

HELPING SMOKERS QUIT

Adding value to every clinical contact by treating tobacco dependence

The expired carbon monoxide (CO) test Guidance for health professionals

This document has been written by clinicians to support other health professionals using the exhaled CO test. The London Clinical Senate recommends it as a motivational tool and within the context of the [CO4 campaign](#)¹.



Know your level and track your improvement – For patients

First and foremost, the value of CO monitoring is as a motivational tool for smokers². Pharmacist and smoking cessation specialist colleagues who have considerable experience of using this test report its acceptability to patients and efficacy for behaviour change when used within the context of a supportive and structured intervention.



Enhanced tobacco smoking metrics – For clinicians, providers and commissioners

The test provides a digital result (parts per million – ppm) that can be coded and then used in conjunction with self reported current tobacco smoking status to help you understand your population. Heavier smoking, mode of smoking e.g. waterpipe and use of other smoked products e.g. cannabis can result in higher levels. Knowing the value can positively impact on the conversation and the subsequent choice of intervention. The CO test result is an alternative measure of success in a harm reduction approach where the patient wishes to cut down rather than quit.



The science, kit, intervention and interpretation

Carbon monoxide is one of the toxic gases inhaled by smokers from cigarettes. It has a short half-life, with elimination becoming slower as the concentration decreases. It is usually undetectable around 24 hours after the last cigarette. It is therefore a useful marker of regular smoking. If a smoker reports not smoking in the preceding 24 hours an exhaled air test can confirm this.

CO is easy to measure using readily available commercial products like those supplied by [Bedfont Scientific Ltd](#)³ and [Carefusion Corporation](#)⁴. These companies are highlighted in this document because their devices have well-established use in the NHS and the authors have experience of using them. The devices are easily portable, handheld and no more expensive than high quality electronic blood pressure monitors of the type you would expect to see on every GP desk.

When using a multiuser device a single use mouthpiece is required. Each kit comes with simple advice about calibration.

There is a new Bedfont iCO monitor for personal use with a smartphone or tablet and it is currently the cheapest on the market.

All devices give a CO reading in parts per million (ppm). 9ppm is generally considered to be the highest acceptable level of CO in the exhaled breath of an individual who reports not smoking though CO arising from airways inflammation in Chronic Obstructive Pulmonary disease (COPD) can result in levels up to 11ppm⁵. In practice, colleagues who have considerable experience in their use would suggest that any value above 5ppm usually suggests exposure to tobacco smoking.

As more health professionals in London become trained to support people to make a quit attempt through very brief advice and by having the right conversations there is an opportunity to utilise this motivational change tool currently proven in specialist quit smoking settings in everyday clinical settings too. The finding of a raised reading emphasises the measurable harm of smoking. Any subsequent reduction following treatment and behaviour change provides motivation, reward and immediate feedback on health gains. As part of the treatment protocol, praise can then be provided and a reinforcement of the 'not-a-puff' rule.

The following [YouTube](#)⁶ link demonstrates how to use one of the currently available devices.



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The science, kit, intervention and interpretation (cont.)

Technique top tips

1. Use non-alcohol sanitiser gel or wipes because the cells within them react to alcohol fumes.
2. Use disposable tubes allowing the patient to attach and remove from the device.
3. Ensure the patient holds their breath for as long as possible, ideally 15 seconds and breathes out slowly into the mouthpiece aiming to empty their lungs completely.

What else causes a raised CO?

Raised CO readings usually indicate tobacco smoking and would normally be checked in the context of motivational support for people attempting or exploring a quit. There are however other reasons for a raised CO such as second-hand smoke exposure, inhalation of fumes from faulty exhausts, or poorly ventilated cooking or heating appliances. Lactose intolerance can also result in raised exhaled CO levels⁷. In the North East of England where CO testing has more recently become embedded in routine midwifery care they have noted unexpected and alarming levels of CO in women due to domestic exposure⁸. Whilst this guide does not advocate the use of CO testing for screening purposes it is important for health professionals to be aware that in a small number of cases further action may be required beyond supporting a quit attempt. This guide therefore provides further advice on initial steps on how to support patients when this arises.



Tried and tested phrases and useful information

The following lines might be useful if you haven't had much experience of testing for CO. It is useful to have a colour CO level chart when you are explaining the result.

