Guide for Implementing the Carbon Monoxide Monitoring and Response Framework in Long-term Care Facilities

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Introduction

This guide is intended for public health practitioners, facility/property maintenance managers, risk managers, occupational hygienists, clinicians, or other persons working at long-term care facilities *(residential care facilities, nursing homes, seniors' residences, care occupancies, etc.)* who would like to implement a program to reduce the risk of indoor carbon monoxide (CO) exposure to residents and staff. This document provides an overview of the **Carbon Monoxide Monitoring and Response Framework (the "Framework")**, the rationale for implementation in long-term care facilities, recommended steps for implementation, and sample resources. The information in this document should be adapted to suit the user's context and resources within their organization.

Emphasis is on integrating components of education, monitoring, and prevention. The objective of the **Framework** is to establish procedures for detecting elevated CO levels and ensure a prepared and adequate response to mitigate harmful CO exposures.

Carbon monoxide exposures in Saskatchewan have indicated the need for CO monitoring and response programs in long-term care facilities and evaluations have found the utility of such programs in capturing CO exceedances over time *(see page 9 - Evidence of Utility and Incidents Averted)*. This led to the development of the **Framework** for detecting elevated CO at these facilities, particularly at levels which are low yet potentially harmful.

Rationale

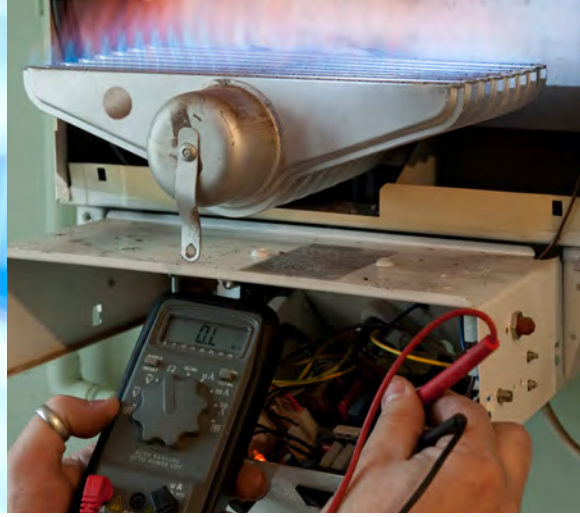
Carbon monoxide is a non-irritating gas that you cannot see, smell or taste. It is produced from combustion of fuels such as natural gas, kerosene, oil, coal, and wood. Common sources include heating and cooking appliances *(e.g., boilers, water heaters, fireplaces)*, vehicle exhaust, and tobacco smoke. CO is an important indoor air pollutant due to its harmful effects when inhaled, including death. CO detectors are needed to detect the presence of CO, but are not often required or currently installed in most long-term care facilities.

To protect residents and staff at long-term care facilities, the **Carbon Monoxide (CO) Monitoring and Response Framework (the "Framework")** described in this document is based on exposure limits established by **Health Canada's Residential Indoor Air Quality Guideline**[1], which also considers CO-sensitive individuals. Implementation in long-term care facilities is a deliberate target of the **Framework** as residents in these facilities include those who have underlying heart disease or respiratory conditions which increase their susceptibility to the harmful effects of CO. Residents also spend substantial amounts of time indoors, where they partake in a variety of activities, some of which increase the volume of air they breathe and with it their vulnerability to the effects of CO. This adds to the importance and relevance of implementing procedures that monitor CO in living environments where prolonged low-level exposures can produce adverse health impacts in already health-stressed individuals.

The Framework is a proactive approach that can be integrated into existing preventive maintenance and emergency response plans, where monitoring and response actions increase the detection of potential CO issues so they can be addressed before dangerous exposure situations arise.

[1] Health Canada. Residential Indoor Air Quality Guideline: Carbon Monoxide. 2010.
Available from: http://healthycanadians.gc.ca/publications/healthy-living-vie-saine/carbon-monoxide-carbone/index-eng.php





Background

The need to better understand and manage CO exposures in long-term care facilities arose from a 2010 incident where residents and staff were exposed to high levels of CO in a long-term care facility in Humboldt, Saskatchewan. The incident affected both residents and staff, requiring the evacuation of one wing of the facility, immediate hospitalization of some evacuees, and contributed to three deaths. Investigations revealed an issue with a boiler to be the cause. Prior to the incident, there was no documented evidence of elevated CO nor were CO detectors required or installed at the facility. The only information on potential exposure was through instantaneous measurements collected by the utility provider upon responding prior to the evacuation.

The CO incident in Humboldt, Saskatchewan brought forward important issues around protecting susceptible persons from CO. First, because CO is a colourless and odourless gas, it can only be detected through monitoring. Saskatoon Health Region now requires CO detectors to be installed in all health care facilities. Second, even if CO detectors had been in place in the facility, it is not clear if harmful exposures would have been prevented among susceptible residents because of the threshold levels at which current CO detectors are set to alarm; current residential CO detectors are designed to prevent CO poisoning (acute, high level exposure) but are not designed to prevent lower-level (10-30 ppm) acute and sub-acute exposures. CO detectors do not alarm at levels associated with lower level CO exposure, such as those that can affect elderly persons and those with chronic heart and lung diseases.

In response, the Saskatoon Health Region (SHR) and the province of Saskatchewan implemented a policy (SHR Monitoring Policy) for CO monitoring, recording, and reporting procedures to manage CO exposures in long-term care facilities. Briefly, the SHR Monitoring Policy attempts to address the risk of low level CO exposures by adopting the following requirements at all long-term care facilities:

- Installation of CO detectors at CO emitting sources and occupied spaces where fuel-fired devices are installed (e.g., room with fireplace).

