**Master's of Public Health Capstone Project:**

# Critical Evaluation of Radon Detector Library Lending Programs in Canada

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## Introduction

### *Background*

A colourless, odourless gas that is naturally emitted from the breakdown of uranium in rocks and soils, radon poses a significant health risk to Canadians. Primarily a concern in indoor settings where it possesses the ability to accumulate to harmful levels, this gas is the second leading cause of lung cancer nationwide, following tobacco smoking. In Canada it is estimated that 16% of all lung cancer cases are attributable to radon (Chen, 2013). Exposure to radon gas is also the leading cause of lung cancer among Canadian non-smokers (Chen, 2013). The Canadian Cancer Society estimates that approximately 3000 Canadians die every year due to lung cancer directly caused by radon exposure (Canadian Cancer Society, 2014).

Certain geographical areas in Canada possess a greater risk for exposure to high radon concentrations due to natural geology, however the hazard is persistent throughout the country (Hystad et al., 2014). Radon can seep through soil and make its way into residential dwellings and other buildings via gaps such as cracks in concrete foundations and open drains, or by simply diffusing through construction materials. Its inherent physical properties make detection extremely difficult without the proper tools, and given this it is imperative that all homeowners, regardless of where they reside, test for the presence of this harmful compound.

While radon is hazardous to all those who come into contact with it, the distinction between risk to smokers (or those who have ever smoked [ever-smokers]) and the risk to non-smokers is crucial. Radon exhibits a characteristic ability to cause severe damage to DNA in tissue, primarily in the lungs. The damaging of DNA is also one of the mechanisms by which smoking leads to lung issues, and when these two exposures (smoking and radon) are present together, a synergistic effect is created that results in heightened risk for lung cancer mortality (Lantz et al., 2013; Yamaguchi, 2019). Further to this point, an American study from 2013 found

that 86% of all radon-related lung cancer deaths were found amongst ever-smokers (Lantz et al., 2013). This phenomenon is well known and documented within the scientific community, however practice and prevention is lagging, as smokers are in fact less likely to have their homes tested for radon than non-smokers (Lantz et al., 2013). Given this, it is paramount that any knowledge translation efforts regarding radon and its detrimental health effects highlight the strong association with smoking.

***Residential testing***

Health Canada has set the following guidelines related to radon gas concentrations in residential homes (Government of Canada, 2016):

- Levels below 200 $Bq/m^3$ do not require any remediation; however, radon is carcinogenic so it is wise to take steps to reduce levels regardless of test results.
- Levels between 200-600 $Bq/m^3$ indicate that remediation should be conducted within the next two years.
- Levels exceeding 600 $Bq/m^3$ indicate that remediation should be carried out as soon as possible, within one year at the maximum.

When testing for radon it is important to conduct analyses in the lowest lived-in level of the building, given that this gas is emitted from within the ground. This means that testing is frequently carried out in basements, where there are several ways by which radon can enter and accumulate. Some of the most common ways that radon can enter and accumulate within buildings are via cracks in concrete foundations, open sump pumps or drains, exposed soil and pipes that originate from the lowest level of the building (Gaskin et al., 2019). Basements and crawlspaces are also conducive to radon buildup as they are generally poorly ventilated, trapping gas within the space.

When conducting a test for radon gas, it is important that a few key steps are followed. As mentioned previously, in order to facilitate an effective test, the device must be placed in the lowest lived-in level of the building. Secondly, the test should be carried out for a period of at least three consecutive months (Canadian Lung Association, 2017). Radon testing devices are capable of returning measurements in as little as one day; however, concentrations may fluctuate due to factors such as seasonality (concentrations usually greater in the winter) and local ventilation and therefore it is crucial that long-term testing be carried out to account for this variability. One final recommendation is that the device be kept in a safe location that is out of the way, such that it is not disturbed during the testing period.

Presently there are few options for Canadians seeking to test the radon levels in their homes. Contractors and service providers who are certified through the Canadian National Radon Proficiency Program (C-NRPP) can be contacted to conduct radon testing and remediation activities (Canadian Lung Association, 2017). Individuals are also able to purchase their own testing device online or at physical locations such as hardware stores, with prices ranging from $30 for basic detectors that allow customers to access their results online, to upwards of $300 for direct-reading devices with greater functionality. The basic detectors, often referred to as ‘puck’ detectors due to their size and shape, are available at many hardware stores in Canada and must be returned to the manufacturer before results can be obtained. These detectors are used for long-term radon tests (> 3 months) and are an economical option for individuals seeking to test their homes in accordance with national guidelines (Radonova Laboratories, 2020). Direct-reading devices, such as the Airthings Corentium Home radon detector, have built-in displays that monitor radon concentrations in real-time (Airthings, 2017). These types of devices can return results in as little as 24 hours, although they are most accurate

when test length exceeds two months. The short- and long-term testing capabilities are intended to be used for testing the effectiveness of radon-reducing measures and assessing health hazards, respectively (Airthings, 2017). Currently there are no federal or provincial grants or programs to subsidize the cost for Canadians wishing to purchase these detectors.

