

Evaluating the Carbon Monoxide Monitoring and Response Framework in Long-term Care Facilities – a Brief Guide

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Use this guide when you...

1

have implemented a carbon monoxide (CO) policy in long-term care facilities (LTCFs) consistent with the framework described in the [Guide for Implementing the CO Monitoring and Response Framework in LTCFs](#)

2

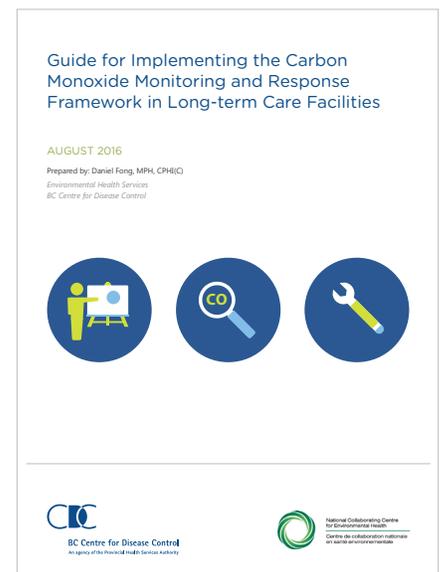
want to evaluate the CO policy and understand how evaluation, built-in from the start, can lead to important improvements and better protection of residents

3

want to identify the facilitators and barriers to successful policy implementation and produce recommendations to guide future policy decisions

Why monitor and respond to elevated CO in LTCFs?

- Seniors in long-term care are more susceptible to adverse health effects of CO. They have poorer physical health (e.g., cardiovascular disease), spend a substantial amount of time indoors, and have limited ability to protect themselves from CO exposures compared to healthy adults.
- Existing residential CO alarms alone do not adequately protect residents from low yet potentially harmful CO levels (e.g, 10-30 ppm).
- Monitoring and response plans ensure indoor CO does not exceed Health Canada's maximum exposure limit, established to be protective of vulnerable subpopulations.¹



¹Health Canada. Residential Indoor Air Quality Guideline: Carbon Monoxide. 2010.

What is this guide based on?

- This guide draws evidence and experiences from an expert consultation meeting and two previous evaluations.
- In 2013, experts discussed the components important for a practical framework to monitor and respond to CO in LTCFs.²
- In 2015, an evaluation of Saskatoon Health Region's CO monitoring and reporting policy indicated its utility in the detection and prevention of CO exposures in LTCFs.³ The policy was developed with expert guidance, following a CO exposure incident that sent 31 LTCF staff and residents to hospital and contributed to the deaths of 3 residents.⁴
- In 2016, findings from a pilot and evaluation in Interior Health, BC showed an increased capacity for pilot sites to identify exceedances that may be harmful for long-term care residents.

[READ MEETING REPORT >](#)

[READ EVALUATION >](#)

