

Enabling Nuclear Medicine Technologists Project

Final Report

Title: "Better Skills, Best Care": Enabling Nuclear Medicine Technologists: the development of skills required in the Nuclear Medicine Department of the 21st century

Agency: The Victorian Society of Nuclear Medicine Technologists

Key Contact/champion: Russell Booth, Chief Nuclear Medicine Technologist, St Vincent's Hospital Melbourne

Commencement date: 9 May 2008

Completion date: 20 March 2009

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Executive summary

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The aim of "*Better Skills, Best Care*": *Enabling Nuclear Medicine Technologists: the development of skills required in the Nuclear Medicine Department of the 21st century* was to provide an enhanced service to both patients and referrers to medical imaging facilities, with the additional benefit of enhancing the role of the nuclear medicine technologist. Patients requiring both CT (computerised tomography) and SPECT-PET (single photon emission computed tomography and positron emission tomography) scans would have these performed on the one modality at the one appointment. The current practice is for the patient to attend two sessions often in different clinical departments. Both studies would be performed by one profession, rather than staffing the facilities with both nuclear medicine technologists (NMTs) and radiographers.

The key objectives of the project were met. They were:

1. *To define the skills required for a nuclear medicine technologist to perform the CT element of the hybrid imaging investigations*

The syllabi of the three different undergraduate programs (nuclear medicine technology and radiography at RMIT, and radiography at Monash) were reviewed and recent nuclear medicine technology graduates were surveyed. In addition several radiologists were asked their opinion on the learning objectives to be included in the educational package. Based on this audit, the skills required were defined.

2. *To develop, design and pilot an on-line web-based academic program*

In partnership with the Department of Medical Imaging and Radiations Science at Monash University an educational package was developed for the pilot project. This education and clinical training program aimed to enable nuclear medicine technologists to safely and competently perform CT examinations on hybrid imaging equipment. This educational package was delivered on-line via the Society's website.

3. *To develop, design and pilot a complementary clinical training program which, when completed, would enable nuclear medicine technologists to perform CT on hybrid equipment*

The clinical component of the educational package was based on the CT component of the undergraduate radiography program at Monash University. It consisted of a minimum of three full-time weeks in a diagnostic CT department able to offer experience in the range of studies covered in module 2. This CT placement enabled candidates to participate in CT examinations and develop competence in a range of diagnostic CT examinations, while under the direct supervision of a CT radiographer.

4. *To evaluate the training and subsequent enhanced nuclear medicine technologist role*

The educational package was evaluated and although there were some suggestions for improvement, the skills of the nuclear medicine technologist were enhanced and their skills found to be acceptable to undertake hybrid CT.

5. *To evaluate the impact on patient waiting times and the overall impact of this new role on the nuclear medicine service, referrers and consumers*

Patient waiting times were found to decrease if both CT and SPECT-PET scans could be performed at the one time. At the pilot sites, relationships between professional staff worked well. Referrers more generally will need to be educated about the possibilities of having both scans performed at a single appointment. There are benefits to consumers in terms of a smoother patient journey, however it was not possible to evaluate this aspect of the project.

While some modifications to the educational package need to be made, overall, the objectives of this project were met.

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Project Aim

The aim of “*Better Skills, Best Care*”: *Enabling Nuclear Medicine Technologists: the development of skills required in the Nuclear Medicine Department of the 21st century* was to provide an enhanced service to both patients and referrers to medical imaging facilities, with the additional benefit of enhancing the role of the nuclear medicine technologist. Patients requiring both CT (computerised tomography) and SPECT-PET (single photon emission computed tomography and positron emission tomography) scans would have these performed on the one modality at the one appointment. The current practice is for the patient to attend two sessions often in different clinical departments. Both studies would be performed by one profession, rather than staffing the facilities with both nuclear medicine technologists (NMTs) and radiographers.

Project Background

In the course of investigating suspected pathology, patients are routinely referred for both CT and nuclear medicine molecular imaging studies. Traditionally both diagnostic tests have been viewed as disparate and independent sources of patient information. Thus patients have had their diagnostic CT and their nuclear medicine investigations performed at a different time, on different machines, and often in different hospital departments. This traditional diagnostic paradigm has meant that there is duplication of some aspects of the service, with patients spending more time being examined and results being unnecessarily delayed.

In the late 1990’s, researchers and engineers produced a hybrid scanner that was able to perform both PET and CT studies on the one machine. Such systems had the potential to offer major advantages in patient care by enabling the CT and nuclear medicine scans to be performed on the one unit at the one appointment, thus eliminating the need to transfer the patient from one modality and room to another, or requiring the patient to return for a second appointment. This would significantly improve the patient journey.

This technology rapidly attracted the attention of commercial manufacturers who quickly realised that this new scanning technology would have a major impact in medical imaging. The subsequent development of hybrid imaging systems has produced a fundamental shift in the delivery of molecular imaging services.

The initial evaluation of the benefits of this technology focused almost exclusively on the clinical advantages of having both studies performed on the same scanner during a single session. This allowed the CT and molecular images to be acquired with a consistent scanner geometry and body habitus, and with minimal delay between the two acquisitions, allowing for seamless fusion/image registration. Hybrid imaging offers a significant advantage in that it provides diagnostic information that is difficult to achieve when the same image data are acquired in separate studies using traditional means.

Recognition of significance of hybrid systems

The significance of these hybrid systems was recognised within medical imaging. PET-CT scanners were quickly followed by SPECT-CT capable gamma cameras. It is now exceedingly rare for a facility to purchase a new PET scanner as a stand alone system. Hybrid PET-CT systems have become industry standard. The sale of gamma cameras with CT capability has also experienced an increase in demand. It is apparent that as ageing equipment is replaced this technology will play a significant role in imaging.

What was not initially apparent was that this technology could significantly improve movement of patients through the diagnostic process. Instead of multiple attendances, a patient requiring both studies could now have the CT and the nuclear medicine test performed at the one appointment. Another advantage was that any suspected pathology evident on the nuclear medicine test could be further investigated with CT, avoiding the need to make an additional appointment.

