Obstructive Sleep Apnoea

Adam Whittle

Respiratory Medicine
Bristol Royal Infirmary
Sleep Service

1990: Bristol respiratory sleep service
   – Drs Catterall & Kendrick, Bristol General
   – ATW since 2001

2008: NICE approved CPAP treatment
   – moderate or severe OSA
   – mild OSA if
     symptoms affect quality of life & daily activities
     AND
     lifestyle advice unsuccessful or inappropriate
What do we do?

- Respiratory sleep disorders
  - Obstructive sleep apnoea - CPAP
  - Chronic Nocturnal hypoventilation - NIV
    - Kyphoscoliosis & chest wall disease
    - Neuromuscular disease
    - obesity
    - COPD crossover syndromes
First Name Your Disease

- OSA  Obstructive Sleep Apnoea
- SAHS  Sleep Apnoea-Hypopnoea Syndrome
- OSAHS

Definition of the syndrome:
- Sleep-induced upper airway narrowing leading to
- sleep disturbance with symptoms when awake
Pathophysiology
Obesity
Retrognathism
Large tonsils
Hypothyroidism
Acromegaly
Supine posture

Airway dilating muscles

Reduced respiratory drive:
Sleep
Alcohol
Sedation
Age

Note balance of factors; not all-or-none
Sleep

- Airway obstruction
  - ↓ muscle tone
  - ↓ respiratory drive

- Arousal from sleep
  - ↑ muscle tone
  - ↑ respiratory drive

- Airway restored
  - ↑ respiratory effort
Arousal from sleep

Airway obstruction

↑ Pulse

↑ BP

Nocturia

Snoring

Hypoxia

Prostatectomy

Cardiovascular morbidity

Road accidents

Social and marital problems

Exacerbation of respiratory failure

SLEEP FRAGMENTATION (sleepy, irritable, depressed, forgetful, confused, ↓ libido...)

Why worry about it?
Why worry about it?

• Quality of life; social & work impact
  – Daytime effects of sleep fragmentation
  – Nocturnal symptoms (snoring, choking)

• Road accidents

• Respiratory failure

• Cardiovascular morbidity
I reviewed Mr X in the sleep clinic at the Bristol Royal Infirmary on the 1st of November. He’s just completed a trial of CPAP, and says it was “brilliant”, “excellent”, and made him a different person. Without it, he has classic symptoms of obstructive sleep apnoea with disruptive snoring and severe daytime somnolence, including frequently falling asleep at work.

His sleep studies confirm severe obstructive sleep apnoea, and his compliance with CPAP during his one-month trial was excellent.

Despite his absolutely clear-cut clinical need for CPAP, we’re not currently permitted to provide him with this on the National Health Service due to funding restrictions imposed by the Primary Care Trusts. There is some limited funding provided for CPAP, which we have to allocate to patients with the greatest need, and for him to be considered for this, he needs to wait until we review our waiting list in January.

He was so impressed by the symptomatic response to CPAP that he has decided to buy his own machine through the private sector, he tells me he’s been saving up in order to do this. This is the only way to guarantee him immediate and long-term treatment, although I personally think it’s appalling that patients such as Mr X should have to pay for urgently necessary clinical treatment out of their own pockets due to the inadequacies of the NHS.
Train driver in deadly New York crash had 'severe' sleep disorder, NTSB says

- Report found William Rockefeller had 'obstructive sleep apnea'
- Commuter train derailment in December 2013 left left four dead

Associated Press in White Plains, New York
theguardian.com, Monday 7 April 2014 20.39 BST

Metro-North engineer William Rockefeller Jr is loaded into an ambulance after a derailment in the Bronx borough of New York 1 December 2013. Photograph: Eric Thayer/Reuters

The driver of a New York commuter train that derailed at high speed last year, killing four people, had a serious sleep disorder that interrupted his rest dozens of times each night, federal investigators disclosed on Monday.

