MEDICAL ISOTOPES

What are medical isotopes?

Medical isotopes are short-lived radioactive forms of chemical elements that are used either in diagnosis or in treatment of disease, primarily cancer. Canada has been one of the world's main suppliers. The old NRU reactor at Chalk River, Ontario, which has produced isotopes for many years, is currently closed down for essential repairs. Plans to replace the NRU with new Maple reactors have collapsed because of major design flaws which appear to be far too expensive to fix.

The Uranium Development Partnership (UDP) recommends building a research reactor in Saskatchewan and using it in part for production of medical isotopes. The purpose of the isotope production would be to provide an income stream to justify part of the expense of operating a research reactor. Medical isotope production is therefore seen by the UDP rather as an income-generator than as a health care tool. **Given that reactors take many years to build, suggesting that a research reactor at the University of Saskatchewan could assist in the current isotope shortage situation in Canada is absurd.**

How are medical isotopes used?

There is no doubt that current radioisotopes are useful for both diagnostic and treatment purposes. The vast majority of uses of radioisotopes in nuclear medicine are for diagnosis, not for cancer treatment.

Some of the radioisotopes in current use:

- **Technetium-99m** is produced through the decay of Molybdenum-99 which, in turn, is produced in nuclear reactors designed for isotope production (not nuclear power). Tc-99m is used in imaging to make diagnoses. Tc-99m is a gamma emitter but has such a short half life that it poses little problem in terms of waste; its short-lived activity means that the patient is exposed to a low dose of gamma rays. When its availability was limited last year, physicians discovered that judicious use of PET (positron emission tomography) scans and ultrasound could serve much the same purpose.

- **Gallium-67** is cyclotron-produced by the proton irradiation of enriched zinc oxide. It is a gamma-emitter with a half-life of 78.3 hours. For cancer staging, gallium scans have largely been replaced by PET scans. Gallium-67 continues to be useful in the imaging of inflammation and infection.

- **Cesium-131** is probably the "new" radionuclide for brachytherapy, the insertion of radioactive beads into the cancerous growth. It is produced by radioactive decay from a neutron-irradiated naturally occurring barium-130 or from enriched barium containing barium-131. The source of the neutrons can be a nuclear reactor or another neutron generating device such as a linear accelerator or neutron generator.

- **Iodine-131** is a fission product of uranium. Its principle use is for ablation of thyroid cancer cells but it is also used in brachytherapy.

Can we have medical isotopes without power reactors?

The nuclear industry often uses the public acceptability of medical radionuclides and the fear of losing access to the services they provide as a suggested reason for needing nuclear power. They imply that nuclear power is necessary if we want medical isotopes. **The reality is that many currently used medical isotopes can be (and are) produced without nuclear reactors, using cyclotron technologies.**

The current supply issues for medical isotopes has more to do with lack of coordination of reactor shut-down schedules than with inadequate world-wide capacity to produce the materials. For the short term, it looks as if we'll have to rely more on alternative diagnostic methods. In the mid term, it appears that the NRU will be repaired and continue in service for a few more years until longer-term solutions are in place. Before anyone commits to trying to build new isotope reactors there is a need for a global review of the whole system of supplying such materials.

Are there alternative ways to produce diagnostic and therapeutic materials?

- Molybdenum-99, the radioisotope whose shortage caused havoc last winter, can be produced by using a cyclotron with a molybdenum-100 target.

- Edmonton's cancer clinic is able to use F sodium fluoride, which is particularly helpful in detecting bone cancers, bone fractures, arthritis and spinal problems and is an alternative to the molybdenum radioisotope produced at Ontario's Chalk River facility. It can also be used in place of Technetium-99m. The new radioactive drugs will first be made in particle accelerators called cyclotrons in Edmonton, Hamilton, Toronto and Ottawa, with ultimate plans to get more cyclotrons on line to reduce waiting time for patients.

- The use of cobalt-60 may be phased out altogether, as safer alternative technologies take over -- especially since several patients have been injured by cobalt-60 radiotherapy devices due to programming errors in the computerized AECL radiotherapy units; alternative radioisotopes may be found which can be produced in cyclotrons and which can substitute for cobalt-60, or a method may be developed for producing cobalt-60 economically in an accelerator.

- Arrangements may be made to maintain a number of small reactors in operation solely for the purpose of producing selected radionuclides for use in medicine, industry and scientific research.

- The most frequently used procedure in nuclear medicine uses technetium-99m to scan internal organs after the patient ingests the isotope. Two alternatives to Technetium-99m are (a) thallium-206, a radioactive isotope produced in a cyclotron (no uranium use) and (b) PET-scans, which require a short-lived radioactive isotope called fluorine-18, also produced in a cyclotron (no uranium use). PET scans often give better pictures than technetium-99m. PET scan machines are expensive, about 2-3 million dollars each, but remembering that Ottawa has poured 1.7 billion dollars into Chalk River since 2006, you could buy 500-600 Pet machines with this amount of money. Even the money wasted on the MAPLE reactors (about 530 million) would buy over 170 PET scan machines.

The amount of uranium used for medical isotopes is an extremely small fraction of the uranium used by nuclear power reactors. Even if no new uranium mines were opened up there would be plenty of uranium to produce medical isotopes for a very long time to come. And, it may be that in a number of years we will look back on radioisotope diagnosis and treatment like our modern perspective on blood-letting or, more recently, open-abdominal surgery for gall bladders -- beneficial when we didn't know how to do anything else, but "out of date" because it will have been replaced with better, less risky treatment.

Based on information supplied by Dale Dewar, MD. Past President, Physicians for Global Survival and
Gordon Edwards, President, Canadian Coalition for Nuclear Responsibility

For more information visit www.cleangreensask.ca