Sustainability of F18 medical isotope production for PET scanning

The challenge of equitable access to PET scans: A pricing problem.

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Canada's small population distributed across its large geography poses significant challenges in providing equitable medical care across its rural and urban areas. A notable challenge is provision of cancer diagnosis techniques, including Positron Emission Tomography (PET) scans.

PET scans rely on short-lived radioisotopes, typically Fluorine18 (F18), which has a half-life of less than two hours. F18 needs to be produced locally to avoid significant losses due to radioactive decay during transportation.

Thus, PET scanning is typically only available in cities large enough to sustain not only the capital costs of a PET scanner, but also a local radiopharmaceutical manufacturer that produces F18 and converts it into the radiopharmaceutical needed for PET scanning: [18F]fluorodeoxyglucose, known as FDG.

Without access to a PET scanner locally, cancer patients must travel to receive their diagnosis. Such travel can burden patients and complicate their condition – and, during an epidemic or pandemic, patients may be discouraged or forbidden to reduce transmission of pathogens from one local medical system to another.

Thus, greater access to PET scanning for patients in rural areas and small cities would be a step toward more equitable medical care and self-sufficiency of local medical systems.

Availability of PET scans in Windsor without local FDG production: Two small cities in Ontario each have a PET scanner but no local supply of FDG, namely, Windsor and Sudbury. In these cases, the FDG is just-in-time shipped from larger centres such as London, Hamilton, or Toronto.

Well over half of the FDG is lost to decay during shipment. These losses drive up the per-patient cost of PET scans and limit the number of patients that can be served from a single production run of FDG from the supplier.

Windsor's PET scanner has been well supplied with FDG from London. However, within the next few years, growth in demand for PET scans could overtake the number of patients that can be served each day, leading either to increased costs for additional FDG shipments or to the need for patients to travel elsewhere for a PET scan.

Modelling sustainability of local FDG production in Windsor: Producing FDG locally would be more efficient because it eliminates losses of FDG during transit. However, the price must be high enough to provide FDG producers with a sound business case for meeting the local demand.

We examined the sustainability of local FDG production in Windsor, looking for insights that may apply generally to the sustainability of FDG production in small Canadian cities (e.g. Sudbury). Our study focused on the role pricing plays in achieving sustainability.

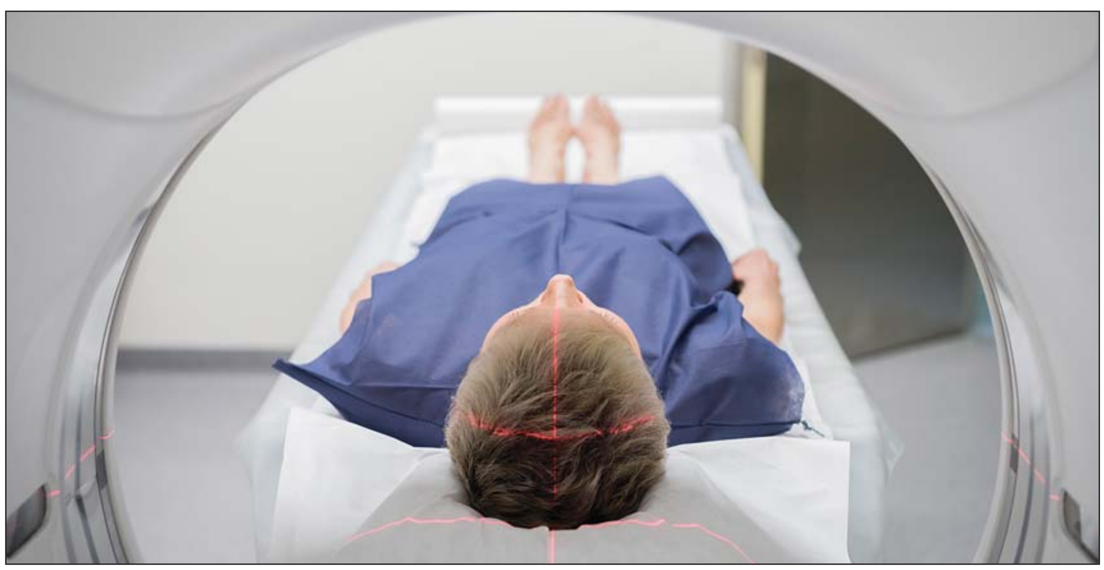
We were motivated in part by the example of the radioisotope Technetium-99m, used for SPECT scans. The Nuclear Energy Agency has shown that a large increase in the price of Technetium-99m could achieve sustainability for producers without causing a noticeable increase in the price of a SPECT scan.

So, we asked, At what increase in the cost of FDG does local FDG production become sustainable? Does this increase make a big difference in the cost of a PET scan? And, how much do these price changes depend on the local demand for PET scans?

To answer these questions, we developed a business model for FDG production in which we could vary inputs, such as demand for the FDG, price of the FDG, whether the FDG is produced locally or shipped in from elsewhere, and expectations for capital cost recovery. We developed our model based on expert insights from FDG suppliers, suppliers of FDG production equipment, and cancer care providers.

Our most notable assumption was that the FDG production personnel would be shared with a host hospital or affiliated university, and that such personnel would perform other nuclear medicine or research functions when they were not needed for FDG production.

This assumption is critical at low production volumes because it enables us to treat personnel costs as a variable cost that scales with the demand for PET scans. More details about our model and key results are described in our corresponding white paper, *Sustainability of F18 medical isotope production in small Canadian cities*, available on the Canadian Healthcare Technology website, in the White Papers section.



Key findings: A key finding of our analysis is that with Windsor's current level of patient demand (typically three days per week, serving five-to-six patients per day) and current PET scan costs, the business model for local FDG production would be close to achieving a basic level of sustainability in which the most critical capital costs of FDG production are expected to be recovered (e.g. the cost of the radiopharmaceutical manufacturing equipment, but not the cyclotron or the building in which it is housed).

To achieve this basic level of sustainability, the price of a batch of FDG would need to rise 56 percent – but this increase would make a difference of only 17 percent in the total cost of a PET scan in Windsor. To recover all capital costs, the total cost of a PET scan would rise 54 percent.

If the FDG was produced locally, however, the PET scanning schedule could be optimized to serve more patients with a single batch of FDG, since losses during shipment would be avoided.

To fully exploit each batch of FDG produced locally, we also modelled a compact schedule in which PET scans are offered 1.5 days per week, serving up to 11 patients per day.

Our calculations show that for locally produced FDG, a basic level of sustainability could be reached in Windsor today using this compact schedule, without increasing the per-patient cost of a PET scan to the public health system. Our calculations assume that the provincial payer would need to agree to doubling the cost of the FDG, which would be offset by reducing the number of FDG batches produced by half.

If all capital costs of FDG production are to be recovered, a 36 percent increase in the cost of a PET scan would be required.

Discussion and conclusion: It is reasonable to consider FDG production scenarios in which not all capital costs must be recovered at current levels of demand, given that (a) hospital buildings (where FDG is best produced to minimize losses due to radioactive decay) and medical equipment are often funded through private donations and special allocations from provincial governments, and that (b) the expected increases in demand for PET scans over the lifetime of a cyclotron and building will only improve the business model and make replacing these assets in coming decades more feasible than today.

With this in mind, our results suggest that a local FDG production facility might be sustainable in Windsor today without increasing the net cost to the public health system, if the PET scanning schedule can be adjusted to fully exploit every batch of FDG produced locally, and if the local producer is a university or hospital that can employ FDG production staff elsewhere on days when FDG is not being produced.

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