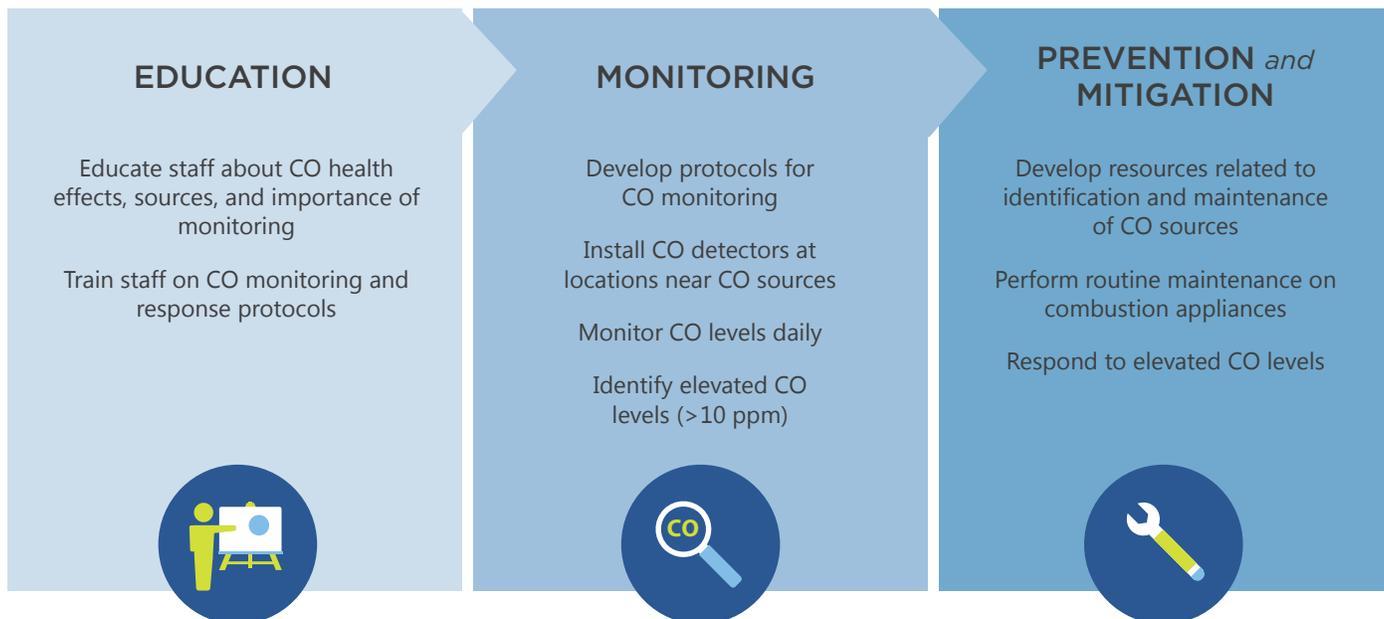
[READ NEWS ARTICLE >](#)

²Managing carbon monoxide in long-term care facilities and hospitals: Meeting report. 2013.
http://www.nccch.ca/sites/default/files/CO_Meeting_2013_Report_0.pdf

³Fong D. Evaluating a novel carbon monoxide monitoring framework in long-term care facilities. 2016.
<http://www.nccch.ca/content/evaluating-novel-carbon-monoxide-monitoring-framework-long-term-care-facilities>

⁴CBC News. Carbon monoxide sends 31 to Sask. hospital. 2010.
<http://www.cbc.ca/news/canada/saskatchewan/carbon-monoxide-sends-31-to-sask-hospital-1.933499>

What are the components of the CO Monitoring and Response Framework in LTCFs?



What are the expected results of a CO monitoring and response policy in LTCFs operated by a health authority?

1. Enhanced region-wide capacity to identify and manage CO risk

- Training and tools delivered for monitoring, mitigation, and staff awareness
- Protocols, oversight, compliance monitoring, and feedback in place
- Roles and resources defined and allocated
- Interdepartmental relationships in place, including agreements with necessary services and support for maintenance and investigation

2. Enhanced facility capacity to reduce exposure to CO

- Staff are aware of CO health effects, sources, and importance of monitoring
- Staff trained to respond to elevated CO
- CO levels monitored and recorded
- CO exceedances detected, reported, investigated, and addressed
- Coordination with necessary departments in response to CO exceedances

There are many excellent guides on conducting evaluation, several of which are specific or highly relevant to the public health context. To familiarize yourself more broadly with evaluation as a field, we recommend:

Evaluation Design: How can we assess results?

Sources of information

1. POLICY DOCUMENTS

Policy development documents, procedures, monitoring forms, and materials used for training

2. MONITORING LOGS AND REPORTS

Weekly logs of daily readings for each CO detector in place and monthly reporting forms. In this context, the log is a record kept of CO measurement actions taken, noting for every action, its location, date, time, measured results, person doing the action, and any subsequent actions. The sites evaluated to date have used paper forms, but the monitoring data could be captured electronically.