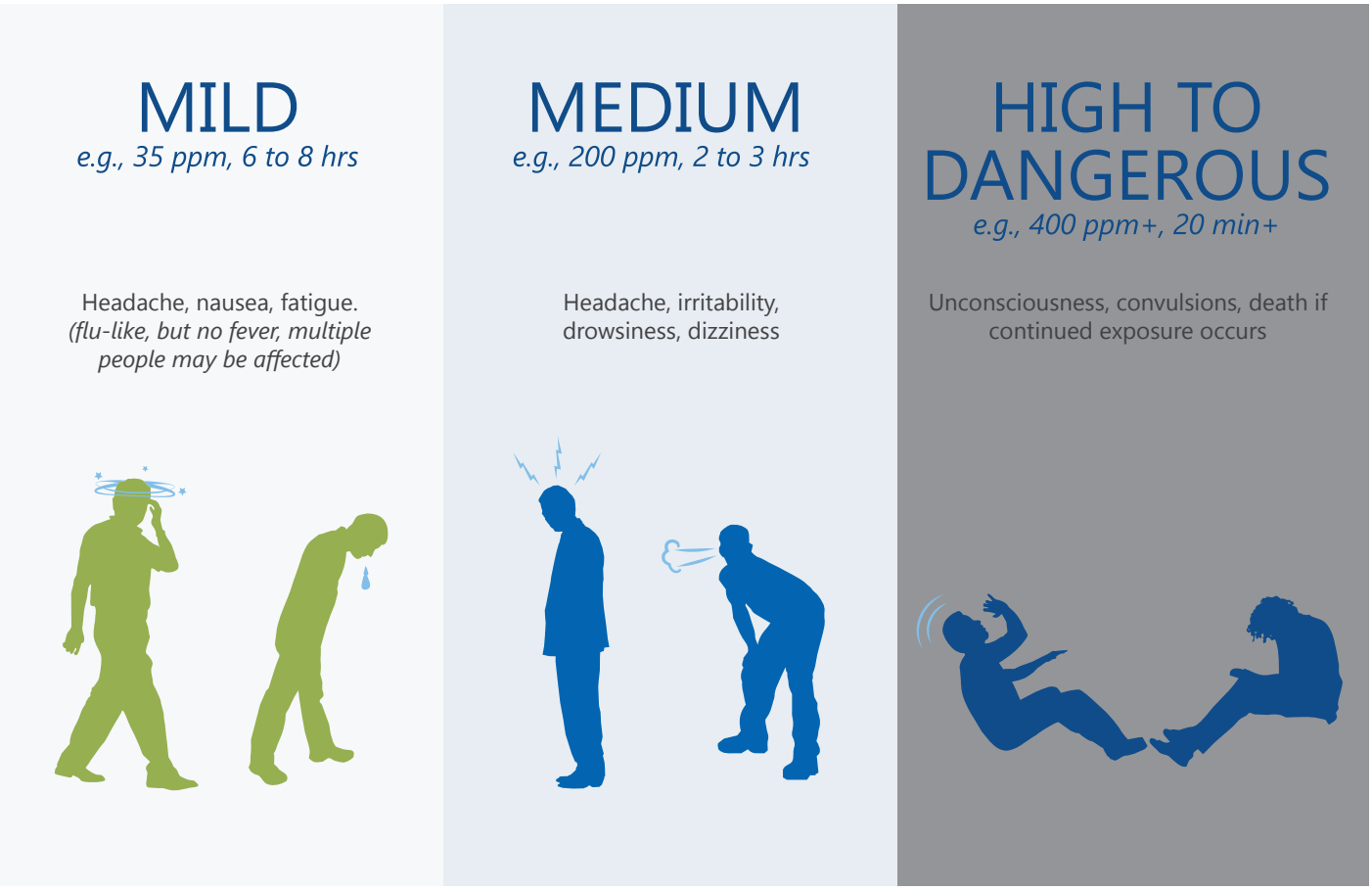
- Recording the instant and peak CO concentrations, as presented by the detector's built-in display, once every 24 hours. Monthly reports are forwarded to the health authority and kept for a minimum of 12 months.

- Responding to elevated readings above 10 ppm, through actions including source investigations, ventilation, notification of utility providers (gas), notification of first responders (fire, ambulance), evacuation, and activation of hospital emergency codes.

Health Risks from CO Exposures

When inhaled, carbon monoxide binds to hemoglobin in blood to form carboxyhemoglobin (COHb), which impairs the delivery and unloading of oxygen to tissues in the body. Certain individuals are especially susceptible to CO, particularly those with pre-existing health conditions such as heart disease. Health effects depend on duration and level of exposure; health impacts may occur over a wide range of exposure conditions and vary from individual to individual. A summary of CO exposure conditions, symptoms, and alarm triggers are presented in Figure 1 below.

Figure 1. CO exposure conditions and symptoms[2,3]



[2] Health Canada. Residential indoor air quality guidelines – Science Assessment Document, Carbon Monoxide. 2010. Ottawa. Her Majesty the Queen in Right of Canada.
[3] Goldstein, M. Carbon monoxide poisoning. Journal of Emergency Nursing. 2008;34(6):538-542.