The final option, which is only available in select areas within the country, is to loan a radon testing kit from a public or regional library. These initiatives, which began in 2017, are located in certain areas of British Columbia, Alberta, Ontario, Nova Scotia and Prince Edward Island. These programs allow patrons to loan a testing device (along with learning materials) free of charge for a 3-6-week period and have been well-received across the country. Demand for the programs has largely exceeded supply, prompting calls for expansion of current programs and the establishment of new programs.

### *Evaluation Statement*

The purpose of this evaluation was to assess the current state of radon detector library lending programs throughout the country. This process involved garnering insight into the formation of the programs, their funding structure, popularity of the programs as well as community and worker perceptions. Given radon's status as a known human carcinogen as well as its pervasiveness throughout the country, this project is a worthwhile investigation that will hopefully help to guide future programs aimed at increasing radon awareness and promoting radon-reducing practices.

## **Methods**

Data for this study, which was conducted with help from CAREX Canada, Health Canada and the BC Lung Association, was obtained via telephone interviews with librarians, collections managers and library directors employed at library branches that have established radon detector lending programs. These individuals were initially contacted via email and were

given the option to voluntarily participate in this project. Interviews were then arranged with those who agreed to participate. Interviewees were asked 21 questions from the interview guide (see Appendix A) and interviews generally lasted between 20-30 minutes. Interviews were taped using a desktop recording application and were subsequently transcribed by hand. In some cases, telephone interviews were unable to be arranged and contacts were instead provided with the list of interview questions, which they returned with their answers via email.

The questions that were posed to interviewees covered a broad range of topics related to radon detector library lending programs. A main area of focus was program establishment, as valuable information can be gained from the analysis of how these programs came to be. This section of the interview contained questions regarding the age of the programs, any issues that were present in the initial deployment, funding/support structure for programs and educational and informational materials that are presented along with the detectors. Inquiries related to the detectors themselves were also included to better understand the current state of programs. This set of questions aimed to determine the make/model of detectors that are loaned, how many detectors are available to be loaned, if the number of available detectors had been augmented since program inception, and if libraries have been able to meet public demand for detectors. An additional set of questions focusing on program specifics was incorporated into the interview guide in order to assess processes across the country. This selection included questions regarding lending period length, return processes, data cataloguing activities, and any surveys that accompany the program. Finally, interviewees were asked to report any feedback that they had received from patrons, as well as their own personal feedback and recommendations for guiding future programs.

Qualitative data obtained from interview transcripts was assessed for common themes and topics via thematic analysis. The main points that emerged from the thematic analyses were then aggregated into a spreadsheet. Quantitative data, specifically the number of detector kits at each library, the number of detectors currently available, and the length of waitlists (if applicable), was also included in the spreadsheet.

This project focused on lending programs that are currently operational, however new programs continue to arise given the success of the existing ones and the importance of the issue that is being addressed.

## Results

The information that comprises this evaluation and that supports the recommendations was obtained from interactions with 13 librarians, collections managers, library directors and other stakeholders across Canada. Eight of these interactions were telephone interviews that lasted between 14-43 minutes, and the remaining five were the result of email exchanges with contacts who were unable to speak by phone.

### *Need for program*

As mentioned previously, radon is the second-leading cause of lung cancer nationwide, trailing only smoking. While its potency and its status as a human carcinogen are well-known in the scientific community, general knowledge and practice surrounding radon is lacking. Specifically, residential testing is severely lacking, as only 4% of Canadians have tested their homes for radon (Canadian Cancer Society, 2014). Among those who are familiar with the effects of radon exposure, this number rises to only 6%. Due to this, it is imperative that accessible, affordable options for residential radon testing be made available to individuals throughout the country, given that radon poses risks from coast-to-coast. Further to this point, it

is paramount that programs aimed at increasing testing also incorporate educational and informational material to better educate the public on the potential harms of this gas.

In speaking with contacts at various libraries throughout the country, it was determined that radon detector library lending programs were established with two main goals in mind: firstly, to educate the public on the potentially detrimental health consequences of radon exposure, and secondly, to increase the frequency of residential testing in local homes. Libraries were selected as program sites largely due to their central, accessible location and librarians' expertise in lending non-traditional items. In many cases library branches were approached by stakeholders to gauge their interest in hosting these programs, while in other instances libraries spurred the initiative themselves.

