Understanding Medical Isotopes

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With the recent shutdown of the Chalk River nuclear reactor, Canada is once again facing a medical isotope shortage and serious diagnostic tests are being postponed.

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In the Uranium Development Partnership's report *Capturing the Full Potential of the Uranium Value Chain in Saskatchewan*, it was recommended that the provincial government "partner with the Federal Government to pursue the construction of a research reactor in the Province as a complement to synergies with existing research infrastructure and capabilities…. Pursue medical isotope production as part of the reactor's mandate."

It is important to note that medical isotopes are not produced in a nuclear power reactor.

What is a medical isotope?

A medical isotope is a very small quantity of radioactive substance used in safe, cost-effective imaging and treatment of disease. New technologies enable medical isotopes to be delivered directly to the site of diseased cells.

Medical isotopes have become the standard treatment for some cancers. They have also brought medical imaging to new levels.

Who uses medical isotopes?

The medical specialty that utilizes medical isotopes for diagnosis and treatment is called nuclear medicine. The doctors that perform nuclear medicine procedures for cancer are called radiation oncologists.

What can medical isotopes do in diagnosis?

Radioisotopes give off energy that can be detected by special equipment. When small quantities are introduced into the body, the imaging equipment tracks their location and movement. This enables the doctors to learn more about the diseased tissues than a diagnostic procedure that just takes a picture from the outside. Medical isotope diagnostic procedures often facilitate an earlier and more complete disease diagnosis and therefore more rapid and effective treatment.

What can medical isotopes do in cancer treatment?

The energy given off by radioisotopes can zap diseased cells. When they are delivered straight to the cancer cells, healthy tissues are spared while cancer cells are eliminated. Medical isotopes are delivered to the cancer cells in several different ways.

How are medical isotopes important in the Canadian context?

The National Research Universal (NRU) reactor went fully online at Chalk River, Ont., on Nov. 3, 1957. It has been used for scientific research, including the development of nuclear medicine. It remains the biggest single source in the world of the isotope cobalt-60, which has been used in cancer treatment for more than half a century.

Chalk River's importance gained worldwide attention in November 2007 when the reactor was taken offline, causing a worldwide shortage in medical isotopes. The reactor produces enough isotopes to treat more than 76,000 people a day — more than 20 million a year.

What's happening to ensure stable production of medical isotopes?

The National Research Universal (NRU) reactor at Chalk River was scheduled to be decommissioned in 2005 and be replaced by two new reactors called MAPLE 1 and MAPLE 2. The MAPLE reactors were a pool-type reactor with a compact core of low-enriched uranium fuel surrounded by a vessel of heavy water.

The MAPLE reactors were initially supposed to be completed in the early years of this decade and be dedicated solely to the production of medical isotopes. However, in May 2008, Atomic Energy of Canada Ltd (AECL) decided to end development of the reactors because of continuing technical problems and cost overruns.

The discontinuation of the MAPLE project has put more pressure on NRU to continue to supply the bulk of the isotopes.

While there are other reactors that can produce medical isotopes in Canada, for instance, McMaster University in Hamilton, Ont. has operated a small reactor capable of producing a few medical isotopes for 48 years, there are not enough to pick up the slack caused by the extended shutdown of the NRU reactor.

The four other main reactors in the world producing medical isotopes are the BR-2 reactor at the Belgian Nuclear Research Centre, the Osiris reactor in France, South African operated Nesca's Safari-1 reactor and the High Flux Reactor at Petten in the Netherlands.

Opportunities for Medical Isotope Production in Saskatchewan

It is clear that the world needs increased stability in its medical isotope supply. In addition, increasing demand coupled with the planned decommissioning of some current medical isotope production facilities means that the world could be facing significant shortages if more production is not brought online.

If Saskatchewan decides to pursue a research reactor, medical isotope production could be an attractive use of this facility. However, as the Uranium Development Partnership Report makes clear, the economics of a stand alone medical isotopes reactor are not attractive and isotope production should only occur in Saskatchewan if it is done within the context of a broader research reactor.

There are different options available in terms of reactor type and Saskatchewan would be able to draw upon the experience of other jurisdictions to find the best fit for the province.

Expanding Saskatchewan research and training capacity through a new research reactor, and providing the province with a new opportunity for medical isotopes production, is a opportunity that needs to be examined closely.

Medical Applications of Radioisotopes

Several isotopes with unique medical applications can be created as a result of the radioactivity within a nuclear reactor. These medicial isotopes serve three different functions: Medical imaging, radiation therapy, and therapeutic drugs.

Diagnostic Imaging – isotopes are injected into a patient along with a pharmaceutical companion agent that targets the isotopes to specific issues, which can then be detected by specialized imaging machines.

Radiation Therapy – radiation emitted from an isotope source is directed into a tumour to destroy cancerous cells.

Therapeutic Drugs – isotopes are manufactured into injectable/ insertable drugs for cancer treatments.

Source: Uranium Development Partnership. *Capturing the Full Potential of the Uranium Value Chain in Saskatchewan.* March 31, 2009