Establishing a CO Action Level for Long-Term Care Facilities

Prolonged CO exposures at low levels that do not result in an alarm of a CO detector may contribute to adverse health effects in persons who may be susceptible to CO, such as residents in long-term care facilities. The Canadian Standards Association (CSA) approves CO detectors that alarm at CO concentrations and exposure durations that are immediately dangerous to human health, equivalent to a 10% level of COHb. Alarm algorithms for CSA-compliant CO detectors are as follows: 30 ppm for 30 days; 70 ppm over 60 to 240 minutes; 150 ppm over 10 to 50 minutes; and 400 ppm over 4 to 15 minutes.

In contrast, Health Canada uses a target COHb level of 2% to set indoor air CO guidelines, accounting for CO sensitive individuals *(see Table 1)*. Given this discrepancy, CSA-compliant CO detectors would adequately protect long-term-care residents from the health effects of high level CO exposure, but not prolonged low level CO exposure *(e.g., 10-25 ppm)*.

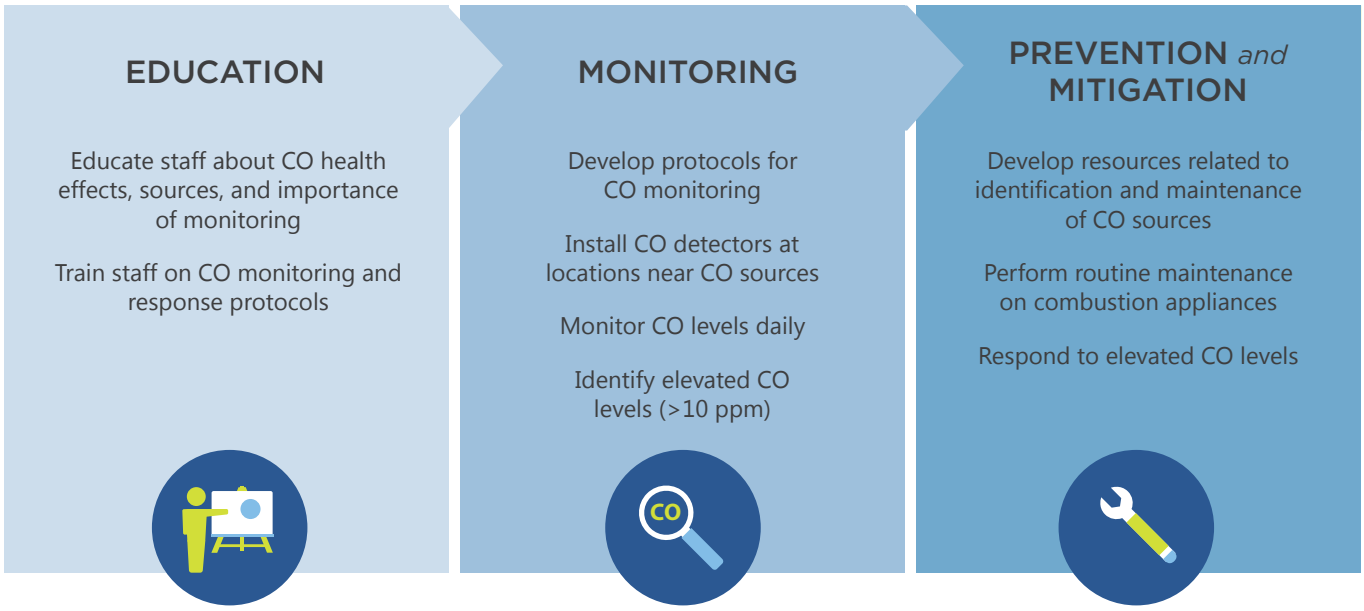
Table 1. Residential Maximum Exposure Limits for Carbon Monoxide

AVERAGING TIME	CONCENTRATION mg/m^3	ppm	CRITICAL EFFECTS
1h	28.6	25	Reduction in maximum duration of exercise in health individuals
24h	11.5	10	Reduction in ST segment in change time *(sign of myocardial ischaemia)* in individual with coronary artery disease

Exposures at 10 ppm for over 24 hours would not trigger any alarm or notification even though this would be above residential maximum exposure limits. Therefore, daily monitoring and use of a 10 ppm action level is consistent with a response toward ensuring indoor CO levels meet established guidelines.

The CO Monitoring and Response Framework

The CO Monitoring and Response **Framework** includes the following elements:



Development of the Framework

With support from Health Canada, the National Collaborating Centre for Environmental Health (NCCEH) and BC Centre for Disease Control (BCCDC) worked with Saskatoon Health Region (SHR) to complete a formative, process-oriented evaluation of the SHR CO Monitoring Policy. The evaluation examined the extent and quality of its implementation in SHR. Findings determined that it has contributed to the prevention of CO exposures through an improved response to elevated indoor CO. Building upon the central component of monitoring present in the SHR CO Monitoring Policy, education, prevention, and mitigation were additionally seen as essential to implementing the policy and responding to CO exceedances. This formed the basis for the CO Monitoring and Response **Framework** and, together with evaluation findings, used to establish a pilot project in a BC Health Authority. The combined experiences have been used, in part, to develop this document and will be part of a guide to implementing and evaluating a CO monitoring and response **framework** in long-term care facilities. This work is built upon a **stakeholder consultation meeting**[4] in 2013 to promote the development of a health-protective CO management framework that incorporates education, monitoring, prevention, and mitigation, with practical means to support program implementation and evaluation.

