Securing Canadian Medical Isotope Talent and Expertise

Contents

CANADIAN NUCLEAR ISOTOPE COUNCIL

The Canadian Nuclear Isotope Council (CNIC) is an independent organization consisting of representatives from various levels within the Canadian health sector, nuclear industry and research bodies, convened specifically to advocate for our country's role in the production of the world's isotope supply.

Message from the Chair

Canada has been at the forefront of isotope research, development, and production for decades and is host to almost the complete supply chain for many isotopes. With a sophisticated production pipeline, key infrastructure, and ongoing investments in research, Canada has become a crucial source of isotopes to meet growing international demand. The Canadian Nuclear Isotope Council was formed to ensure that Canada maintains its leadership in the global supply chain by advocating on behalf of its membership.

Global demand for isotopes is projected to reach between $14 and $30 billion US by 2030. This growth reflects the development of emerging isotopes reaching the market in the coming years. However, Canada will only be able to capitalize on this significant opportunity with sufficient personnel and labour in place.

Canadian companies are planning for significant production growth and exciting projects to match the growing market demand. Canadian companies have begun exploring new ways to produce rare isotopes for commercial use, which will connect patients around the world with life-saving technology. At the same time these companies are developing game-changing techniques to innovate for the entire lifecycle of isotopes, from irradiation, to processing, to packaging and beyond. However, this innovation requires the right talent pool and as this report finds, companies in the isotope sector already face significant challenges accessing and retaining trained talent.

As a result, progress in the isotope sector is not limited by opportunity but rather, a lack of personnel. We cannot allow a lack of labour to inhibit or stall ground-breaking innovation in isotope production when Canada plays such an essential role in the global supply chain. Without the right labour in place, Canada cannot maintain its leadership and this progress will be restricted or slowed.

It is time that Canada commits to ensuring that the isotope industry has the talent it needs to encourage innovation and support our global leadership position.

Introduction

Since 1940, Canada has been a global leader in producing isotopes and has a long-standing history of innovation in nuclear technology, through cutting-edge nuclear research, and upcoming revolutionary techniques to produce isotopes. Canada is the world's leading supplier of two of the top 10 isotopes in medicine, namely Cobalt-60 and Iodine-125.

In 2020, the global market for nuclear medicine reached just over $5.9 billion US, growing by 8.2% in comparison to the year 2018, and the market is expected to reach between $14 billion and $30 billion US in 2030. With tremendous growth in the industry expected in the years to come, the availability of talent and labour for the industry is a growing concern.

Members of the Canadian Nuclear Isotope Council (CNIC) have noted it is already a struggle to hire the correct talent to support their growing isotope endeavors. Therefore, the market growth over the next decade, coupled with the current hiring challenges of CNIC members, necessitates a further understanding of the possible needs, opportunities, and gaps in the current talent supply chain.

This report seeks to understand exactly what these needs are and inform the type of training programs necessary to address the challenges.

The study, undertook by the CNIC, explores the following subjects:

- What type of skilled labour is needed for the medical isotope sector?
- Are colleges and universities training enough people and with the right skills needed to support the industry growth?
- Is there a need for new training programs (micro credentialling, certificate programs, etc.)?
- How can we better support transition between the nuclear industry and isotope sector and vice versa?
- What is the demand for talent in this sector today, and in three and five years down the road?

Key takeaways

- Almost all the isotope producers surveyed are planning for significant production growth. Most have major capital projects taking place or being planned that would lead to a substantive change (step change increase in production and/or a new significant business stream such as a new isotope) to their business.

- Currently, CNIC members are employing about 850[1] people that are directly and permanently involved in isotope production. This number will increase by 33% to about 1,130 as the projects in the pipeline enter production. Most of these staff will be needed within the next three years.

Management of production activities	77
Regulatory and QA	34
Operations	221
Radiation Technicians	60
QC Technicians	170
Logistics	25
Sales/Admin/Finance/Exec Management	42

- Turnover rates have increased recently to, in some cases, 20% per year.