Need to review traditional professional roles

However utilising this technology effectively requires a change to traditional professional roles.

Currently radiographers perform CT investigations on dedicated CT scanners, while the nuclear medicine studies are performed by nuclear medicine technologists on either a PET or SPECT scanner. Under this traditional workforce delineation, if a hybrid machine is used the two professional groups are required to be in attendance to perform the diagnostic CT and nuclear medicine component of the test. (Note currently low-dose CT scans for anatomical correlation and attenuation are already performed by nuclear medicine technologists.)

Requiring both radiographers and nuclear medicine technologists to attend an examination is inefficient and produces long delays. Adherence to traditional roles is an inefficient utilisation of staff and resources. There are significant advantages in one professional group performing both studies.

When the RMIT undergraduate curriculum for nuclear medicine was evaluated it became apparent that nuclear medicine technologists had the academic foundation to perform both roles.

From 1996, undergraduate nuclear medicine technologists at RMIT University in Victoria have been required to complete the same CT curriculum as radiographers. In addition, after graduation, interns are required to spend a minimum of two weeks in a CT facility as part of their Professional Development Year. It was reasoned that with appropriate additional training, nuclear medicine technologists had the prerequisites to acquire the skills necessary to perform both the CT and nuclear medicine test on these hybrid scanners.

Early experiences overseas indicate the use of this equipment will rapidly spread. Unfortunately, due to the limited exposure to CT in traditional training, technologists overseas have to undertake lengthy programs to achieve the required competency. In

Victoria however, due to the academic content of undergraduate courses, nuclear medicine technologists already have most of the necessary prerequisites in CT. Nuclear medicine technologists in Victoria are in a unique position to upskill and thus take full advantage of this technology.

If nuclear medicine technologists are appropriately trained and subsequently credentialed to perform diagnostic CT on hybrid equipment, radiographers will not be required to leave the CT unit to assist in performing the CT. This will reduce demand on a group already experiencing high workloads.

Although some patients will have their diagnostic CT performed in this hybrid environment, it is anticipated that the impact on overall numbers of CT studies radiographers perform will be negligible. CT is an important diagnostic test used in a large number of clinical settings. The number of clinical conditions where nuclear medicine also forms part of the pathway is significantly smaller. The use of hybrid CT is specific to this setting, that is, where both tests contribute to the diagnosis.

The impact on patient care can also be substantial if modifications to referral patterns can be achieved. Patients can have their diagnostic CT and molecular imaging tests performed at the one appointment. In addition, patients requiring CT as a result of the findings on molecular imaging tests can have the CT performed immediately. These changes to workflow are likely to produce real benefits to patients.

Current practice

Since 2002 and the introduction of hybrid imaging in Victoria, nuclear medicine technologists have been operating these scanners at several PET and SPECT facilities. The operation of the CT modality on these scanners has been limited to acquiring scans for the purpose of attenuation correction and anatomical co-registration. This practice has been defined and accepted within guidelines provided by the Medical Radiation Technologists Board (now Medical Radiation Practice Board of Victoria - MRPB) the Australian Institute of Radiography (AIR) and the Australian and New Zealand Society of Nuclear Medicine.

Despite the limited nature of this practice there is a requirement of knowledge of the CT system and its use to optimise protocols and ensure safety. It is commonly cited that nuclear medicine technologists are not permitted to perform diagnostic CT scans under these guidelines but this describes the end application of the CT scan, not the complexity of the CT protocol required to acquire it. It would generally be acknowledged that the training and credentialing of nuclear medicine technologists to perform more complex CT scans would be a more accurate description of the aims of this project.

Most sites operate the CT component with the knowledge and assistance of their in-house radiographer colleagues. Where necessary they are consulted regarding protocol development, safety and innovation.

Nuclear medicine technologists have uniformly applied a professional demarcation between the CT scans they acquire and those used for diagnostic clinical purposes. However, the CT scans co-acquired on modern hybrid scanners when combined with PET or SPECT scans form a powerful diagnostic tool, so the practice of nuclear medicine technologists in the hybrid scenario can be confusing when evaluating the degree of diagnostic power attributed to the CT scan and the constraints under which they practise.

The following are the additional duties and expectations of current nuclear medicine technologist practice relating to CT:

- Dose minimisation for high-risk subjects (eg. pregnant, paediatric and adolescent patients).
- Protocol optimisation to improve quality and application of studies.
- Protocol adaptation of standard CT protocols for hybrid imaging.
- Implement new CT technology (eg AutoDose options, 4D)
- Implement radiotherapy protocols (simultaneous radiation therapy planning and diagnostic PET studies).
- Participate in CT application training for new equipment.
- Communicate with camera service engineers and application specialists on faults, maintenance and repairs.
- Perform routine calibration.

It is current practice that accredited nuclear medicine technologists perform all the operational aspects of existing low-dose hybrid CT. This practice is recognised by the Medical Radiation Practitioners Board of Victoria. The change proposed to existing practice would enable these nuclear medicine technologists to perform a full diagnostic CT or more complex CT protocols at the same time as the nuclear medicine test.

The project assumes the quality of the CT scanner on hybrid systems is comparable to the quality of CT scanners in the radiology community. This is certainly true on PET-CT systems. Most CT scanners currently in use in radiology are comparable to the ones on hybrid systems. As new hybrid systems are deployed the CT component will be updated to reflect current technology.

Victoria has led Australia in a pragmatic approach to hybrid operations. The third hybrid scanner in the world was installed in Melbourne and a model of practice was developed, in consultation with the Medical Radiation Technologists Board. Soon after, the Australian Institute of Radiography and Australian and New Zealand Society of Nuclear Medicine issued guideline statements that reflect current practice. Nuclear medicine technologists adhere to protocols but are expected to be able to adopt and assess CT protocols.

The Victorian Society of Nuclear Medicine Technologists (VSNMT) initiated this study with the Department of Human Services (DHS) and relevant professional groups to capitalise, in an economically sustainable way, on the opportunity this new technology offers.

