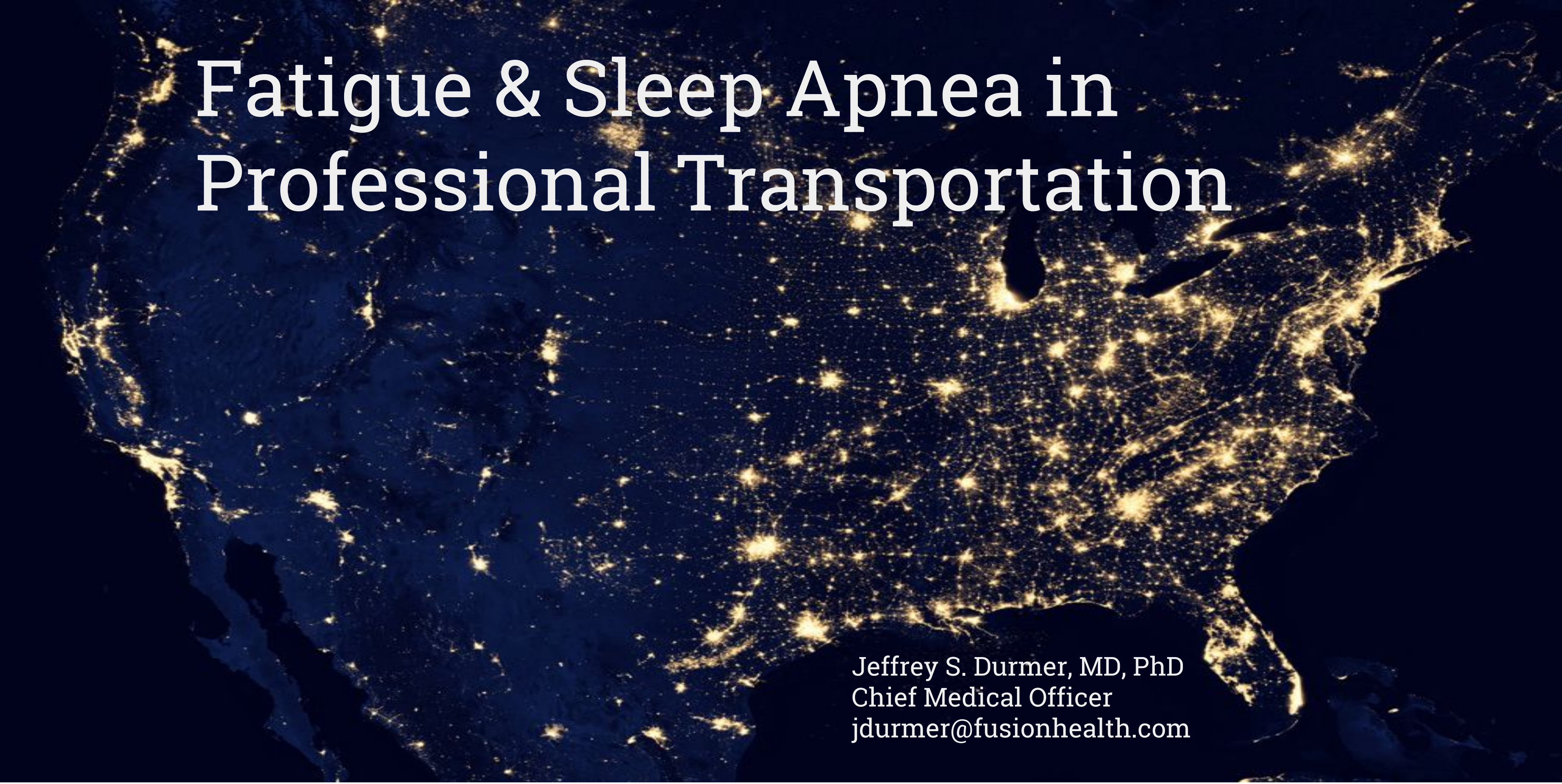


Fatigue & Sleep Apnea in Professional Transportation

Jeffrey S. Durmer, MD, PhD
Chief Medical Officer
jdurmer@fusionhealth.com

Overview

Fatigue
- the basics of human fatigue, driving metrics and the impact of sleep

Managing Fatigue
- the evolution of fatigue management

Sleep and Sleep Apnea
- the importance of sleep and the silent sleep apnea problem

Managing Sleep Apnea in a Professional Transportation Environment
- the present & future of sleep apnea policy, programs & outcomes

The Many Faces of Fatigue

Fatigue Is Defined By Its Effects on Behavior

FSS questionnaire

During the past week, I have found that:	Disagree						Agree
My motivation is lower when I am fatigued.	1	2	3	4	5	6	7
Exercise brings on my fatigue.	1	2	3	4	5	6	7
I am easily fatigued.	1	2	3	4	5	6	7
Fatigue interferes with my physical functioning.	1	2	3	4	5	6	7
Fatigue causes frequent problems for me.	1	2	3	4	5	6	7
My fatigue prevents sustained physical functioning.	1	2	3	4	5	6	7
Fatigue interferes with carrying out certain duties and responsibilities.	1	2	3	4	5	6	7
Fatigue is among my three most disabling symptoms.	1	2	3	4	5	6	7
Fatigue interferes with my work, family, or social life.	1	2	3	4	5	6	7

VAS for fatigue questionnaire

How much fatigue are you having now?

0	1	2	3	4	5	6	7	8	9	10
No fatigue										Worst possible fatigue

Fatigue Is Measured By Reduced Function & Impaired Abilities

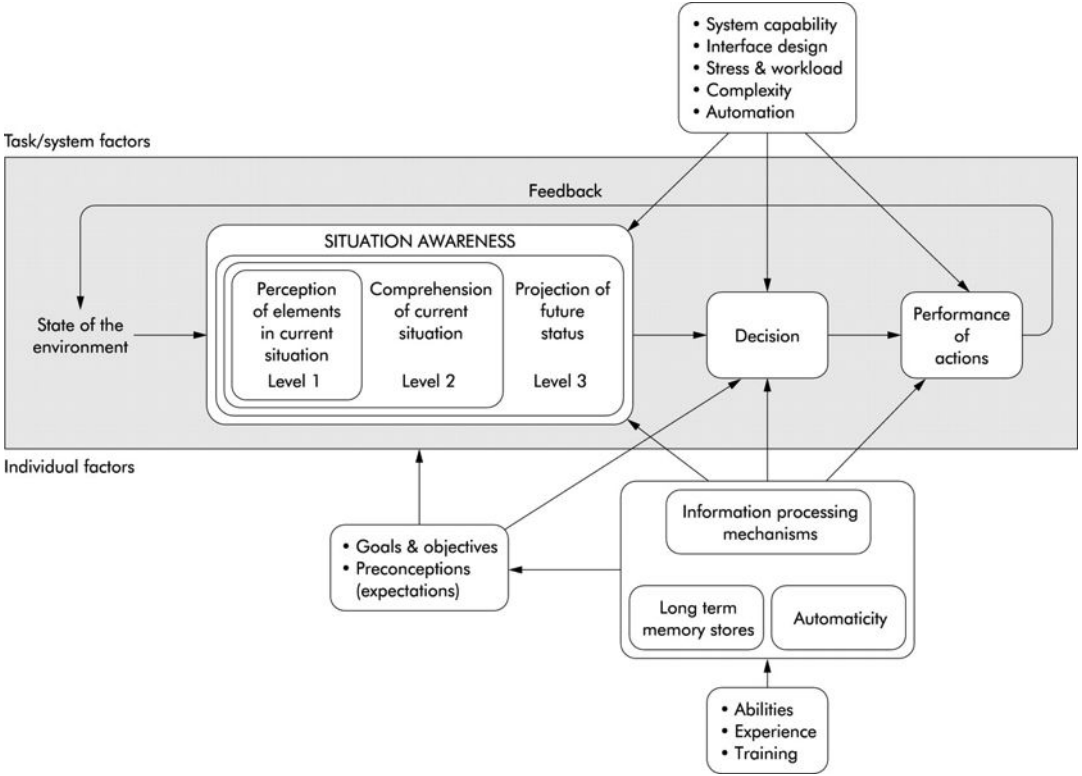
Fatigue Reduces

- Mood & Motivation
- Physical Performance
- Attention & Awareness
- Problem Solving
- Creativity
- Resilience
- Learning & Memory
- Physical & Mental Health

Fatigue Impairs

- Judgement
- Productivity
- Communication
- Quality of Life
- Socialization
- Leadership
- Emotional Regulation
- Safety

Measuring Human Fatigue: Model of Situational Awareness

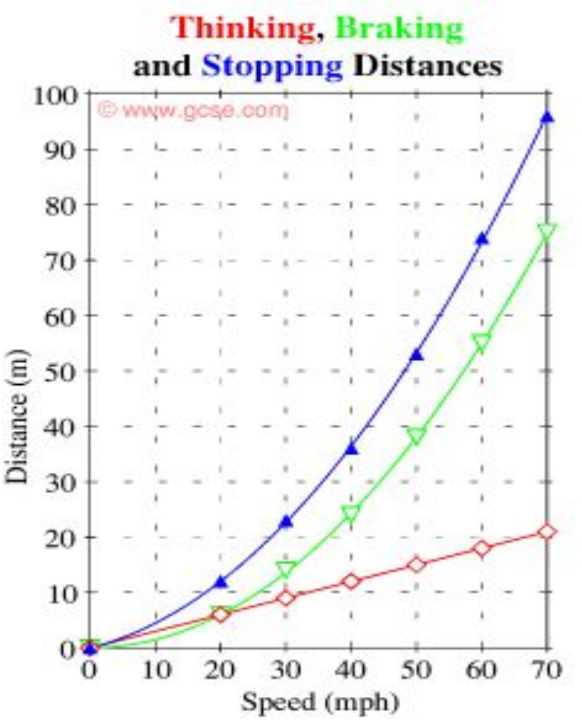


Focus is on the Task

Focus is *During* the Task

Model of Situational Awareness in Dynamic Decision Making (Endsley, 1995)

