



# Raised CO Readings in a Non-Tobacco Dependant Pregnant Person Guidance

Title	Raised carbon monoxide in a non-tobacco dependent pregnant person Guidance
Version	1.0
Document type	Guideline
Author	Lucy Huscroft
Approval date	02/10/2023
Review date	02/10/2025
Document owner	Public Health Prevention in Maternity Team

---

**This guidance has been produced to support all staff providing care to pregnant people and their families where there is a raised Carbon Monoxide (CO) reading despite a pregnant person reporting to not having a tobacco dependence.**

## **Rationale for Carbon Monoxide (CO Breath testing)**

Saving Babies Lives Care Bundle Version 3 states that all pregnant people should be CO breath tested at their booking appointment regardless of whether they report to being tobacco dependent or not and other points in pregnancy, including 36 weeks. NICE NG209 recommends that pregnant people should be CO monitored at every subsequent appointment if they smoke tobacco; are quitting; used to smoke tobacco or tested 4ppm or more CO at 1<sup>st</sup> antenatal appointment.

In line with NICE NG209 Guidance any pregnant person with a CO reading of 4ppm or above should have their smoking status ascertained and be referred to an inhouse NHS Tobacco Dependency Treatment Service, or considered to be experiencing environmental CO exposure; the source of which should be established, such as a faulty boiler (ASH, 2021).

CO testing provides staff with the opportunity to identify whether someone has been exposed to CO, using a non-invasive biochemical method. Testing can assist with further discussions about the pregnant person's tobacco use/ second-hand smoke and can alert professionals to other causes of raised CO levels. CO binds to haemoglobin in the blood, with a 200-260 times higher affinity to binding than oxygen (Pan et al, 2021). CO has a short half-life resulting in CO levels reducing by half in 320 minutes on breathing air (NICE, 2022), so ideally CO level should be monitored as soon as possible on entering the clinical room. CO levels can be measured directly from blood samples and reported as a percentage of carboxyhaemoglobin or indirectly measuring the CO in expired breath (the standard method used for testing pregnant persons in antenatal appointments).

## **Sources of carbon monoxide**

The cause of CO could be in the home, car or workplace. Other than tobacco smoke the most commonly causes of CO exposure are –

- Faulty boiler
- Gas, oil, wood burning heating appliances
- Inappropriate use of generators and BBQs indoors
- Faulty car exhaust
- Recent fitting of double glazing/ blocked air vents may result in a problem appliance radiating CO without proper ventilation (PHE, 2015)
- Occupational exposure – such as Construction workers (UK HSA, 2022), mechanic, firefighter, diesel engine and fork lift operators, tunnel or toll booth attendants, restaurant charcoal meat grillers and indoor barbeque workers (Hawley, Cox-Ganser & Cummings, 2017).

## Carbon monoxide poisoning

Carbon Monoxide is a colourless, odourless and non-irritating gas. When inhaled carbon monoxide passes through the lungs, into the blood and attaches to haemoglobin. Brief exposure to small amounts of carbon monoxide may cause –

- Headache
- Flushing
- Nausea
- Dizziness
- Vertigo
- Muscle pain
- Personality changes

Exposure to higher amounts of carbon monoxide may cause –

- Movement problems
- Weakness
- Confusion
- Lung and Heart problems
- Loss of consciousness
- Death
- 

Being exposed to low levels of carbon monoxide for long periods of time can be difficult to differentiate from other common illnesses and may present as tiredness, headaches, nausea, dizziness, memory loss and loss of vision (UK HSA, 2022). If there is believed to be exposure to low levels of carbon monoxide advise the pregnant person to seek medical advice from their GP. Any suspicion of high levels of CO poisoning or a CO reading  $\geq 10$ ppm and/ or symptomatic of CO poisoning advise to attend local A&E department. NICE 2018 provides further information on how to manage suspected CO poisoning [NICE suspected CO poisoning](#).

CO may be transferred across the placenta and into fetal circulation. The half-life of CO in the fetus is 4-5 times longer than in the pregnant person due to fetal haemoglobins having a greater binding affinity and the relatively small diffusion gradient between pregnant person and fetal blood. Fetal carboxyhaemoglobin levels may be 10-15% higher than maternal blood concentrations (UK HSA, 2022).

Any suspected environmental exposure to CO consider possible CO poisoning. If it's suspected that exposure to CO is from the home environment, but not the result of second-hand smoke, request the pregnant person calls the free Gas Emergency line on 0800 111 999. Advise the pregnant person to turn off all fossil fuelled appliances, open windows and check all other residents in the house are safe. Any gas appliances should be checked by a qualified/registered engineer as it may be more than one appliance causing the issue. Anyone experiencing CO poisoning symptoms should seek medical advice immediately.

