of heavy snoring even while consciously concealing symptoms of daytime hypersomnolence. The utility of our tool also relies on corporate-promoted education of nurses, physical therapists, and contracted physicians to inquire and recognize subjective cues a driver might offer suggesting an underlying sleep disorder. Additionally, medical reviews of an obese driver's co-morbidities, such as diabetes or heart disease, may trigger a referral for a sleep study. This latter fact may account for the low negative predictive value of our tool. The recent article by Gurubhagavatula, et al (2004) suggests that coupling nocturnal oximetry to certain screened subgroups will improve specificity. Nevertheless, in a population where SDB is so prevalent, the positive predictive value of our tool at 91% represents an important and inexpensive aid in identifying affected drivers.

One of the most dramatic and significant results of our study is the documented reduction in global health care costs derived from the treatment of SDB drivers. After CPAP intervention, affected SDB patients experienced roughly one fourth as many hospital admissions and spent about one half the health care dollars compared with the period prior to intervention. These per member per month (PMPM) savings are large, ranging from $433.59 to $666.53 per month. When coupled with the fact that at least 10%, and perhaps closer to 28% of a commercial carrier's drivers have SDB, annual savings in health care costs alone become staggering. For example, using the most conservative figures of a 10% prevalence for SDB and a $433.59 per month per SDB-treated driver, a company employing 1000 drivers can expect annual health cost savings of over $500,000. Larger companies, such as SNI, can expect annual savings in the millions of dollars implementing programs designed to identify and treat their SDB drivers.

Our results demonstrating these huge savings are consistent with the few previous studies published in this regard. From Canada, a study published by Kryger, et al (1996) showed that severe sleep apnea patients generated twice as much expenditures from physician claims than a comparable matched group of controls without sleep apnea. In that report, hospital stays were nearly three times greater in the sleep apnea patients compared to matched controls. Bahammam, et al (1999) extended these findings showing a 57% reduction in hospital stays in pre-versus-post sleep apnea treated patients. Interestingly, our findings of a 73% reduction in hospital admissions and an approximate 50% reduction in global health care spending closely match these Canadian studies.

Significant reductions in health care utilization and costs gained from CPAP treatment of SDB highlights the increasingly recognized interplay between this condition and the major health risk concerns encountered in commercial drivers. First and foremost is cardiovascular disease which remains the number one killer in America. It is estimated by the American Heart Association (2004) that 70 million Americans have some form of cardiovascular disease. Hypertension is a major risk factor for heart disease and afflicts 65 million Americans. Both of these conditions, as well as diabetes and obesity, represent major health expenditures for the commercial carrier. Appropriate treatment of SDB has been shown to ameliorate these conditions. Kryger et al (2005) cites data showing an increased insulin level in sleep apnea independent of weight and central obesity. They further state that CPAP improves insulin sensitivity in type 2 diabetes mellitus. Campos-Rodriguez, et al (2005) has found that the trend in excess mortality in SDB patients was attributable to poor compliance with CPAP therapy and the presence of hypertension. Anecdotally, many physicians who treat SDB patients with co-existing hypertension have witnessed significant reductions in their patients' blood pressure with CPAP therapy. These associations between SDB and other medical conditions are continually refined and expanded, offering numerous reasons why CPAP therapy of SDB results in significant health cost savings.

Our study suggests that most drivers treated for SDB with CPAP are compliant and they generally rate their quality of life as improved with therapy. Future studies should explore productivity measures in drivers before and after therapy. Our finding of a 73% reduction in preventable accidents highlights the societal, as well as the financial value of identifying and treating commercial drivers with SDB. According to the 1999 FMCSA study, the average cost per large truck crash involving a fatality in 1999 was $3.54 million, and involving an injury was $217,005. Preventing just a single major accident can avoid millions of dollars in claims and enhances our society's welfare. As Friedman (2005) states in his popular novel, The World is Flat, "The bottom line is that a growing number of companies have come to believe that moral values…can help drive shareholder values….In sum, we are now in a huge transition as companies are coming to understand not only their power in [the] world but also their responsibilities." Indeed, SDB-treated drivers at SNI are demonstrating high retention rates, perhaps reflecting a heightened level of satisfaction with their employer.

Commercial carriers who embrace the widespread identification and treatment of drivers afflicted with SDB should be commended by society and government for their efforts in reducing the risk for large truck accidents. Programs already underway to identify and treat sleep apnea will save lives and millions of dollars in liability costs. These forward thinking companies are pursuing their programs without a specific federal mandate to do so. In time, these same companies will enjoy reduced employee health care costs. Their drivers will have been screened for possible SDB and treated when indicated. Their drivers will be more alert and healthier. Those same commercial carriers will be rewarded financially through lower health care costs, lower liability premiums, and drivers anxious to work for a company considerate of their well-being.

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