INTRODUCTION TO PROGRAM
EVALUATION FOR PUBLIC
HEALTH PROGRAMS
*A self study guide*⁵ >

KELLOGG FOUNDATION
*Evaluation Handbook*⁶ >

EVALUATING HEALTH
PROMOTION PROGRAMS
*Introductory Workbook*⁷ >

MONITORING LOG⁸ >

⁵U.S. Department of Health and Human Services Centers for Disease Control and Prevention. Office of the Director, Office of Strategy and Innovation. Introduction to program evaluation for public health programs: A self-study guide. Atlanta, GA: Centers for Disease Control and Prevention, 2011. <https://www.cdc.gov/eval/guide/cdcevalmanual.pdf>

⁶W. K. Kellogg Foundation. W. K. Kellogg Foundation Evaluation Handbook. 2004. <https://www.wkkf.org/resource-directory/resource/2010/w-k-kellogg-foundation-evaluation-handbook>

⁷Ontario Agency for Health Protection and Promotion (Public Health Ontario), Snelling S, Meserve A. Evaluating health promotion programs: introductory workbook. Toronto, ON: Queen's Printer for Ontario; 2016. http://www.publichealthontario.ca/en/erepository/Evaluating_health_promotion_programs_workbook_2016.pdf

⁸Laidlaw J. Logs and diaries. 2014. <http://www.betterevaluation.org/evaluation-options/logsanddiaries>

EXAMPLE ANALYSIS AND REPORTING OF CO EXCEEDANCES WITH MOCK DATA

SITE NAME	LOCATION	DATE (M/D/Y)	DAY OF WEEK	INSTANT READING (PPM)	PEAK READING (PPM)	NOTES
Home D	Room w/ hot water tanks	9/12/2016	M	0	18	Firing sequence checked
Home D	Room w/ hot water tanks	9/13/2016	Tu	0	10	Identified issue with intake air
Home D	Boiler	10/01/2016	Sat	0	25	Ongoing monitoring.
Home B	North care wing	12/23/2016	F	110	n/a	Ventilated area. Identified contractor using equipment near rooftop air exchanger; asked to move equipment.
Home C	Laundry room	1/17/2017	M	0	15	Exhaust partially blocked by overnight snow/ice; cleared.
Home A	Boiler	12/25/2016	Sun	0	20	Maintenance scheduled
Home A	Boiler	1/06/2016	W	0	15	Increased air intake

EXAMPLE RESULTS AND REPORTING OF CO EXCEEDANCES WITH MOCK DATA

SITE NAME	DATE RANGE OF LOGS REVIEWED	TOTAL NO. OF DAYS REVIEWED	NO. OF DETECTORS	NO. OF EXCEEDANCES	MEDIAN (RANGE) CO EXCEEDANCE LEVELS ≥ 10 PPM	LOCATION OF EXCEEDANCES (FREQUENCY)
Home A	8/1/2016 to 3/31/2017	242	9	30	12 (10-180)	Boiler (10), kitchen (8), laundry room (8), south care wing (2), west care wing (2)
Home B	8/20/2016 to 3/31/2017	223	10	16	15 (10-24)	Boiler (5), kitchen (6), north care wing (5)
Home C	7/28/2016 to 3/31/2017	246	15	5	10 (10-15)	Kitchen (4), laundry room (1)
Home D	8/10/2016 to 3/31/2017	233	8	25	18 (10-46)	Room w/ hot water tanks (12), boiler room (10), laundry room (3)

3. DIRECT OBSERVATION

Site audits help in understanding the actual implementation as well as monitoring and response operations. "A site visit is when an external evaluation team goes to an institution to evaluate verbal, written and visual evidence."⁹ An audit in general terms refers to checking to see whether rules were followed; in our case, it refers to checking to see if the monitoring requirements set out in the policy are actually being carried out.