"Carbon monoxide is a gas inhaled by smokers when they smoke a cigarette and it is one of the harmful substances that we can measure with this machine. Our bodies produce small amounts of carbon monoxide and so the reading will probably not be zero; it will also fluctuate slightly depending upon what air you have been exposed to in the last few hours."

"The monitor is showing a reading of over x parts per million which is a level consistent with light/moderate/heavy or possibly joint (cannabis & tobacco) or Shisha smoking..."

If you haven't been smoking there are a number of other possible reasons for this:

- 1) You have been exposed to carbon monoxide fumes from a faulty gas boiler, car exhaust or from paint stripper - you should check these things out as exposure to carbon monoxide is dangerous;
- 2) Lactose intolerance [most people know if they are] and the high reading is a consequence of you consuming dairy products which can produce gases in your breath.
- 3) Passive smoking, although readings above 10 parts per million are not normally caused by being in the company of smokers; this can cause increased exposure to carbon monoxide but it does not normally push the reading above 10."

Use non-alcohol sanitiser gel

Use disposable tubes

Ensure the patient holds their breath for as long as possible



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Useful information

Finding out about CO poisoning from domestic appliances

The National Gas Helpline number is 0800 111 999. It is a free phone number with a 24 hour helpline. Deaf or hearing impaired can use the Minicom or Textphone number: 0800 371 787.

Finding out about lactose intolerance

The NHS choices site can help you decide whether you have the symptoms of lactose intolerance. If you have problems with your bowels or digestion then see your GP too, as they will also want to exclude other causes.

www.nhs.uk/Conditions/lactose-intolerance/Pages/Diagnosis.aspx

Infection control

1. Follow usual local procedures and the instruction provided by your monitor supplier.
2. Ensure your machine has a filter mechanism and that you are using it correctly to prevent cross infection. You do not usually need additionally to use cardboard tubes with filters for most commonly used devices.



How much does it cost?

These are the CO test costings from a London smoking cessation team that provides services for two boroughs.

Purchase of each machine – Approximately £129 plus VAT (negotiation possible when ordering higher volume)

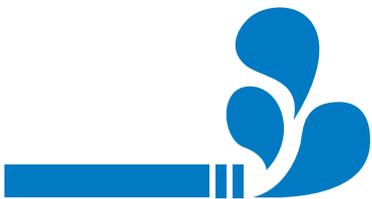
Disposable mouth tubes – £15 for 250

D pieces – monthly change per machine: £20 for 12

Calibration – Buy a new version that doesn't need calibration.

Historically calibration cost £400 per year

New purchases per year – Approximately 20 for upwards of 6000 patient contacts where CO was tested.



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The CO test in Pregnancy

London in 2014 had a reported prevalence of smoking in pregnancy that was lower than other parts of the UK at 5.1%. However because smoking prevalence varies according to age, socioeconomic and ethnic status this could be a falsely reassuring figure. Smoking rates in teenagers are as high as 36%⁹. The London Clinical Senate recommends that maternity units carry out routine 'opt-out' testing of smoking status and move away from self-reporting that may be more prone to error in pregnancy due to the higher perceived stigma¹⁰.

More maternity units are now embedding routine exhaled CO testing and anonymous cotinine (nicotine metabolite) measuring of urine provided by women at antenatal checks has helped to determine local prevalence figures. The Tobacco Control Collaborating Centre at Warwick has been measuring prevalence by testing cotinine levels at time of delivery and by doing so in 13 maternity units across England is improving the accuracy of prevalence data. They say:

"20% is a pretty reliable figure for the percentage of pregnant women who feel unable to tell the truth about their smoking and therefore never receive any help. The women are mostly young and poor but there are surprises - so don't make any assumptions.

For example in certain ethnic groups where it is culturally difficult to admit to smoking, Shisha smoking shows up with high CO levels"

Lessons from the north east of England

- Midwives in every North East trust are now including systematic CO testing as part of the routine tests all women receive at first booking appointment, which is part of national NICE guidance. All high readings are referred to NHS Stop Smoking Services within 48 hours.
- At the time of the dating scan, any women still smoking are given a more detailed explanation of the potential harm to the fetus from being exposed to carbon monoxide and other poisons contained in tobacco smoke.
- Midwives on the babyClear project get 2 hours briefing on why and how to use the monitors, and have time for a discussion

about smoking and CO which enables them to share their beliefs and attitudes and understand the evidence. They also use numbered CO monitors and therefore individual feedback can be given.