The National Transportation Safety Board's (NTSB) medical examination of engineer William Rockefeller uncovered "severe obstructive sleep apnea", according to documents released by the agency.
Practical management

• Investigate patients with...
Practical management

• Investigate patients with
  – daytime sleepiness
  – plus at least one of
    • snoring
    • witnessed apnoeas
    • nocturnal choking episodes
    • obesity or large collar size (but 1/3 of pts are slim)
    • retrognathia
Other causes of sleepiness

- ‘Sleep hygiene’
- Environmental disturbance
- Medication
- Shift work
- Insomnia
- Alcohol

- Medical conditions:
  - Narcolepsy
  - Periodic leg movements
  - Idiopathic hypersomnolence

- Depression
- Chronic Fatigue
EPWORTH SLEEPINESS SCALE

Name: .................................................................................................................. Hospital number
............................................................................................

Date: ........................................... Your age (Yrs).............. Your sex (Male = M / Female = F) ..........

How likely are you to doze off or fall asleep in the situations described in the box below, in contrast to feeling just tired?

This refers to your usual way of life in recent times.

Even if you haven't done some of these things recently try to work out how they would have affected you.

Use the following scale to choose the *most appropriate number* for each situation:

0 = would **never** doze  
2 = *Moderate* chance of dozing

1 = *Slight* chance of dozing  
3 = *High* chance of dozing

<table>
<thead>
<tr>
<th>Situation</th>
<th>Chance of dozing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting and reading</td>
<td></td>
</tr>
<tr>
<td>Watching TV</td>
<td></td>
</tr>
<tr>
<td>Sitting, inactive in a public place (e.g. a theatre or a meeting)</td>
<td></td>
</tr>
<tr>
<td>As a passenger in a car for an hour without a break</td>
<td></td>
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<tr>
<td>Lying down to rest in the afternoon when circumstances permit</td>
<td></td>
</tr>
<tr>
<td>Sitting and talking to someone</td>
<td></td>
</tr>
<tr>
<td>Sitting quietly after a lunch without alcohol</td>
<td></td>
</tr>
<tr>
<td>In a car, while stopped for a few minutes in the traffic</td>
<td></td>
</tr>
</tbody>
</table>

Thank you for your cooperation
In favour

- Quick and easy
- If it is high, patient is probably sleepy
- Scores fall with successful treatment

Against

- Not specific for OSA
- Poor correlation with measures of severity
- Some sleepy patients score low
- Open to manipulation
  - drivers are never sleepy...
  - scores fall with realisation of implications...
Rank correlation of apnoea + hypopnoea index (AHI) and Epworth sleepiness scale score in (A) patient and (B) partner.
<table>
<thead>
<tr>
<th>ESS Score Range</th>
<th>AHI</th>
<th>Likely Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>0 - 4</td>
<td>the patient is within normal levels</td>
</tr>
<tr>
<td>11-14</td>
<td>5 - 14</td>
<td>the patient has mild OSAHS</td>
</tr>
<tr>
<td>15-18</td>
<td>15 – 30</td>
<td>The patient has moderate OSAHS</td>
</tr>
<tr>
<td>19-24</td>
<td>&gt; 30</td>
<td>the patient has severe OSAHS</td>
</tr>
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</table>
Sleepiness is not the only symptom of Sleep Apnoea

- Witnessed apnoeas
- Restless, unrefreshing sleep
- Nocturnal choking attacks
- Nocturia
- Loss of libido
- Irritability, poor concentration
- Refractory hypertension, pulmonary hypertension, disproportionate respiratory failure
Measurements

- **AHI**
  - apnoea-hypopnoea index (events / hr)
  - polysomnography

- **ODI**
  - Oxygen desaturation index
  - oximetry
  - 4%, 3%, 2% dip rate

- < 5 /hr normal
- 5-15 /hr mild
- 15-30 /hr moderate
- >30 /hr severe
ODI and AHI are not the same thing!