EXAMPLE SITE VISIT/AUDIT FORM

ITEM	yes	no	NOTES (e.g., reason or explanations for response)
Documentation as to who is responsible for monitoring tasks (e.g., names of site leader, staff responsible)			
CO protocol or policy available for reference on site			
Emergency contact information available in response to CO incidents			Contacts:
Site map/floorplan or similar available on site			
Location of CO DETECTORS recorded on site map or similar documentation			List locations:
Location of CO SOURCES recorded on site map or similar documentation			
Appropriate CO detector placement			
Appropriate CO signage where applicable			
Records maintained for 12 months			
Are records complete?			If no, list missing dates and reason:
Any excessive CO readings recorded?			If yes, #: Range of CO readings (ppm): Action(s) taken:
Any CO source investigations?			Action(s) taken:
Are CO source investigations documented?			Action(s) taken:
Are CO investigations resolved?			Action(s) taken:
Any false alarms?			If yes, #: Action(s) taken:

⁹Harvey, L., 2004-17, Analytic Quality Glossary, Quality Research International, <http://www.qualityresearchinternational.com/glossary/sitevisit.htm>

4. KEY INFORMANT INTERVIEWS

- Staff who carry out monitoring tasks and their supervisors
- Maintenance staff who oversee fuel-burning appliances and investigate exceedances
- Facility managers
- Regional managers

We recommend individual, semi-structured interviews, in person or by phone, of about 20-30 minutes. Group interviews are not recommended because if the policy is not being implemented as planned, staff may be reluctant to admit in front of others that the task is not being performed or that they do not consider it important. Confidentiality of those interviewed must be respected, and this should be made clear to management before beginning the evaluation.

5. OPTIONAL TRAINING EFFECTIVENESS TESTS

Training effectiveness is generally measured using the 4-level Kirkpatrick model:

Level 1: Reaction - The degree to which participants find the training favorable, engaging and relevant to their jobs;

Level 2: Learning - The degree to which participants acquire the intended knowledge, skills, attitude, confidence and commitment based on their participation in the training;

Level 3: Behavior - The degree to which participants apply what they learned during training when they are back on the job;

Level 4: Results - The degree to which targeted outcomes occur as a result of the training.

Review all information to answer three main questions

- How is the policy implemented?
- Is the policy implemented as planned?
- Does the policy have the potential to prevent CO exposure if effectively implemented?

There are many guides on interview design and techniques.

TIP SHEET¹⁰ >

THE KIRKPATRICK MODEL¹¹ >

EXAMPLE INTERVIEW GUIDE AND QUESTIONS
See appendix >

¹⁰Miller, PR. Tipsheet- Question wording. n.d.

https://dism.ssri.duke.edu/sites/dism.ssri.duke.edu/files/pdfs/Tipsheet-Question_Wording.pdf

¹¹Kirkpatrick Partners, LLC. The Kirkpatrick model. 2017.

<http://www.kirkpatrickpartners.com/Our-Philosophy/The-Kirkpatrick-Model>

Evaluation Approach: When and how should we evaluate?

What is the overall intent?

Should be formative, to help improve monitoring and contribute to informed resource allocation.

Formative evaluation aims to improve a program, policy or project, in contrast to summative evaluation which aims to provide an overall judgement about the program.

Not likely to measure long-term outcomes like reduction in CO-related health impacts.

The intended Long Term Outcome of the monitoring policy is: Reduction in CO-related health impacts. It is unlikely in a short-term evaluation of policy implementation that this outcome will be observable, in part because it is hard in general to measure prevention (effective prevention results in the absence of events to measure) and also because there will be no control group or baseline against which to compare residents' exposure to CO, prior to or without installation of the monitor. The evaluation should therefore focus on the potential, or plausibility of, the linkage between monitoring and exposure prevention.

Findings should not be used in a punitive sense.

When and for how long?