Recommend installation of an audible CO alarm in the home, European Standard EN 50291 with British Standards Kitemark (NICE, 2018), however this should not be used as an alternative to regular maintenance and care of appliances. If pregnant person resides in a rental home advise of the landlords responsibilities and legality of ensuring they install a CO alarm (PHE, 2015).

## **Lactose intolerance**

A person with an intolerance to lactose could result in having a high CO reading when tested during routine antenatal appointments. The high reading could be the result of the pregnant person eating dairy products, which can produce gases in a lactose intolerant person's breath (NCSCT, 2015).

Hydrogen is produced in the small intestine. People with a lactose intolerance could have raised breath hydrogen levels, related to food intake, with highest levels being found after waking.

Hydrogen can mimic CO in breath testing, where 20ppm of hydrogen can be equal to 4ppm of CO. In lactose intolerant individuals, consuming 350ml of milk could produce 35.75ppm of hydrogen, equal to 10ppm of CO (McNeill et al, 1990). To confirm presence of CO rather than hydrogen a blood sample/ arterial blood gas should be performed. Where COHb is within normal range and confirmed lactose intolerance it should be advised that CO is not causing any risk to pregnant person or fetus. Other health conditions have also been found to potentially increase exhaled CO such as diabetes (Paredi et al, 1999), Cystic Fibrosis (Paredi et al, 1999) and asthma, without steroidal treatment (Horvath et al, 1998).

Infections creating fevers, sepsis and acute respiratory distress syndrome, such as Covid-19 could also create raised endogenous CO levels (Scholkmann *et al*, 2021) which would be evident in blood samples. If the pregnant person has agreed to the NENC ICS Incentive Scheme a voucher should not be issued if CO  $\geq$ 3ppm, any queries consult with Public Health Prevention in Maternity Team.



# Carbon monoxide testing for a non tobacco dependent pregnant person

At antenatal booking appointment and 36 weeks – complete CO reading as soon as possible on entering the clinical area (symptoms will be less severe the longer the person is away from the CO source) and recorded in electronic maternity records.

ASK, ADVISE, ACT

CO reading of  $\geq 4$ ppm at booking appointment – repeat CO at every antenatal appointment in line with NICE Guidance NG209

Discuss CO reading and determine if person has been in contact with any potential CO sources, such as faulty boiler, faulty car exhaust, defective gas cooker, consider occupation, tobacco dependency/ second hand smoke exposure, Shisha or cannabis use. Advise of risks of CO exposure

Exposure to second hand smoke – make referral for partner/ significant other to Local Authority Stop smoking Service

Suspected medical reason, such as lactose intolerance, diabetes, cystic fibrosis, infection.

Unknown or environmental cause of high CO reading.

In persons with CO reading  $\geq 10$ ppm and/or symptomatic of carbon monoxide poisoning (dizzy, nausea, vomiting, confusion, low O2 sats). Advise to self-refer to A&E urgently. Advise to contact the Gas Emergency Line on 0800 111 999 Be aware of other household members in the same residence that may also be affected by CO poisoning.

Complete a blood carboxyhaemoglobin test (in green top bottle) or Arterial blood gas analysis (follow Trust Laboratory Guidance for preferred method) and record result on electronic maternity record

Toxic effects of CO appear at carboxyhaemoglobin levels of 15 -20%



Carboxyhaemoglobin level  $\leq 1.26\%$ . NENC Incentive Scheme voucher can be issued for people already signed up. Advise PHPiM team if voucher offered after COHb level confirmation. If symptomatic of Lactose intolerance prior to pregnancy consider referral to GP/ Gastro Specialist Team. Monitor breath CO at next antenatal appointment.

Carboxyhaemoglobin level  $\geq 1.27\%$  indicates exposure to carbon monoxide. If person on the NENC Incentive scheme a voucher can not be issued. Discuss potential environmental sources of CO. Explain how to reduce exposure to CO. Complete VBA. Monitor breath CO at next appointment

Refer pregnant person to the Tobacco Dependency Treatment Service, as per NICE Guidance NG209 . If  $\geq 36$  weeks gestation refer to Local Authority Stop Smoking Service

Breath CO reading  $\geq 4$ ppm at next appointment  
Repeat blood carboxyhaemoglobin level and record results on electronic maternity record. If carboxyhaemoglobin levels  $\geq 1.27\%$  for 2 or more consecutive readings the pregnant persons should be identified for an enhanced care pathway.

