Screening for Obstructive Sleep Apnea in Commercial Vehicle Operators

Indira Gurubhagavatula, MD, MPH
Assistant Professor of Medicine
University of Pennsylvania Medical Center
Director, Sleep Disorders Clinic
Philadelphia VA Medical Center

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Alexandria, VA

My Background
- FMCSA-funded study of commercial drivers
  - Screening for sleep apnea
  - Laboratory measures of sleepiness
- NIH – NIOSH/CDC-funded study of screening for sleep apnea in commercial drivers
  - In progress
- Screening commercial vehicle operators for sleep apnea

Jackson, Tennessee, July 26, 2000

Tennessee State Trooper Killed
Driver of Chevy Blazer Seriously Injured

Timeline of Events Leading to Crash

Outcome
- Pleased guilty to
  - vehicular homicide by recklessness
  - aggravated assault with a deadly weapon
- Driver and company responsible for paying $3.25 million judgment to trooper’s family

Outline
- Symptoms, prevalence, risk factors
- Consequences
- Diagnosis
- Treatment
- Industry initiatives
- Available guidelines
- Recommendations
WHAT IS SLEEP APNEA?

Recurrent stops in breathing (apneas) or decrements in airflow (hypopneas) during sleep.

Fall in oxygen level (hypoxia)
- high blood pressure
- heart attack
- stroke

Arousal from sleep
- Neuro-cognitive effects
  - SLEEPINESS
    - crash risk

SYMPTOMS OF OSA

DURING SLEEP
- loud snoring
- choking during sleep
- gasping/snorting
- witnessed apneas
- nighttime urination

DURING WAKEFULNESS
- sleepiness despite adequate sleep duration
- low mood, memory, concentration
- Reduced attention, reaction time
- Morning headache
- Impotence

worse with weight gain, alcohol

WHO IS AT RISK FOR OSA?

Airway crowding
- Central obesity
- Large tongue
- Jaw set back
- Large tonsils

Demographic
- Middle age
- Male gender
- Heredity
- Race
- Menopause

“Floppy” airway
- Alcohol
- Narcotics
- Sedatives
- Age
- Low thyroid function

Nose problems
- Deviated septum
- Polyps, allergies
- Smoking

EXAMPLE OF AN APNEA

OSA AND OXYGEN LEVEL DURING SLEEP
APNEA-HYPOPNEA INDEX

APNEAS + HYPOPNEAS
HOURS OF SLEEP

<table>
<thead>
<tr>
<th>Severity</th>
<th>AHI (events/hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>[0-5)</td>
</tr>
<tr>
<td>Mild</td>
<td>[5-15)</td>
</tr>
<tr>
<td>Moderate</td>
<td>[15-30)</td>
</tr>
<tr>
<td>Severe</td>
<td>&gt;=30</td>
</tr>
</tbody>
</table>

IS SEVERE SLEEP APNEA COMMON IN COMMERCIAL DRIVERS?

<table>
<thead>
<tr>
<th></th>
<th>FMCSA</th>
<th>AUSTRALIA</th>
<th>STANFORD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence AHI &gt;= 30 events/hour</td>
<td>4.7%</td>
<td>10.6%</td>
<td>10%</td>
</tr>
</tbody>
</table>

WHY IS APNEA SO COMMON IN COMMERCIAL DRIVERS?

Airway crowding
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- Polyps, allergies
- Smoking

BMI DISTRIBUTION IN TWO COHORTS OF CDL HOLDERS

CDL HOLDER SELF-REPORTS

<table>
<thead>
<tr>
<th></th>
<th>102 CDL HOLDERS</th>
<th>250 VETERANS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slight</td>
<td>25 (24.5%)</td>
<td>22 (9.1%)</td>
</tr>
<tr>
<td>Moderate</td>
<td>4 (3.9%)</td>
<td>5 (2.1%)</td>
</tr>
<tr>
<td>High</td>
<td>0 (0%)</td>
<td>4 (1.7%)</td>
</tr>
</tbody>
</table>