- Recruiting and retaining appropriately trained staff is already a challenge and this will become more of a challenge as teams are recruited for the new production routes. It is possible that these challenges will delay or restrict future production. The biggest challenges to production are in radiation safety, regulatory affairs, and Quality Control.

- A shortage of radiochemists is slowing up research and even preventing some research from progressing. It is also likely giving rise to a lack of research ambition as there are not enough leaders to establish programs.

- Commercial isotope supply is an extremely competitive business going through a period of disruption brought about by:

    - *A renaissance of the industry arising from the success of new therapies that is leading to significant growth of medical isotope use in general, and substantive growth for certain isotopes that were previously only being used in research or small-scale trials.*

    - *The maturation of projects to re-establish supply following closure of the NRU at Chalk River.*

    - *The development of new approaches to irradiation that includes new research reactors, the use of accelerators and the expanded use of power reactors.*

- The industry has little exposure in teaching institutions with a limited number of courses and this may give rise to few people appreciating the career opportunities available.

1 This number is likely a gross understatement of the actual number of jobs in the industry, medical isotope production companies themselves and sub-contractors due to project segregation and data quality.

Almost all the isotope producers surveyed are planning for significant production growth.

Recommendations

1. Working with national labs and institutes to **establish multi-disciplinary learning and training programs**, co-op placements, post-graduate and post-doctorate positions in career and research programs directly related to medical isotopes.

2. Working with universities to **establish a multi-disciplinary track that links medical isotopes, science and engineering** at the undergraduate level in Canadian Universities.

3. Working with the private sector to **establish a pre-employment training course for technicians able to work in these specialized facilities** that would enable people with appropriate skills to be identified before job specific trainings begin.

4. Pursuing **greater engagement with students to the industry at an earlier age** with the inclusion of more isotope and radiochemistry courses at the undergraduate level.

5. **Increasing communication with the public about Canada's medical isotope industry** so that the job force is more familiar with it and more likely to both retain jobs and increase the number of those seeking to work in the industry.

6. **Leveraging and building upon existing programs** at federal (i.e. Canadian Nuclear Laboratories, National Research Council, Canadian Institutes of Health Research, etc.) and provincial (i.e. Fedoruk Centre, University of Saskatoon, TRIUMF, University of British Columbia, McMaster University, University Health Network, etc.) institutions to develop an academic network focused on radiochemistry, radiochemical production and the uses of radioisotopes would both increase training capacity for professionals and trades and would help draw undergraduate attention to the industry and its opportunities.

Study limitations

Irradiation for commercial production is taking place on a research reactor, several power reactors, some commercial cyclotrons, and on linear accelerators. Many of these reactors are not dedicated solely to isotope production and the operators of the reactors are not relevant to the medical isotope business itself. Except for TRIUMF, the cyclotrons are largely dedicated to production so that their operatives are part of the medical isotope production business.

Therefore, the focus of this study is the labour directly associated with commercial production and does not include tethered production or labour needed to operate irradiation facilities that exist primarily for another purpose.

Data limitations

There are 294 medical facilities licensed to handle radioactive materials, either small dose isotopes, large sources or powerful irradiators like cyclotrons or electron beams. There is no accessible database for these facilities making surveying of these jobs impossible in a study of this size.

There are 28 cyclotrons in Canada (most of which are producing or can produce medical isotopes) and most of these are tethered to an individual hospital, research institute or health care region and their issues are generally regional. As with the licensed medical facilities, there is no accessible database for these facilities which makes surveying of these jobs impossible in a study of this size.

Additionally, the different approaches to job designation/recording meant that collecting data on types of jobs was difficult. In some cases, the companies did not keep that data.

Notwithstanding these deficiencies in the available data, it shows some very clear trends and issues.

Employment statistics

Currently CNIC members are employing about 850 people[2] who are directly and permanently involved in isotope production. This can be broken down as follows.

