Issue: PET-CT Programs
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Evidence *in* Context

Health research — synthesized and contextualized for use in Newfoundland and Labrador

CHRSP

About NLCAHR's Contextualized Health Research Synthesis Program

The Newfoundland and Labrador Centre for Applied Health Research is working with decision makers in the provincial health system to identify and address issues of pressing interest to Newfoundland and Labrador on which guidance from the research evidence is important. These issues are being addressed through the Contextualized Health Research Synthesis Program (CHRSP).

CHRSP analyzes the findings of high-level research (systematic reviews, meta-analyses and health technology assessments) that has already been done on the issue in question. The findings of these studies are synthesized and are subjected to a systematic process of 'contextualization': they

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Synthesis Topic

Options for the Development of a PET/CT Program in NL

Positron emission tomography (PET) is a type of Nuclear Medicine (NM) imaging technology that allows true imaging of human physiological and biochemical processes.

At present, patients in Newfoundland and Labrador who require a PET scan must travel out of the province to either Alberta or Quebec at a substantial cost to the provincial health system as well as to the patient and his/her family.

While the recorded number of NL residents who received PET scans in the past has been relatively small (fewer than 35 patients per year since 2004), these numbers may not represent the true size of the population that might have benefited from PET nor provide a reliable guide to future demand.

Today, PET scanners are most often available only as 'hybrid' models that combine PET with computed tomography (CT). When PET is combined with CT, the fused images allow accurate simultaneous visualization of function or physiology (in the PET element) and anatomy or structure (in the CT element). A technology closely associated with PET scanning is a medical cyclotron; Locating a PET scanner close to a cyclotron is important for its clinical and research utility.

This report was initially designed to examine research-based evidence about *whether* the province of NL should acquire a PET scanner. Given that the Government of NL has announced its intention to purchase a PET scanner and a medical cyclotron, and that a further decision has been reached to locate both pieces of equipment in St. John's, our focus has been on a set of ancillary, but still very important, issues that contribute to the primary research question, below.

NEWFOUNDLAND & LABRADOR CENTRE FOR APPLIED HEALTH RESEARCH

The Research Question

"Given the geographic, demographic, fiscal and political context of Newfoundland and Labrador, what is the most appropriate, effective, and efficient way to operate a PET/CT program so that the population derives the maximum benefit at the best possible cost?"

Background

About PET/CT

How PET/CT is used

There are currently three broad categories of accepted clinical application for PET/CT technology:

1. in oncology imaging, to help determine how extensive a cancer is, whether it has responded to therapy, and whether it has recurred;
2. in brain imaging, for select patients with seizure disorders and for the early detection of dementia; and
3. in cardiac imaging, to assess the viability of heart muscle.

Demand for PET/CT

PET/CT imaging is publicly funded throughout Canada, though not all provinces have PET/CT scanners. According to CADTH (January, 2008), PET/CT scanners are located in all provinces and territories of Canada except Saskatchewan, PEI, Yukon, NWT, Nunavut, and NL (see the full report for details). A limited number of cyclotrons are located across the country.

The Canadian regulatory environment for the production of FDG (see box, below) and other PERs is complicated, and Health Canada (HC) requires new producers to conduct clinical trials to prove both the safety and the clinical efficacy of their PERs for specific indications. A list of the HC-approved indications for the use of FDG in PET and a list of the indications that are currently in approved clinical trial applications are available in the full CHRSP report.

PET/CT imaging research is a rapidly growing field and there are new emerging indications for this technology. It is, therefore, difficult to predict the future demand for FDG PET/CT scans in NL accurately. Demographically, the trend toward an aging population in this province, and the associated increased incidences of cancers and dementia, will likely be a major driver of the demand for this technology in the future.

What is a cyclotron and why is it important to PET/CT?

A technology closely associated with PET scanning is a medical cyclotron which produces positron-emitting radioisotopes which are subsequently processed to produce positron emitting radiopharmaceuticals (PERs) containing a radioactive isotope.