11,500 Australian sleep clinic patients

Multiply 4% ODI by 2-4x to get AHI
Sleep studies

Overnight oximetry + pulse rate

– Cheap and easy
– When combined with clinical assessment, gives enough information to manage most patients
– 30% of pts with ‘abnormal’ AHI have ‘normal’ oximetry
– Cannot exclude OSAHS – needs clinical correlation
– Generates ODI: numerical cut-offs for AHI do not apply
4% dip rate (ODI) = 45.8 /hr
ESS = 8
4% ODI = 1.5 /hr
2% ODI = 4.9 /hr

Trial of CPAP – definite benefit, keen to continue

ESS = 15
4% ODI = 3.2 /hr
2% ODI = 10.8 /hr

Polysomnography
AHI = 18.8 /hr
Polysomnography

- Complex and expensive (approx £1000)
- ‘Gold Standard’ but far from perfect
- Useful if diagnostic or legal problems
- Research
Arousal

Apnea

Compressed recording - 2.5mm/sec
‘HypnoLaus’ study

- polysomnography, random sample of Lausanne population aged >40
- n = 2121
- latest AASM definitions (!)

Approx 7% of men and 3% of women would meet NICE criteria for CPAP (moderate or severe OSAHS)

'Syndrome' = SDB and ESS >10; severity defined by AHI
### 2.12 - Excess weight in Adults

<table>
<thead>
<tr>
<th>Area</th>
<th>Recent Trend</th>
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<th>Value</th>
<th>95% Lower CI</th>
<th>95% Upper CI</th>
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<td>-</td>
<td>-</td>
<td>64.6</td>
<td>64.4</td>
<td>64.7</td>
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<tr>
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<td>-</td>
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<td>63.7</td>
<td>64.6</td>
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<td>Bath and North East Somer...</td>
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<td>59.3</td>
<td>56.6</td>
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<tr>
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<td>58.0</td>
<td>63.3</td>
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<td>-</td>
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<td>54.2</td>
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<td>-</td>
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<td>66.0</td>
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<tr>
<td>Isles of Scilly</td>
<td>-</td>
<td>-</td>
<td>64.0</td>
<td>57.5</td>
<td>70.5</td>
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<tr>
<td>North Somerset</td>
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<td>62.7</td>
<td>60.1</td>
<td>65.3</td>
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<tr>
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<td>59.9</td>
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<tr>
<td>Swindon</td>
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<td>69.5</td>
<td>67.0</td>
<td>72.1</td>
</tr>
<tr>
<td>Torbay</td>
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<td>-</td>
<td>68.1</td>
<td>65.6</td>
<td>70.7</td>
</tr>
<tr>
<td>Wiltshire</td>
<td>-</td>
<td>-</td>
<td>63.6</td>
<td>60.9</td>
<td>66.3</td>
</tr>
</tbody>
</table>

Source: Active People Survey, Sport England

‘Excess weight’ = BMI >25 kg/m²
Management

• Assess whole patient
  – Symptom severity and consequences
  – Driving, work and legal implications
  – Sleep hygiene, medication etc
  – Co-morbidities (respiratory, cardiovascular, diabetes)
  – Hypothyroidism, acromegaly…

• As well as
  – Sleep study results
    • Night-to-night variability
    • Insensitivity of oximetry
Severity of OSA (for NICE CPAP criteria)

• Use AHI if available

• If relying on oximetry
  – Use ODI but allow for underestimation of AHI
  – Include symptom severity in assessment
Management Strategies

- Weight loss
- Sleep hygiene
- Sleep position
- Alcohol reduction
- Improve nasopharyngeal airway
  - Medication
  - Surgery
- ...Treatment
April 2003, after barbecue
(4% dips/hr = 66)

January 2004, sober
(4% dips/hr = 14)

38 y.o. man
petrol tanker driver
Treatment

- Continuous Positive Airway Pressure
  - Cost approx. £500 initially, £100-500 p.a. thereafter

Individually moulded mask using silicone rubber – actually stuck onto face!

Pressure varied by altering resistance at blow off.
A Guaranteed CURE for
RHEUMATISM
WHETHER
ACUTE, CHRONIC,
SCIATIC, NEURALGIC
or
INFLAMMATORY
50¢ a Bottle.

PREPARED FROM PURE
RATTLESNAKE OIL.
THE ONLY COMPANY IN
THE UNITED STATES
THAT MAKES THE
GENUINE ARTICLE.
50¢ a Bottle.

SNAKE OIL
RELIEVES INSTANTANEOUSLY
AND CURES:
HEADACHE, NEURALGIA, TOOTHACHE, RHEUMATISM, RHEUMATISM,
SWELLINGS, SPRAINS, SORE THROAT, CONTRACTED CORDS
AND MUSCLES, STIFF JOINTS, WRENCHES, DISLOCATIONS, Cuts and Blisters.

