Carbon Monoxide (CO) Monitoring for Smoking Management: A brief guide for staff

Statewide Respiratory Clinical Network
March 2021
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1. An introduction to carbon monoxide (CO) monitoring

1.1 What is CO monitoring?

A hand-held carbon monoxide monitor, such as a Smokerlyzer®, is a device used to measure the level of carbon monoxide (CO) in the body via a breath test. The monitor measures the level of CO in a person’s breath, which indirectly measures the level in the blood. The monitor can be used to measure CO levels in adults, adolescents and unborn babies and can provide a reading for both smokers and passive smokers.

1.2 What is carbon monoxide (CO)?

CO is a colourless and odourless gas that is created from combustion or the burning of organic matter. Sources of CO include smoke from a cigarette, joint, bong, fire or BBQ, exhaust fumes from a vehicle or a leak from a faulty gas appliance.

Exposure to CO at the workplace can occur in blast-furnace operations in the steel industry and when gasoline or propane-powered forklifts, chainsaws, or other machines are used in confined spaces, such as buildings, tunnels and mines.

Environmental exposure to CO can occur while traveling in motor vehicles (9-35 ppm); visiting urban locations with heavily travelled roads (up to 50 ppm); or cooking and heating with domestic gas, kerosene, coal, or wood (up to 30 ppm); as well as in fires and by environmental tobacco smoke.

Endogenous CO formation during normal metabolism leads to a background carboxyhemoglobin (COHb) concentration of about 0.5-0.8%. Smokers are exposed to considerable high CO concentrations leading to a COHb of about 3-8%. CO can remain in the bloodstream for up to 24 to 48 hours, depending on factors such as physical activity. The half-life of COHb is approximately five hours.

1.3 What effect does CO have on the body?

CO is absorbed into the blood through the lungs. CO deprives the body of oxygen by binding very strongly with red blood cells. The body responds by creating more red blood cells, which in turn thickens the blood and puts a person at increased risk of clotting, heart attack, stroke, vascular disease and deep vein thrombosis.

1.4 Why use a CO monitoring device with patients / clients?

When utilised as part of an overall quit smoking intervention, measuring a person’s CO levels can be an effective tool to engage, motivate and chart the progress of smokers (Bittoun, 2008).

The more a person smokes, and the more intensely they inhale or ‘drag’ on their cigarette, the higher their CO reading will be. CO monitoring therefore assists to determine the level of nicotine dependence and provides the smoker with visible and real-time proof of the effects of smoking on their body. This can help to motivate the person during a quit attempt by charting changes in CO levels over a period of time.
2. Equipment and resources

2.1 What equipment is required to use the Smokerlyzer® device?

D-piece™ (new or old style)  Disposable plastic tube* (SteriBreath™)  CO indication chart

Wipes – must be alcohol free.

Non-sterile gloves - if a risk of contact with blood, body fluid or respiratory droplets.

Soap and water (preferred) or hand sanitiser - Note: it is very important to allow sanitiser to dry completely as alcohol can damage the device sensor.

Written resource (optional / recommended) - to provide to the consumer with CO monitoring results (available on QHEPS via the Addiction Services Info Hub under ‘Smokerlyzer’ tab).

*The single-patient use disposable plastic tube (SteriBreath™) is required if the D-piece™ is being used for multiple tests. The SteriBreath™ is optional if planning to dispose of the D-piece™ after one use. Another less common option (not pictured) is the single-use OneBreath™ mouthpiece which incorporates the filter of a D-piece™ and the length of a SteriBreath™.
3. Device operation

**Important note:** Use of the Smokerlyzer® is considered an aerosol generating procedure. See [infection control section](#) below to guide clinical practice and precautions.

### 3.1 Multiperson use Smokerlyzer® models
(Micro+™, piCO™ & piCObaby™)

The following videos can be viewed by staff to learn how to operate the device:

- [How to use a Smokerlyzer® device](#) - Dovetail Qld with Metro South Addiction Services.
- [How to use a Smokerlyzer® device](#) - Darling Downs HHS.
- [How to: piCO™ Smokerlyzer®](#) - Bedfont (manufacturer).