Practicalities of testing in pregnancy

1. Explain that CO is a poisonous gas contained in cigarette smoke and that CO monitoring is a simple, routine part of antenatal care.

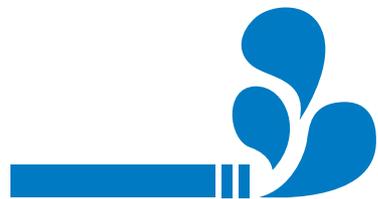
"Carbon monoxide is a gas inhaled when you smoke a cigarette. It passes via your bloodstream to your baby. Fortunately, CO levels return to normal very quickly once someone stops smoking. One of the routine antenatal checks we carry out tests the CO level in your bloodstream. It's a simple breath test which only takes a couple of minutes to do and we can give you the results immediately"

2. Explain that CO affects the body's ability to transport oxygen around the body, which reduces the oxygen available to the baby. Explain that CO crosses the placenta and enters the bloodstream of the baby: it increases the risk of miscarriage and slows the baby's growth and development.
3. CO readings will typically be lower in the morning than afternoon because CO levels build up over the course of the day.
4. What you need to do if the reading is over 4ppm.

"Exposure to tobacco smoke is the most common cause of carbon monoxide being found during the breath test. Do you or anyone else in your household smoke?"

5. If the pregnant woman says that she has stopped smoking but the CO reading is higher than 4ppm, advise her about possible CO poisoning and advise accordingly. It is, of course, possible that the woman is a current smoker but is reluctant to admit this; and so any further questions should be phrased sensitively to encourage a frank discussion.
6. Why you need to do this:
 - a. NICE recommend CO monitoring at every stop smoking consultation with pregnant women.
 - b. Many pregnant women are unaware of the high risks associated with smoking in pregnancy and CO tests provide visible proof of the effects of smoking on the body.

National Centre for Smoking Cessation and Training (NCST) module for pregnancy and post partum period¹¹



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Conflicts of interest

None



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Interpreting expired air carbon monoxide (CO) readings

10ppm
and over

Almost certainly smoking

A reading of 10ppm and over suggests recent exposure to a high level of CO. He/she can be a smoker (higher readings indicate heavier smoking).

- If a person says he/she does not smoke, discuss potential reasons for a high CO reading (e.g. secondhand smoking, faulty gas appliances, cannabis smoking).

Example of what to say:

- “Your CO reading is ... times higher than what would be safe for you. As CO is a poisonous gas, which can cause serious health problems, it is important that you stop smoking completely to improve your overall health. Once you stop smoking, CO is eliminated from your body rapidly, and help is available to increase your chance of quitting.”
- “Your CO reading today is ... ppm which we normally only see in smokers, as the typical readings for adult non-smokers are below 10ppm. You can get support from trained professionals and there are effective medications to help you stop smoking.”
- “One of the immediate health benefits of stopping smoking is a rapid decline in your CO level. If you stop smoking completely, your CO reading will return from ... ppm to that of a non-smoker within a day of quitting.”

5-9ppm

Possibly smoking

A reading between 5ppm and 9ppm suggests recent exposure to a moderate level of CO. He/she can be a non-smoker or a light smoker.

- If a person says that he/she smokes, discuss potential reasons for a low CO reading (e.g. CO monitors can only detect smoking in the last 24 hours).

Example of what to say:

- “This reading is consistent with that of a non-smoker, which is below 10ppm in adults. ”
- “Your CO reading is within the normal range. As long as you do not have a single puff on a cigarette, you can maintain this low level and become a non-smoker for good.”

Almost certainly not smoking

A reading of 4ppm and below suggests recent exposure to a low level of CO.

Example of what to say:

- “It is normal to have a small amount of CO in your breath even if you are not a smoker. The body naturally produces CO and the air quality around you can also affect your CO readings.”

1-4ppm



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CO (ppm)	% COHb
20 and above	3.20+
20	3.20
19	3.04
18	2.88
17	2.72
16	2.56
15	2.40
14	2.24
13	2.08
12	1.92
11	1.76
10	1.60
9	1.44
8	1.28
7	1.12
6	0.96
5	0.80
4	0.64
3	0.48
2	0.32
1	0.16

Highly Dependent
- 20+ppm

Almost certainly smoking
- 10-20ppm

Possibly smoking
- 5-9ppm

Non - smoker
- 1-4ppm