Accidents
- Ever 68 (67%)
- Single-vehicle 13 (13%)
- Sleepy 4 (3.9%)

WHY IS OSA IN COMMERCIAL DRIVERS OF PARTICULAR IMPORTANCE?
I. Gurubhagavatula

8/29/2011

ESTIMATES OF OBJECTIVELY MEASURED SLEEPINESS IN COMMERCIAL DRIVERS

PACK ET AL, AJRCCM 174(4): 446, 2006

ESTIMATED LAPSES DURING PSYCHOMOTOR VIGILANCE TESTING IN COMMERCIAL DRIVERS

PACK ET AL, AJRCCM 174(4): 446, 2006

ESTIMATED DIVIDED ATTENTION DRIVING ERRORS IN COMMERCIAL DRIVERS

PACK ET AL, AJRCCM 174(4): 446, 2006

SLEEPINESS AND CRASHES IN CMV OPERATORS

Sleepiness has been attributed to:

- 31-41% of crashes of commercial vehicles
- 1500-2000 deaths/year
- For each fatality, there are 25 injuries
- For each accident resulting in injury, there are 3.7 crashes with property damage

SLEEP STUDY

- Brain waves
- Eye movement
- Chin, leg muscles
- Chest and abdomen effort
- Airflow, snoring
- Oxygen level

85% of cases remain undiagnosed

COST OF CMV CRASHES (2008 DOLLARS)

<table>
<thead>
<tr>
<th></th>
<th>Property Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>$23 billion</td>
</tr>
<tr>
<td>Injury</td>
<td>$20 billion</td>
</tr>
<tr>
<td>Only</td>
<td>$5 billion</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$48 billion</td>
</tr>
</tbody>
</table>

Non-fatal crash: $91,112/crash

Fatal crash: $3.6 million/crash

PORTABLE SLEEP STUDY

Brain waves
Eye movement
Chin, leg muscles
  • Chest and abdomen effort
  • Airflow, snoring
  • Oxygen level

USEFULNESS OF SCREENING TOOLS IN PREDICTING SEVERE APNEA IN 57 CDL HOLDERS

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Neck circumference</th>
<th>BMI</th>
<th>Oximetry</th>
<th>Self-assembled study</th>
<th>Full sleep study</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUC</td>
<td>0.68</td>
<td>0.72</td>
<td>0.91</td>
<td>0.96</td>
<td>1</td>
</tr>
<tr>
<td>N</td>
<td>57</td>
<td>57</td>
<td>57</td>
<td>57</td>
<td>57</td>
</tr>
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*Area under receiver-operating characteristic curve

0.5 = poor, 1 = perfect

TREATMENT OF OSA: CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP)

WHAT ARE THE BENEFITS OF CPAP?

• Lowers crash risk
• Improves alertness
• Improves performance on driving simulator
• Lowers blood pressure
• Raises oxygen level
• Lowers AHI
• More efficient work performance
• Reduces health care costs

TREATMENT FOR OSA

• Wear CPAP during sleep (in berth)
• Lose weight
• Avoid sedatives, alcohol, narcotics
• Make sure nasal passages are open
• Follow safe driving habits
• Monitor blood pressure, heart health
Studies of crash risk in OSA patients showed that after treatment with CPAP:

- Crash risk dropped:
  - Risk ratio = 0.278, 95% CI: 0.22 to 0.35; P < 0.001
- Daytime sleepiness improved after one night
- Simulated driving performance improved within 2-7 days

