The Effect of Sleep Deprivation on Health & Productivity

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Learning Objectives

The Science
- Basic sleep/circadian biology

Contributing Factors
- Provide an understanding about different sleep disorders that impact the workplace

What Employers Can Do
- In depth review of the common sleep disorder—obstructive sleep apnea & impact on health care outcomes

Consequences of Interaction Between Sleep and Circadian Systems

- Alertness in morning following major sleep episode
- Become “sleepy” after lunch (1:00-3:00 PM) (siesta time)
- Alertness then returns even if individual does not sleep
- Early evening becomes forbidden time for sleep
- Sleepy again in late evening
- Sleep efficiency impaired if try to sleep at “alert clock times”

CLOCK SETS TIME WINDOW FOR SLEEP
Time of Occurrence of Fall-Asleep Crashes in Individuals Age 16-25 Years

Time of Occurrence of Fall-Asleep Crashes in Individuals Over 65 Years

Sleep Problems in the Workplace
• Chronic insufficient sleep
• Shift-work sleep disorders
• Insomnia
• Obstructive sleep apnea
Concurrent Session – Tuesday, July 19th
3:00 PM – 4:00 PM

Chronic Insufficient Sleep

But you don’t realize that you are getting worse.

Shift Work and Insomnia

- Shift-work sleep disorder
  - Difficult to sleep at “incorrect” circadian time

- Insomnia
  - Chronic difficulty initiating and sustaining sleep

The Cost of Sleep Lost

- In a typical good sleeper, the cost of lost productivity was approximately $1,293 per employee per year
  - Insomnia: $3,156 (144%)
  - Insufficient Sleep: $2,796 (116%)
  - At-risk: $2,319 (79%)

- Significant productivity lost due to:
  - Time management
  - Mental and interpersonal demands
  - Output demands
  - Physical job demands
How to Address This?

At the individual level

At the group level

At the system level

Obstructive Sleep Apnea

What is Sleep Apnea?

AWAKE

ASLEEP

Life with Sleep Apnea

Worse with weight gain

DAYTIME

• ↓ Productivity
• Absenteeism
• Sleepiness
• ↑ Crash risk
• ↑ Mood, memory, concentration, attention
• ↑ Reaction time
• Morning headache
• Impotence

LONG-TERM

• Hypertension
• Heart disease
• Stroke
• Pre-diabetes
• Death

NIGHTTIME

APNEAS, HYPOPNEAS (observed by others)

Snoring

Choking

Gagging

AROUSALS

ADRENALINE

LOW OXYGEN
We Have a Growing Problem

As obesity becomes more common, so does sleep apnea

<table>
<thead>
<tr>
<th>Year</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>2007-2010 (Peppard et al)</td>
<td>10%</td>
<td>3%</td>
</tr>
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</table>

In-Lab Sleep Study (Polysomnography)
- Brain waves
- Eye movement
- Chin, leg muscles
- Chest and abdomen effort
- Airflow, snoring
- Oxygen level

85% of cases remain undiagnosed

Ambulatory Sleep Study (Home Sleep Test)
- Chest and abdomen effort
- Airflow, snoring
- Oxygen level
Is Sleep Apnea Treatable?

Continuous Positive Airway Pressure (CPAP)

Effects of CPAP on Sleep and Oxygen Levels

Without CPAP
- Sleep fragmentation
- No N3, REM
- Low oxygen saturation

With CPAP
- Sleep consolidation
- REM rebound
- Slow wave sleep achieved
- Oxygen saturation restored

In Addition to Eliminating Breathing Pauses During Sleep and Improving Oxygen Level, What are the Benefits of CPAP?

- CPAP lowers:
  - health care costs¹,²,³
  - disability claims³
  - absenteeism³
  - workplace turnover⁴
  - crash risk⁴
  - blood pressure⁷,⁸

- CPAP improves:
  - quality of life⁵
  - alertness⁶
  - performance on driving simulator⁶

¹Albarrak, Sleep, 2005
²Ronald, Sleep Res Online, 1998
³Hoffman, JOEM, 2010
⁴Osterberg, Schneider Trucking, Sleep Apnea Trucking Conference, 2010
⁵Sanner, Eur Respir J, 2000
⁶Tregear, Sleep, 2010
⁷Haentjens, Archives Int Med, 2007
⁸Bazzano, Hypertension, 2007
How Do We Know Patients Are Using CPAP?