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This number will increase by 33% to about 1,130 as the projects in the pipeline enter production. Most of these staff will be needed within the next three years.

Almost all the production organizations surveyed are planning for significant production growth. Most have major capital projects taking place or being planned that would lead to a substantive change (step change increase in production and/or a new significant business stream such as a new isotope) to their business.

The new projects include expanding capacity of existing isotope lines, new approaches to producing existing isotopes, the production of new isotopes and the

2 This number is likely a gross understatement of the actual number of jobs in the industry, medical isotope production companies themselves and sub-contractors, due to project segregation and data quality.

production of the stable isotopes needed to support the business, including the ytterbium needed for lutetium production (ytterbium is currently only produced in Russia, and Canada could lead the world in establishing an alternate source).

Project staff, employed temporarily to design, fabricate, install, write procedures, and gain approval for the new projects, are split between the medical isotope production companies themselves and sub-contractors. For example, just one of those projects explored in the survey involved more than 100 people that are not included in the numbers above. Each project involves investments of tens of millions of dollars.

Availability of trained staff

All the production companies reported they had internal training programs for their production staff, with key technical staff requiring a minimum of three months of training. Some of the more challenging positions, such as manipulator operators, require three years of experience before they become fully effective.

Most companies reported challenges in finding people who were either trained or could be quickly trained to become:

a. Radiation safety operatives and Radiation Safety Officers (RSOs)

b. Regulatory staff

Most of the companies with capital projects reported challenges in finding staff for those projects and in finding qualified sub-contractors. It is likely that this is a transient situation, an artefact of the refurbishment programs taking place at Bruce Power and Ontario Power Generation, which are demanding services from the same pool of contractors. The one exception had a very large, aligned business from which it was able to divert staff.

Furthermore, every organization involved in research reported a dire shortage of Radiochemists, noting this capability could not be developed in-house. Additionally, every organization employing manipulator operators mentioned how long it takes to train them, and one noted that quite often, after a lot of training, they would lack the dexterity to be a good operator.

Companies have experienced these challenges in their pre-existing production lines. The problems will be exacerbated by new projects.

Recruitment and retention

Turnover rates have increased recently to, in some cases, 20% per year with contributing factors being:

a. The ability to work from home, enabling international poaching, notably by pharmaceutical companies.

b. The substantive nuclear programs taking place at OPG and Bruce Power.

The challenges in retaining operational staffing vary depending on location and the nature of the role, and include:

a. For all staff, poaching within the industry to support the expansion projects.

b. For more senior level staff with pharmaceutical expertise, domestic and international competition from the pharmaceutical industry made possible by virtual working.

c. For staff with radiological experience, the growth of opportunities in the conventional nuclear industry.

d. Night shift workers wanting to move to a day shift for personal reasons.

e. Mass retirement in the sector.

It appears it is difficult to attract people to the industry, possibly because interest in the industry is not consistent. It appears people may separately understand the pharmaceutical industry and the nuclear power industry, but not the medical isotope industry, so job postings do not necessarily attract attention, which leads to fewer people actively seeking jobs in the industry.

Gender, Equality, Diversity and Inclusion

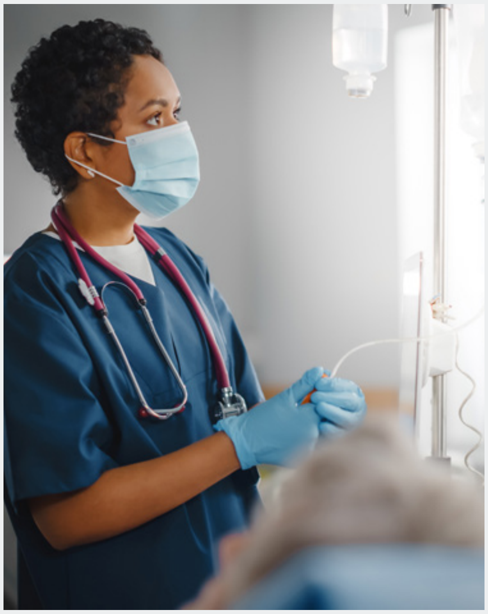
Like Canada's nuclear industry, women, Black and Indigenous people, people of colour, and people with disabilities are underrepresented in the isotope sector. While this topic was only lightly explored in the study, the evidence of the challenge exists. For example, Women in Nuclear reported that just 22% of our industry's employees are women.