Another emergent theme was the importance of emphasizing that radon readings obtained via these programs are not to be taken as concrete measures of radon concentration. The lending period allowed for in these programs (3-6 weeks) is shorter than the optimal test length specified by Health Canada (>3 months), meaning that lending programs are designed to serve as a first step that may lead to more thorough residential testing. Many interviewees (6/13) explicitly stated this and mentioned that this information is communicated to patrons. The hope for these programs is that the results obtained from testing as well as knowledge gained from the accompanying learning materials will help lead to lower residential radon exposure for Canadians. In turn, this may also decrease the incidence of lung cancer and other respiratory conditions associated with prolonged exposure to radon. At this point, it is solely the patron's responsibility to act on their results, as this information is mainly kept at an individual level, with the exception of a few surveys distributed by stakeholders.

***Stakeholders***

As with any program, it is important to identify the various stakeholders involved in the establishment and delivery of radon detector library lending programs to better understand what has made these programs successful and what can be improved upon to ensure future success.

One of the primary stakeholders for lending programs is the entity that provides the funding. In many cases, funding for the library lending programs comes from multiple sources. Throughout the country, nine of twelve (75%) contacts who provided detailed feedback on stakeholders reported that their programs are supported in some capacity by Health Canada. This organization provides critical funding in the form of grants that are used for radon detector procurement, as well as guidance on educational materials that are incorporated into program delivery. Given the causal link between radon exposure and lung cancer, another commonly identified primary source of funding and support were the various provincial Lung Associations. These organizations have been involved in programs in British Columbia, Alberta, Ontario, Nova Scotia and Prince Edward Island. Provincial Lung Associations are primarily responsible for the aiding in the establishment of lending programs at certain library branches in Ontario, Nova Scotia and Prince Edward Island by applying for federal grants and providing continued guidance.

Furthermore, numerous not-for-profit organizations such as CAREX Canada in British Columbia and EcoSuperior in Ontario also support the implementation of these programs. Similar to the previously mentioned stakeholders, their help manifests in the form of guidance on program delivery and financial assistance for the purchasing of radon detectors. Finally, an additional stakeholder that has played a vital role in the establishment of these programs is the device manufacturing companies themselves. The only such company that was identified during librarian interviews was Airthings, a Norwegian corporation that helped by providing their

detectors to libraries from coast to coast for the purpose of being loaned to the public. Outside of one library (Castlegar, BC), 100% of Canadian libraries with existing radon detector lending programs exclusively offer Airthings radon detectors.

Another important stakeholder group are those who directly oversee the programs on a day-to-day basis. As radon detector lending programs are presently only located in public, regional, memorial and heritage libraries, this group is entirely comprised of librarians. These individuals are responsible for many tasks that often go unseen, including cataloguing the devices, testing devices upon their return, arranging new loans, and reporting voluntary data from the devices, should it be provided. Of the 13 individuals who contributed data to this report, six were librarians.

Closely linked to librarians are collections managers and other executive-level employees whose responsibilities include the initial obtainment of radon detectors and liaising with other stakeholders throughout the course of the lending program, among others. Four of the 13 library contacts who partook in this project were either executive directors or managers for their respective library systems. The remaining three contacts were a member of a provincial Lung Association that supports radon detector lending programs, a consultant at the Edmonton Public Library and the founder of a non-profit organization that established and continues to support the lending program located in Castlegar, BC.

The next stakeholder group is the intended audience for these programs; the general public. These programs are intended to be as accessible as possible, such that any individual who is seeking to test the radon concentration in their home can do so easily. Public libraries are ideal sites for these initiatives as, in being centrally located (generally speaking), they support the idea of equitable access. The public has a significant amount to gain from a properly run lending

program, as the results that they obtain can be used to inform decisions that may lead to improved health outcomes. Given this, it is important that evaluation and consultation processes incorporate public feedback when considering further recommendations. While this project did not attempt to obtain primary data from patrons who have accessed radon detector lending programs, this is a potential area for future investigation.

One final stakeholder in this project are research and government institutions. The results that are obtained from radon detectors that are loaned as a part of these programs can be used to guide future studies and policies (at all three levels of government) in an effort to reduce the impact of radon exposure on the health of Canadians. To date, the only research institution that has participated in a radon detector lending program is Simon Fraser University, as they provided support needed to establish the lending program in North Vancouver.