Project Objectives

The key objectives of the project were:

- to define the skills required for a nuclear medicine technologist to perform the CT element of the hybrid imaging investigations;
- to develop, design and pilot an on-line web-based academic program;
- to develop, design and pilot a complementary clinical educational package which, when completed, would enable nuclear medicine technologists to perform CT on hybrid equipment;
- to evaluate the training and subsequent enhanced nuclear medicine technologist role; and in the light of this
- to evaluate the impact on patient waiting times and the overall impact of this new role on the nuclear medicine service, referrers and consumers.

The desired outcome would be to significantly improve the "patient journey" through medical imaging. By performing both molecular imaging and CT tests at the same appointment, the need for patients to return for CT as a result of the molecular imaging test can be eliminated. By changing existing work practices we envisage this project will reduce waiting times for patients and carers and reduce the costs of health care resources associated with multiple appointments.

In addition to the scenario of two separate diagnostic scans being acquired in the one sitting, it is now emerging that specialised "hybrid" protocols will become common place and potentially increase the impact of what can be achieved by separate protocols. One obvious new field is in radiotherapy planning where, particularly in lung and head and neck cancers, PET and CT modalities are performed in the radiotherapy treatment position. This requires a more complex CT acquisition protocol, well within the skill set of nuclear medicine technologists. The advantage to the patient is the increased sensitivity of disease detection of PET combined with the precise anatomy of CT.

The desired outcome would require nuclear medicine technologists to be suitably trained and credentialed to perform diagnostic CT within the hybrid imaging environment. Further, these nuclear medicine technologists would seek registration from the Medical Radiation Practitioners Board of Victoria. In a Policy Statement regarding the operation of hybrid PET-CT imaging systems by registered nuclear medicine technologists, the Medical Radiation Practitioners Board of Victoria states:

"Further, where a new procedure or technique is implemented within the practice of Nuclear Medicine, the Board has determined that registered Nuclear Medicine Technologists will be deemed capable of also performing this procedure or technique, where evidence of appropriate training, onsite instruction, professional development or tertiary education can be provided."

(Medical Radiation Practitioners Board of Victoria, Guideline, Policy Statement by the Board regarding the operation of hybrid PET-CT imaging systems by registered Nuclear Medicine Technologists)

Milestones

Financial reports were submitted to the Department of Human Services by the deadlines included in the initial funding agreement. However, the timelines set for the project were not met. In a project that relied on a significant input from volunteers, the time commitment required to complete activities was underestimated and did not allow for any contingencies. In addition, the delay in finalising the funding agreement meant some activities could not be undertaken at the time originally planned, and when they could be undertaken on the delayed timeline, volunteers had other commitments. There was also a change of project manager three months into the project.

Project Activities

Project steering committee

In order to oversee and coordinate the project an expert steering committee was established and several members were seconded to be part of the committee. This committee included specialist radiologists and nuclear medicine physicians, nuclear medicine technologists with PET and SPECT expertise, a radiographer with recognised expertise in CT, management representatives from participating institutions and representatives from the Department of Human Services. The committee provided management and guidance to the project, assisted by a part-time project manager. A list of the steering committee is provided later in this report.

The steering committee met monthly to evaluate the progress of key activities and to set the agenda for the next phase of the project. A report on the finances was submitted regularly to ensure the project remained within the allocated budget.

The steering committee established a sub-committee to develop the educational package and work with the website designers. Each steering committee meeting received an update on the progress of this part of the project.

The content of the educational package was reviewed at each meeting. As the project evolved the material required was discussed and modified by the steering committee.

A sub-group of the steering committee was allocated the task of defining and collecting the data from the two pilot sites. While the project plan focused on the patient journey, each institution required a data collection strategy specific to the organisation's referral patterns. This group regularly discussed issues relating to data collection and reported back to the steering committee.

The steering committee was charged with overseeing the evaluation of the project. Evaluation of the educational package was delegated to a sub-group of the committee. That group decided on the appropriate person to evaluate the delivery of the educational package. Once selected, this group met with her to develop the framework for the evaluation.

Stakeholder management and consultation

At the outset it was recognised this project would be of interest to other professional groups. Stakeholders were notified of the intention to conduct the project, and as a result the steering committee included stakeholders from the radiography, radiology and nuclear medicine physician communities. In addition, the project was informally discussed with senior members of the radiography and medical physics community and advice was sought on various matters.

Senior management of participating institutions were formally notified of the project. Agreement to participate was given on behalf of each organisation and a representative of each institution was invited to join the steering committee. Agendas and minutes of all meetings were circulated to all members of the steering committee and other interested parties.

The steering committee was the group that managed issues that arose as the project progressed. Individual members of the group addressed matters that related to their specific organisation or professional jurisdiction.

The project did not include those general nuclear medicine procedures considered to be within the current scope of practice of a nuclear medicine technologist including hybrid protocols, and for which the nuclear medicine technologist has already gained recognition and registration.

The educational package was not designed to train nuclear medicine technologists to an advanced level of skill attained by CT supervisors.

The project focused on the performance of the study by the nuclear medicine technologist. The VSNMT accepts unequivocally that the conduct and supervision of the CT examination rests with the radiologist. Any discussion regarding the formal reporting of studies acquired using hybrid PET-CT and SPECT-CT was not within the scope of this project.

Definition of skills

To define the skills required for a nuclear medicine technologist to perform the CT element of the hybrid imaging investigations, consultation was undertaken with potential stakeholders and the nuclear medicine community.

This included:

- defining the specific CT curriculum taught to undergraduate nuclear medicine technology students at RMIT University;
- defining the specific CT curriculum taught to undergraduate radiography students at RMIT University;
- defining the specific CT curriculum taught to undergraduate radiography students at Monash University;
- identifying any material covered in the radiography undergraduate curriculum at either university but not included in the undergraduate nuclear medicine technologists curriculum; and
- identifying any additional educational material the project steering committee thought the educational package should contain.

The assessment was performed in several phases. The first phase involved a direct comparison of the course content of the three different undergraduate programs (nuclear medicine technology and radiography at RMIT, and radiography at Monash). The result of this audit showed that all material was covered, although the emphasis differed between the two universities.