The process of PET/CT imaging begins by injecting the patient with trace amounts of these PERs isotopes that, unlike the majority of commonly used radiopharmaceutical isotopes, generally have quite short half-lives[1].

Radiolabeled glucose or fluorodeoxyglucose (FDG) is the primary PER currently used for oncology imaging and it has a half-life of 110 minutes. The other common positron isotopes have half-lives ranging from 2 to 20 minutes. Locating a PET scanner close to a cyclotron is important for its clinical and research utility. If NL had a PET/CT but not a cyclotron, the province would be dependent on radioactive isotopes flown in from elsewhere.

The full report on this project provides a detailed analysis of the estimated demand for PET/CT scans, based on the currently approved or accepted indications, and suggests that NL ought to plan for sufficient funding and services for 600 – 1200 PET scans annually for oncology indications and less than 10 scans for seizure disorders. However, anticipated increases in demand for brain imaging for dementia, the development of new PERs, and an aging population, mean that demand for PET scanning for current and additional indications can be expected to increase significantly.

Focus of the Synthesis

What We Looked At

Sources of evidence

The sources of evidence for this research synthesis are limited to systematic reviews, health technology assessments, and a few very recent original studies for the most commonly published indications for FDG PET/CT imaging in adults. Most of the literature is oncology-related, with limited discussions of cardiac and neurological indications.

A recent comprehensive systematic review by Facey et al. (2007) of PET and PET/CT for selected cancers is, unless otherwise specified, the principal source of information for this report.

Secondary research questions for this synthesis

- where, within the St. John's area, should the new equipment be located?
- for what clinical indications is PET currently the best choice in terms of clinical effectiveness and cost-effectiveness?
- what other indications are emerging for which it makes sense to plan for PET use?
- what is the optimal method for organizing and managing access to PET scans?
- what are the advantages of early development of a cyclotron program and the challenges of operating without one?
- what are the requirements of a PET/CT scanning program in terms of professional competencies for physicians and technologists, training, financing and space?
- what is the optimal sequencing of the activities required for effective acquisition, installation, licensing and start-up of a PET/CT scanning program?

Preliminary findings from the synthesis

There is good evidence that FDG PET/CT is beneficial in the management of many types of cancer. The strongest evidence relates to the characterization of indeterminate pulmonary nodules (to assess the risk of cancer), staging of lung cancer, restaging of colorectal cancer, and the staging, assessment of response and restaging of lymphoma (cancer of the lymph nodes). There is also reasonable and growing evidence on the limited use of FDG PET/CT for specific neurological (e.g., epilepsy and dementia) and cardiac (e.g., chronic ischemia) indications.

Clinical practice guidelines

On the basis of current best evidence and professional consensus, agencies in North America and Britain have developed clinical practice guidelines (CPG) for FDG PET and PET/CT scanning for select cancer, neurological, and cardiac indications (see Table 3 in the full report). Guided by these CPGs, NL will have to determine its own list of indications for PET scans and modify it as appropriate to include emerging indications in the future.

Benefits

Although PET/CT is largely an adjuvant imaging modality, cost savings may be realized in that PET/CT scanning can significantly influence patient management by providing an opportunity to avoid futile and costly, invasive interventions (e.g., surgery or radical radiotherapy) and to provide more appropriate palliative therapy, thus increasing the patient's quality of life despite not improving overall survival.

Impact on research

PET/CT, in combination with a medical cyclotron program, is a powerful research tool with the potential to enhance research capacity and improve recruitment and retention of Nuclear Medicine and other specialist physicians, technologists, and academics. The introduction of PET/CT scanning in NL will also enhance the eligibility of patients for certain types of clinical trials (e.g., in oncology) that would otherwise not be open to them.