***Program Design***

The target group for radon detector library lending programs are homeowners and renters throughout the country. Currently there are 52 libraries across the country that have existing programs, and they are located in the following regions:

- North Vancouver and Sea to Sky region, British Columbia
- Kootenays region, British Columbia
- South-central Alberta (Edmonton, Red Deer, Strathmore and Lacombe)
- Northern Ontario
- Nova Scotia
- Prince Edward Island

Further expansion of lending programs in other regions and provinces/territories is expected as programs gain in popularity.

During the analysis of interviews with library contacts, it became apparent that all radon detector library lending programs operate in a similar fashion; detectors are first loaded into the library cataloguing system, then loaned out to a patron for a specified length of time, returned, the contents are inspected and replaced as necessary and then the kit is loaned out to the next patron on the waitlist, should there be one. While this sequence of events is identical throughout all programs, there are several minute differences that should be considered when updating programs or establishing new ones.

Once radon detectors were obtained, the first step for libraries in establishing their lending programs were to make the devices available for circulation. This involved an initial inspection, assembling the detector kits, barcoding the kits, cataloguing the kits into the library circulation system and finding a place to store them. While time-consuming (it was noted that this process took up to 40 hours to complete), the library contacts who were interviewed did not identify any concerns or issues with this phase of the program. In many instances (4 interviews), libraries' previous experience with loaning non-traditional items such as power tools and sports equipment was identified as a reason why integration of radon detector kits into circulation was seamless.

The act of loaning devices to patrons was also free of reported issues from library contacts, however there were distinct differences in lengths of loaning periods. Loaning periods for the radon detector kits ranged from three weeks in Alberta to eight weeks in Ontario. In some cases the loaning period was re-evaluated, for example libraries in the Sea to Sky and Kootenay regions in British Columbia extended their loaning periods for detector kits from three to four weeks. The detector kits are eligible for renewal in all locations throughout the country, however renewals can only be fulfilled in the absence of a waitlist. It is important to note that contacts

throughout the country, regardless of the length of their loaning period, iterated that their programs are marketed to patrons as initial tests and are not to be viewed as a substitute for a proper three-month test (5 interviewees explicitly stated this).

One other important consideration with loaning is the time of year when the device is out in circulation. This is significant as the most accurate radon concentration readings are obtained when testing is carried out during the winter, when heating systems are on and windows are less likely to be open, decreasing local ventilation (Take Action on Radon, n.d.). Currently, most programs loan detectors throughout the entire year, with those in Alberta and in Castlegar, BC being the only outliers as they do not circulate the devices from May 1st to September 31st. The reasons for this is that it may be conducive to more accurate tests, and it enables libraries to return their devices to stakeholders in order to be tested and calibrated. The issue of calibration was mentioned in conversations with five interviewees. While removing the detector kits from circulation for a period of the year creates an added layer of complexity as seasonal loans are uncommon in libraries, it is an aspect that must be examined in order to deliver the most accurate test results to patrons.

The tasks associated with returning and preparing radon detector kits were also similar in libraries throughout the country. 11 of the 13 interviewees with knowledge of the return process at their local library branch(es) iterated that detector kits had to be returned in-person, rather than being placed in overnight collection bins or drop-off slots. Reasons for this included detector kits being too large to fit into the slots, concerns about kits being damaged by other items returned in the bins or slots, and librarians wanting to inquire about patrons' experiences with the kit. Inquiries into patrons' experiences with detector kits mainly occurred in smaller libraries (ie. those with < 3 detector kits available) and responses by patrons (either via personal conversation

or survey) were voluntary. After kits were returned, library staff inspected and reset the detectors using the standard protocol specified by the device manufacturer. One issue with this specific process was the replacement of batteries, as in two instances battery purchasing was cited as being a significant cost that was not initially accounted for. Two interviewees also noted that informational brochures are often retained by customers, so librarians make copies of templates provided by stakeholders and replace the contents as necessary. Following the resetting of the device, detector kits were either returned to circulation if a waitlist was not present or set aside to be loaned by the next patron on the list.

One final aspect of lending programs that required addressing was the functionality of detectors throughout the course of the program. All interviewees were posed questions regarding technical issues with detectors, and respondents only reported issues in two cases. These two cases comprised four total detectors, two of which went missing while the other two were returned to the manufacturer for repair or replacement. This low level of reported issues is likely a factor of lending programs being established recently (67% of programs less than six months old), and should not be relied upon or taken as a marker of the robustness of detectors. In the future, it may be wise to rotate detectors in and out of circulation such that they can be tested for efficacy while also continuing to closely inspect devices for any damage or errors upon their return.

***Program specifics***

All radon detector kits available at lending program sites are accompanied by a set of instructional and learning materials (Figure 1).