The second phase entailed a survey of recent nuclear medicine technology graduates. The purpose of this audit was to ensure all material in the curriculum was in fact covered in the delivery of the program. This survey found that graduates were familiar with all learning objectives considered essential to the program. The graduates were also asked whether further detail was required in any areas. Their comments were incorporated into the development of the educational package.

In the third phase of development of the program, several radiologists were asked their opinion on the learning objectives to be included in the educational package. They were also of the opinion that the program covered all the required material.

In October 2008, the project steering committee finalised the material to be covered in the two academic modules of the pilot educational package. This included defining a detailed subheading list for each topic. The major topic headings are listed later in this report.

All involved in the development of the educational package were of the view that a clinical placement was required. The committee canvassed the views of those members with CT expertise and also sought the views of those involved with the Monash radiography undergraduate program. Module 3 was a result of this process.

The radiologists involved in the third phase of the assessment were of the view that some of the critical learning objectives needed to be emphasised during the clinical component of the educational package. The steering committee ensured this recommendation was also incorporated into module 3.

This process identified the skills and key competencies required for nuclear medicine technologists to safely and competently perform more specialised CT examinations on hybrid imaging equipment.

Issues of significance that arose from these consultations included the extent of radiation safety expertise that would be required of the candidates. The committee was fully aware of its responsibility to ensure the safety of patients and therefore the radiation safety component of the educational package was enhanced.

The steering committee discussed the performance characteristics of current CT equipment. This was an important debate as CT scanners in clinical use in radiology range from single slice to 64 slice units. Given the CT specifications on the hybrid systems currently in use in nuclear medicine, the course material was targeted at the average 4 slice machines.

The steering committee discussed at length the organs and body systems that needed to be included in the educational package. This discussion was guided by the members of the committee with medical expertise. They had the insight and expertise to identify the clinical scenarios where hybrid imaging would be applicable. This discussion was enhanced by the views and considerable expertise of the CT radiographer member of the committee. She drew on a wealth of experience to give a practical insight into the specifics of each CT protocol.

The discussion included input from the Monash University radiography program in CT. It was invaluable for the committee to have this program as a resource to underpin its discussions.

Develop training and assessment

The educational package was developed as described in the key objectives. A sub-group of the steering committee examined the course content of each of the university programs. The aim of this analysis was to establish what undergraduate nuclear medicine technologists were taught and what was taught to radiographers in both the Monash and RMIT university programs. This analysis was supplemented by a survey of recent graduates to ensure the material documented accurately reflected their experiences.

The analysis did not identify any discrepancy between the undergraduate CT and nuclear medicine technologist streams at RMIT. The Monash CT program did contain some minor elements not taught to RMIT undergraduate nuclear medicine technologists. As the educational package is based on the Monash undergraduate course these elements were included in the educational package. The pilot program was modelled on the radiography undergraduate course but also contained material from the postgraduate CT program. The steering committee felt it was important to underpin the program with validated material. The members did not wish to construct a program specifically for this project.

At the outset a decision was made to deliver the theoretical section of the educational package on-line to enable nuclear medicine technologists to complete the academic component of the educational package while still working. All material was placed on the VSNMT website, which was redesigned to accommodate the requirements of the educational package. There were practical difficulties associated with uploading the course material. The people responsible for the task had limited time available and it took longer than initially anticipated.

In considering the definition of skills required to perform CT, the steering committee took the view that CT would be performed for a variety of indications in various facilities and that the educational package needed to reflect this requirement. The committee believed that the competencies attained by nuclear medicine technologists completing the educational package had to be equivalent to those of a radiographer who performed CT.

In the early stages of the design process the steering committee agreed that the most effective educational package would contain the competencies required in the radiography program. Therefore, the committee examined the CT course content of the radiography undergraduate program from both RMIT and Monash Universities. This was then compared with the undergraduate nuclear medicine technologist program from RMIT University.

In partnership with the Department of Medical Imaging and Radiations Science at Monash University an educational package was developed for the pilot project. This education and clinical training program aimed to enable nuclear medicine technologists to safely and competently perform CT examinations on hybrid imaging equipment.

The steering committee made the decision to increase the content of the radiation safety component of the educational package. The safety of patients was of paramount importance when devising the course content and so it was decided to repeat material already covered in the undergraduate course. Additionally, in the interest of patient safety, emphasis was placed on the safe administration of contrast media. The steering committee also required the clinical component be broadened and formally documented.

The educational package which was developed contains three modules. In addition a *Course Guide for Candidates (2008 Diagnostic CT for Molecular Imaging)* and a *Clinical CT Workbook* were produced. Multiple choice questions were used to assess each module. The entire educational package is supplied with this report on CD.

The first module *CT Instrumentation and Radiation Safety* is principally focused on the physics of CT and radiation dosimetry. The content is identical to the Monash University program for diagnostic radiographers and contains all the requirements deemed necessary for radiographers to perform diagnostic CT. This module contains four topics:

1. Dose and clinical CT
2. Multi-slice CT scanner technology
3. Dose in multi-slice CT
4. CT image reconstruction: principles and practice

The second module, *CT Clinical Methods* was produced by Monash University and contains all the material taught in the undergraduate program offered to diagnostic radiography students in CT. It contains seven topics:

1. Concepts related to the use of contrast agents in radiology
2. The use of contrast agents in clinical CT
3. Single and multi-slice CT protocols for the head
4. Single and multi-slice CT protocols for the neck and spine
5. Single and multi-slice CT protocols for the chest
6. Single and multi-slice CT protocols for the abdomen and pelvis
7. Single and multi-slice CT protocols for the extremities

The third module is the clinical component of the educational package. It is based on the CT component of the undergraduate radiography program at Monash University. This module consisted of a minimum of three full-time weeks in a diagnostic CT department able to offer experience in the range of studies covered in module 2. This CT placement enabled candidates, while under the direct supervision of a CT radiographer, to participate in CT examinations and develop competence in a range of diagnostic CT examinations.

The clinical component could be done as a three-week block (ie 15 working days) or as day release. If day release is chosen the course requires a minimum of 2 days per week, to be completed in 2 months (8 weeks).