[4] National Collaborating Centre for Environmental Health. Managing carbon monoxide in long-term care facilities and hospitals: Meeting report. 2013.
Available from: http://www.ncceh.ca/content/carbon-monoxide-monitoring-long-term-care-facilities-and-hospitals

Evidence of Utility and Incidents Averted

Evaluation findings from SHR have indicated the utility of the **Framework** in capturing elevated CO levels (>10 ppm). Monitoring data from eight long-term care facilities revealed over 130 exceedances that were captured over a period of 19 months. Elevated levels were typically found in areas near sources of combustion such as boilers, kitchens, and laundry equipment. However, exceedances were also captured in resident wings, dining rooms, halls, and offices, an indication that CO may be distributed in areas away from CO sources. Reported CO levels ranged from 10 to 195 ppm, the majority of which did not result in a CO alarm. Response actions ranged from turning on ventilation equipment to activating hospital code browns and remodelling of building infrastructure.

At least three examples of CO incidents averted as a result of having the **Framework** in place have been reported in the media:

- **Regina, Saskatchewan** – Fire department and gas utility provider responded to elevated CO levels detected by security and maintenance personnel. CO levels from approx. 20 to 33 ppm were reported on all three floors of the facility.[5]
- **Wakaw, Saskatchewan** – Code brown *(hazardous releases)* activated in response to elevated CO levels detected in a boiler room and service wing; three staff and one resident reported feeling unwell.[6]
- **Kinistino, Saskatchewan** – Staff responded to carbon monoxide alarms by ventilating and turning off fuel supply. Investigations identified CO accumulation as a result of airflow issues with a boiler.[7]

Logic Model

The generalized logic model on the next page is intended to capture the activities that are part of the **Framework**, while relating these to two main intermediate outcomes, at regional and site levels. The logic model can be refined depending on the stakeholders involved in implementation. The usual categories of "outputs" and "immediate outcomes" were collapsed into "immediate results"; it is at this level that short-term evaluation indicators would be measured in the initial stages of implementing the **Framework**, such as a pilot. The intermediate outcomes would only be measurable after full implementation and covering at least one full seasonal cycle and ideally two winter seasons.

The goal of the **Framework** is to improve the capacity to prevent CO exposures, respond to CO exceedances, and reduce the risk of harmful exposure of CO to residents and staff at long-term care facilities.

[5] CBC News. Carbon monoxide leak at Regina seniors residence. 2016
Available from: **http://www.cbc.ca/news/canada/saskatchewan/carbon-monoxide-regina-seniors-residence-1.3564003**
[6] Giles, D. 'Code Brown' alerts staff to CO leak at care home. 2013.
Available from: **http://globalnews.ca/news/771806/code-brown-alerts-staff-to-co-leak-at-care-home/**
[7] Giles, D. Carbon monoxide scare at Saskatchewan seniors home. 2015.
Available from: **http://globalnews.ca/news/2228221/carbon-monoxide-scare-at-saskatchewan-seniors-home/**

INPUTS	ACTIVITIES	IMMEDIATE RESULTS	INTERMEDIATE OUTCOMES	LONG-TERM OUTCOMES
Regional Senior Leadership Health Protection Facilities Management Residential Services Risk Management Emergency Preparedness and Planning	EDUCATION	**Regional Level** Training and tools delivered for monitoring, mitigation, staff awareness Oversight, compliance monitoring, feedback **Facility Level** Staff aware of CO health effects, sources, and importance of monitoring Staff trained to respond to elevated CO	ENHANCED REGION-WIDE CAPACITY TO MANAGE CO RISK	REDUCTION IN CO-RELATED HEALTH IMPACTS
Facility Management Staff assigned to monitoring and mitigation	MONITORING	**Regional Level** Protocols in place Allocated roles and resources Interdepartmental relationships in place **Facility Level** CO levels monitored and recorded Exceedances detected and reported		
Financial, physical and technical resources	PREVENTION *and* MITIGATION	**Regional Level** Agreements with necessary services Support for maintenance and investigation **Facility Level** CO exceedances investigated and addressed Coordination with necessary departments and services in response to CO exceedances	ENHANCED FACILITY CAPACITY TO PREVENT AND REDUCE EXPOSURE TO CO	

Features of the Framework: CO Monitoring, Reporting, and Response

Installation of carbon monoxide detectors

CO detectors used for monitoring must have the following specifications:

- Compliant with the Canadian Standards Association (CSA) Standard, CSA 6.19 Residential Carbon Monoxide Alarming Devices
- Have a digital display showing CO levels with instant (i.e., continuous) and peak reading functions.
- Retail hardware providers typically carry battery-operated residential indoor CO detectors that meet the above specifications.

Installation, maintenance, and replacement of detectors should be as per manufacturer's instructions.

- Detectors will be placed at a height that allows optimal monitoring of the digital display; CO diffuses evenly in room air and does not need to be placed in a specific height range.
- Consider parameters in the manufacturer's instructions/specifications such as temperature, humidity, and interference from environmental conditions (forced or unforced air, vents, ceiling fans, etc.).
- Detectors should be unobstructed and air should flow freely around the detector.
- Avoid placing detectors in high traffic areas or where they can be a nuisance to residents or accidentally damaged *(e.g., too low to the ground where movement of people, carts, equipment, strollers, wheelchairs may inadvertently touch the detector)*.

CO sources must be identified and locations of CO detectors must be mapped on a site map (e.g., floorplan) available at the facility.

- An indoor air quality specialist with knowledge of ventilation systems and building layout would be preferable to consult, but not required. Staff responsible for monitoring should be familiar with and have access to the CO detector manufacturer's instructions (i.e., user manual) for troubleshooting.
- Facility Managers and/or maintenance personnel (or a designate) will conduct an inventory of CO sources and mark them on an up-to-date site map or floorplan.
- Every room with a CO source should have a CO detector installed.