*Figure 1: Radon kit contents in North Vancouver District library*

Interviewees indicated that contents often included an operating manual, information brochures from program partners (e.g. Health Canada, Lung Associations), a fact sheet, a usage sheet and an instruction sheet. Learning and instructional materials were often accompanied by voluntary surveys; these were distributed by different organizations however most were commissioned by Lung Associations. In some cases, the libraries developed and distributed surveys themselves when there are no other reporting measures. These surveys posed questions related to issues with the devices, feedback on the program, specifics on where the detector was deployed and specifics of the home. Some surveys also asked patrons to report their test results or directed patrons to an online tool where their data could be reported. As these surveys were voluntary, the number of copies received was generally low and the three interviewees who shared their results reported response rates of 10-20%.

Marketing is an important aspect of any successful program, and this was recognized by those responsible for overseeing the implementation of many lending programs. Program

launches in many libraries were accompanied by or preceded by community information sessions lead by program partners. In many cases the establishment of programs was also promoted by local news outlets as well as program partners (e.g. Health Canada, Lung Associations). In the libraries themselves, posters and pamphlets were deployed to market the programs. Recurring promotional initiatives such as Radon Action Month and additional information sessions are vital in maintaining public interest, as many programs have reported decreased utilization since their initial unveiling.

One other component of messaging campaigns around radon detector kits is the promotion of alternative testing options. In many cases libraries had waiting lists that exceeded six months and spanned up to one year, so it is imperative that libraries are able to provide accurate information for those seeking to test their homes immediately. All library contacts who provided complete interviews stated that this information was either given verbally, provided in the promotional materials available at the libraries and in the detector kits, or accessible on the websites of program partners. This information usually guided patrons to an online portal via their provincial Lung Association where they could directly purchase a radon detector or provided them with a list of potential products available at local hardware stores. In some instances, such as in Nipigon, Ontario, librarians even offered to purchase puck detectors themselves for patrons who were unsure of what detector to buy or unable to travel to acquire the detector.

***Program utilization***

This is perhaps the most important question regarding the current state of radon detector lending programs. As the only numerical metric that is consistently recorded across all programs, the number of patrons currently loaning devices and the length of waitlists serve as the most

concrete measure of program utilization. The following table displays the number of devices currently available in libraries across the five provinces with existing programs:

| Province | Number of detectors | Number of detectors currently loaned | Number of detectors available |
|---|---|---|---|
| British Columbia | 79 | 50 | 29 |
| Alberta | 100 | 100 | 0 |
| Ontario | 70 | 70 | 0 |
| Nova Scotia | 246 | 246 | 0 |
| Prince Edward Island | 15 | 15 | 0 |

*Table 1: Number of total and available radon detector kits at libraries in Canada (data current as of March 25, 2020)*

To date the programs have been a massive success, with 94% of kits being loaned out to patrons. Although all library locations have experienced significant demand for their detector kits, programs in Alberta, Ontario, Nova Scotia and Prince Edward Island have been particularly well-utilized. The popularity of programs from coast to coast helps to illustrate that there is a desire for these types of initiatives, and that there is significant room to grow. The demand for detector kits is highlighted by reporting numbers at select libraries across the country, some of which have waitlists that exceed six months:

| Library Branch | Number of Kits | Patrons on Waitlist | Estimated Waitlist Length (Weeks) |
|---|---|---|---|
| North Vancouver District Public Library (BC) | 11 | 111 | 40 |
| Thunder Bay Public Library (ON) | 10 | 130 | 52 |
| Annapolis Valley Regional Library (NS) | 22 | 117 | 32 |
| Colchester-East Hants Regional Library (NS) | 13 | 72 | 33 |
| Halifax Public Libraries (NS) | 154 | 1021 | 40 |
| Pictou-Antigonish Regional Library (NS) | 17 | 94 | 33 |
| Prince Edward Island Public Libraries | 15 | 102 | 41 |

*Table 2: Program waitlist data from selected library branches. Lending period 4 weeks in Ontario, 6 weeks in Nova Scotia. Data current as of March 25, 2020*

As demonstrated in Table 2, in some cases individuals at the end of waitlists will not be able to loan a detector until up to one year after they placed a hold on a kit. Many other libraries also report lengthy waitlists, although not as significant as those in the identified areas. Given this, 73% of library contacts that were interviewed indicated that they had either already acquired more kits to augment their supply or have had ongoing discussions about doing so. The most recent example of this is in Halifax, where 100 kits were added to help address the waitlist which spanned over two years, prior to the infusion.