The *Clinical CT workbook* prepared for the clinical component of the educational package was forwarded to all candidates

The CT supervisor at each institution was an experienced radiographer with specialist expertise in diagnostic CT. In addition, each CT supervisor was experienced in the training of radiographers in clinical CT. The assessment of the clinical skills of the candidates was similar to, and based on, the clinical skills assessment currently used by undergraduate radiography students at Monash University.

Modules 1 and 2 were web-based via the Victorian Society of Nuclear Medicine Technologists' website. A course co-ordinator was available to assist the candidates, and a discussion board facility was also available for them to discuss relevant matters.

Deliver pilot of training and assessment

The clinical component of the educational package must be undertaken in a CT facility. The details of the clinical placement were defined during the detailed program design phase.

All candidates participating in the pilot were registered and accredited nuclear medicine technologists who had graduated from the RMIT University program within the last 5 years. As candidates were awarded credit for prior learning, the relevance and recency policy of the Department of Medical Imaging & Radiation Sciences at Monash University was applied. This policy will only award credit in undergraduate and postgraduate courses for studies completed within the last 5 years.

The pilot project was originally designed to focus on patient studies using hybrid imaging equipment at two clinical sites. The two facilities piloting the project were the Peter McCallum Cancer Centre for PET-CT and Monash Medical Centre for SPECT-CT. Three nuclear medicine technologists at these facilities undertook the program: two from the Peter McCallum Cancer Centre for PET-CT and one from Monash Medical Centre for SPECT-CT.

The clinical educational package was designed to complement the academic modules. This requirement could be met at Monash Medical Centre where the candidate was able to spend time in diagnostic radiology to gain exposure to a variety of imaging protocols.

For the two candidates at the Peter MacCallum Cancer Centre, the opportunity to experience a variety of protocols was not readily available in this specialist cancer hospital. In order to expose candidates to the variety of protocols necessary to complete the program, the steering committee decided to include St Vincent's medical imaging in the clinical program.

Taking the opportunity to increase the number of candidates, one nuclear medicine technologist from St Vincent's was included in the pilot program.

Assessment of the supervised CT clinical practice took place over a three-week period and was performed by the senior CT radiographer at the three institutions. The assessment took the form of a clinical skills assessment with the supervisor providing feedback on each candidate's competency development. All clinical skills assessments were recorded in a clinical CT workbook. This assessment process is based on the clinical skills assessments currently used by undergraduate students in the Monash University radiography program.

Data collection and analysis

Patient data collection occurred at the Peter McCallum Cancer Centre (PET-CT) and Monash Medical Centre (SPECT-CT). No patient data collection occurred at St Vincent's hospital as this institution does not have hybrid imaging systems.

Both institutions accepted that the data collection associated with this project was within the NHMRC guidelines *When does Quality Assurance in Health Care Require Independent Ethical Review Advice to Institutions, Human Research Ethics Committees and Health Care Professionals* for a Quality Assurance activity and as such formal organisational ethics committee approval was not required.

Data was collected in an attempt to:

- establish the patterns of referral for PET-CT and SPECT-CT;
- monitor the patterns of referral to the two facilities;
- identify those patients where both studies were required;
- collect data on the time taken to obtain both studies using the traditional workflow; and
- collect data on the time taken to obtain both studies at the one attendance.

In order to establish the number of patients requiring CT as a result of the molecular imaging study, data was collected on:

- the number of patients requiring CT as a result of the molecular imaging study;
- the time for the next available appointment for the CT;
- the delay to obtain the CT on the hybrid scanner;
- whether there was any benefit to the patient; and
- any potential cost savings as a result of these changing work practices.

The original project plan was to collect data around the referral patterns of clinicians. This appeared feasible during the planning phase, but proved to be much more complex than originally anticipated. The time frame required to implement change and collect this information was the major reason in deciding to relinquish this strategy.

The data collection was designed in the expectation that certain changes to referral patterns would occur. In practice, changing referral patterns requires broad consultation. While medical staff are the most obvious group, nursing and administrative staff also have a stake in the redesign of how the patient is referred to imaging. This was not fully appreciated by the steering committee during the early stages of the project.

The data collection was also planned to include cost savings associated with any gains in efficiency. Some estimate could be made based on staffing costs but an accurate cost benefit analysis would need to be performed in consultation with a health economist. This could be explored in more detail in the future.

The data collected as part of the "patient journey" information was collated and presented by a medical statistician.

Equipment: Philips Precedence SPECT-CT (6 slice CT)

Findings from the data supplied on 91 patients at the Monash Medical Centre:

	Mean Delay	25 th -75 th percentile	Range
Number of Patients: 91			
CT Performed on Hybrid Scanner: 83			
Inpatients	1.15 Hours		0-2 hours
Outpatients	1.30 Hours		0.1-2.2 hours
CT Performed in Radiology: 8	14 Days	14-21 Days	1-55 Days

Scenario 1. **Patients requiring a CT scan (performed on the hybrid machine in nuclear medicine) as a result of the molecular imaging study.**

This CT was focused on a specific area of concern to the reporting physician. In this circumstance the CT can be performed with varying parameters and is typically regarded as either a low-dose or a standard “diagnostic” CT protocol. The radiation dose to the patient can be minimised in these cases where the main purpose of the study is for detailed anatomical correlation.

Delays occurred in waiting for a radiographer to attend nuclear medicine, waiting for the scan to be performed, and waiting for the CT report before finalising the nuclear medicine study. In order to present this information as a total potential time saving these components were summed. It was found these patients had to wait on average 1.25 hours for the radiographer to attend, perform the CT and generate a report.

Implicit in this scenario is the adverse effect on the CT department as the radiographer is required to leave the CT department for an average of 30 minutes for each scan.

Scenario 2. **Patients requiring a diagnostic CT which could not be performed in the radiology department on the same day.**

These patients had to wait an average of 14 days (range 1 to 55 days) for the next available appointment. This can be reported as 50% of patients fall within the range of 2 to 21 days (the 25th to 75th percentiles).