Wait until all components of the policy are in place and provide enough time for initial issues to be worked out. If a policy or program is evaluated too soon after its initial implementation, there is a risk of committing a Type 3 Error: "erroneously concluding that lack of program impact was due to attributes of the particular intervention". Moreover, as the policy "settles in", it may undergo major changes – and the evaluation will no longer relate to the program as it currently exists.

The evaluation should cover a minimum of six months and ideally cover the winter (heating) season. CO exposure risk may be higher in winter not only due to operation of heating systems, but also due to intake of exhaust from vehicles idling next to air intakes in LTCF. Other external sources of CO in the evaluations included a roof repair contractor's generator in operation next to an intake.

Which sites to include?

Evaluate the CO policy using a representative sample of your LTCFs. A representative sample is one where the overall makeup of the sample resembles the overall makeup of the population. In this case, the sample should contain the same proportions of types of LTCFs that are subject to the CO monitoring policy; for example, of urban versus rural facilities, of large versus small facilities, etc. Although random sampling—where each member of a population has an equal chance of being selected for the evaluation—should theoretically result in a representative sample in practice for small samples it may produce a biased sample. It is recommended to choose the categories (urban, rural etc.,) and then select within those to get the right proportions. It is however essential to sample without bias: not to choose LTCFs that are believed to have been better or worse at implementing the policy.

- Sample small, medium, and large sized facilities (based on number of beds)
- Ideally, aim to cover 25-50% of long-term care beds in the region. The scope of the evaluation will of course depend on the resources available for it, but a sample size between 25% and 50% of beds will almost always ensure that results of the evaluation can be generalized to all the LTCFs in the region. An evaluation can still be useful if this is not attainable.
- Include rural and urban locations
- Include different management models if this applies to you. The LTCFs in previous evaluations included: small owner-operated licensed homes, a range of moderately to mid-size facilities operated by contracted organizations or the health authority, and wings of larger hospitals. The management models – for example, how maintenance staff are made available (e.g., onsite or not), the extent and type of weekend staffing; how staff are assigned and supervised in the monitoring tasks—varied across these, with resulting implications for the CO policy implementation.

Indicator of implementation fidelity and completeness: the proportion of total possible monitor readings actually present in logs, per day of week and per facility. For example, if there are two sites with 10 monitors each that are to be read daily for 50 days, there should be a total of 1000 recorded readings. If 100 are missing, the proportion actually present is .90. Previous evaluations in Saskatchewan and British Columbia have shown there can be considerable variation by site (from 10% to 60% missing) and by day of the week (from 0% to 35% missing).

IMPLEMENTING FIDELITY¹² >

¹²Hasson, H. Systematic evaluation of implementation fidelity of complex interventions in health and social care. 2010. <https://implementationscience.biomedcentral.com/articles/10.1186/1748-5908-5-67>

Who should conduct the evaluation?

An Evaluation Committee, consisting of stakeholders that can affect change in the policy/practices, should be formed to guide the evaluation and ensure findings will be useful.

Ideally the evaluator and certainly the interviewers should be external to the CO policy. These individuals can be contractors or from other departments not directly tied to the CO policy. This allows issues to surface if they exist and minimizes biases. It is important to ensure that any problems with the policy implementation can be found without jeopardizing the outcomes of those involved: the purpose of the evaluation is to learn and improve (formative). For example, if the policy is not being implemented as planned, in interviews staff may be reluctant to admit to the policy implementation manager or anyone who reports to him or her that the task is not being performed or that they do not consider it important. An external viewpoint can be more objective and better protect evaluation participants. It is not necessary to use an external evaluator however: an internal evaluator who is not connected to the policy implementation team is a good option.

What does this cost?

The process from developing an evaluation framework, conducting the evaluation, and providing analysis and dissemination of evaluation findings may cost \$10-15K, or 5-7% of policy implementation cost. 5-7% of annual operations costs is a generally accepted rule of thumb for appropriate level of investment in routine administrative evaluation (e.g., see Kellogg Foundation Evaluation Handbook p. 54); the 10-15K\$ estimate is based on the costs of the previous evaluations.

