Fostering Low-Carbon Healthcare in Europe
A Carbon Footprinting Pilot Project
PRESENTATION OVERVIEW

• Introduction
• Why Anaesthetic Gasses?
• Benchmarking information
• Recommendations
• What can I do?
• Extra resources
INTRODUCTION

Healthcare organisations have a responsibility to reduce their impact on climate change just like other industries.

The health sector can reduce environmental impacts whilst improving quality of care.

Reducing carbon emissions can also contribute to improving health in communities and staff.

The sector makes up an estimated 5% of the European carbon emissions and has a significant role to play in contributing to the European 2030 climate and energy targets.

Anaesthetic gases are potent greenhouse gases: comparing with energy use (measured in many acute hospitals) anaesthetic gases are an additional 15% of carbon equivalent emissions.
WHY ANAESTHETIC GASES?

Sevoflurane - GWP 130
Bottle (250ml) 49 kg CO₂e

Isoflurane - GWP 510
Bottle (250 ml) 191 kg CO₂e

Desflurane - GWP 2540
Bottle (240 ml) 893 kg CO₂e

Nitrous oxide - GWP 298
Cylinder (3.4 kg) 1013 kg CO₂e
# RELATIVE POTENCY OF ANAESTHETIC GASES

<table>
<thead>
<tr>
<th></th>
<th>IR absorption range (µm)</th>
<th>Tropospheric lifetime (yr)</th>
<th>GWP 100</th>
<th>Standard container</th>
<th>kg CO$_2$e for container</th>
<th>Amount needed (MAC$_{40}$)</th>
<th>Relative CO$<em>2$e (per MAC$</em>{40}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sevoflurane</td>
<td>7-10</td>
<td>1.1</td>
<td>130</td>
<td>250ml</td>
<td>49</td>
<td>1.8</td>
<td>1</td>
</tr>
<tr>
<td>Isoflurane</td>
<td>7.5-9.5</td>
<td>3.2</td>
<td>510</td>
<td>250ml</td>
<td>191</td>
<td>1.2</td>
<td>2.6</td>
</tr>
<tr>
<td>Desflurane</td>
<td>7.5-9.5</td>
<td>14</td>
<td>2540</td>
<td>240ml</td>
<td>893</td>
<td>6.6</td>
<td>72</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>4.5, 7.6, 12.5</td>
<td>110</td>
<td>298</td>
<td>Cylinder size G</td>
<td>5066</td>
<td>104</td>
<td>132</td>
</tr>
</tbody>
</table>

References:
- GWP 100 from Sulbaek Andersen 2012 [http://dx.doi.org/10.1021/jp2077598](http://dx.doi.org/10.1021/jp2077598)
- MAC$_{40}$ from Tom Pierce, Environmental Advisor to the Royal College of Anaesthetists, UK
ANAESTHETIC CARBON EMISSIONS PER HOUR

Research comparator carbon emissions per hour of anaesthesia

ANAESTHETIC GASES BENCHMARKING RESULTS

Benchmarked anaesthetic use per hour of surgery

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Anaesthetic N2O</th>
<th>Desflurane</th>
<th>Isoflurane</th>
<th>Sevoflurane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SUSTAINABLE ANAESTHETIC PRACTICE

• The key messages for anaesthetic practice are:
  1) Whenever possible use Sevoflurane and only use Desflurane when clinically necessary.
  2) Reduce or eliminate the use of nitrous oxide during surgery.
  3) Reduce flow rates and train in the use of Closed Circuit Anaesthesia which confers clinical benefits as well as saving costs and reducing carbon emissions.
  4) Consider the use of intravenous and regional anaesthesia whenever possible.
ANAESTHETIC GASES POTENTIAL SAVINGS

• Estimate of potential carbon savings on implementing changes in anaesthetic practice
• 20% of potential savings and 40% of potential savings would be achievable
• 40% of potential savings would be equivalent to an average of 3% reduction in building energy use for these four hospitals
• 393 tCO₂e is 3 million km in a new car
• Equivalent to 166 cars off the road for these four hospitals (assuming average of 20 thousand km per year)
• If half of European hospitals had similar savings this would be 700 kilotonnes of carbon dioxide savings equivalent to 300,000 cars off the road

<table>
<thead>
<tr>
<th>Tonnes of CO₂e</th>
<th>Hospital 1</th>
<th>Hospital 2</th>
<th>Hospital 4</th>
<th>Hospital 5</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>20% of potential savings</td>
<td>90</td>
<td>56</td>
<td>169</td>
<td>77</td>
<td>393</td>
</tr>
<tr>
<td>40% of potential savings</td>
<td>180</td>
<td>75</td>
<td>339</td>
<td>155</td>
<td>749</td>
</tr>
<tr>
<td>Potential savings as a proportion of energy emissions</td>
<td>4%</td>
<td>0%</td>
<td>17%</td>
<td>8%</td>
<td>3%</td>
</tr>
</tbody>
</table>
Whenever possible use Sevoflurane; only use Desflurane when clinically necessary

Global Warming Potential (GWP) is standardised to CO₂ = 1

Sevoflurane
GWP = 130

Desflurane
GWP = 2540

Source: RCoA
Saving a conservative 40% of potential CO$_2$e savings from anaesthetic gases for four hospitals would be equivalent to 166 fewer cars on the road.

Scaling this up to half of Europe's hospitals could equate to **300 000** cars.
Reduce flow rates through training in closed circuit anaesthesia (CCA)

Closed circuit anaesthesia reduces CO$_2$e emissions, and can also benefit patients
Consider the use of intravenous and regional anaesthesia when possible
Reduce or eliminate the use of nitrous oxide in anesthesia
RESEARCH FOR SUSTAINABLE ANAESTHESIA

Recommendations for further project research:

1) Research anaesthetic practice for more hospitals across Europe
2) Research into the change for these six hospitals in 1 year
3) Further exploration of benchmarking possibilities
4) Tighten the current definitions to make them more robust
5) Monitoring changes over time 3-5 years
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HCWH Europe is solely responsible for the content of this presentation and related materials - the views expressed do not reflect the official views of the European Commission, EUKI, or BMUB.
Extra Resources:

Healthcare Without Harm, Hippocrates carbon footprinting tool: http://www.greenhospitals.net/hippocrates/


Sustainable Development Unit for the NHS, public health and social care system in England, Carbon Hotspots - breakdown of carbon footprint for different types of health services:

Sustainable Development Unit for the NHS, public health and social care system in England, Detailed carbon footprint methods paper - detailed methods for calculating energy, travel, goods and services carbon footprint

Sustainable Development Unit for the NHS, public health and social care system in England, Wedges - which show the level of change needed to reduce emissions for energy, travel, goods and services

Sustainable Development Unit for the NHS, public health and social care system in England, Marginal Abatement Cost curve (MACC) - for investment and return in finances and carbon