Typical sources of CO are *(but not limited to)*:

- Fuel-burning *(propane, oil, wood, gasoline)* appliances

- Boilers
- Laundry equipment

- Water heaters
- Fireplaces

- Kitchen equipment, gas-stoves
- Generators

- Exhaust from cars, delivery trucks *(garages, loading bays)*

- Shared occupied spaces where residents may spend substantial amounts of time, should have a CO detector if there is a suspected pathway for CO to accumulate in these areas. Some facilities may also place a CO detector in each wing of resident units.
- CO detectors should not be activated until all procedures and on-site training have been communicated.

Monitoring and response procedures

The primary activity within the Framework involves monitoring daily CO readings on the installed CO detectors. Instant and **peak** level readings on all installed CO detectors are read (built-in display) and **recorded in standard weekly logs once every 24 hours**; logs should be kept on-site for a **minimum of 12 months**. It would be beneficial to enter data (periodically) in an electronic database (e.g., spreadsheet) to facilitate analysis of trends and identify recurring issues. Preventive maintenance of fuel-burning appliances should be integrated into CO monitoring procedures.

If a detector has an instant or peak level reading of 10 ppm or higher:

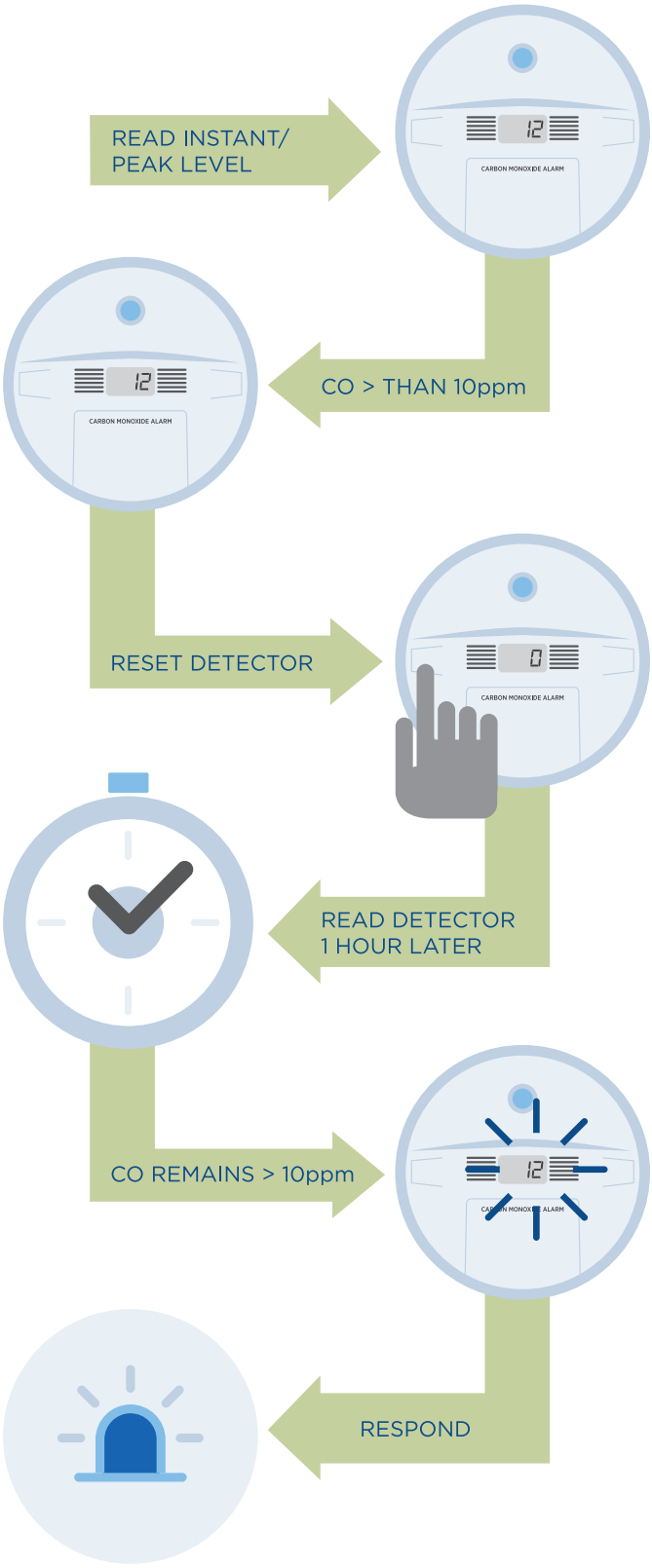
1. reset the detector
2. read the detector 1 hour later

If reading is still 10 ppm or higher, follow procedures related to CO response and a source investigation should commence

A CO Source Checklist in the appendix can be used or adapted for initial investigations

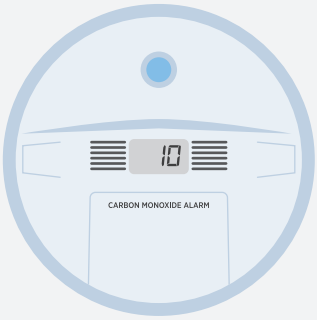
A simple route map may be useful to create, such as numbering the detectors on a floorplan for staff to follow.

A monthly CO reporting form will be completed by the long-term care facility site administrator (or designate) and sent to a regional-level department in the health authority to be compiled or assessed for completeness and CO incident follow-up, if necessary.