INTERNAL VS EXTERNAL
EVALUATION¹³ >

¹³HARC Inc. Internal vs. External Evaluation – Pros and Cons. 2016.
<http://harcdata.org/internal-vs-external-evaluation/>

There are many resources on how to develop good indicators and avoid indicator pitfalls. We recommend the CDC's guide.

CDC: GUIDE TO DEVELOPING EVALUATION INDICATORS¹⁴ >

HealthCOMpass
*How to develop indicators*¹⁵ >

MEASURES AND INDICATORS¹⁶ >

Key Indicators

Indicators are the measures used to establish how well the policy is being implemented.

Allocation of roles and resources:

- Adequacy of oversight and support
- Clarity of roles and responsibilities related to the policy
- Clarity and adequacy of resource allocations

Staff awareness, education, and training

- Coverage of staff training and level of awareness of CO health effects and sources. Indicator of staff capacity to address CO: Level of staff awareness of CO effects and vulnerabilities. This can be measured through qualitative interviews or through a staff survey.
- Staff ability to perform monitoring and response procedures
- Staff perception of training adequacy

Compliance with monitoring and reporting

- Protocols in place and, where applicable, integrated into staff schedules and responsibilities. Indicator of facility capacity to address CO: Level of monitoring staff agreement that task easily fits into their daily routine. This is best measured through qualitative interviews, where staff can explain any areas of challenge in incorporating the monitoring task, how much time it takes, etc.
- Completeness and accuracy of records
- Proportion of total possible monitor readings actually recorded in logs, per day of week for each site.

¹⁴U.S. Center for Disease Control and Prevention. Developing evaluation indicators. n.d. <https://www.cdc.gov/std/Program/pupestd/Developing%20Evaluation%20Indicators.pdf>

¹⁵HealthCOMpass. How to develop indicators. n.d. <http://www.thehealthcompass.org/how-to-guides/how-develop-indicators>

¹⁶BetterEvaluation. Use measures, indicators or metrics. n.d. http://www.betterevaluation.org/en/plan/describe/measures_indicators

Detection and response to exceedances

- Reports of exceedances in monitoring logs
- Documentation of details related to exceedances
- Presence of formal relationships between departments

Common issues found in previous evaluations

- Gaps in coverage on weekends and holidays
- Staff motivation and policy compliance can lapse over time
- Continuity of information and training for tasks is important where turnover is high or casual staff are involved
- Staff not directly involved in the CO policy may have less awareness of CO or be less primed to respond to CO exceedances.
- Exceedances are sometimes not correctly reported or documented

Tips for a useful evaluation

Be a “critical friend”¹⁷ – there to listen, understand the reality on the ground, and move forward to improve processes

Have an Evaluation Committee composed of stakeholders involved in implementation to ensure grounding and buy-in. Use their input in evaluation planning and interpretation of findings. This ensures stakeholder-driven, utilization-focused evaluation.¹⁸

Ensure confidentiality. This is a key tenet of ethical practice in evaluation.^{19,20}

DIALOGUE FOR LEARNING
*Evaluator as critical friend*¹⁷ >

¹⁷Rallis, SF, Rossman, GB. Dialogue for learning: Evaluator as critical friend. 2000.

<http://onlinelibrary.wiley.com/doi/10.1002/ev.1174/abstract>

¹⁸Patton, MQ. Utilization-Focused Evaluation (U-FE) checklist. 2013.

http://www.wmich.edu/sites/default/files/attachments/u350/2014/UFE_checklist_2013.pdf

¹⁹Joint Committee on Standards for Educational Evaluation. Program evaluation standards. 2012.

<https://evaluationcanada.ca/program-evaluation-standards>

²⁰Government of Canada. Tri-Council Policy Statement 2 – Chapter 5 Privacy and Confidentiality. 2014.