Current Fatigue Detection During a Driving Task



Fatigue Risk Detection Moving to Pre-Task Prediction

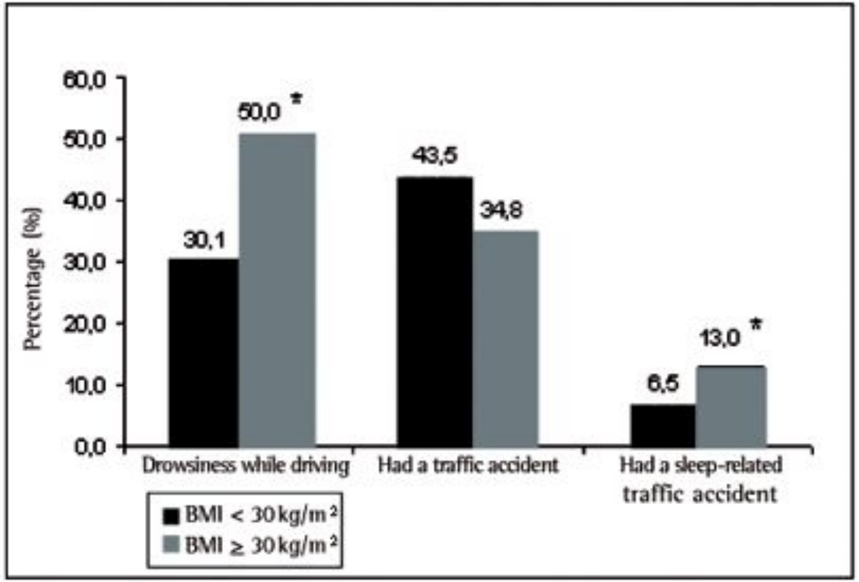


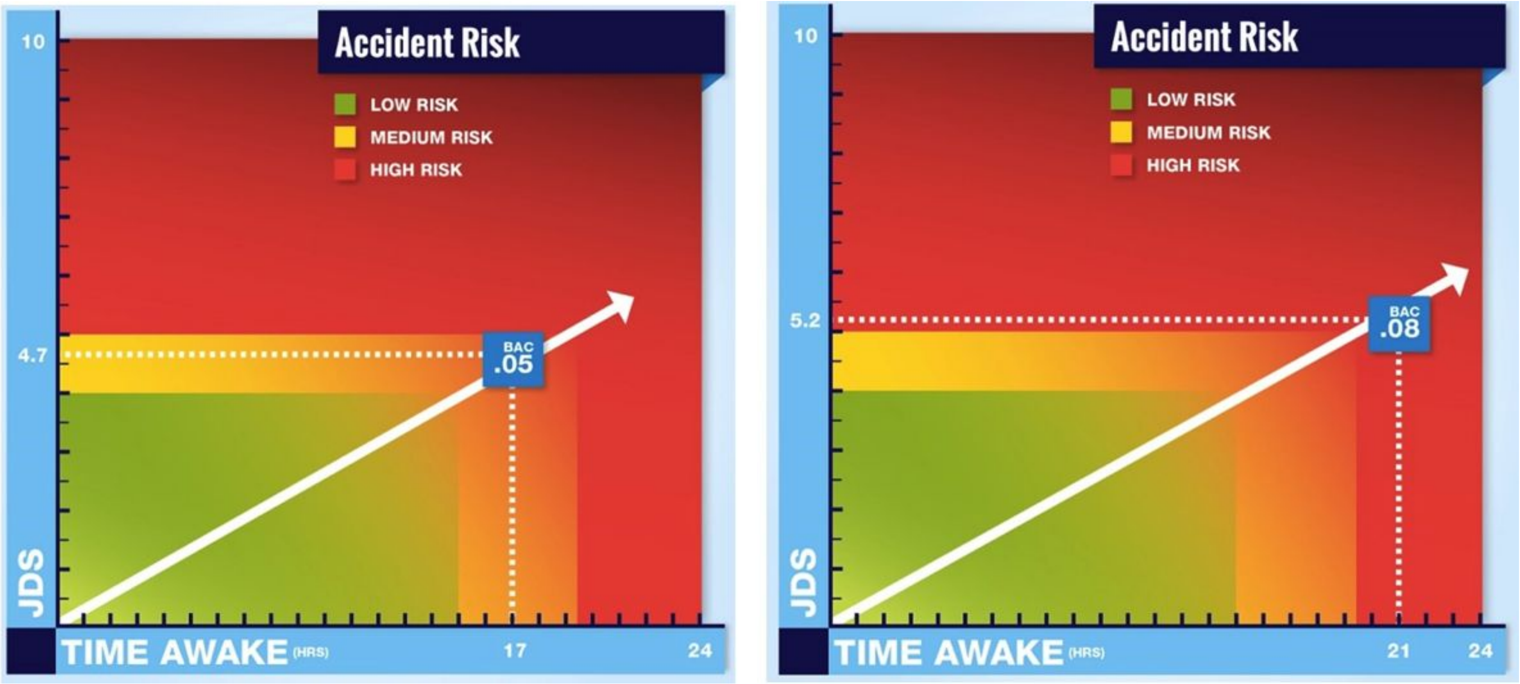
Figure 3 - Drivers divided according to sleepiness, number of accidents and BMI, in percentages $p < 0.05$; BMI: body mass index

Focus on the Person *Before* the Task

Biometrics Predict & Prevent the Risk for Situational Awareness-Related Accidents

Viegas, Carlos Alberto de Assis, & Oliveira, Haroldo Willuweit de. 2006. Prevalence of risk factors for obstructive sleep apnea syndrome in interstate bus drivers. J Brasileiro de Pneumologia, 32(2), 144-149

Accident Prediction Equivalents Between Sleepiness & EtOH



Williamson AM and Feyer AM. Moderate sleep deprivation produces impairments in cognition and motor performance equivalent to legally prescribed levels of alcohol intoxication. Occup Environ Med 2000;57:649-55

Accident Prediction Equivalents Between Sleepiness & EtOH

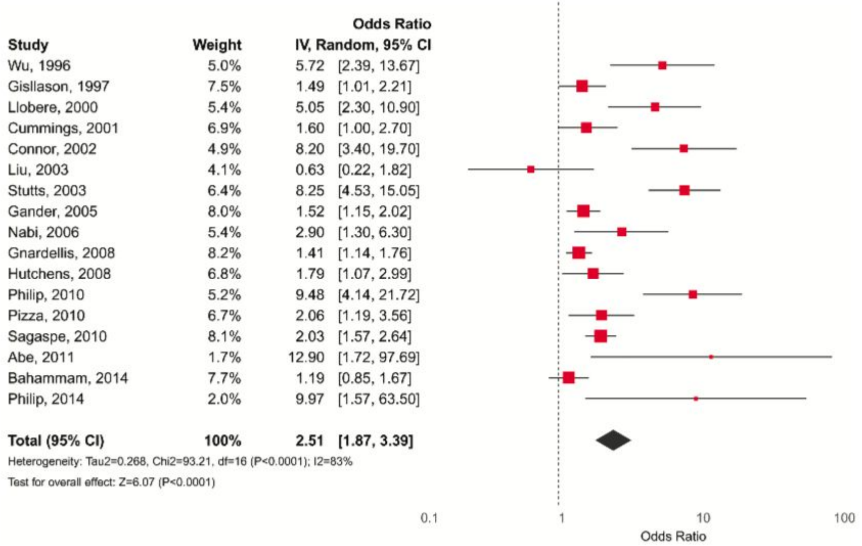


Table. Factors Associated With the Driver Being Responsible for a Serious Crash (Multivariate Analysis)

Factor	Adjusted OR (95% CI)
Age, y	
18-29	1.80 (1.08-2.87)
≥30	1 [Reference]
Type of vehicle	
Car	2.30 (1.33-3.97)
Other	1 [Reference]
Did you drink alcohol on the day of the crash?	
No	1 [Reference]
Yes	2.39 (1.36-4.21)
How sleepy were you during the 15 minutes before the crash?	
"Feeling active, vital, alert, or wide awake" to "Functioning at high levels, but not at peak; able to concentrate "	1 [Reference]
"Awake, but relaxed; responsive but not fully alert" to "Asleep"	2.00 (1.05-3.81)
Use of medicinal drugs before the crash	
No	1 [Reference]
Yes without pictogram	0.46 (0.25-0.86)
Yes with pictogram (DADAs)	0.58 (0.29-1.15)

Abbreviations: DADAs, drugs affecting driving ability; OR, odds ratio.

2017 meta-analysis of 17 studies from 5 continents with more than 70,000 drivers over a 20 years period showed an overall 2.66x increased risk of motor vehicle accidents due to sleepiness

Alcohol Use & Sleepiness are Equivalent Risk Factors for a Crash
2.39x vs 2.66x Increased Risk

Blazejewski S, Girodet PO, Orriols L, Capelli A, Moore N, for the CESIR Group. Factors associated with serious traffic crashes: a prospective study in SW France. Arch Intern Med. 2012;172(13):1039-41; Bioulac S et al., Risk of motor vehicle accidents related to sleepiness at the wheel:a systematic review and meta-analysis. Sleep. 2017;40(10): http://dx.doi.org/10.1093/sleep/zsx134

Managing Fatigue

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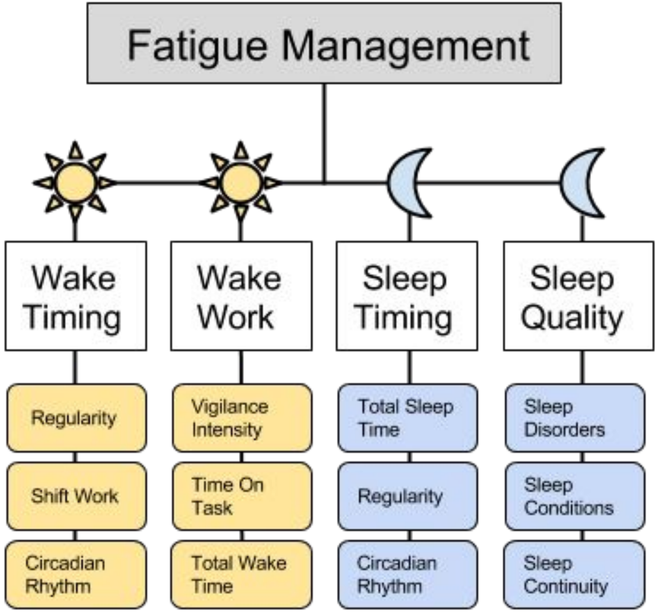
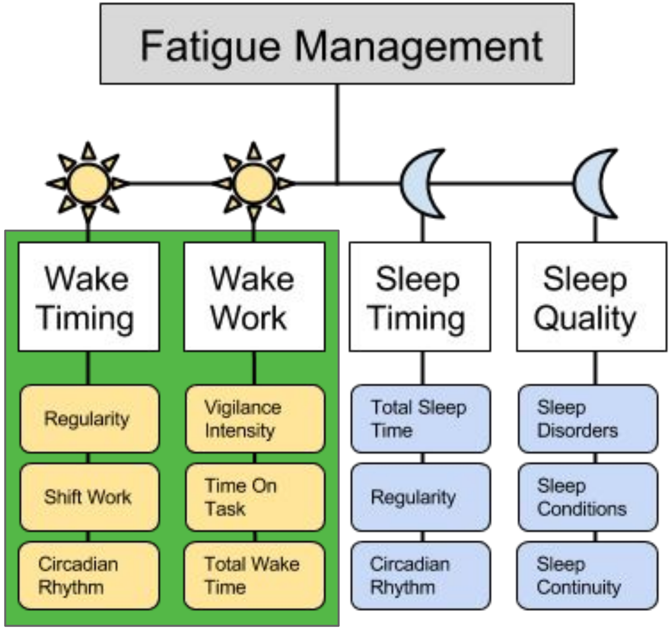
24 Hour Cycle of Fatigue Management