**Step-by-step instructions** (in addition, follow [infection control](#) as per section 4).

To ensure an accurate reading, conduct the test at least 10 minutes after the person’s last cigarette.

**Step 1:** Turn on the device (button on top) and insert the D-piece™ and the disposable plastic tube SteriBreath™ (optional).

**Step 2:** Explain to the person: ‘Shortly I’ll ask you to take a deep breath in and hold for 10-15 seconds. When the three beep count down is complete, blow out into this clean mouthpiece, aiming to gradually empty your lungs’.

**Step 3:** Tap the screen to activate the countdown and then ask the person to take their deep breath in and hold it. After the three beep countdown, indicate for the person to blow into the mouthpiece. *

**Step 4:** Once the result appears on the screen, refer to the [indicator chart](#) to determine if the person falls into the green, orange or red zone. Take note of the different indicators for adults, adolescents and unborn babies. Record the level and discuss with the person.

**Step 5:** Remove the D-piece™ between tests. Allow the sensor to purge with fresh air between tests.

**Other considerations:**

- Use a non-judgmental, non-threatening and culturally appropriate communication style when performing the test and interpreting the CO monitoring results.
- If the person cannot hold their breath for the full 15 seconds, they can commence exhalation at a comfortable point prior to the three beep count down.
- When holding the device, do not block the vent hole at the back with your hand.
- If the CO reading is lower than expected, this could be due to recent physical exercise, a faulty device or the person may not be inhaling the smoke deeply.
- If the CO reading is higher than expected, this could be caused by the person inhaling deeply or indicate a discrepancy in self-reported smoking, environmental factors (pollution/occupational exposure), passive smoking or a fault with the Smokerlyzer® device.
- A very high or low reading may also indicate the device requiring calibration.

**For more information:** Refer to the manual available from the [manufacturer’s website](#)
3.2 Single person use Smokerlyzer® model (iCO™)

The iCO™ Smokerlyzer® is intended for use by a single person and may have cost implications to the person or clinical service:

1. Person to download the Smokerlyzer® app on their smart phone.
2. Ensure that the volume is turned up to maximum.
3. Attach the device to the phone via the headphone/charging port or via bluetooth and turn on app.
4. Answer set up questions including PIN and include the clinician’s email address.
5. Provide instructions on how to perform the test (according to manufacturer's instructions).

For more information: refer to the manual available from the manufacturer’s website.

3.3 Interpreting the CO monitoring results

The device will show the result in two formats:

- Parts per million (PPM)
- Percentage of CO in the blood (%COHb or %FCOHb).

**PPM**
The number of CO molecules in a million parts of air.

**%COHb**
The percentage of red blood cells carrying CO instead of oxygen (percentage of carboxyhemoglobin).

**%FCOHb**
Only available in piCObaby™ Smokerlyzer® model: The amount of CO in an unborn baby’s blood (percentage of fetal carboxyhemoglobin).

**Explaining the reading to a person (examples)**

“The test shows that nearly 4% of your red blood cells are carrying carbon monoxide instead of oxygen. This result puts you in the ‘red’ zone and indicates that you are a heavy smoker”.

Or

“The test shows that nearly 4% of the vital oxygen in your blood stream has been replaced with carbon monoxide indicating that you are a heavy smoker”.

4. Infection control

4.1 How do I clean the device?

Never use alcohol wipes or organic solvents as this will damage the internal CO sensor. Use only the cleaning wipes provided by the company with the device or use detergent wipes.

4.2 What infection control practices are required in routine care?

Prior to the face to face appointment, follow any COVID screening guidelines in place by your service such as verbal screening or completing the Queensland Government COVID-19 Screening Assessment on or before arrival.