A response to CO exceedances should include verification of the alarm or exceedance and consider the range of CO readings being recorded and potentially affected areas. Stakeholders should discuss, agree upon, and clearly document their response options and actions prior to fully implementing the **Framework**. Staff should be aware of actions to take in response to exceedances. It is for the health authority to determine the appropriate response based on risk assessment and considering the negative impacts of alarming or moving residents and staff.

The following response actions are examples:

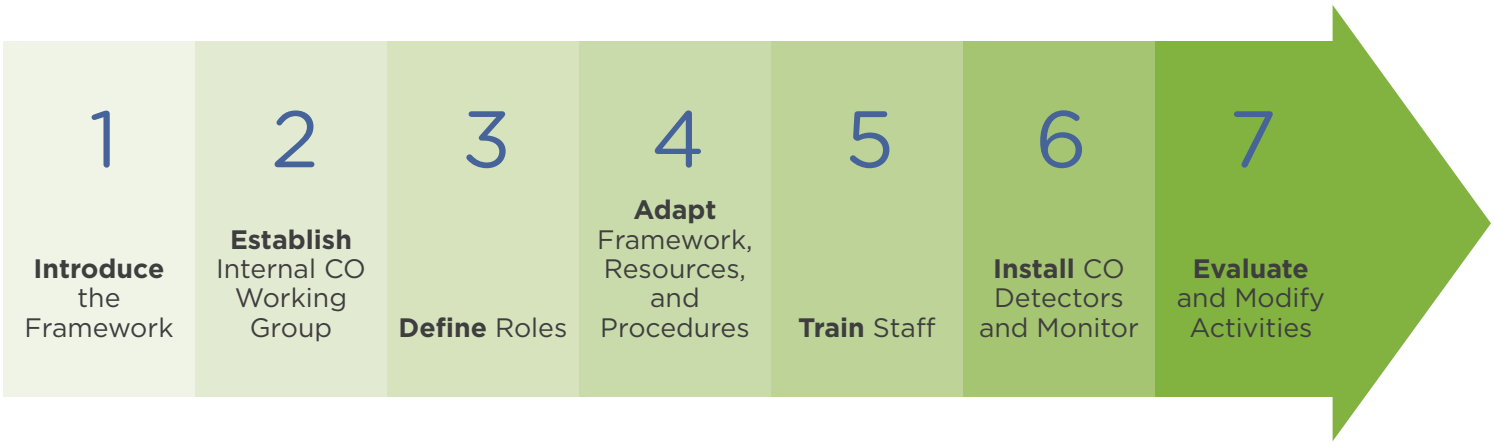


If levels are low (10-24 ppm) **and isolated** (at a single detector in a boiler room), a less intensive response is recommended, such as investigating the source; reporting any potential signs and symptoms of CO exposure in staff and residents; and continued attention to monitoring in suspect areas. If low levels continue to be read and levels are determined to be abnormal (or source cannot be identified), the utility provider may be contacted (e.g., gas) to verify and troubleshoot as they may have more accurate devices to examine the problem.

If levels are higher or **widespread, but do not trigger an alarm** (e.g., 25-50 ppm) *(detected in multiple locations)*, response actions may include ventilating affected areas; calling fire/emergency responders and utility provider; notifying regional departments responsible for emergency management/response; and or evacuation of the affected area. Some health authorities have embedded the CO response inside hospital emergency codes, whereas others have not.

If a CO detector is alarming, emergency responders should be called immediately, in addition to other pre-established actions to coordinate a response.

Recommended Steps for Implementation



The **Framework** is conceptually simple and resources *(including those in this document)* have been developed to facilitate implementation. Initially, implementation requires dedicated resources and coordination to discuss and refine the documents required for the **Framework**, but ongoing tasks are straightforward. Tasks can be easily integrated into existing routines of long-term care facility staff. Primary initial costs are associated with purchasing CO detectors *($30-50 per detector)* and time for initial implementation *(e.g., meetings, consultation)*. Ongoing costs include those for replacement of detectors *(typical lifespan of up to 7 to 10 years)*, staff time for recording/reporting of levels *(10-80 min/day),* and follow up actions *(e.g., CO source investigation)*. For regional implementation, establishing the program in a small number of pilot sites can reduce the time required to implement in subsequent sites and may be more efficient. The general steps are described below; it is likely that they will be considered within the context of organizational requirements and practices of the sites who will be implementing the **Framework**.

1 Introduce the Framework

After reviewing the **Framework**, its rationale should be introduced to senior and executive leadership of the health authority with oversight of long-term care facilities. This should include a high level discussion focused on establishing a baseline understanding of how the **Framework** and its goals may align with guiding principles and mandates of the health authority. It should also identify its initial requirements and stakeholders/departments which are suitable for facilitating the implementation. Initial discussions should include (but not limited to) individuals from departments with mandates encompassing public health and population health; residential care services; facility maintenance and property management; support (kitchen, housekeeping) services; communications; risk management; and workplace health. At this initial stage, various Directors, Managers, and Medical Officers of Health may be involved in the decision to move forward.

2 Establish Internal CO Working Group

The **Framework** requires a multi-portfolio approach for successful implementation. An internal CO Working Group may be formed, consisting of representatives from departments identified in the initial discussions with leadership.

The CO working group requires a chairperson that can oversee the implementation process and coordinate between stakeholders; project management experience would be beneficial, but not required. Together, members are responsible for planning logistics; developing or adapting the required educational resources and procedures; and addressing concerns related to the **Framework**. Web-conferencing or teleconferencing has been used to facilitate meetings, initially weekly and later on a monthly basis as implementation unfolds. Occasionally, staff from different departments may join the meeting to refine details (*e.g., staff coverage on weekends*) or communicate necessary information to train staff. It is important to keep agendas clear and establish a mechanism to share files to maintain momentum and avoid confusion.