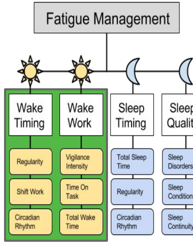
Placing the focus on Wake & Sleep periods that predict Human Performance

24 Hour Cycle of Fatigue Management



The Wake period of Human Performance

24 Hour Cycle of Fatigue - Wake Period



Regular Cues

Light activates wake promoting brain regions, shuts down sleep circuits, causes cortisol release
Determines work performance maximums/minimums

Accentuate wake cues – light activation for consistent cortisol release; routine wake behaviors & pharmacotherapy as required to accentuate circadian timing

Shift Work & Extended Hours

Consistency of wake/sleep patterns predict regular circadian entrainment to environmental cues
Off-circadian work increases accidents, health complications and productivity costs

Maintain regular circadian entrainment to environmental cues by limiting variability. Use multiple sleep neurobiological strategies to combat shift work sleep loss such as pre-shift light therapy, regulating off-shift wake periods, post-shift wavelength filtering glasses & pharmacotherapy. Provide recovery performance naps for Off-Circadian work hours

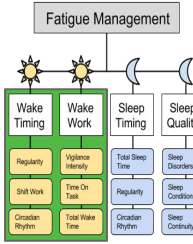
Circadian Rhythms

Inherited biological rhythms for sleep and wake *predict* periods for optimal wake and sleep performance

Determine circadian variability of individuals to predict and avoid potential timing conflicts with biological rhythms

Van Dongen HP & Dinges DF, Clin Sports Med, 2005;24(2):237-49; Van Dongen HP, Chronobiol Int, 2006;23(6):1139-47; Mollicone DJ et al. Aviat Space Environ Med, 2010; 81(8):735-44; Waggoner LB et al., SLEEP, 2012;35(11):1575-7; Griefahn B & Robens S, Eur J Appl Physiol, 2010;108(4):719-26; Goel N et al., Prog Mol Biol Transl Sci, 2013;119:155-90; Bolvin DB et al., Chronobiol Int, 2012;29(5):629-40; Wilhelmsen-Langeland A et al., J Biol Rhythms, 2013;28(5):306-21; Gulyani S et al., Chest. 2012;142(6):1659-68; Giannotti F et al., J Sleep Res, 2002;11(3):191-9; Roenneberg T et al., Sleep Med Rev, 2007;11(6):429-38; Matsumoto, K and M Harada. 1994. The effect of night-time naps on recovery from fatigue following night work. Ergonomics 37:899-907

24 Hour Cycle of Fatigue - Wake Period



Vigilance Intensity

Psychomotor energy required to maintain attention without omission or commission errors

Measure the psychomotor energy required to avoid over-exposure and fatigue
Rate intensities and implement controls to avoid fatigue

Time on Task

Continuous behavior or attention increases physical and psychological fatigue

Create attention breaks to enhance physical and psychological performance based on vigilance intensity ratings

Total Wake Time

Sustained wake predict performance lapses - after 15 hours of wakefulness, performance degrades to levels equal to alcohol intoxication

Total wake periods should be maintained below 15 hrs; initiate sleep recovery strategies including napping, sleep banking and recovery sleep
Designate compensatory medical and OTC preparations for use

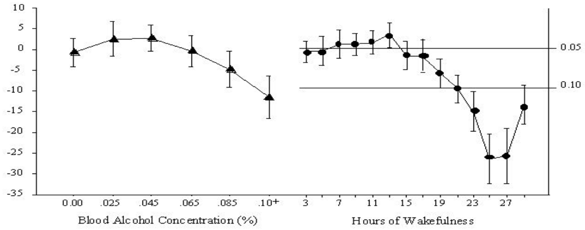
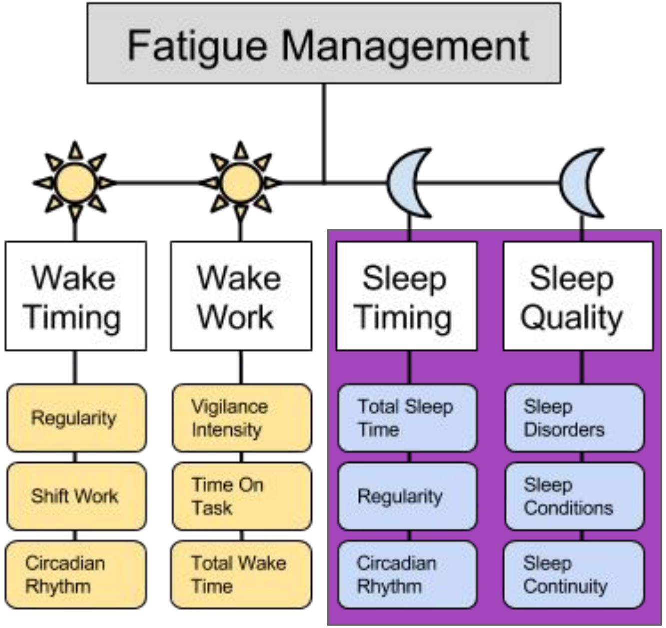


FIG. 1. Mean relative performance levels for the response latency component of the grammatical reasoning task in the alcohol intoxication (left) and sustained wakefulness condition. The equivalent performance decrement at a BAC of 0.05% and 0.10% are indicated on the right hand axis. Error bars indicate ± one s.e.m.

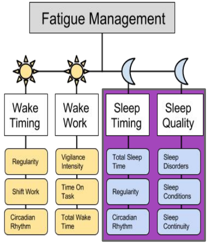
Van Dongen HP et al., SLEEP, 2003;2:117-26; Raslear TG, et al., Prog Brain Res, 2011;190:155-67; Akerstedt T et al., Aviat Space Environ Med, 2004;75(3Supp):A75-83; Sauter C et al., Sleep Med, 2013;14(6):542-8; Goel N et al., Prog Mol Biol Transl Sci, 2013;119:155-90; Dawson D & Reid K, Nature, 1997;388; Basner M & Dinges DF, SLEEP, 2012;35(2):193-202; Banks S et al., SLEEP, 2010;33(8):1013-26; Vgontzas AN et al., Am J Physiol Endocrinol Metab, 2007;292(1):E253-61;Wesnes KA et al., Appetite, 2013;67:105-13; Repantis D, Pharm Res, 2010; 62(3)187-206; Hartley SL et al., Neurophysiolo Clin, 2013;43(3):161-9; Rupp TL et al., SLEEP, 2009;32(3):311-21; Kamdar BB et al., Sleep Med, 2004;5(5):441-8; Belenky et al., J Sleep Res, 2003;12(1):-12

24 Hour Cycle of Fatigue Management



The Sleep period of Human Performance

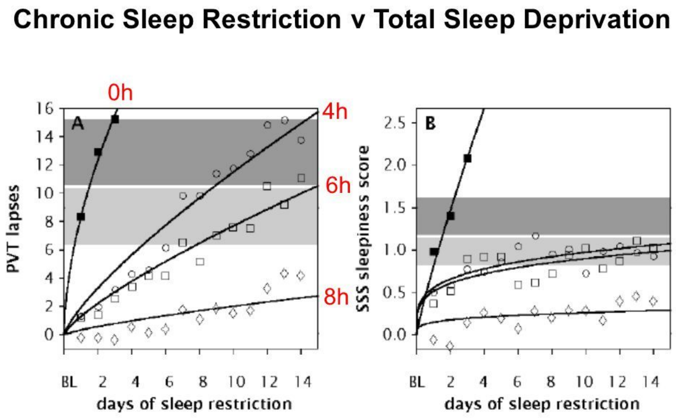
24 Hour Cycle of Fatigue - Sleep Period



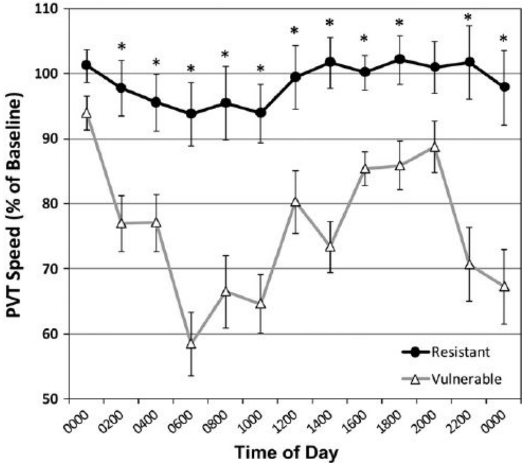
Total Sleep Time

Chronic partial sleep loss impacts cognitive and motor systems that determine performance
Total Sleep Time (including performance naps) is directly related to energy balance

Schedule work-related activities that allow sleep opportunities of 7-9 hours
Provide incremental 30 min performance naps for extended work schedules and shift-work schedules

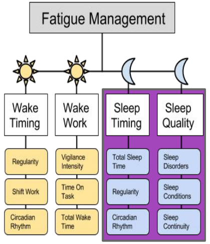


Van Dongen et al, Sleep, 2003



Durmer JS & Dinges DF, Semin Neurol, 2005;25(1):117-29; Banks S & Dinges DF, J Clin Sleep Med, 2007;15(5):519-28; Fernandez-Mendoza J et al., SLEEP, 2010;33(4):459-65; Smith MR et al., SLEEP, 2009;32(11):1481-9; Shekleton JA et al., J Clin Sleep Med, 2013;9(4):353-62; Goel N et al., Prog Mol Biol Transl Sci, 2013;119:155-9; Crowley SJ et al., SLEEP, 2004;27(6):1077-87; Niu SF et al., J Nurs Res, 2011;19(1):68-81); Killgore WDS et al., Executive Functions and the Ability to Sustain Vigilance During Sleep Loss. Aviation Space and Envir Med. 2009;80: 81-7; Van Dongen HP et al., SLEEP, 2003;2:117-26