It quickly relieves the Soreness and Inflammation from Cures, Soreness, Soreness, and Soreness.

The best External Preparation for CYCLISTS and ATHLETES. It makes the Muscles supple
and relaxes the cords. Lowsers the Joints and gives a feeling of Freshness and Vigor to the whole System.

SNAKE-OIL LINIMENT CURES ALL ACHES AND PAINS.
If you are suffering from Rheumatism, ALWAYS take LA-CAS-KA internally for the Blood and
sneak-oil liniment externally. When used together we GUARANTEE A CURE in every
instance or MONEY REFUNDED.

If You Are Afflicted With DEAFNESS
Get Our Specially Prepared
PURE Rattlesnake Oil

WHAT A PROMINENT BUTCHER OF COTTAGE GROVE, OREGON, SAYS:
The Yaque Medicine Co., Portland—Please send me by express, C. C. B., one bottle of your Rattlesnake Oil Liniment.
I have used that bottle of the Liniment and am fully satisfied of its merits. It did not work
good than anything I have ever used. I want to keep a supply always on hand. Yours very truly,
W. H. Buxton.

THE YAQUIS MEDICINE COMPANY
SAN FRANCISCO, CAL.

PORTLAND, OREGON.

64 Washin St., Portland, Oreg.
CPAP evidence

- Grade A
- Improves:
  - Symptoms, especially quality of life
  - Partner’s quality of life
  - Sleep study abnormalities
  - Hypertension
  - Road accidents
  - Life expectancy?
Mean (SD) accident rates for (A) patients with OSA during the 3 years before and after treatment with CPAP and (B) control subjects during the same time frame.
Up to 12 year follow up of patients with varying severity of OSA.

Fatal, and non-fatal, cardiovascular events.

31/1/2005

My husband was a lot better when he was on the machine and I could go to bed at night and sleep without being woken up. I am now sleeping down stairs again because I do not get any sleep up in bed.

As I have no narcolepsy in my legs, it no doing me any good. I have diabetes as well arthritis and angina.

Mrs M Bit"
BNSSG PCT Jan 2013 (draft)

TREATMENT UNDER THIS POLICY REQUIRES PRIOR APPROVAL FROM THE PCT

THIS POLICY RELATES TO ALL PATIENTS

Continuous Positive Airway Pressure For The Treatment Of Obstructive Sleep Apnoea/ Hypopnoea Syndrome

Policy Statement [pending ratification]: Date of Issue: XXXX

The provision of Continuous positive airway pressure (CPAP) is subject to a RESTRICTED POLICY.
Other Treatments

- Mandibular Advancement Device (M.A.D.)
Mandibular/Dental devices

- Evidence-based treatment
- Improves mild OSA symptoms
- Good for simple snoring
- Partial improvement in sleep studies
- Can be
  - fitted by dentist
  - do-it-yourself (internet)

Mandibular...
advancement device MAD
repositioning device MRD
advancement splint MAS
Other treatments

• Surgery
  – Tonsillectomy
  – Nasal patency
  – Weight reduction – bariatric – very effective!
  – Tracheostomy
  – Uvulopalatopharyngoplasty (UPPP)
  – Mandibuloplasty
OSA and Driving

Couple ‘killed by trucker who fell asleep’

Motorway crash driver had been ordered off the road by his doctors, court told
Excessive sleepiness
– including obstructive sleep apnoea syndrome

Excessive sleepiness having, or likely to have, an adverse effect on driving includes:
- obstructive sleep apnoea syndrome of any severity
- any other condition or medication that may cause excessive sleepiness.

Legislation states that objective sleep study measurements for driving assessment purposes should use the apnoea-hypopnea index (AHI). Recognising that not all sleep services use AHI, the DVLA will accept results of equivalent objective tests.

The ‘Tiredness can kill’ leaflet (INF159) is for drivers concerned about excessive sleepiness.
Tiredness can kill – Advice for drivers
including drivers with Obstructive Sleep Apnoea Syndrome (OSAS)

What if I have a condition causing sleepiness/tiredness during the day?