Programs in British Columbia, particularly in the Sea to Sky and Sunshine Coast regions, have experienced a decline in program utilization, although there are generally more kits loaned than there are available kits. Some programs in this region were established in early 2018, at least a year before many other library lending program in Canada, so it is possible that public interest has diminished due to lack of recent promotional materials geared towards enhancing

visibility. As such, it is important that these programs, as well as all others across the country, continue to be marketed at libraries and across different forms of media to ensure that as many people as possible make use of the programs.

One other important aspect of program success is patron feedback. Of the 13 survey respondents, nine provided complete answers to questions related to feedback. Of these, there were only three individual instances of negative feedback. Negative feedback was related to unexpectedly high radon concentrations (2) and a patron feeling that screening tests provided by programs such as this are unnecessary due to Health Canada recommending a longer 3-month test. Those with high readings were instructed to cross-test or re-test and were not heard from again. Five of nine respondents noted the significant public popularity of the program, while four of nine reported that the public response was overwhelmingly positive. It is important to be wary of the context of these results, as only one of the nine respondents have direct contact with patrons on a daily basis, while others mainly received anecdotal reports from those on the frontlines. Two interviewees also noted that one of the reasons for mandating in-person returns was to obtain feedback directly from patrons. Gaining a better understanding of patron experience with these programs is incredibly valuable and methods may need to be reassessed moving forward.

Through conversations with contacts in Ontario and British Columbia, this initiative became aware of communities in the Kootenays, BC as well as in Orangeville and Almonte, Ontario, that are looking to actively expand their existing programs (Kootenays) or establish new ones (Ontario).

**Recommendations/Discussion**

A few main themes emerged when discussing areas for potential program improvement with library contacts. The most obvious, and most frequently identified, suggestion to aid in program advancement was the purchasing of more radon detector kits, as 44% of respondents who provided recommendations were seeking to increase the number of available kits. This is an understandable suggestion given the often lengthy waitlists for detector kits, however finding the funds to acquire more detectors may prove difficult. Some larger libraries have been successful in purchasing supplies to augment the number of kits available, such as in Halifax where 100 kits were recently added and in Sault Ste. Marie where 30 kits were added. While this is a realistic solution to alleviate waitlists and increase the number of radon tests that are performed in communities, it may be challenging for libraries in smaller communities. Annual budgets at most libraries are mostly comprised of municipal funding obtained via local taxes, meaning that budgets will be reflective of community size. As such, libraries that serve smaller communities, and that therefore have smaller budgets, may be less likely to have excess funds available to purchase detector kits to meet local demand. Some libraries (those in Nova Scotia) also receive provincial funding, and it may be wise to leverage this funding stream to establish a needs-based program to which libraries can apply to receive financial support for their radon detector lending programs. As provincial Lung Associations are involved in programs across the five provinces that currently have lending programs, this organization is an ideal partner for such an initiative. Their experience with existing programs would also be an asset when attempting to determine the libraries who have the greatest need for additional funding. While this funding program may prove difficult to properly implement due to possible challenges in coordination between funding

bodies, independently run libraries and numerous stakeholders, it has the potential to alleviate long waitlists and enable more Canadians to test their homes for the presence of radon.

Another potential area for improvement focuses on program-related educational materials and attempts to make programs more visible in communities. All lending programs reported significant initial success, with the vast majority of detector kits being loaned out to patrons within the first week of establishment. Program launch was often accompanied by news/media blasts and community information sessions, which helped to increase radon awareness within communities and may have contributed to the initial success. However, some longer-standing programs such as those in the Sea to Sky and Sunshine Coast regions in British Columbia have seen decreases in popularity in recent months. This may be due to the fading of public awareness, as 44% of library contacts expressed a desire to hold additional community education sessions to keep the issue in the public eye. These sessions, as well as maintaining promotion of programs within the library branches, are vitally important to promote the programs. The limited data on program discovery by patrons helps to reinforce this notion. In most instances where this data was available, it was determined that most patrons who were surveyed indicate that they learned about programs in the libraries from library staff. For example, in North Vancouver 84% of patrons who accessed the lending program indicated that they heard about the program from staff. Given this, it may be prudent to arrange regularly scheduled information sessions and media promotions at libraries. This data also highlights the need for more effective promotion outside of physical library branches. Increased emphasis should be put on increasing the visibility of this issue via forms of media such as news websites, print advertisements, radio and television.