24 Hour Cycle of Fatigue - Sleep Period



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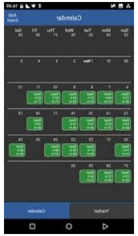
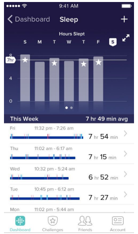
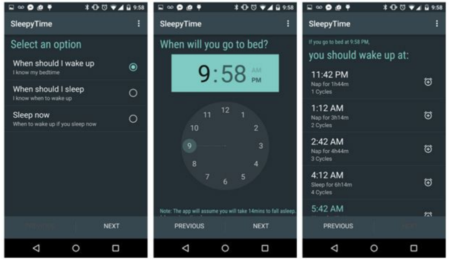
Regularity of Sleep Schedule

Routine sleep-conducive behaviors, environments and timing for sleep periods enhance the recovery function of sleep and directly impacts wake performance

Educate workforce on proper sleep behaviors, timing and effects
Measure sleep/wake timing with technology and utilize incentives for outcomes
Light treatment/avoidance therapies for off-circadian work shifts and pre-shift preparation







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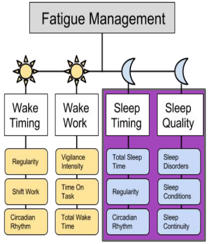

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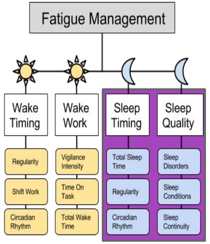
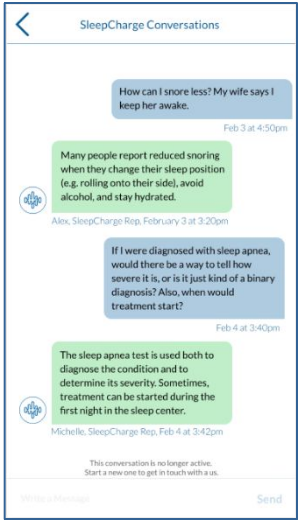
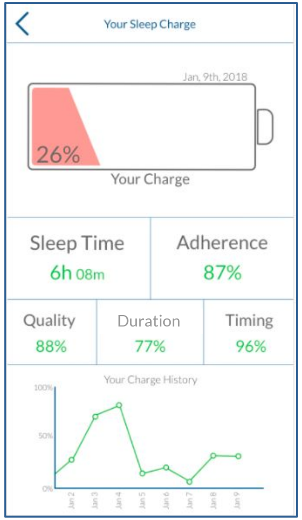


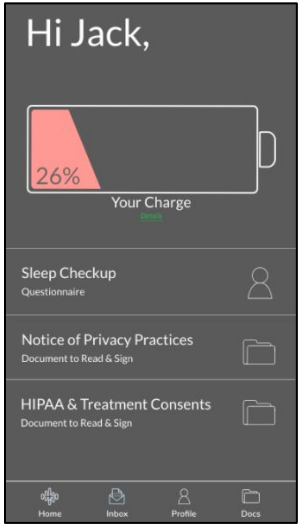
Sleep Disorders

Over 80 different sleep disorders & 80% of people with them are undiagnosed and untreated
Common Sleep Disorders contribute to disease, reduced vitality, lost productivity and accidents

Technology -enabled population risk assessments, tele-diagnostics & treatment with continuous care







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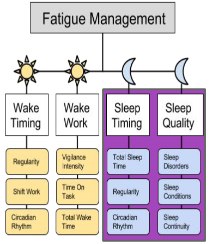
24 Hour Cycle of Fatigue - Sleep Period



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Sleep Conditions

Environmental noise, temperature, light and comfort impact both sleep quality and quantity
Medical & non-medical problems like pain, anxiety, depression and stress interfere with sleep

Educate workforce on sleep environments and provide workplace napping/sleep choices that utilize these characteristics
Provide connectivity to non-medical and ancillary medical treatments for sleep disrupting problems

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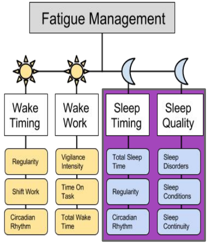

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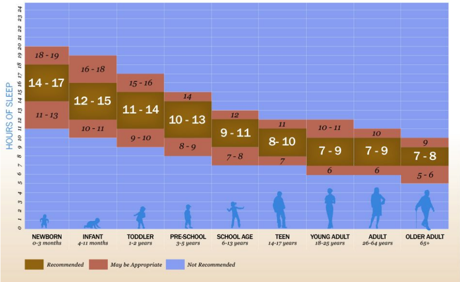
Sleep Continuity

Fragmented sleep and inadequate sleep duration due to multiple physical and psychological conditions impair sleep cycles required for health, cognitive and mood benefits

Educate workforce on sleep duration requirements, and provide support for sleep with family sleep support services, childhood/parenting sleep training, and integration of sleep solutions for existing condition & wellbeing management programs



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Sleep & Sleep Apnea

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The Elements of Good Sleep

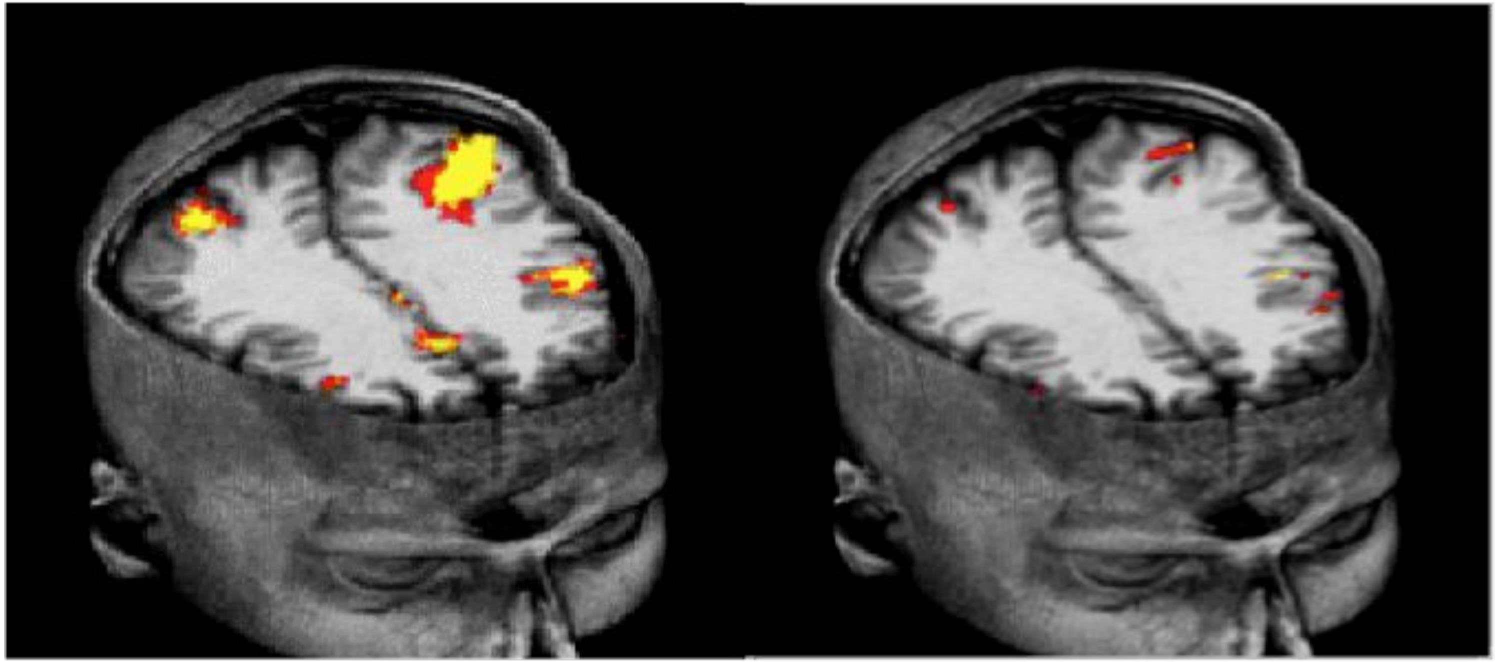
Sleep Duration

Sleep Timing

Sleep Quality

$$\left[\text{Sleep}_{\text{CHARGE}} = \frac{\text{Quality x Duration}}{\text{Timing (Variability)}}\right]$$