Guided by Dr. Demeter's experience in developing the Winnipeg PET/CT program, the synthesized evidence on PET/CT was applied to the NL context, providing guidance about the essential components of both a PET/CT and a cyclotron program and about optimal timelines and sequencing. The contextualized evidence was further verified by consultations with leaders in the development of the Halifax PET/CT program.

Applying the Synthesis to Newfoundland & Labrador

Putting the Evidence Into Context

Locating the PET/CT program

Based on population demographics, distribution of services, availability of medical and support personnel, and research potential, St. John's is the most appropriate location for the PET/CT scanner and cyclotron. The Winnipeg experience suggests that the PET/CT suite should be located in a tertiary acute care setting from the outset.

Local oncologists in NL are eager to provide input into the design of the PET/CT suite, particularly as it relates to specific considerations for both adult and pediatric patients. Both Winnipeg and Halifax use approximately 2000 sq. ft. for their PET/CT suite. The suite should be located as close as possible to the cyclotron facility to allow for rapid delivery of short-lived PERs, not only for clinical purposes, but to facilitate basic science and clinical research.

Managing referrals for PET/CT

In both Winnipeg and Halifax, referrals for PET are limited to oncology specialists and other select specialists (e.g., lung specialists). All PET/CT requests are reviewed by Nuclear Medicine PET physicians guided by approved indications and CPGs. Local NL specialists consulted for this project concur with this approach and support the establishment of a committee to develop guidelines and to monitor these activities.

Operating the cyclotron

Having a local cyclotron provides a number of important advantages, including potential cost-savings, better scheduling of patients, and innovative research applications. Detailed explanations can be found in the full report. These advantages are so substantial as to suggest that, now that the province has decided to purchase a cyclotron to support the PET/CT program, it should pay serious attention to the optimal sequencing of activities so that the cyclotron program is initiated as early as possible.

Experience in Winnipeg and Halifax suggests that, if human and financial resources are available for both programs from the start, it takes about one year to start up a scanning program but two-to-three years to get a cyclotron program commissioned. Therefore, unless NL starts development of the cyclotron program well in advance, there will be an initial period during which PERs will have to be brought in from outside the province. The cyclotron suite including the research lab requires 1500 to 2500 sq. ft. of space.

Human resource requirements

The human resource requirements for both the PET/CT and cyclotron programs are considerable and will involve the recruitment, remuneration and training of professional and technical staff of many types at various stages in program development.

Minimal operational staffing includes specially trained physicians, NM technologists, and quality assurance technologists, and a regulatory consultant, physicist, radiochemist/radiopharmacist, radiation safety officer, cyclotron operator, and clinical trials/research coordinator.

The full CHRSP report provides a summary of the human resource requirements for both the PET/CT and cyclotron programs along with supporting details for each staff position. While NL currently has NM physicians and technologists, specialized training will be required in some cases in order to establish and maintain competency in PET/CT. Planning for training in PET and CT is an important consideration, as is the scarcity of radiopharmaceutical and cyclotron scientists, both nationally and internationally.

Regulatory and other requirements

Significant time and resources must be dedicated to regulatory issues involving both Health Canada and the Canadian Nuclear Safety Commission. It would be prudent to engage a project consultant with specialized expertise in regulatory requirements, early in the planning process, as issues related to non-compliance can be a significant rate-determining step in the process. It has proved impossible to provide a detailed program development template because too many factors are unpredictable. These include regulatory requirements, the procurement process, location (new building or renovated space?), the source of FDG while the cyclotron is being built, and the availability of construction services and skilled operations staff. The full report, however, presents a generic guide to the timelines and sequencing of events for the development of a PET/CT program in NL.