One aspect of current radon detector library lending programs that has the potential for substantial future growth is user surveys. The system that is currently in place is disjointed, with some libraries providing hardcopy surveys for patrons to fill out, others directing patrons to online surveys or reporting tools, and others who have no method of obtaining feedback. This was recognized by interviewees, as three library contacts iterated that the streamlining of data collection methods and improved communication between stakeholders were among the issues they would like to see addressed. Given this, one way by which programs could be improved moving forward is by deploying a standard survey that is to be distributed with all kits that are loaned. This survey would be voluntary, as all current surveys are, and would ideally pose questions related to the specifics of the test (ie. device location, details on home, length of test, radon reading) as well as ask for feedback from patrons on their perceptions of the program and what (if any) follow-up measures they may take based on their results. Furthermore, the inclusion of additional questions for the purpose of determining if programs are reaching vulnerable populations may also prove incredibly valuable.

Given the fragmented nature of programs across the country, to ensure the success of an initiative such as this it may be best if the survey were to be coordinated at a national level. Health Canada is well-positioned to make this a reality with radon firmly on the national radar, as evidenced by federal initiatives like Radon Action Month. Surveys could be made available in hardcopy form and could be presented along with each detector kit that is loaned. These surveys would provide valuable first-hand feedback and help to pinpoint future areas of focus and research**.**

Moving forward, an additional recommendation is to continually monitor the utilization and effectiveness of these programs. Given that most programs are in their relative infancy, the

life limit of the detectors and programs themselves has not been truly tested. It is therefore crucial that libraries and stakeholders continue to assess whether the programs are reaching their intended audience and if patron feedback remains positive.

Another aspect of this project that merits further discussion is its interplay with the idea of citizen science. As the name suggests, citizen science involves the collection and analysis of data by members of the public, usually as a part of a larger initiative that may or may not be guided by professional researchers. As a researcher, this type of science can be incredibly valuable. Promoting community engagement can not only enhance the general public's knowledge on the research topic, but it may also result in a much greater breadth of results than would have typically been attainable with a standard research team. Mobilization of community members in the name of citizen science may therefore result in more knowledgeable and engaged communities, all the while enhancing the richness of datasets. Citizen science is a potentially effective solution for researchers seeking to address issues at both small and large spatial scales and has been successfully utilized in many studies to date.

While citizen science does offer great promise as a means of data collection and analysis, it is important to be aware of some of the potential downfalls. The most pertinent issue is that of engagement and participation: in order to ensure the success of initiatives that rely on citizen science it is vital that communities stay involved throughout the course of the research project. This is often one of the most challenging aspects of citizen science, as promoting the issue in communities and ensuring engagement often comes at a significant cost, in terms of both time and resources. This can be remedied by methods such as community education sessions and media promotion, and it is important that these initiatives are ongoing in order to facilitate continued engagement. Additionally, ensuring transparency with results is imperative, as

researchers must demonstrate that the general public's efforts are being used to effect change. Another issue with citizen science is that data collection methods may not be universal, given that there are so many data collectors. This is a crucial aspect that must be weighed by researchers when determining if citizen science is appropriate for them.

While radon detector lending library programs are not explicitly citizen science initiatives, they possess similar characteristics as data collection is carried out solely by members of the general public. Currently most of the data that is obtained from radon detectors in these programs remains with the users, given the current lack of reporting surveys across the country. Of those who do have data reporting surveys (e.g. Nova Scotia, Castlegar (BC), Sea to Sky region (BC)), response rate has been low, and further studies are needed to understand how this data is utilized. Due to this, there is significant potential for expansion of these programs in the mold of citizen science. With continued engagement and the deployment of a standardized patron survey, data obtained from citizens participating in these programs could be used to better understand radon risks. If results are shared and made widely available this may further promote community engagement, as patrons are able to visualize how their data is being used to shape larger initiatives. While it important to again emphasize that radon detector library lending programs are screens rather than replacements for three-month tests, data collected by citizens as a part of these programs can still be mobilized to enhance radon awareness and understanding.

Finally, it is imperative to note that the success currently enjoyed by radon detector library lending programs throughout the country would not be possible without the invaluable help and expertise of librarians. Librarians are instrumental to the functioning of these programs; their experience in lending other non-traditional items, as well as their enthusiasm about the program and their roles in actively marketing detector kits to patrons, have created an

environment that has enabled these programs to thrive. Ensuring continued buy-in by librarians is key to building on the progress that has been achieved to date.