On Any Given Night … When the Brain Does Not Rest



Normal Activity & Preserved Performance

Loss of Activity & Loss of Performance

Adapted from Drummond S et al., NeuroReport 1999

Business Impact of Poor Sleep for US Employers

50% Less Productive

3.6X More Costly to the Health Plan

2.9X More Likely to Cause Workplace Accidents

2.2X More Likely to Take Extended Disability Leave

242% More Sick Days

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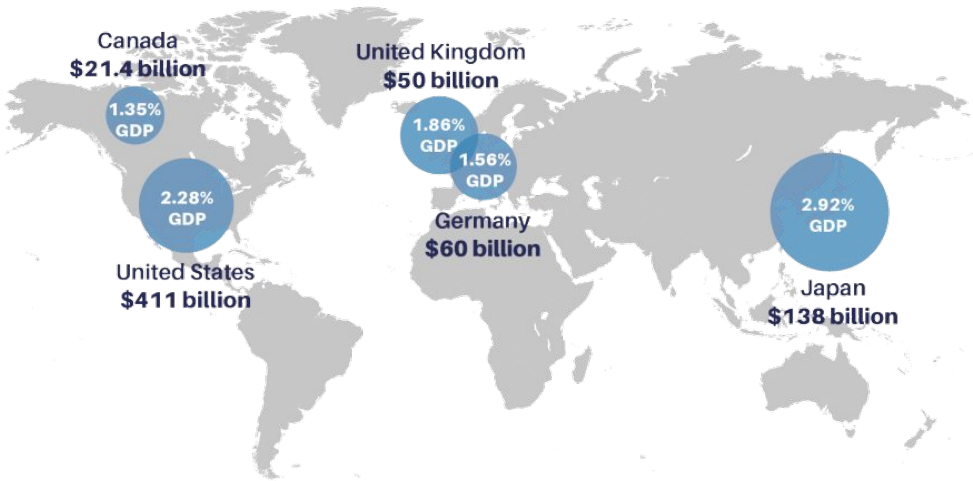
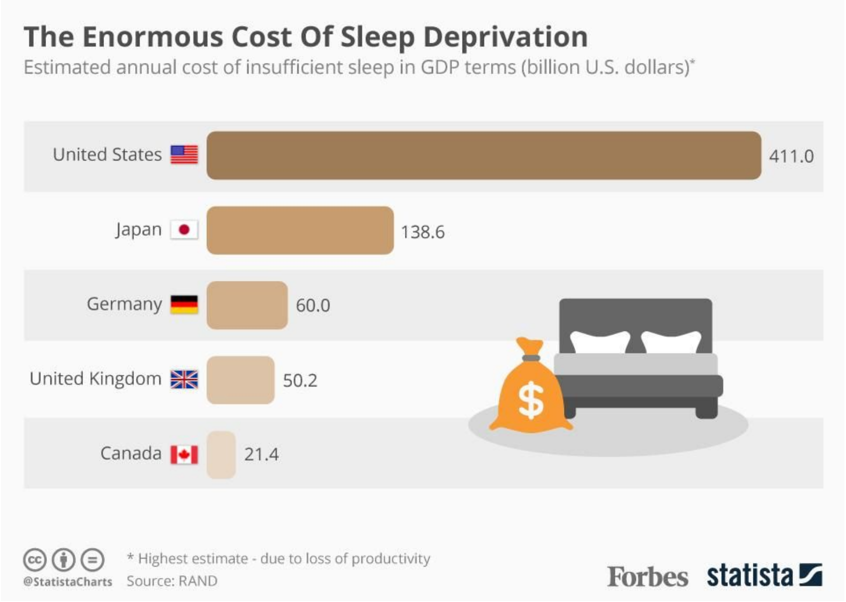
Source: Leger D et al., Impact of sleep apnea on economics. Sleep Med Rev 2010; Lallukka T et al., Sleep and sickness absence: a nationally representative register-based follow-up study. Sleep 2014; Sjosten N et al., Increased risk of lost work days prior to the diagnosis of sleep apnea. Chest 2009; Harvard Medical School & McKinsey Company: The price of fatigue report. 2010; Skaer TL, Sclar DA, Economic implications of sleep disorders. Pharmacoeconomics 2010. FusionHealth / HealthCare Data Partners Claims Database (n ~770,000)

Economic Impact of Poor Sleep for the World





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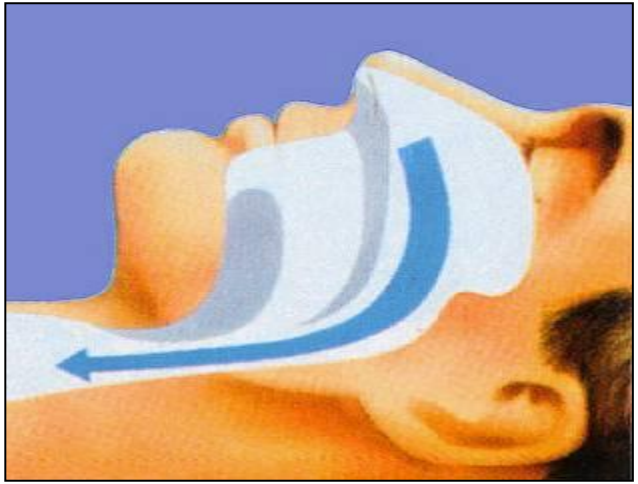
Leger D et al., Impact of sleep apnea on economics. Sleep Med Rev 2010; Harvard Medical School & McKinsey Company: The price of fatigue:the surprising economic costs of unmanaged sleep apnea. 2010; Skaer TL, Sclar DA, Economic implications of sleep disorders. Pharmacoeconomics 2010; https://www.rand.org/randeurope/research/projects/the-value-of-the-sleep-economy.html

The Most Commonly Diagnosed Sleep Condition: Obstructive Sleep Apnea (OSA)

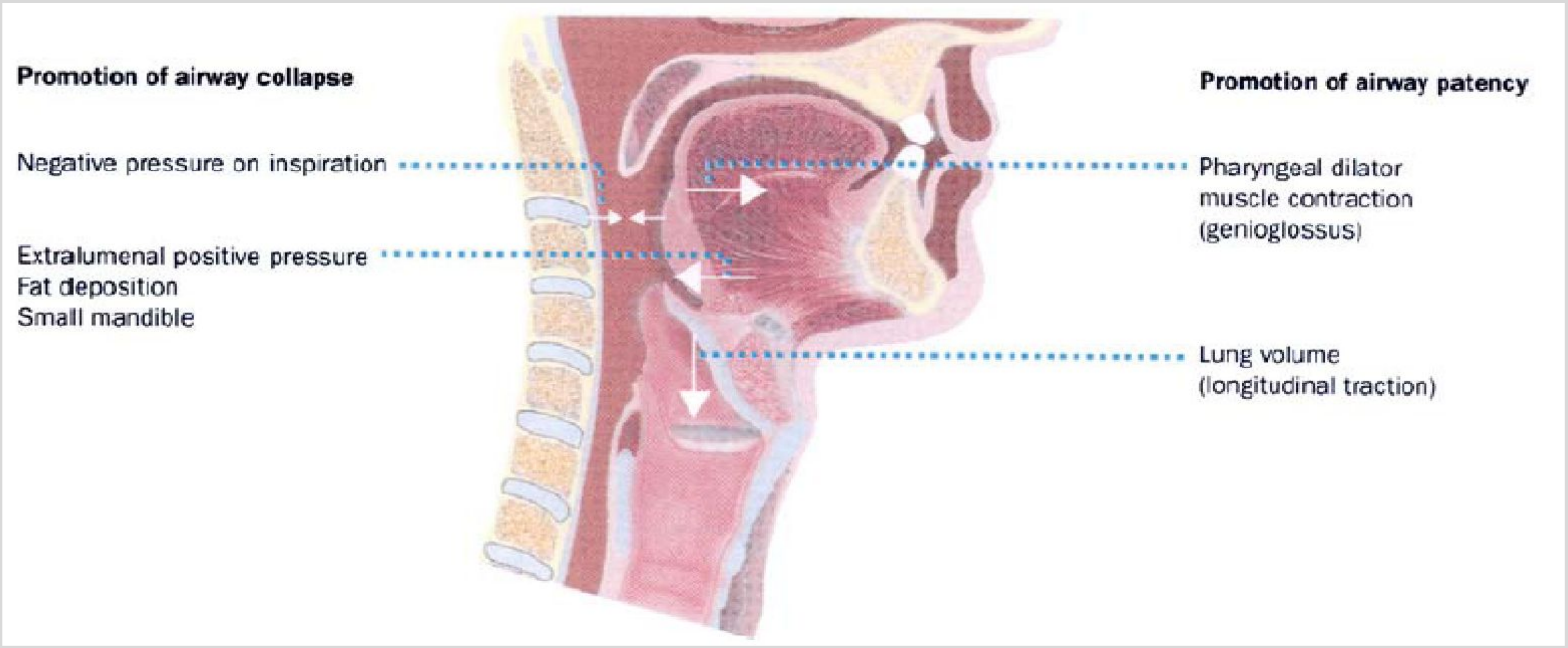


OPEN

OBSTRUCTED

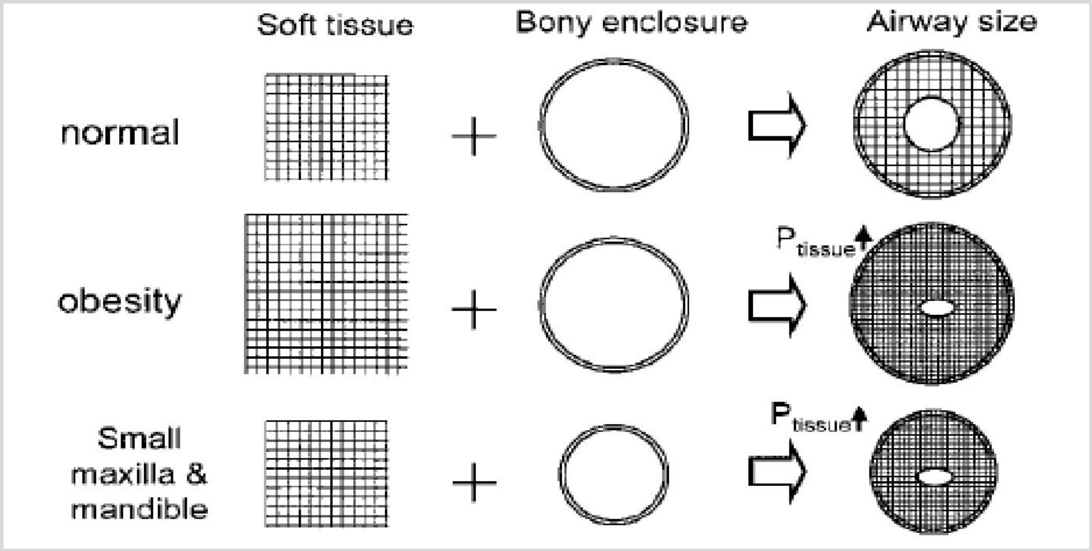
Apneas + Hypopneas / Hours of Sleep = **Apnea Hypopnea Index** (AHI)
(Normal ≤ 5/hr) (Mild = 5.1-14.9/hr) (Moderate 15-29.9/hr) (Severe ≥ 30/hr)