- You need to tell us if you hold a current driving licence of any type.
- You can tell us by email or download a form from the ‘medical rules for drivers’ section of www.gov.uk/driving-medical-conditions
Obstructive sleep apnoea and driving

You must tell DVLA if you have:
- obstructive sleep apnoea which affects your ability to drive safely
- obstructive sleep apnoea syndrome

⚠️ You can be fined up to £1,000 if you don’t tell DVLA about a medical condition that affects your driving. You may be prosecuted if you’re involved in an accident as a result.

Ask your doctor if you’re not sure if your obstructive sleep apnoea will affect your driving.

**Car or motorcycle licence**
Fill in form SL1 and send it to DVLA. The address is on the form.

**Bus, coach or lorry licence**
Fill in form SL1V and send it to DVLA. The address is on the form.

Driving while tired
Read [‘Tiredness can kill’](https://www.gov.uk) for more information on the dangers of driving while tired.

Last updated: 7 March 2016
<table>
<thead>
<tr>
<th><strong>Excessive sleepiness</strong> including due to mild obstructive sleep apnoea syndrome:</th>
<th><strong>Group 1</strong> car and motorcycle</th>
<th><strong>Group 2</strong> bus and lorry</th>
</tr>
</thead>
<tbody>
<tr>
<td>• AHI below 15 (mild) on the apnoea-hypopnoea index or equivalent sleep study measure</td>
<td><strong>Must not drive but may not need to notify the DVLA.</strong> Driving may resume only after satisfactory symptom control.</td>
<td><strong>Must not drive and must notify the DVLA.</strong> Driving may be licensed again once control of symptoms is satisfactory. The DVLA will require a specialist’s confirmation of ongoing adherence to treatment. Licensing is subject to review, usually annually.</td>
</tr>
<tr>
<td><strong>Obstructive sleep apnoea syndrome</strong> – moderate and severe apnoeas syndrome with sleepiness:</td>
<td><strong>Must not drive and must notify the DVLA.</strong> This requirement also applies for a suspected diagnosis yet to be confirmed. Subsequent licensing will require: control of condition; sleepiness improved; treatment adherence. The DVLA will need medical confirmation of the above, and the driver must confirm review to be undertaken every 3 years at the minimum.</td>
<td><strong>Must not drive and must notify the DVLA.</strong> This requirement also applies for a suspected diagnosis yet to be confirmed. Subsequent licensing will require: control of condition; sleepiness improved; treatment adherence. The DVLA will need medical confirmation of the above, and the driver must confirm review to be undertaken annually at the minimum.</td>
</tr>
<tr>
<td>• AHI 15 to 29 (moderate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• AHI 30 or more (severe) on the apnoea-hypopnoea index or equivalent sleep study measure</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Obstructive sleep apnoea</strong> – moderate and severe apnoeas without sleepiness:</td>
<td><strong>Must not drive but need not notify the DVLA.</strong> Driving may resume once associated symptoms such as poor concentration have been brought under control.</td>
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My conclusions about OSA & driving

• It is an important issue!
  – 20% of accidents are due to sleepiness
  – Sleep-related RTA 50% more likely to cause death or injury

• All patients (OSA or not) can be advised of the law:
  – do not drive if sleepiness is affecting concentration
  – It is a criminal offence to fall asleep driving – no excuses

• Current DVLA guidance is
  – confused and unrealistic
  – reliant on poorly-defined criteria
OSA & Driving

• **Which patients should GPs advise to stop driving?**
  – road accident or near miss due to sleepiness, or
  – suspected OSA & severe sleepiness (e.g. ESS >14), or
  – suspected OSA & class 2 licence
    • stop class 2 driving

• **Urgent referrals to sleep service** – we will try to see within 2 weeks, if you tell us
  – Anyone you have advised to stop driving
  – All group 2 & other professional drivers
DVLA notification

• Who?
  – All OSA patients on CPAP
  – All symptomatic OSAHS patients

• When?
  – ‘Once assessment is complete’ – this can include CPAP trial if done promptly

• It is the patient’s responsibility to inform DVLA
  – Drs can break confidentiality and inform DVLA following written warning including an offer of second opinion