## Conclusion

Radon detector library lending programs serve a critical purpose; by allowing free access to radon detectors for the general public, they both promote the issue of radon gas exposure in local communities and allow patrons to test their homes without incurring any personal costs. These programs utilize the existing structure for lending non-traditional items currently deployed by libraries across the country and have been supported by numerous organizations such as Health Canada, provincial Lung Associations, and many non-profits. To date, there has been significant public interest in these programs, with 94% of detector kits in Canada currently being loaned and waitlists measuring up to one year. Programs have been well-received by staff and patrons alike, and there is a growing interest to expand existing programs. Presently there have been very few issues with the functioning of detectors or the programs themselves, however this may be reflective of the recency of programs rather than their robustness. In the future, program expansion or the creation of new programs should focus on remedying some of the key issues that arose in discussions with interviewees such as having an adequate number of detector kits to meet local demand, continuously promoting lending programs via various forms of media, and deploying a standard user survey.

## Limitations

This project was significantly impacted by the closing of facilities across the country in response to the covid-19 outbreak. Of the 27 individuals who were contacted as a part of this initiative, responses were only obtained from 13, with only nine of these 13 providing answers to all survey questions. Contacts were unable to be reached after the first week of March 2020, after

which public libraries throughout the country had all closed. Libraries with smaller programs (i.e. those with <3 radon detector kits) are particularly underrepresented in this report, and subsequent investigations into loaning programs should aim to gain insight from employees at these branches.

## Reflection

I believe that the work that I have conducted as a part of this capstone project has greatly enhanced my knowledge of this topic, in addition to highlighting the importance of radon detector library lending programs. At the beginning of this project my understanding of radon and residential radon testing was fairly rudimentary: I knew the potential dangers of radon and that detectors could be loaned from a few select libraries, but I didn't know any program specifics or the impact that these programs were having. As I conducted more research and began carrying out interviews with library contacts from across the country, my expertise grew and I began to feel more comfortable in my ability to accurately present this issue in my capstone project. After a few interviews I began to probe a little deeper, asking additional questions that were not included in the list of 21 that were initially planned (e.g. whether detectors were loaned throughout the year; if programs were marketed as a screening tool rather than a definitive test) in order to gain a better understanding of certain issues that I felt weren't explicitly addressed in the interview guide. The answers that I obtained from these questions, as well as the others that had been laid out, helped to enrich my understanding of radon detector library lending programs and I hope that this report and the recommendations contained within it will help stakeholders guide programs in the future.

The two primary core competencies that were developed throughout my capstone experience were CC8: Policy and program planning, implementation, and evaluation and CC6:

Partnerships, professionalism, collaboration and advocacy. Core competency CC8 was the most applicable and the most strongly reinforced, as this project was primarily a program evaluation. I had little experience with program evaluations prior to beginning my capstone, but I feel that I have a much better understanding of the relevant processes and procedures now after its completion and feel confident carrying out similar projects in the future. This competency was reinforced through researching and applying numerous different frameworks, as well as receiving input from project stakeholders. Core competency CC6 was also vital to ensuring the success of this project, as almost all data had to be obtained firsthand from stakeholders. I had a similar experience during my summer practicum when I had to reach out to others in order to retrieve necessary data, and this project served to strengthen my communication skills while also highlighting the importance of working collaboratively. During this project I was in contact with individuals working at the municipal, provincial and federal levels for various employers such as non-profits, public libraries and governments, and this project would not have been possible without their collaboration.

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## Appendix A

**Program history and current status:**

1. How long has the program been in place?
2. Were there any initial issues with the start up of the program? If yes, please elaborate
3. How many detectors do you have in the program? Was this the number you began with or has the program been augmented?
4. What kind of detectors are they (make/model)?
5. How long do you lend them out for?
6. What is the demand like for the detectors? Do you have a wait list? If yes, please explain more
7. For patrons not wanting to wait are they provided with information on how to order / purchase a long-term test kit?
8. What types of materials are provided to patrons when they rent a detector?

**Program funding:**

9. How is your library program funded? If you don't know, please note this

**Returning process:**

10. Please describe how the kits are returned? Can they be put in overnight collection bins or drop offs?
11. Do you know what happens to the detectors once they are returned? If yes, please explain.
12. Do patrons provide you with information about their test?
13. Does the library provide or include on their lending website / portal how patrons can purchase a radon test kit?
14. Does your library have a survey or form for people to fill out once they complete the testing?

**Program issues and feedback:**

15. Do you know of any technical issues with any of the detectors in your program thus far? If so, please explain
16. Have you had feedback from patrons about their experiences with the detectors? If yes, please explain. Please feel free to share positive and negative experiences.
17. What has been your own personal experience with the program? Are you involved in handing out or collecting the kits?
18. Do you or the other librarians get questions about radon? If yes, do you feel you have enough information to answer them?

**Next steps:**

19. Has the implementation of this program changed your perception of radon?
20. Do you find that patrons are likely to refer friends after using this program?
21. How do you think the program could be improved?