Despite ongoing efforts, these groups are also underrepresented in science, technology, engineering, and mathematics (STEM) fields. This gap has considerable implications for the future of nuclear energy and nuclear medicine, both of which need new generations of specialists to ensure the continued safe and efficient use of nuclear technologies for a wide range of industrial, scientific and medical purposes. Therefore, addressing gender, equality, diversity and inclusion in STEM is an important goal that many CNIC members are pursuing.

Equal by 30

In May 2018 at the Clean Energy Ministerial (CEM-9) in Copenhagen, Canada and Sweden jointly launched the "Equal by 30" campaign, which aims to reach 50% representation of women in the energy sector by 2030.

The CNIC is currently looking to join the initiative.



Other employment observations

While the survey did not investigate the downstream issue of resourcing clinical trials, initial interviews revealed that clinical trials could be being restricted in Canada because of a shortage of nurses capable of caring for patients. This problem arises from the generic challenge in attracting people to nursing, combined with the nursing demographic that includes many young females concerned about effects of radiation on their reproductive health. It is generally believed that if there was more of a demand for clinical trials, it would be difficult to resource them.

Clinical trial activity in Canada is also restricted by the ability to recruit patients arising from Canada's small population.

Conclusion

The medical isotope sector is experiencing a period of significant growth, which is giving rise to significant opportunities within the medical isotope industry that will see 33% growth in employment over the next five years.

Members of the CNIC have revealed it is already a struggle to hire the correct talent to support their growing isotope endeavors. As this report has revealed these challenges include:

- **Recruiting and retaining appropriately trained staff**, which will become more of a challenge as teams are recruited for the new production routes. It is possible these challenges will delay or restrict future production.
- **A shortage of radiochemists** is slowing up research and preventing some research from progressing. It is also likely giving rise to a lack of research ambition as there are not enough leaders to establish programs.
- **The industry has little exposure in teaching institutions**, with a limited number of courses, and this may give rise to few people appreciating the opportunities.
- **There are no courses available for training technicians.**

To address these challenges, the CNIC has provided six recommendations in this report.

1. Working with national labs and institutes to **establish multi-disciplinary learning and training programs**, co-op placements, post-graduate and post-doctorate positions in career and research programs directly related to medical isotopes.
2. Working with universities to **establish a multi-disciplinary track that links medical isotopes, science and engineering** at the undergraduate level in Canadian Universities.
3. Working with the private sector to **establish a pre-employment training course for technicians able to work in these specialized facilities** that would enable people with appropriate skills to be identified before job specific trainings begin.
4. Pursuing **greater engagement with students to the industry at an earlier age** with the inclusion of more isotope and radiochemistry courses at the undergraduate level.
5. **Increasing communication with the public about Canada's medical isotope industry** so that the job force is more familiar with it and more likely to both retain jobs and increase the number of those seeking to work in the industry.
6. **Leveraging and building upon existing programs** at federal (i.e. Canadian Nuclear Laboratories, National Research Council, Canadian Institutes of Health Research, etc.) and provincial (i.e. Fedoruk Centre, University of Saskatoon, TRIUMF, University of British Columbia, McMaster University, University Health Network, etc.) institutions to develop an academic network focused on radiochemistry, radiochemical production and the uses of radioisotopes would both increase training capacity for professionals and trades and would help draw undergraduate attention to the industry and its opportunities.

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We look forward to working together with governments to advance these recommendations.

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