When undertaking CO monitoring in routine, the following precautions must be taken to reduce the risk of cross infection:

- Perform the test in accordance with the manufacturer’s instructions.
- Remember, D-piece™ can be multiple use OR single use; and SteriBreath™ is strictly single use. Clinician judgement is required whether they choose to use the D-piece™ for single use or multiple use due to cost implications. Also see COVID precautions section.
- Always use either a new D-piece™ for each person OR a new SteriBreath™ and the common D-piece™ that is being used for multiple persons while maintaining infection control practices.
- Multiple use D-piece™ should be disposed of after maximum 30 days of use.
- Prior to use, hand hygiene must be performed by both the clinician and client (soap and water preferred or <73.5% alcohol hand sanitiser – completely dried) – clinician and client. Alcohol must not come in contact with the Smokerlyzer® as this can damage the sensor.
- Non-sterile gloves may be worn by the clinician if there is a risk of contact with blood or body fluid / respiratory droplets.
- Do not face the person, stand side-on. Continue to maintain physical distance where possible.
- At the completion of the assessment, ask the patient to remove the single use SteriBreath™ and/or D-piece™ and dispose one or both directly into the general waste.
- Clinician may decide to store patient specific D-pieces™ into a zip lock bag labelled with patient name for 30 days during a pandemic situation.
- The clinician must clean the device after each use with a non-alcohol detergent cleaning wipe. Do not use cleaning solutions / wipes that contain alcohol or other organic solutions.
- After cleaning with detergent wipes - leave the device to air dry for a minimum of 60 seconds.
- Hand hygiene must be performed following use of the device by both the clinician and the client.
- The device must be stored away from direct patient contact when not in use.
4.3 How often do I need to change the mouthpieces?

The manufacturer (Bedfont) states the following:

- Bedfont recommends one D-piece™ can be used for multiple patients for a continuous 30 days in conjunction with the single-patient-use SteriBreath™ mouthpieces.
- The disposable tubes (SteriBreath™) are single-use and must be disposed of after every use.
- A clinician can opt to use the OneBreath™ mouthpiece or D-piece™ for single use. This option is recommended by Niche Medical, the Australian supplier of Smokerlyzer® products.
- Some smaller clinics or groups may choose to keep separate D-pieces™ for individual patients (e.g. in a labelled zip lock bag) and then dispose of after 30 days.

4.4 Why is the D-piece™ re-useable?

- The manufacturer states that the D-piece™ incorporates a one-way valve and an infection control filter. It states that the filter removes/traps 99% of airborne bacteria, 97% of viruses and any moisture from the patient’s breath.
- The D-piece™ and OneBreath™ mouthpieces have been tested to filter viruses as small as 24 nanometers in diameter. The COVID-19 virus particle has a diameter of approximately 125 nanometers.

Note: CO testing should only be performed using a mouthpiece that utilises an inline filter to remove or trap bacteria. Always check with the CO monitor manufacturer if the plastic mouthpieces provided include a bacterial and viral control filter before use. The Smokerlyzer® brand is the only CO monitoring device available in Australia at the time of writing these guidelines and utilises appropriate filters.

4.5 COVID Precautions

CO monitoring is considered an aerosol generating procedure; hence precautions are required to prevent COVID transmission. When undertaking CO monitoring, follow local PPE recommendations for aerosol generating procedures which may change based on current transmission risk level. For example, this may include P2/N95 respirator or face mask, protective eyewear, gloves and gown/apron.

The below table is an example of a moderate risk escalation stance as detailed in the Pandemic Response Guidance – Personal protective equipment in Healthcare delivery, Clinician judgement is required for selection of correct PPE. These requirements also apply to outreach and in-home services.

<table>
<thead>
<tr>
<th>Aerosol Generating Procedures</th>
<th>PPE guidance example for healthcare workers during moderate risk escalation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspected / probable / confirmed COVID-19</td>
<td></td>
</tr>
<tr>
<td>Important note: Avoid CO monitoring where possible in this situation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• P2/N95 respirator</td>
</tr>
<tr>
<td></td>
<td>• Protective eyewear</td>
</tr>
<tr>
<td></td>
<td>• Gown</td>
</tr>
<tr>
<td></td>
<td>• Gloves</td>
</tr>
<tr>
<td>Non-COVID-19 patients</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Surgical mask</td>
</tr>
<tr>
<td></td>
<td>• Protective eyewear</td>
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</tbody>
</table>
Suspension of CO monitoring may be required during high-risk transmission periods e.g. a local cluster or community spread. Consult statewide_respiratory_network@health.qld.gov.au for more information.

The Smokerlyzer® manufacturer (Bedfont) has a statement including a step by step guide/demonstration video supporting the use of the device during COVID-19.