How Does OSA Happen & Why It Is So Common



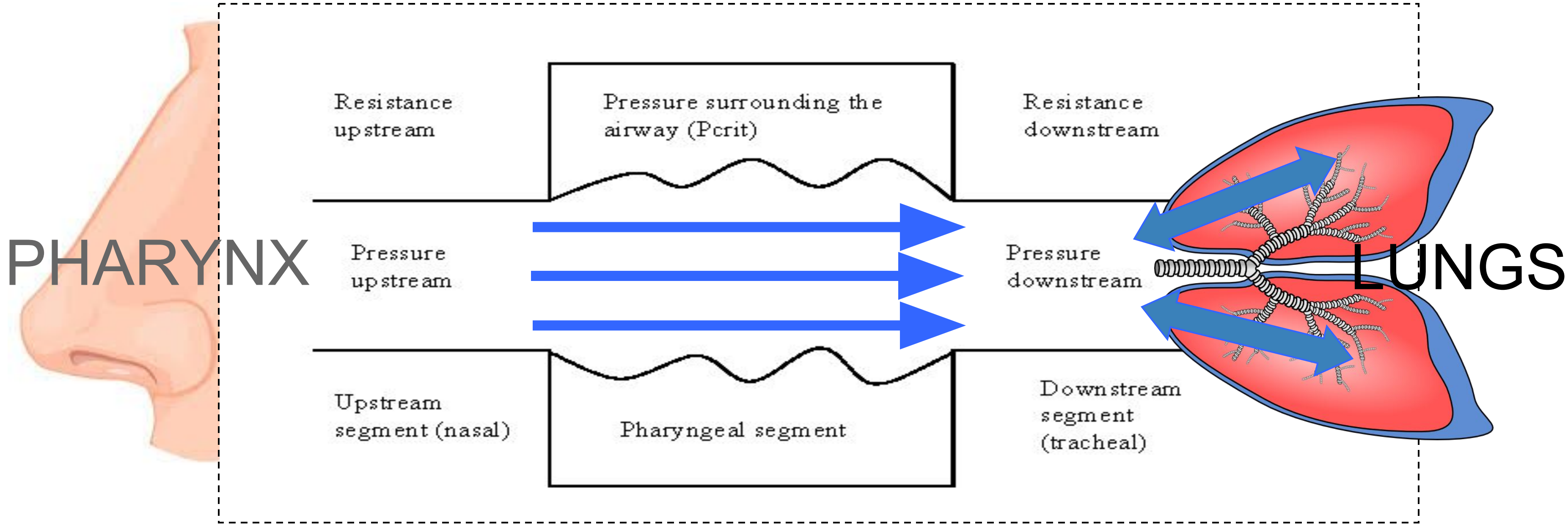
(White, AJRCCM, 2005)

How Does OSA Happen & Why It Is So Common



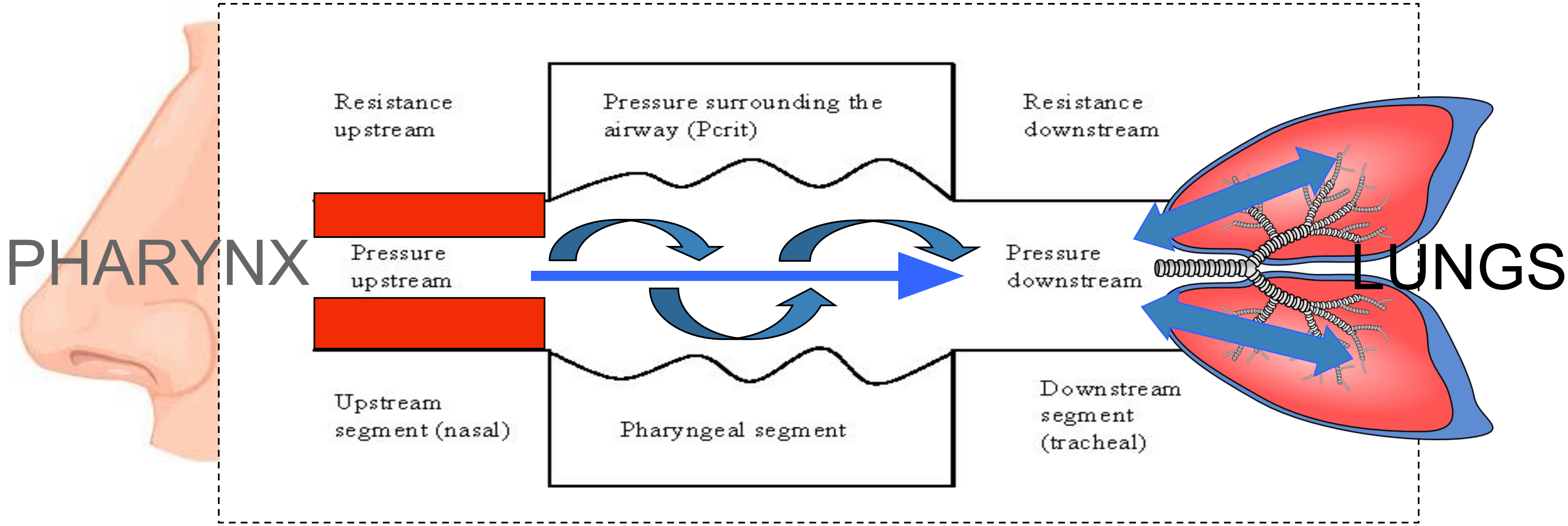
Increased Tissue Pressure

How Does OSA Happen & Why It Is So Common



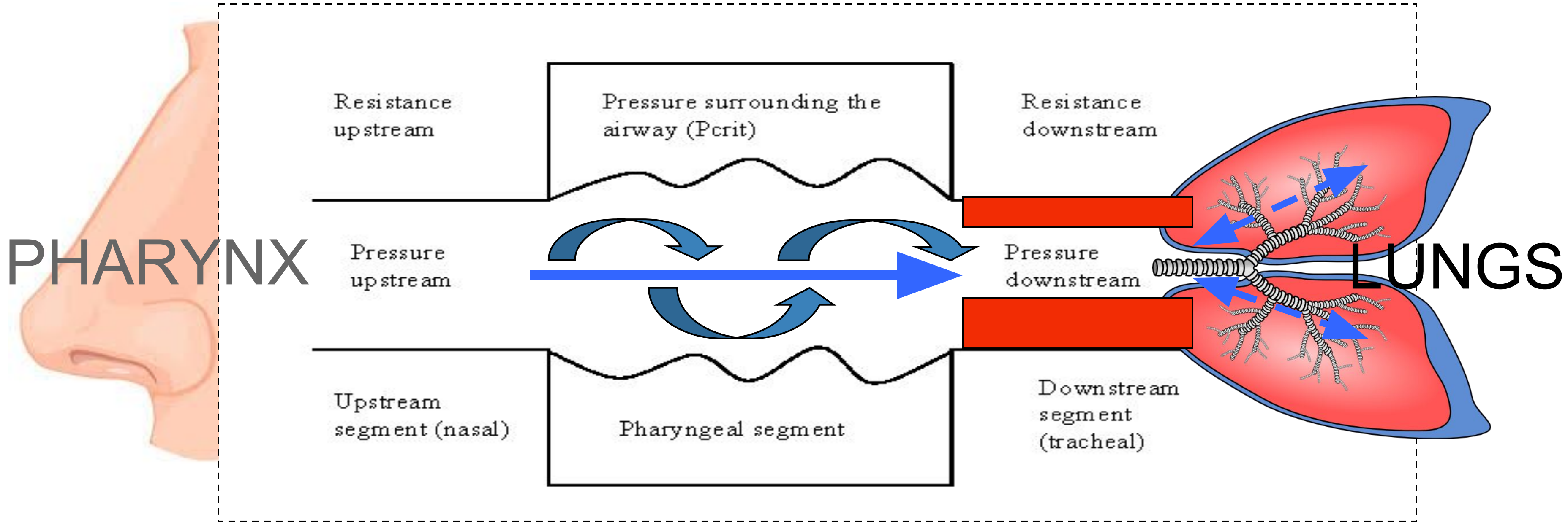
Starling Resistance Model

How Does OSA Happen & Why It Is So Common



Starling Resistance Model

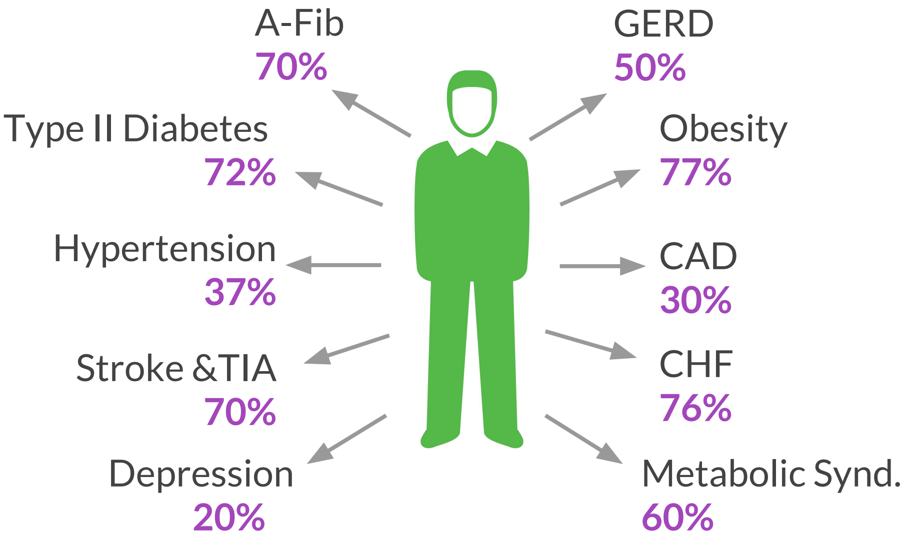
How Does OSA Happen & Why It Is So Common



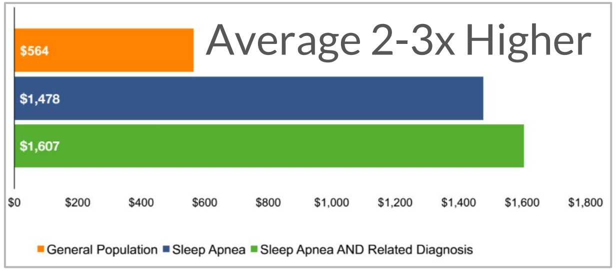
Starling Resistance Model

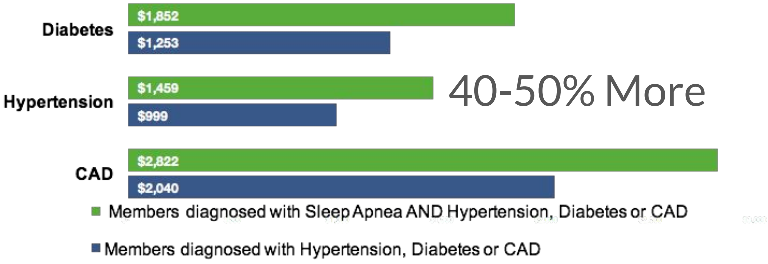
The Silent Problem with Obstructive Sleep Apnea