**Data from 9 Studies Show that After CPAP,**

**Crash Risk Drops,**

<table>
<thead>
<tr>
<th>Rate</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbie</td>
<td>0.407</td>
</tr>
<tr>
<td>George</td>
<td>0.333</td>
</tr>
<tr>
<td>Fadley</td>
<td>0.090</td>
</tr>
<tr>
<td>Horstman</td>
<td>0.256</td>
</tr>
<tr>
<td>Schef</td>
<td>0.266</td>
</tr>
<tr>
<td>Yamamoto</td>
<td>0.036</td>
</tr>
<tr>
<td>Krieger</td>
<td>0.313</td>
</tr>
<tr>
<td>Casell</td>
<td>0.188</td>
</tr>
<tr>
<td>Engelman (Navy)</td>
<td>0.270</td>
</tr>
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TO RATES SIMILAR TO RATES IN THOSE WITH NO OSA

**Industry Initiatives:** Waste Management, Inc.

The Long-Term Health Plan and Disability Cost Benefit of Obstructive Sleep Apnea Treatment in a Commercial Motor Vehicle Driver Population

Determination of the health plan and disability cost benefit of CPAP treatment in OSA patients over time.

<table>
<thead>
<tr>
<th>CPAP vs No CPAP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Missed workdays</td>
<td>↓</td>
</tr>
<tr>
<td>Disability claimant rates</td>
<td>↓</td>
</tr>
<tr>
<td>Total health plan and disability costs</td>
<td>↓ $6,000 (41%)</td>
</tr>
</tbody>
</table>

**Industry Initiatives:** Schneider Trucking

N=348 drivers with OSA

- PMPM health care spending ↓ >$500 (47.8%) (p<0.001)
- Preventable driving accidents (225 FT-CPAP-treated drivers) ↓ 73%
- Driver retention rate, compared to 2004 global corporate rate ↑ 2.29 times

“CPAP as a treatment for sleep apnea yielded very high returns… produces both short and long-term savings and reduces hospitalizations.”

Don Osterberg, Sleep Apnea & Trucking Conference, BWI Airport, 5/12/2010

**Industry Initiatives:** JB Hunt

- Clinical trial in progress
- Partnered with two sleep provider groups to screen drivers for apnea
- Will assess:
  - Compliance
  - Health care costs
  - Accident rates

**How Do We Know Patients Are Using CPAP?**

**Monitoring Systems**
- Data cards
- SD cards
- Remote/wireless

**Reported Data**
- Hours of use
- Pressure level
- Residual apnea
- Mask leak

*Issues can be addressed in “real” time*
SCREENING AND MANAGEMENT GUIDELINES FOR OSA IN COMMERCIAL DRIVERS

TWO SETS OF GUIDELINES ARE AVAILABLE FOR SCREENING AND TREATMENT

- When to keep driver in-service
- Conditional in-service
- Out-of-service
- Diagnosis
- Treatment
- Reinstatement after out of service

FMCSA
TRI-SOCIETY TASK FORCE

ARE GUIDELINES ENOUGH?

Screened 456
Referred for PSG 53 (12%) 33 lost to follow up
OSA confirmed 20 (100%) 1
Demonstrated CPAP compliance

"Drivers identified by the consensus criteria have a high likelihood of OSA. Drivers' poor compliance with PSGs and OSA treatment support federally mandated screening of commercial drivers."

SUMMARY

- SLEEP APNEA IS COMMON IN COMMERCIAL DRIVERS
- CAUSES SLEEPINESS
- LINKED TO CRASHES
- CAN BE DIAGNOSED IN THE HOME

- CPAP TREATMENT IS INEXPENSIVE
- ACCESSIBLE
- REDUCES CRASHES AND LOWERS COSTS
- TRACKABLE IN REAL-TIME

TWO SETS OF GUIDELINES ARE AVAILABLE FOR SCREENING AND EVALUATING FITNESS FOR DUTY
NOT ENOUGH DRIVERS ARE GETTING HELPED

WHAT NEXT?

Hartenbaum, CHEST, 130:902, 2006
Parks, JOEM, 51 (3): 275, 2009

“Drivers identified by the consensus criteria have a high likelihood of OSA. Drivers’ poor compliance with PSGs and OSA treatment support federally mandated screening of commercial drivers.”
TIMELINE OF EVENTS LEADING TO CRASH


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QUESTIONS?