MONITORING SYSTEMS
- SD cards
- Remote/wireless

REPORTED DATA
- Hours of use
- Pressure level
- Residual Apnea-Hypopnea Index (AHI)
- Mask leak

Issues can be addressed in “real” time

Impact on Transportation

Major crashes indicate impact of insufficient sleep, diurnal time and sleep apnea

Metro North Rail Crash
- Driver of train did not adjust speed. Speeding at 82 MPH in a 30 MPH curve
- Driver stated he was “stupefied”
- Train derailed – 4 dead, 82 injured
- Driver has now been diagnosed with severe obstructive sleep apnea
Tracy Morgan Crash
- Driver of Wal-Mart truck struck the rear of limo Tracy Morgan was in
- Driver had been awake for more than 24 hours
- Had been driving for 9 hours, 37 minutes
- Was speeding at 65 MPH through work area (45 MPH limit)
- Comedian killed – Tracy Morgan seriously injured

O’Hare Rail Crash
- Driver fell asleep – train went up escalator
- Occurred at 2:52 AM – circadian low
- No deaths or serious injuries
- 32 minor injuries

Awake @ the Wheel
Business Issue

- Sleep impacts safety, productivity, health care costs
- Department of Transportation (DOT) physical
  - BMI assessment
  - Time impact on the business with our drivers out of the truck if sleep apnea testing was required
- Benefit coverage impact
  - New hires were ineligible for coverage
  - Cost prohibitive even for current EE's/recertification

Sleep Apnea Program - UPenn

- Target new hires with telehealth program in available states
- Speed to virtual assessment – ipad
  - @ home sleep study
- Follow-up & support
- Direct contract with UPenn Sleep Medicine Department
AmeriGas’ Pre-Penn Sleep Program

- Secondary internal review of all Commercial Driver License (CDL) occupational exam notes, focusing on risk of sleep disordered breathing
- At risk drivers must undergo sleep testing
- Diagnosed drivers must begin CPAP therapy and achieve minimum Department of Transportation (DOT) compliance before CDL is granted or recognized by AmeriGas
  - 4+ hours on at least 70% of nights over the last 30 days prior to the exam

The AmeriGas/Penn Sleep Pilot Program Goes Well Beyond Federal Guidelines

- Mandatory for all new hires in pilot states
  - 6-state pilot scope; expansion to 14 states in 2016/17
- Telemedicine Visits and Home Sleep Tests by mail
- Auto-adjusting PAP therapy with ongoing Care Management and mandatory compliance monitoring via wireless modem data
  - Non-compliant drivers are immediately removed from the truck until compliance is regained

Penn Sleep Providers Must Assess Risk Differently Compared to the Traditional Clinical Patient Encounter

- Patients frequently deny symptoms to avoid diagnosis
- Confirmed data on comorbidities is obtained from CDL exam notes
- Unless Provider can rule OUT risk with high confidence, home sleep test will be ordered
Home Sleep Testing Has Additional Challenges in a Mandatory Program

Successful Initial HSTs: 70%

Failed Initial HSTs: 30%

- High initial failure rate due to "patient error" or refusal to wear device
- Negative test results with high pre-test probability results in in-lab PSG, OR repeat HST using telemedicine chain of custody protocol

Patients Who Fail Initial HST Are More Likely to Show OSA on Second HST

| Initial HST, OSA+ | 34% no OSA |
| Initial HST, no OSA | 14% no OSA |
| Second HST, OSA+ | 14% no OSA |
| Second HST, no OSA | 14% no OSA |

- "Patient error" on the initial HST is a surprisingly accurate predictor of a positive diagnosis for sleep disordered breathing

The Care Team Proactively Coordinates All Activity to Enhance the Patient Experience

- Patient Need
- Resolution
- Proactive Compliance Outreach
- HAPPY AND COMPLIANT PATIENT
Results – First Year

- 100 home sleep test
- 73 cleared
- 55 OSA +
- 45 OSA -
- 43 set up with DME
- 12 in early stage of set up
- ALL are 100% compliant

Health Care Financial Impact

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<tr>
<th>Service</th>
<th>Cost</th>
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<tr>
<td>Average Cost/Driver (Initial Consult, HST, OSA &amp; Follow-up, 1 yr Case Management)</td>
<td>$580</td>
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<tr>
<td></td>
<td>173 drivers</td>
</tr>
<tr>
<td>Average Sleep Lab Cost</td>
<td>$2,500</td>
</tr>
<tr>
<td></td>
<td>173 drivers</td>
</tr>
<tr>
<td>Net Savings to Health Cost</td>
<td>($332,000)</td>
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Things We Learned

Mandatory programs will encounter resistance from many patients in the population…

Proactive patient management is crucial!

Compliance to therapy can be impacted from very first encounter with the patient…

Centralized coordination of care significantly and positively impacts the patient experience!
Tactical Learning

- Equipment/user failures
  - EE/Patient was not using the at home test correctly
- Durable medical equipment network & support can be challenging
- Health plans struggled with the pre-cert process
  - EE's in the program vs. Other EE's/Dependents who were not part of program
- Some employees need additional “convincing” the importance of what we are providing for them

**Health + Your Job = Your Livelihood**

What Employers Can Do

- Awareness/Education
  - Understand your population & work schedules
  - Provide opportunities to educate EE's on tips for better sleep/time management
  - Address the 24/7/365 culture without sacrificing productivity
  - Take advantage of the wearable device trend
- Assessment & Program Support
  - Partner w/3rd party vendors to assess & gather sleep data
  - Digital/Telehealth coaching support

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