3 Define Roles and Responsibilities

The CO working group should ensure appropriate and adequate coverage of the activities in the **Framework**. These should be refined and documented so all stakeholders have a mutual understanding of their roles and responsibilities prior to continuing with implementation. The unique context, structure, resources, and departments in each health authority should be considered. Below is an example of stakeholder roles and responsibilities for a regional health authority:

LEVEL	STAKEHOLDER ROLES AND RESPONSIBILITIES
Site *(long-term care facility)*	**All Staff** Must be informed of the process related to CO monitoring and reporting for their site and have an understanding of response duties as outlined in the procedure related to CO exposure.
	Maintenance staff *(or designate)* Responsible for all CO monitoring and recording tasks Records daily instant and peak level CO detector readings on standard weekly logs which are retained for 12 months. • CO levels above 10 ppm require investigative processes and emergency preparedness procedures to be initiated where appropriate.
	Site Manager Responsible for implementation at site, including assigning/coordinating tasks Coordinate with Support Services supervisor, the delegation of monitoring outside of Facility Management operating days of work and ensure required training of Support Services staff Coordinate CO investigations and response Conduct random audits of standard weekly logs. • If there are incomplete, unavailable, or non-compliant records, notify the Carbon Monoxide Project Coordinator, Health Protection • Submit monthly (electronic) CO monitoring compliance reports to Carbon Monoxide Project Coordinator, Health Protection
Regional	**Carbon Monoxide Project Coordinator** Chair the CO Working Group Monitor submissions of CO monitoring compliance reports • If non-compliance is found, notify Site Manager, Facilities Management, CO Working Group **Program Managers/Supervisors** Ensure sites are informed of processes and conduct training/education.
	CO Working Group Responsible for amending and monitoring the policy Responsible for policy and procedure implementation

4 Adapt Framework, Resources, and Procedures

The appendices contain sample monitoring instructions; weekly log template; monthly reporting template; and CO source investigation checklist that can be adapted to meet the monitoring and response requirements of the **Framework**. Details on the response should be written in a separate document. Previous sites have used a clipboard consisting of the following materials to help staff conduct daily monitoring tasks and to train new staff on procedures:

- CO monitoring instructions
- CO reading monthly reporting form
- CO monitoring weekly log form
- CO source investigation checklist
- CO detector and CO source list or facility floorplan marking their locations
- CO monitoring route (numbered with CO detector locations marked on a facility floorplan)
- Additional contact numbers for personnel involved with a CO response

5 Train Staff

Staff should be aware of the signs of CO exposure and procedures to respond to CO exposure events. The CO Working Group may schedule online (webinar) or in-person training for managers of staff that will be responsible for daily monitoring tasks as well as individuals potentially involved in the response. The training should increase the awareness of staff to CO sources and health impacts, rationale for implementation; there should be time for questions to be discussed. An internal memo to notify participating sites (including staff and visitors) may be useful to address questions prior to implementation. Facility management (maintenance, security), housekeeping (laundry, kitchen), and clinical staff (nurses) are potential participants. After this, managers will conduct on-site training with hard copies of the resources and procedures, going through the features of the CO detectors, and running through the daily tasks.

A sample **powerpoint presentation**, based on materials in this document, can be adapted to facilitate webinars or on-site presentations and discussions of the Framework; a copy can be obtained by contacting Daniel.Fong@bccdc.ca.

6 Install CO Detectors and Monitor

Installing CO detectors in rooms with a CO source presumes that downstream exposures are lower, although ventilation systems may transfer CO to areas throughout a building. Daily (once every 24hr) recording of levels ensure actions can be taken in response to elevated levels and prevent exposures above Health Canada's residential maximum indoor exposure limits for CO (10 ppm over 24 hrs). CO detectors have limitations with accuracy, but are used to provide early detection and notification of potential situations that can lead to harmful exposures.

7 Evaluate and Modify Activities

It is recommended that a few sites be piloted with the **Framework** so that an initial evaluation can be conducted to assess the feasibility of expanding to other sites and address any barriers to implementation. Sites should have fully implemented the **Framework** for a minimum of 3 full months prior to conducting an evaluation. A general evaluation framework will be included in the guide to implementing and evaluating a CO monitoring and response framework in long-term care facilities.

Appendices

Sample CO Reading Monthly Reporting Form

CARBON MONOXIDE (CO) READING MONTHLY REPORTING FORM

Facility name: _____

Reporting
month and year: _____
(e.g., December 2015)

List location of CO monitors:
_____
_____
_____
_____

Please answer the following questions:	yes	no	Notes/comments
1. Are CO detector readings recorded daily?	☐	☐	
2. Are CO readings recorded on the weekly log sheets?	☐	☐	
3. Any excessive CO readings recorded this month?	☐	☐	Date of excessive reading(s): _____ /_____ /_____ What was the reading(s)? _____ Location of excessive reading(s): _____
4. What was the response to the excessive reading?			
5. Was a source investigation carried out?	☐	☐	
6. Was the source of the excessive reading identified?	☐	☐	
7. Was the situation resolved?	☐	☐	

Submitted by: _____Date submitted: _____ /_____ /_____

Sample CO Monitoring Instructions

CO MONITORING INSTRUCTIONS

1. DAILY READING INSTRUCTIONS

Note: This is the "instant reading", which refers to the number displayed on the unit and visible at all times.