<http://www.pre.ethics.gc.ca/eng/policy-politique/initiatives/tcps2-eptc2/chapter5-chapitre5>

How to use findings

Discuss the findings within your Evaluation Committee and their implications for quality improvement in your policy and then communicate the results to stakeholders, with input from your Evaluation Committee.

Remember to reinforce the positives: showcase good practices, emphasize what is working well. If problems are found, develop “3-part solutions” that address ACTIONS, STRUCTURES and TOOLS:

- If problems are found with how the monitoring ACTIONS are being carried (e.g., monitors improperly installed or read), remediate with improved information and training, and also make sure that tools and structures support improved action;
- If problems are found with STRUCTURES (e.g., lack of monitoring coverage on weekends and holidays; confusion in roles and responsibilities for CO alarm response), work with management to clarify them, and also make sure that monitoring actions and tools are in line with structures;
- If problems are found with TOOLS (e.g., exceedances not correctly recorded or documents), ensure the tools are easy to understand and use, staff are trained to use them, and management is supportive.

Test the feasibility of the recommended solutions with the Evaluation Committee before making recommendations to management.

PROGRAM EVALUATION FOR
HEALTH PROGRAMS²¹ >

DEVELOP
RECOMMENDATIONS²² >

²¹U.S. Centers for Disease Control and Prevention. Introduction to Program Evaluation for Public Health Programs: A Self-Study Guide. Step 6: Ensure Use of Evaluation Findings and Share Lessons Learned. 2011.

<https://www.cdc.gov/eval/guide/step6/>

²²BetterEvaluation. Develop recommendations. n.d.

http://www.betterevaluation.org/en/plan/reportandsupportuse/develop_recommendations

APPENDIX

EXAMPLE INTERVIEW GUIDE AND QUESTIONS

Interview date: _____

Facility: _____

Interviewee position: _____

Interviewee role in CO policy/program : _____

CARBON MONOXIDE MONITORING AND RESPONSE: EVALUATION INTERVIEW GUIDE – FACILITY MANAGERS

(INDIVIDUAL OVERSEEING CO MONITORING IMPLEMENTATION AT CARE HOME)

The Carbon Monoxide Monitoring and Response Policy in your health region require ongoing monitoring and reporting of CO emissions in your long-term care facility. The health region is now evaluating this program, to:

- Document how it is being implemented, including challenges to and facilitators;
- Assess whether and how the program is contributing to increased safety; and
- Identify ways of improving the program, with consideration that it may be expanded to other long-term care facilities.

Your experiences with and views of the policy/program will be an important contribution to the evaluation. Your confidentiality will be protected.

1. To begin, please describe how the monitoring program works here:

When and where are readings taken and recorded? How much time does it take?

Who is involved in:

Monitoring? Reporting? Inspecting and maintaining detectors? Looking for and fixing source CO sources if there is an exceedance? Reacting to a CO alarm? Have there been changes in these people over time?

How do these procedures vary:

For detectors in machinery rooms versus other areas? On weekends and holidays versus weekdays?

2. Have there been any challenges or barriers to implementing the monitoring protocols? If so, which?

3. What factors, if any, have facilitated the implementation of the monitoring protocols?

4. To what extent and how, if at all, have the processes and tools in place in your facility been adapted from the initial protocols? Why were these adaptations made?

5. How clear are the roles and responsibilities for CO monitoring and response: Within your facility? If they are not clear, what are any gray areas of roles and responsibilities? Between your facility and the regional level? If they are not clear, what are any gray areas of roles and responsibilities?

6. What is the level of awareness among your staff regarding: CO health effects in the types of clients in your facility? Sources of CO? The CO Monitoring and Response Framework?

7. How are your staff who are involved trained or prepared to:

a) Carry out the monitoring protocols? Do you feel that this preparation is adequate? Do staff feel prepared to monitor properly? How could it be improved? What proportion of involved staff have received training? How is training delivered to new staff?