CHRSP Project Team: PET/CT

- **Dr. Sandor Demeter** (Team Leader), Winnipeg Health Sciences Centre & University of Manitoba
- **Dr. Stephen Bornstein** (Program Coordinator, CHRSP), NLCAHR , Memorial University
- **Janice Butler** (Project Coordinator, CHRSP), NLCAHR , Memorial University
- **Dr. Benvon Cramer** (Local Scientific Expert), Faculty of Medicine, Memorial University
- **Dr. Peter Hollett**(Local Scientific Expert), Faculty of Medicine, Memorial University
- **Louise Jones** (Health System Expert), Eastern Regional Health Authority, St. John's
- **Dr. Alexander McEwan** (External Reviewer), Faculty of Medicine & Dentistry, University of Alberta

see the full CHRSP report for additional consultants & advisors for this PET/CT Project: www.nlcahr.mun.ca/research/chrsp

Implications For Decision Makers

The following policy-relevant suggestions can be drawn from our examination of the best available scientific evidence on PET/CT programming as it applies to the context of NL:

1. Given that the NL Government has declared its intention to purchase PET/CT technology and since a PET/CT imaging facility needs to be located in an acute tertiary care setting, planning for a PET/CT program should begin immediately and should be integrated into the redevelopment of Eastern Health.
2. The cyclotron facility should be located as close as possible to the PET/CT imaging facility.
3. The planning process for the cyclotron should begin as soon as possible, and certainly no later than the process for the scanner. Both processes should utilize expertise that has developed across the country and recruitment should be started early in the planning process.
4. The province will need to develop a list of approved indications for FDG PET/CT scanning. This list should be evidence-based and guided by accepted Clinical Practice Guidelines and it should be revisited periodically and adapted to new clinical evidence and to the development of new PERs.
5. A committee of specialist physicians should be formed to develop clear guidelines regarding who would be permitted to order PET/CT scans. All requisitions from referring physicians should be screened by NM physicians.
6. A communications strategy should be developed to inform referring physicians and the medical community at large about the approved indications for a PET/CT and who can order such studies, and to provide guidance on how to interpret results.
7. The Chief of Nuclear Medicine, the Clinical Chief of Diagnostic Imaging and the Vice-President of Medicine should be consulted to establish training and experiential guidelines on physician qualifications and continued competency to interpret PET/CT studies as well as for a Director of the PET/CT facility.
8. Continuing education programs for physicians, nuclear medicine technologists and other supporting technical and scientific staff should be developed.
9. Human resource needs involving physics, biomedical engineering, and radiopharmaceutical support, fulfillment of regulatory requirements, clinical trials coordination, and NM technology support should be assessed and adjusted to the scope and timelines of the PET/CT and cyclotron programs.
10. The sponsorship program in technologist training in NM, including PET/CT, should be continued so as to enhance recruitment and retention of technologists in NL.
11. A communications program will be needed to educate the public about PET/CT imaging, the conditions that benefit from its use, and its limitations.
12. Given the complexities of implementing a PET/CT program and an associated cyclotron program, the province of NL and Eastern Health should consider consulting other Canadian jurisdictions that have recently completed similar processes during the NL planning process.
13. A strategy to determine the research activities that will be undertaken by the facility should be considered including determining the resources required and the associated regulatory issues.

About CHRSP

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are analyzed in terms of their applicability to the conditions and capacities of the unique context of Newfoundland and Labrador. CHRSP uses a combination of external experts and local networks to synthesize and contextualize the research and to facilitate the uptake of the results by local research users.

The CHRSP Process

CHRSP endeavors to be timely and relevant to research users while ensuring a reliable and comprehensive process. Our goal is to produce a synthesis report within six months of topic identification.

When the synthesis is complete, an external expert reviews the work of the project team, providing feedback to ensure validity. The results of the synthesis project are then communicated to the province's decision makers and health professionals in formats and forums designed to maximize their uptake into the decision-making process.

For the complete CHRSP report on this project, including details on the evidence reviewed by the project team, see the NLCAHR website:

www.nlcahr.mun.ca/research/chrsp

Newfoundland & Labrador Centre for Applied Health Research

www.nlcahr.mun.ca
nlcahr@mun.ca
1.709.777.6993

Note:

[1] The half-life is the time it takes an isotope to lose half of its radioactivity.

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