- ☐ Record the digital number displayed on the weekly log sheet in the instant reading column

If the digital number displayed is higher than 10 ppm:

- ☐ Return to the detector in 1 hour and check the reading again
- ☐ If the detector reading is still **ten (10) ppm** or higher, call facility management who will immediately investigate using CO SOURCE CHECKLIST and ventilate. If the detector reading is **twenty-five (25) ppm or higher, call Facility Management and CODE Grey will be activated.**
- ☐ **Call**

Monday to Friday:

Site 1 – John Doe, Phone number

After hours and weekends:

Site 1 – John Doe, Phone number; 24 hr after hours on call emergency number – Phone number

2. DAILY PEAK LEVEL MEMORY READING INSTRUCTIONS

Note: This reading indicates the highest CO level in memory since the detector was last reset.

How to obtain a Peak Level Memory Reading

- ☐ Press and hold the **Peak Level Memory button**. The digital number displayed will be the highest CO reading taken since the last reset.
- ☐ Record this reading on the weekly log sheet in the peak level reading column.
  If the reading is **zero (0)**, no action is required;
  If the reading is **ten (10) ppm or higher**, reset the detector as per instructions below.

To reset the Peak Level Memory Reading:

- ☐ Press the **Peak Level Memory** button.
- ☐ While still pressing the button, press the **Test/Reset** button for two seconds and release. You may want to cover the sound hole during the test as it will emit a loud tone.
  The number of the display will turn to "0",
  The memory will be cleared and the alarm will begin detecting for CO

If the Peak Level Memory Reading is 10 ppm or Higher:

- ☐ Reset the detector
- ☐ Return to detector and check the **Peak Level Memory Reading** again in **1 hour**.
- ☐ If the detector reading is still ten (10) ppm or higher, call facility management who will immediately investigate using CO SOURCE CHECKLIST and ventilate. If the detector reading is **twenty-five (25) ppm or higher, call Facility Management and CODE Grey will be activated.**
- ☐ **Call**

Monday to Friday:

Site 1 – John Doe, Phone number

After hours and weekends:

Site 1 – John Doe, Phone number; 24 hr after hours on call emergency number – Phone number

Sample CO Monitoring Weekly Log template

	WEEKLY CARBON MONOXIDE LOG SHEETS retain on-site for 12 months minimum								Weekly Test Date:____ /____ /____ Printed Name:		
	Site										
	Carbon Monoxide	CO #1	CO #2	CO #3	CO #4	CO #5	CO #6	CO #7	CO #8	CO #9	CO #10	CO #11
	Detector Location											
MONDAY	Instant Reading											
	Peak Level Reading											
	Time											
	Recorder											
TUESDAY	Instant Reading											
	Peak Level Reading											
	Time											
	Recorder											
WEDNESDAY	Instant Reading											
	Peak Level Reading											
	Time											
	Recorder											
THURSDAY	Instant Reading											
	Peak Level Reading											
	Time											
	Recorder											
FRIDAY	Instant Reading											
	Peak Level Reading											
	Time											
	Recorder											
SATURDAY	Instant Reading											
	Peak Level Reading											
	Time											
	Recorder											
SUNDAY	Instant Reading											
	Peak Level Reading											
	Time											
	Recorder											

Sample CO Source Investigation Checklist

CARBON MONOXIDE SOURCE CHECKLIST

- [ ] **Inspect the burners of all fuel burning appliances.**

  The flame should be a nice blue colour (except for gas fireplaces which may have a yellow flame).

  The appliance list can include: cooking equipment, dishwashers, heating equipment, fireplaces, lab equipment, laundry equipment, emergency generators, maintenance equipment, etc.

  This should be performed by a qualified contractor.

  Each site needs to have a list of all fuel burning appliances. This includes all fuels, not just natural gas.

- [ ] **Check for possibility of contaminated outside air entering the building through building air intakes, entrance doors left open (e.g. vestibule design, vehicle drop off configuration, automatic doors), etc.**

  The source may be vehicle exhaust, building exhaust short circuiting back into building air intakes, or possibly other outside air quality problems.

- [ ] **Check for sufficient combustion and relief air supply to all fuel burning appliances in the area of the elevated CO reading.**

  Typical issues include: original design deficiency (both sizing and configuration), blockages or restrictions in air flow (damage, loose insulation, snow, frost, tree fuzz, intentional blockages, etc.), un-engineered modifications to either heating equipment or ductwork.

  This may require professional engineering services.

- [ ] **Sequencing of equipment start-ups.**

  Non-optimal equipment start up sequencing may result in an elevated CO reading.

- [ ] **Check for adequate equipment exhaust.**

  Typical issues include: inadequate ducting, inadequate air flow (many root causes), blocked filters, inadequate make up air, un-engineered modifications to duct design or equipment installations, original design deficiencies, other blockages or restrictions to air flow (many root causes), failed exhaust piping system (can be hard to detect as this is often insulated), unusual atmospheric conditions may also be a contributor.

- [ ] **Check HVAC equipment and ductwork**

  This equipment and ductwork is often located in areas of fuel burning equipment.

  Typical issues include: failed gaskets, dampers, holes, blockages or restrictions in air flow (filters, physical damage, loose insulation, snow, frost, tree fuzz, intentional blockages, etc.), improper air being sucked into the HVAC system.

  The building (or parts of) can also be under negative pressure relative to areas where CO sources are present.

- [ ] **All investigations performed, deficiencies found, remedial measures taken, and any other relevant information should be documented and readily available if requested.**

- [ ] **Any contractors called in should submit reports of their activities.**