Consider a Covid test to rule out this being the cause of raised CO

# **Raised Carbon Monoxide readings in non-tobacco dependent pregnant persons Standard Operating Procedure**

## **References and Resources**

ASH (2021), *Evidence into Practice: CO Monitoring and data collection throughout pregnancy*, accessed 11 April 2023, [CO- monitoring-and-data-collection-FINAL.pdf \(smokefreeaction.org.uk\)](https://www.smokefreeaction.org.uk/CO-monitoring-and-data-collection-FINAL.pdf)

Hawley, B. Cox-Ganser, J. Cummings, K. (2017) *Carbon Monoxide Exposure in Workplaces, Including Coffee Processing Facilities*. American Journal of Critical Care Medicine 196(8) pp1080, accessed June 27 2023, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5649989/>

Horvath, I. Donnelly, L. Kiss, A. Paredi, P. Kharitonov, S. Barnes, P. (1998) *Raised levels of carbon monoxide are associated with an increased expression of heme oxygenase-1 in airway macrophages in asthma: a new marker for oxidative stress*. Thorax Journal 53(8): 668-72. accessed 27 June 2023 <https://pubmed.ncbi.nlm.nih.gov/9828853/>

McNeill, A. Owen, L. Belcher, M. Sutherland, G. & Fleming, S. (1990) Abstinence from smoking and expired-air carbon monoxide levels: lactose intolerance as a possible source of error. American Journal of Public Health 80: 1114-5 accessed 27 June 2023 [https://www.researchgate.net/publication/20772843\\_Abstinence\\_from\\_smoking\\_and\\_expired-air\\_carbon\\_monoxide\\_levels\\_Lactose\\_intolerance\\_as\\_a\\_possible\\_source\\_of\\_error](https://www.researchgate.net/publication/20772843_Abstinence_from_smoking_and_expired-air_carbon_monoxide_levels_Lactose_intolerance_as_a_possible_source_of_error)

National Centre for Smoking Cessation Training (2015) *Smoking Cessation: A briefing for midwifery staff*, accessed 12 April 2023, [https://www.ncsct.co.uk/usr/pub/NCsCT\\_midwifery\\_briefing.pdf](https://www.ncsct.co.uk/usr/pub/NCsCT_midwifery_briefing.pdf)

North East and North Cumbria *Tobacco Dependency in Pregnancy and the postnatal period pathway* (2023) [North East North Cumbria Tobacco Dependency in Pregnancy and the Postnatal Period Pathway and conversation guide v4 060623.pdf](https://www.necnc.org.uk/060623.pdf)

National Institute for Health and Care Excellence (2018) Carbon monoxide poisoning: Scenario: Management of carbon monoxide poisoning. Accessed 29 June 2023 [NICE suspected CO poisoning](https://www.nice.org.uk/guidance/NG209)

National Institute for Health and Care Excellence (2022) Guidance: Carbon monoxide: toxicological overview, accessed 29 June 2023 [NICE CO toxicological overview](https://www.nice.org.uk/guidance/NG209)

National Institute for Health and Care Excellence NG209 (updated 2023) , accessed 11 April 2023, [Overview | Tobacco: preventing uptake, promoting quitting and treating dependence | Guidance | NICE](https://www.nice.org.uk/guidance/NG209)

NHS England (2023) *Saving Babies' Lives Version 3: A care bundle for reducing perinatal mortality*, accessed 30 June 2023, [Saving Babies Lives Care Bundle Version 3](https://www.nhs.uk/healthcarebundles/savingbabieslives)

Pan, K-T. Leonardi, G. Ucci, Marcela. Croxford, B. (2021) *Can exhaled carbon monoxide be used as a marker of exposure? A cross-sectional study in young adults*. International Journal of Environmental Research and Public Health 18(22) 11893. accessed 29<sup>th</sup> June 2023 <https://www.mdpi.com/1660-4601/18/22/11893>

Paredi, P. Biernacki, W. Invernizzi, G. Kharitonov, S. Barnes, P. (1999) *Exhaled carbon monoxide levels elevated in diabetes and correlated with glucose concentration in blood: a new test for monitoring the disease*. Chest Journal 116(4): 1007-11. accessed 27 June 2023 <https://pubmed.ncbi.nlm.nih.gov/10531166/>

Paredi, P. Shah, P. Montuschi, P. Sullivan, P. Hodson, M. Kharitonov, S. Barnes, P (1999) *Increased carbon monoxide in exhaled air of patients with cystic fibrosis*. Thorax Journal 54(10): 917-20, accessed 27 June 2023 <https://pubmed.ncbi.nlm.nih.gov/10491455/>

Scholkmann, F. Restin, T. Ferrari, M. Quaresima, V. (2021) The role of Metaemoglobin and carboxyhaemoglobin in Covid- 19: A review. Journal of Clinical Medicine 10(1): 50. accessed 26<sup>th</sup> July 2023 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7795966/>

UK Health Security Agency (updated 2022) *Guidance: Carbon Monoxide: general information*, accessed 12 April 2023, <https://www.gov.uk/government/publications/carbon-monoxide-properties-incident-management-and-toxicology/carbon-monoxide-general-information>