The delay in obtaining an outpatient CT appointment ranged from 1 to 55 days (the 25th to 75th percentiles were 14 to 21 days). Interpretation of the clinical impact of this delay was not within the scope of the data collection. It may be that the CT scan was not critical to patient management however from the patients’ viewpoints such a delay is likely to be of concern.

The delay in performing a CT scan on inpatients or other hospital patients may have greater significance. The delay ranged from 1 to 21

days (the 25th to 75th percentiles). Again any assessment of the clinical significance of such delays was not part of this project. It would however be reasonable to assume that any delay in diagnosis would potentially increase the length of stay for patients. Within this category were inpatients from other hospitals and facilities. Transporting these patients would put a considerable demand and expense on community resources. Being able to perform the CT on the same day would eliminate these pressures.

Peter MacCallum Cancer Centre

Equipment:

- GE Discovery LS PET System with 4 slice Lightspeed CT scanner – purchased 2002
- GE STE PET-CT, 3D BGO PET scanner with 8 slice helical CT scanner – purchased 2006
- Siemens 64/40 PET-CT scanner, 3D LSO PET scanner with 64 slice CT – purchased 2008

The data from the Peter MacCallum Cancer Centre was of a different nature due to the specialised patient population of the hospital. This data is based on 289 consecutive patients over 17 days.

	Number of Patients	Percentage	Mean Difference	25 th -75 th percentile
Total Patients	289	100%		
Co-requested Diagnostic CT	76	26%		
Same day as PET	30	10%	3.37 hours	2 - 4.25 hours
Separate day to PET	46	16%	4.5 days	1 - 7 days

Scenario 1. Of the 289 patients who attended for PET scans, 76 patients were requested by their managing medical specialist to have a diagnostic CT scan prior to their next appointment. Therefore in ~25% of PET scans performed, diagnostic CT scans were requested simultaneously. Of the 76 patients requiring a diagnostic CT scan, 30 were able to have the scan on the same day. The average wait was 3.37 hours with a range of 2 to 4.25 hours (25th to 75th percentiles).

Scenario 2. For 46 patients, the PET and CT were performed on different days. Those patients were required to return on a second day for either the PET or the CT scan, the average difference between the two appointments was 4.5 days with a range of 1 to 7 days (the 25th to 75th percentiles). These patients were required to attend a second hospital visit with associated travel, and for a significant number of patients delays of up to 7 days were experienced due to separation of modalities.

Cancer diagnosis and treatment is very dependent on the use of diagnostic imaging investigations especially PET and CT scanning. At a specialist cancer centre the waiting time for scans needs to be kept to a minimum because the consequences of delay are significant.

Benchmarking of waiting times to treatment for various cancers has been formulated recently and key performance indicators are routinely used to monitor the performance of health facilities. This is occurring in many of the cancers where PET plays a pivotal role in the staging process for radical treatment. Peter MacCallum, as part of the Western and Central Melbourne Integrated Cancer Service (WCMICS), participates in evaluations of waiting times for many of its patient cohorts. The importance of timely results from diagnostic imaging (particularly PET and CT) is critical to the rapid delivery of treatment, which conclusively improves outcomes.

Initially it was proposed that two groups of patients would be selected to have diagnostic CT scans performed at the time of their PET scan. These were:

1. Sarcoma patients undergoing staging and restaging PET-CT scans, where the referring specialist routinely refers patients for a diagnostic CT of the chest.
2. Head and neck cancer patients undergoing staging PET-CT scans in the treatment position for radiotherapy planning (RTP). Stand alone CT with intravenous contrast for radiotherapy planning is routine standard of care. The use of intravenous contrast needed to be introduced as part of the hybrid PET-CT protocol.

Combined PET and CT protocols were developed for both cohorts. Workflows were also developed which would facilitate availability of images on the Picture Archiving Communication System (PACS) and reports on the Radiology Information System (RIS) for each of the modalities separately or combined as fused information. It was originally hoped to recruit approximately 20 patients into each project, however as a result of slower than anticipated change in referral practice these changes only occurred quite late, and insufficient numbers were ultimately scanned using the combined protocols. This was, in part, a reflection of the difficulty in changing the referral practices of a group that follow a standard of care determined by consensus. It is easier to affect change in the practices of individual referrers.

However a large amount of procedural information was obtained, and importantly there was no practical impediment to achieving hybrid imaging protocols including diagnostic CT.

In summary, the initial data collection from the two hospitals would suggest that there is the potential for considerable improvement in the patient journey through medical imaging by nuclear medicine technologists performing both scans. These improvements would require institute specific changes to fully capitalise on this technology. This would need to be considered in the planning stages if this project is rolled out to the general nuclear medicine community.

Project Evaluation

Evaluation was undertaken of the following aspects of this project:

- The physics component of the course materials – materials were reviewed by a medical physicist resulting in several minor amendments to module content.
- Data analysis – all data collected in this project was analysed by a medical statistician (results discussed earlier in this report).
- The educational package.

Evaluation of the educational package delivered during the pilot

An evaluation of the pilot educational package was commissioned by the VSNMT. It was conducted by Associate Professor Rosalind Hurworth, Director, Centre for Program Evaluation, The University of Melbourne. This evaluation is included as an attachment to this report.

All nuclear medicine technologists who completed the pilot program were asked to participate in a focus group to assess the educational package and to identify improvements that could be made to the content or delivery. Interviews were conducted with key stakeholders (CT supervisors overseeing the clinical educational package and key medical imaging specialists at the two main training sites). In addition, the evaluation also included canvassing the views of a key figure in the clinical field who is both a steering committee member and dual qualified imaging specialist. It was also decided to interview the academic responsible for putting the educational package together.

On-line mode of delivery

The academic modules were delivered on-line. The candidates who participated in the pilot program were of the view that this mode of delivery was by and large effective. They felt the on-line delivery would allow nuclear medicine technologists to undertake the program wherever they are working. The candidates also saw an advantage in being able to study when it was convenient for them.

There were some concerns with the delivery of the pilot. The candidates felt there were problems in communicating with support staff allocated to the on-line program. They commented that they were not clear who they should contact if they experienced difficulties. They noted that some of the information that should have been available was missing or inaccessible, and the candidates were of the view that the discussion board did not function as they expected.