Contributes to Disease



Contributes to Cost





Einhorn et al. Endocrine Prac 2007; O'Keefe and Patterson Obes Surgery 2004; Tasali E et al., OSA and type 2 diabetes. Chest 2008;133:496-506; Sjostron et al.Thorax 2002, Bassetti et al. Sleep; 1999, Schafer et al. Cardiology 1999; Oldenburg et al. Eur J Heart Failure, 2007; Harvard Med School & McKinsey Co.The Price of Fatigue Report: the surprising economic costs of unmanaged sleep apnea, December, 2010; National Institute of Health, Centers for Disease Control and Prevention; Lee J. et al. Poor-quality sleep is associated with metabolic syndrome in Korean adults, Tohoku J Exp Med 2013;231:281-91; Tasali E et al., OSA and metabolic syndrome. Proc Am Thorac Soc 2008;5:207-17; Parish JM et al., Relationship of metabolic syndrome and OSA. J Clin Sleep Med 2007;3(5):467-72; Goyal SK and Sharma A, atrial fibrillation in OSA. World J of Cardiol 2013;5(6):157-63; Kanagala R et al., OSA and the recurrence of AFib. Circulation 2003;107:2589-94; Jung H et al., GERD and sleep disorders. J Neurogastroenterol Motil 2010;16(1):22-29; Basoglu OK et al., OSA and GERD-the importance of obesity and gender. Sleep Breath 2015;19(2):585-92; Sharafkhaneh A et al., Association of psychiatric disorders and OSA in large cohort. Sleep 2005;28(11):1405-11; Gupta MA et al., OSA and psychiatric disorders-a systematic review. JCSM 2015;11(2):165-75.

Managing Sleep Apnea in a Professional Transportation Environment

FusionHealth®

2016 FMCSA MRB & MCSAC Recommendations for OSA

Screening Tools

Epworth Sleepiness Scale (Sleepiness)
Berlin Questionnaire (SDB)

Examiner Determines

High Risk According to the Berlin Questionnaire or clinical judgement (medical issues, sleepiness & accidents)
BMI ≥ 40 kg/m^2 (mandatory testing)
BMI ≥ 33 kg/m^2 (mandatory testing with ≥ 3 associated factors)

Associated Factors:

Age ≥ 42 yrs, Small Airway/Mallampati score, Large Neck Size (≥ 17 inches males; ≥15.5 inches females)
Small Jaw, Male or Post-menopausal Female, Stroke, CAD, Arrhythmia, Type II Diabetes, Hypertension, Hypothyroidism, Chronic Loud Snoring, Witnessed Apneas During Sleep

At Risk for OSA Based Based on Other Known Risk Factors:

Daytime Sleepiness
Family History of Sleep Apnea
Depressed Mood, Morning Headaches, Asthma, COPD, Emphysema, Nasal Airway Constriction

Problems with OSA Care: Fragmented, Time Lost, Costly

ID RISK

Flag by CME or MD

DIAGNOSE

Sleep Doctor Visit
Sleep Lab Test (or 2)
Sleep Doctor Return Visit

INITIATE TREATMENTS

Get PAP at DME
Use it for days/weeks
Return to CME

TREATMENT TRACKING

MD Visit for PAP data
Re-Test in Sleep Lab
DME Visit for PAP data

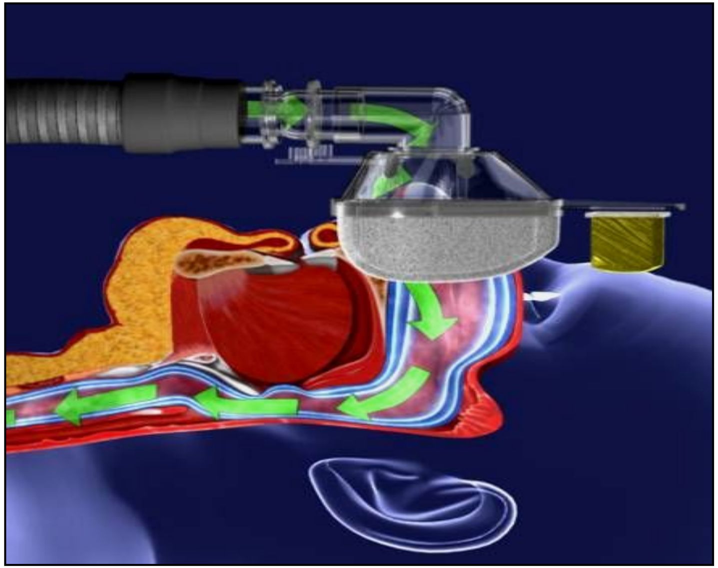
SUPPORT & SUCCESS

Sleep Doctor Visits
Call DME for help
Annual Recert by CME

1-7 Days | 3-8 Weeks | 3-6 Weeks | 2-3 Weeks Every Year

Problems with OSA Care: Treatment Works, but Not Used

Positive Airway Pressure



Problems with OSA Care: Multiple Kinds of PAP

CPAP – one level of pressure on inspiration and exhalation. May provide pressure relief in early exhalation

Bi-level therapy – one level of pressure on inspiration and lower level of pressure on expiration. Back-up rate available.

Auto-titration therapy – pressure is adjusted based on airway dynamics and device algorithm

Adaptive Servo-Ventilation – automatically adjusts minute ventilation to control complex and central sleep apnea

Volume Assist Pressure Support – automatically adjusts pressure support to control sleep apnea and alveolar hypoventilation

Problems with OSA Care: Multiple Kinds of PAP Masks

Nasal
- A common starting mask for OSA patients

Full
- Good for mouth breathers

Pillows/Prongs
- Claustrophobia
- Allergic reaction
- Side sleepers

Chinstrap may be used for m nasal interfaces

Problems with OSA Care: Use & Adherence is Low

CMS reimbursement: ≥ 4 hours of use, ≥70% of time (Kribbs, et al.[1])

Studies show patient adherence to therapy is not ideal:
- Kribbs found that *54% are inconsistent users*[1]
- Weaver found *47% are inconsistent users*[2]

Weaver, et al.[3], demonstrated that a minimum of 6 hours use is required to overcome cognitive impact of OSA

Filtness, et al.[4], showed that even in compliant PAP patients a single night's withdrawal dramatically impairs driving and cognition

1.Kribbs, et al., Objective Measurement of Patterns of Nasal CPAP Use by Patients with OSA. Am Rev of Respir Dis 1997:147(4); 2.Weaver, et al., Night-to-Night Variability in CPAP Use Over the First Three Months of Treatment. Sleep 1993:20(4):278-28; 3.Weaver, et al., Relationship between hrs of CPAP use and normal levels of sleepiness and daily functioning. Sleep 2007; 30(6):711-19; 4.Filtness, et al., One night's CPAP withdrawal in o/w compliant pts: marked driving impair but awareness of sleepiness. Sleep Breath 2012;16(3):865-71.