5. Associated equipment costs

5.1 Initial purchase and ongoing operation costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smokerlyzer® device</td>
<td>$693 - $1232 (depending on which device you choose to purchase). The price includes 1 x box of 250 disposable Steribreath™ mouthpieces, 1 x box of 12 D-pieces™ and one packet of cleaning wipes.</td>
</tr>
<tr>
<td>A box of 250 Steribreath™ mouthpieces (disposable plastic tubes)</td>
<td>$88 (approximately $0.35 per Steribreath™ mouthpiece).</td>
</tr>
<tr>
<td>A box of 12 D-pieces™</td>
<td>$52.80 (approximately $4.40 per D-piece™)</td>
</tr>
<tr>
<td>iCO™ Smokerlyzer®. (Single person multiuse: attaches to a smart device/phone)</td>
<td>$132</td>
</tr>
</tbody>
</table>

5.2 Calibration cost and frequency

Device calibration to maintain device accuracy is required every 6 months for older device models and every 5 years for newer models.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration:</td>
<td>Calibration performed by Niche Medical - $66. Alternatively, a calibration kit can be purchased at a cost of $622.60.</td>
</tr>
</tbody>
</table>

*Prices include GST and exclude delivery fees and are current at the time of writing - March 2021. These prices have been provided by the Australian supplier for Smokerlyzer® devices (Niche Medical). There may be other brands and suppliers available in Australia that staff members can research. This is a guide only, to confirm prices please contact the supplier for a quote as the prices may change and discounts may be available for bulk purchases.
5.3 How much would CO monitoring mouthpieces cost for a month?

1. **Scenario 1: If a D-piece™ is used for multiple patients:** If 10 breath tests were conducted per month, the cost for mouthpieces (1 x D-piece™ plus 10 x SteriBreath™) would be approximately $7.90 per month.

2. **Scenario 2: If a clinician decides to use the D-piece™ for single use:** If 10 breath tests were conducted per month, the cost of mouth pieces would be approximately $40.40 (without SteriBreath™) to $48.30 (with SteriBreath™) per month.

6. More information

- Visit the Bedfont website [www.bedfont.com](http://www.bedfont.com/) or Niche Medical website [www.nichemedical.com.au](http://www.nichemedical.com.au/)
- Qld Health staff can visit the ‘Addiction Services Info Hub' on QHEPS
- Contact the Metro South Addiction Services Preventative Team
  P: 07 3299 3963 or E: MSAMHS_ADS_Preventative@health.qld.gov.au
- Email: statewide_respiratory_network@health.qld.gov.au

7. Further reading

- Video: [How to use a Smokerlyzer® device](http://www.bedfont.com/) - Dovetail Qld with Metro South Addiction Services
- Video: [How to use a Smokerlyzer® device](http://www.bedfont.com/) - Darling Downs HHS
- Bedfont (manufacturer) resources:
  - Video: [How to: piCO™ Smokerlyzer®](http://www.bedfont.com/)
  - Smokerlyzer® Range User Manual
  - Infection Control and maintenance guidelines
  - Coronavirus and Bedfont products update
## 8. Version Control and Review History

<table>
<thead>
<tr>
<th>Version</th>
<th>Reviewed by</th>
<th>Endorsement</th>
</tr>
</thead>
</table>
| V-2.0 September 2017 New Document | Natalie Davis (Author) - Health Promotion Officer, Addiction Services Preventative Team, MSAMHS - Metro South Health.  
Deepali Gupta (Author) - Advanced Pharmacist - Metro South Health. | Metro South Smoking Cessation Working Group  
Metro South Addiction Services Preventative Team |
| V-3.0 March 2021 Added Section on Infection Control - and COVID precautions 1. Added references and further reading 2. Added single patient use Smokerlyzer® model | Natalie Davis - Health Promotion Officer, Addiction Services Preventative Team, MSAMHS - Metro South Health.  
Deepali Gupta - Advanced Pharmacist - Metro South Health.  
Jenny M Minchell - Dual Diagnosis Co-ordinator, Darling Downs Health.  
Margaret McElrea - Respiratory Scientist, Queensland Children's Hospital.  