The evaluation also suggested that the candidates did not understand how on-line material was delivered. Only one candidate had experienced on-line learning previously.

The candidates were unclear whether questions were to be addressed to the CT clinical supervisor or the on-line course supervisor.

Length of the course

The candidates thought the length of the course was appropriate. They did comment that, for the pilot, the time to prepare to undertake the course was insufficient. There were also delays in commissioning the website which added to dissatisfaction.

Content

Most candidates thought the content was logical, the syllabus appropriate, and the information provided correct. They did comment about the currency and accuracy of some of the material. They commented that the information was taken from an undergraduate course and was dated, and that the equipment discussed in the course material has been superseded. Other comments included a perception that the material was pitched at undergraduate levels, the content pertained purely to radiographic CT not the hybrid CT, there were typographical errors, and some of the answers to exam questions were thought to be incorrect.

Timeliness of the provision of information

The timeliness of the provision of information was raised during discussions. It was felt that workflow was disrupted because the assessment expectations did not line up with course content. Often candidates were undertaking clinical examinations before they had received the underpinning theoretical material.

Workbook

As mentioned previously, each candidate was given a clinical workbook to record details of cases that had been completed during their clinical placement. Views about the workbook were mixed. One supervisor thought it was standard for most undergraduate programs and was easy to use. Another thought it contained out of date and irrelevant material. There was a common belief that there was too much repetition and that completing the entries required too much time for candidates and more particularly supervisors.

As a result many suggested the workbook be modified. Nevertheless, even with these concerns the candidates thought the workbook was required.

Competency

The consensus view was that candidates were thought to be competent upon the completion of the program. The common opinion, expressed in the evaluation, was that they could perform routine CT competently and without direct supervision. However it was recommended they have access to senior CT radiographers and radiologists, and should undertake continuing education. This scenario was thought to be similar to a normal radiographer.

General comments about the program

All those interviewed thought the course is a worthwhile project which will impact positively on patient care. There was support for the "hands-on" nature of the program. The candidates were given every opportunity to interact with senior CT radiographers and learn from the leading experts in the field. They felt participating in the program had added to their skill set and provided a valuable educational experience.

Suggested improvements to the program

There were difficulties with the delivery of the program which need to be addressed: the accuracy of some of the material needs to be reviewed; the roles of clinical supervisor and academic supervisor need to be more clearly defined; the clinical placement needs to be organised with more attention to delivering the desired outcomes; and the workbook needs to be reviewed.

General issues raised during the evaluation

- Some of the people canvassed in the evaluation had concerns that the number of hybrid machines would not be enough to warrant the program. They believe PET-CT will have a limited number of sites due to the costs associated with setting up a PET facility. The VSNMT is of the view that PET will expand and in future all PET will be performed on PET-CT hybrid systems. This view is supported by overseas data.

With regard to SPECT-CT, the VSNMT has obtained data from one of the world's largest equipment manufacturers that suggest SPECT-CT will experience steady growth over the next five years. In the last 12 months, 48% of SPECT systems

sold had diagnostic CT capabilities. The impact on patient care will ensure this technology is deployed.

- The change to work practices within departments was raised as an issue. This is addressed elsewhere in this report, particularly in the assessment of the patient journey at the Peter MacCallum Cancer Centre. Each facility has its own unique patient load and work practices, and as a result there will not be one model of care that fits all. This will be a matter for each facility.
- Those canvassed thought there might be resistance from the radiography community to the change in role of nuclear medicine technologists. Evaluation of the pilot project suggested that this concern was unfounded. In most departments, as in those that participated in the pilot, radiographers and nuclear medicine technologists have an excellent professional relationship. In the sites involved, this relationship was in fact strengthened during the pilot. A better understanding of what each group does has a positive impact on patient care.
- The issue of ongoing maintenance of competence was identified by almost all of those involved in the evaluation process.
- There were some concerns expressed that nuclear medicine technologists who completed this program could be exploited in the work place. Specifically they could be asked to perform "stand alone" diagnostic CT. The VSNMT would be strongly opposed to this practice. This program is very specific, showing that CT could be done by nuclear medicine technologists but only in the hybrid imaging environment. The VSNMT would be asking the Medical Radiation Practice Board of Victoria to reinforce this stance and register nuclear medicine technologists to perform CT only on hybrid machines.
- Concern was also expressed that the employment opportunities for graduates of this program would be limited. The VSNMT is of the view that the demand for this program will be steady. This is another aspect of the roll out of this technology and is similar to the first point in this section.

Implications for service delivery within medical imaging

- There was strong agreement that patients would significantly benefit from this role change. Several of those interviewed commented that to combine the two studies would save time and reduce the number of attendances in medical imaging. This was predicted at the start of the project, and data has been collected on this issue and discussed elsewhere in this report.
- Some suggested that there could be a reduction in radiation dose as a result of this project. The VSNMT does not share this view. There are certainly some scenarios where it may prove to be true, but there is no evidence to support a broad statement suggesting it would occur universally.
- Hospital policies in relation to credentialing and scope of practice would need to be addressed. This was mentioned by several people interviewed in the evaluation. The VSNMT has investigated this and expects that if the Medical Radiation Practice Board of Victoria registers nuclear medicine technologists to perform CT, there will be no governance issues. The performance of CT is ultimately the responsibility of the radiologist and this supervision would be an essential requirement for practice. As stated elsewhere in this report, the CT must be performed under the supervision of a radiologist.

- The evaluation highlighted how the introduction of this technology requires a change to current referral practices to maximise the benefit to patients. This change would need to be introduced after consultation with referring clinicians. The VSNMT believes this can be accomplished but will take time. One of those interviewed for the evaluation recounted how the referral for one study was changed from a nuclear medicine study to a SPECT-CT, with the referrer specifically asking for SPECT-CT on the request.

Project Impacts

The project was limited to two sites. However, even from the limited data collected it was apparent that the changing work practices enabled by this project produced significant improvements in the patient journey. Coupled with this, the project identified the probability that, if rolled out, it could reduce the number of medical imaging attendances required of these patients.