Correcting the Problems with OSA Care for Transportation

TELECLINIC | CONTINUOUS CARE

ID RISK

Flag by CME or Sleep Health Risk Assessment

~~1-7 Days~~

1-2 Days

DIAGNOSE

Multi-Level Sleep Testing & Medical Informatics

~~3-8 Weeks~~

1-5 Days

INITIATE TREATMENTS

On-Site Therapy
Sleep Coaching
Tailored Care Plan

~~3-6 Weeks~~

12-18 Hours

TREATMENT TRACKING

Real-Time Tracking & Ongoing Support

SUPPORT & SUCCESS

Passive Data Flow
Continuous Sleep Health

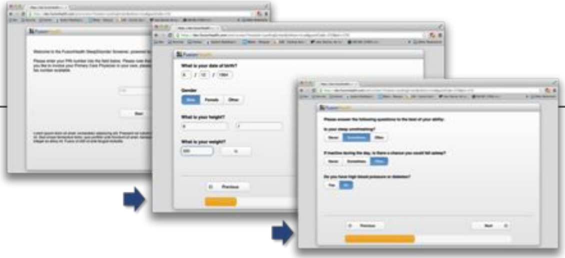
~~2-3 Weeks Every Year~~

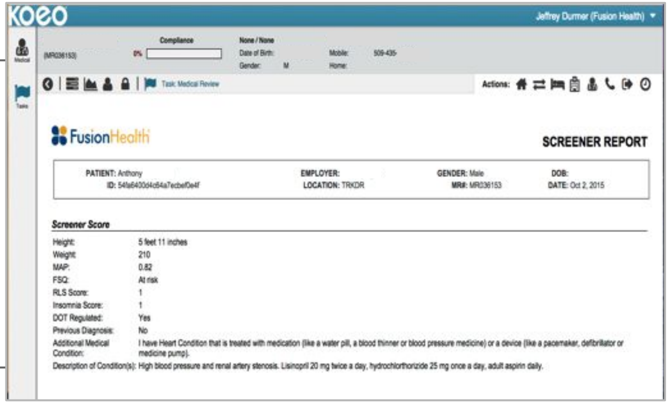
No Additional Time

Correcting the OSA Screening Problem for Transportation

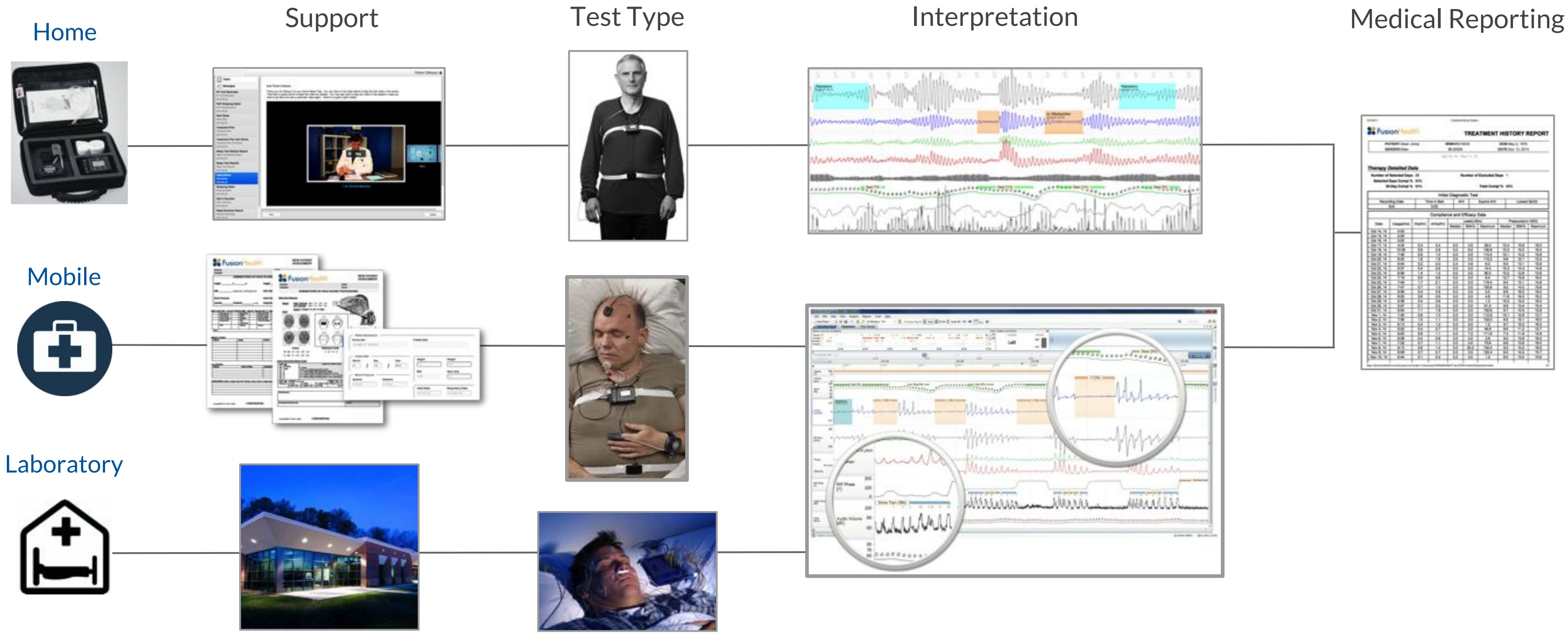
Drivers May Be Flagged by CME, or Identified using an Accepted & Validated OSA Screening Algorithm

NATIONAL REGISTRY OF CERTIFIED MEDICAL EXAMINERS
nationalregistry.fmcsa.dot.gov





Correcting the OSA Testing Problem for Transportation



Correcting the OSA Treatment Problem for Transportation

Medical Orders

HOME

MOBILE

LABORATORY

Treatment Initiation

Results

Home

Medical Review
PAP & Program Education
PAP Fitting & Dispensing
1-2 WEEKS

Mobile

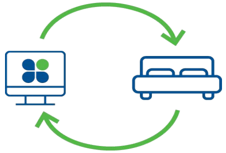
Medical Review
PAP & Program Education
PAP Fitting & Dispensing
12-18 HOURS

Laboratory

Medical Review
PAP & Program Education
PAP Fitting & Dispensing
1-4 WEEKS

Correcting the OSA Treatment Adherence Problem

CONTINUOUS CARE



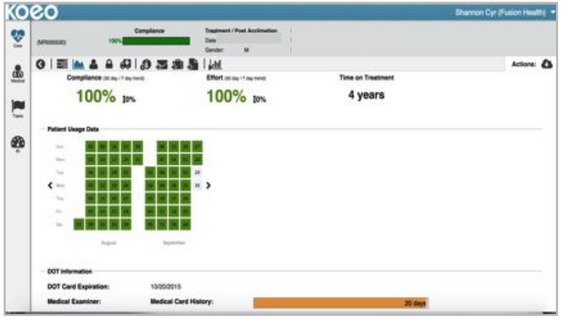
TREATMENT TRACKING

Real-Time Tracking & Ongoing Support

SUPPORT & SUCCESS

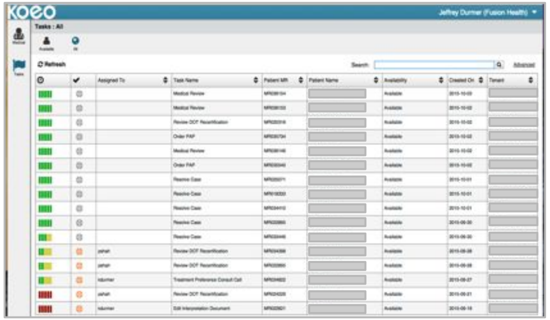
Passive Data Flow Continuous Sleep Health

Individual Measurements



AHI, AI, HI, Central/Complex Apnea
Mask Leaks, Pressures
Effort & Compliance
Successful Use (Weeks, Days, Hrs)
Recertification Dates & Requirements
Medical History & Sleep Symptoms
Biometrics & Physical Evaluations
Resupply Schedule by Use Patterns
Personal Motivation Factors
Predictive Behavioral Analytics

Systematic Issue Escalation



Behavioral Modification
Technical Barrier Resolution
Treatment Augmentation
Medical Management & Coordination
Therapy Equipment Resupply
Certification Data for Medical Examiner
Account Policy Adherence
Account Data Analytics & Reporting
Account Program Enhancements

FusionHealth®

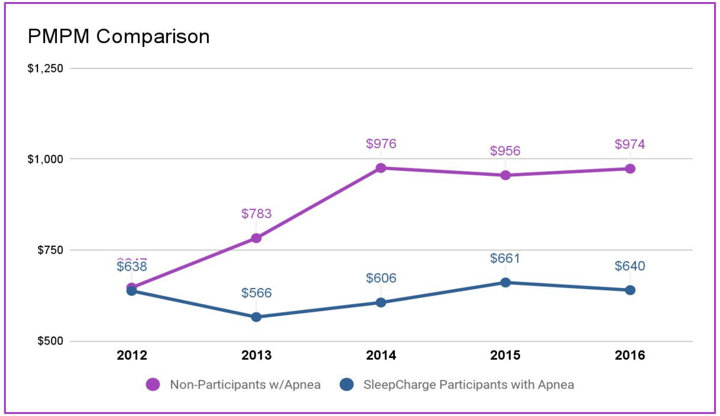
Outcomes of Restoring Sleep

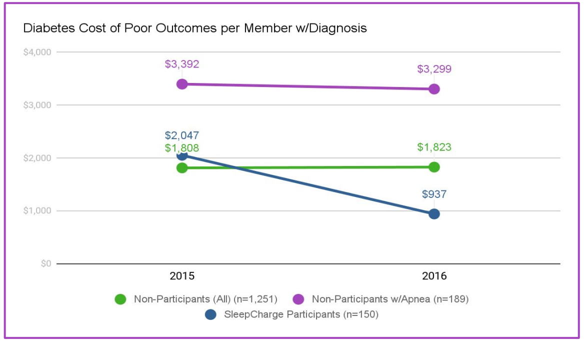
50% Reduction in Claims Cost (5 yrs)

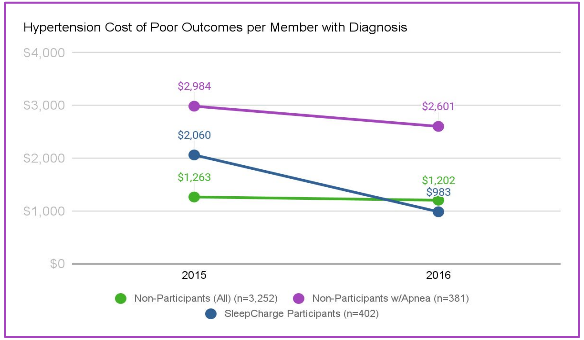
51% Reduction in Diabetes Claims Costs (1 yr)

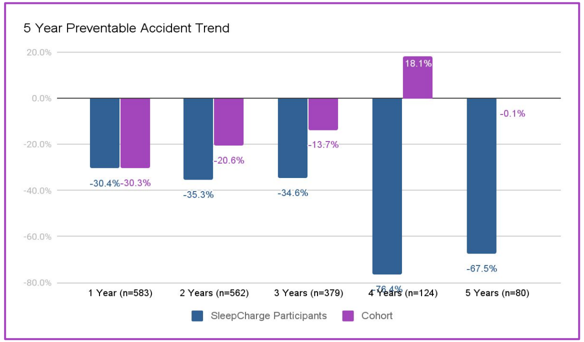
52% Reduction in Hypertension Claims Costs (1 yr)

69% Reduction in Preventable Accidents (5 yrs)









Employee Outcomes: Mood, Health & Behaviors

Measurable Improvements in 3 Months

Employees Report	Employees Feel	Employees Become	Translates into
34%	50%	25%	40%+
More Vitality	healthier	more productive	**Less Errors in Production**

Durmer, JS et al., Effect of mobile testing, treatment and care management for OSA on adherence and clinical outcomes in professional drivers, APSS, 2014; Durmer, JS et al., Economic benefits of care management for OSA in a prospective cohort of professional truck drivers, APSS, 2014; Confidential FusionHealth Client (unpublished data, 2015). Healthy Sleep and Fatigue Management Six Sigma Project

Employer Outcomes: Healthcare Utilization

Healthcare Costs & Waste

Health Care Delivery **improved by**

160%

SAVED

50%

in annual healthcare claims costs

SAVED

$250k

in Wasted Health Care System Expense in first 3 mos

Durmer, JS et al., Effect of mobile testing, treatment and care management for OSA on adherence and clinical outcomes in professional drivers, APSS, 2014; Durmer, JS et al., Economic benefits of care management for OSA in a prospective cohort of professional truck drivers, APSS, 2014; Confidential FusionHealth Client (unpublished data, 2015). Healthy Sleep and Fatigue Management Six Sigma Project

Long-Term Changes by Restoring Sleep

Average Healthcare Costs

22.8% savings after **12 months**

22.7% savings after **24 months**

Workplace Risks & Accidents

69% less accidents after **12 months**

75% less accidents after **24 months**

Durmer, JS et al., Effect of mobile testing, treatment and care management for OSA on adherence and clinical outcomes in professional drivers, APSS, 2014; Durmer, JS et al., Economic benefits of care management for OSA in a prospective cohort of professional truck drivers, APSS, 2014

Summary

Human fatigue is the result of a 24 hour cycle of Wake and Sleep related risk factors

Addressing wake related fatigue risk factors is important, but *may be rendered ineffective* if sleep related fatigue risk factors are not taken into account

Sleep Duration, Timing and Quality determine the ability of sleep to restore the body and brain to reduce fatigue the next day

Obstructive Sleep Apnea is the most common sleep disorder that impairs all 3 sleep restoration fundamentals, health, wellbeing, productivity, safety and healthcare costs

Managing Obstructive Sleep Apnea in the transportation workplace is particularly problematic due to fragmentation, time, and cost. Utilizing technology-enabled sleep health systems can drive health, safety and cost outcomes for both employees and employers.

Reduce the Risk, Manage the Night

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