Several patients studied at Monash Medical Centre were from smaller hospitals or specialist care facilities. The impact of having the number of attendances reduced would produce significant savings in staffing resources and the costs involved in transporting patients.

The reduction in the time to diagnosis should produce a saving in outpatient attendances. In the traditional patient journey the CT would be recommended in the nuclear medicine report. The patient would attend the next outpatient appointment where the clinician would request the CT. An appointment for the CT would be made and the patient would attend at a later date for the test. The impact of the project would be to have the CT performed immediately the need for it was recognised. The time saved adopting this workflow is substantial.

As demonstrated at the Peter MacCallum Cancer Centre, hybrid imaging will evolve and new protocols will be developed that enhance both PET and CT studies. This is already happening overseas, and having nuclear medicine technologists trained to operate hybrid systems will facilitate this in Victoria.

The project clearly saved time for staff in nuclear medicine and eliminated the need for a radiographer to attend the hybrid test. The average saving in time is a real efficiency gain for both groups and again impacts on patient waiting times.

As discussed earlier, the cost savings resulting from this change in work practices have not been fully explored. The project suggested that when rolled out such savings could be significant for medical imaging departments. The impact on patients could also have a cost benefit. Patients in full-time employment have to take time off work to attend for these tests. Many patients are accompanied by relatives or friends who have also taken time off work. This has not been quantified in this project but the cost savings appear to be evident.

The original project plan included the possibility of assessing image quality. This was discussed at several steering committee meetings. It was decided, principally by the medical specialists, that such an audit would be too difficult within the timeframes and budget of this project, and that such an audit undertaken without a full understanding of the circumstances of each scan was extremely subjective. The consensus was that if the quality of CT was compromised the radiologists would immediately address this issue. This matter was considered in the evaluation by Associate Professor Hurworth. The view was that the quality of CT was unchanged. This is not unexpected as the scans were performed under supervision. The quality of studies is a product of competency and the four candidates were all said to be competent. The CT supervisors thought that, once

credentialed, nuclear medicine technologists would benefit from having access to the CT radiographer to monitor quality.

Current Project Status

The results of this project indicate that an expansion of the traditional role of nuclear medicine technologists can be delivered by this educational package. The combination of on-line learning and clinical experience can prepare nuclear medicine technologists to competently perform diagnostic CT within the hybrid imaging environment. Changes to procedures where some CT is performed by nuclear medicine technologists will be of benefit to both the nuclear medicine technologists and radiographers.

The evaluation highlighted that some aspects of the delivery of the educational package could be improved. Some were process issues which, while frustrating for the candidates, have been addressed. The development of the website proved more difficult and time consuming than expected and continued into the period the pilot was being run. All the material is now on the website and can be accessed easily. Candidates felt the program was "very good now the website is finally complete". Issues raised around the functionality of the discussion board have also been addressed.

The evaluation sought feedback on the duration of the clinical placement. It is interesting that some thought it was too short while others thought it could be provided in a shorter period, i.e. two weeks. The VSNMT believes three weeks is appropriate but acknowledges that students progress at different rates and as a result some mechanism to extend the placement should be available if required. The VSNMT will take advice on this matter.

Other issues raised that need to be addressed:

- The VSNMT takes on board the comments in relation to the student-staff communication. When this program is more generally available the VSNMT will ensure qualified experts will be available on-line to answer any queries the students may have. There will be performance criteria regarding response time and a process to escalate issues. The students will also have clear lines of communication. The course coordinator will be the first point of call and all matters will go through him/her.
- It appeared from the evaluation that the candidates were not clear about how on-line education is delivered. While information about how the material is delivered is well covered in the course outline document, some additional explanation is also needed.
- The discussion board was not utilised in the way the steering committee expected. Some candidates did not wish to use it and some were unsure how it operates. The provision of information on the use of the discussion board will need to be considered.

Aspects of the educational package which require comment in light of the evaluation:

- It is not possible to devise an educational package that remains current in a rapidly changing environment like medical imaging. The advances in CT equipment occur so quickly that it is impossible to include detailed material on state of the art equipment. This is recognised as a limitation.

The material must contain the fundamental principles which are in the educational package used in this pilot. The expectation is that the students would be exposed to the latest equipment and techniques within the clinical setting.

Having read the comments made during the evaluation, the VSNMT accepts that all educational material will need to be reviewed regularly and reflect current practice. For the pilot program, the VSNMT felt it was essential the academic program contained the same CT material as the radiography course. In addition, the steering committee wanted to develop a program that contained the academic rigour of a university program.

- The course content drew comment in the evaluation. It was felt that the material was pitched at undergraduate level. The material is taken primarily from the Monash radiography undergraduate program but includes some material from the postgraduate programs. Again this is a result of the requirement placed on the university by the VSNMT that the candidates undertake the same program as radiographers.
- The workbook was also the subject of some comment. The students and CT supervisors thought the workbook could be improved. The VSNMT will review the content of the workbook and ensure it achieves the desired aims. In particular repetition in recording information will be assessed, as will the need to document so much information. Revision of the workbook will be done in consultation with academic experts.

A significant aspect to come out of the evaluation was the need for continuing education for those nuclear medicine technologists completing the program and performing CT. The VSNMT will need to ensure this is provided, and discussions have commenced with various groups to provide ongoing education. In addition, the VSNMT will expand its website to include material specific to CT. To this end, discussions have commenced with equipment manufacturers to enlist their support in providing material. The VSNMT will also enlist the support of CT radiographers to provide material. This is regarded as a critical component to the roll out of this program and the VSNMT will ensure this matter is addressed.

Coupled with the requirement to maintain skills is the necessity to perform new studies. The VSNMT expects that the range of studies will expand as the technology rolls out and this will require ongoing training. This scenario already occurs in nuclear medicine. Nuclear medicine technologists are constantly updating their skills as new studies are introduced, and CT can be incorporated into this process.

The potential benefits to patients could be substantial if changing referral practices could be introduced. The VSNMT expects that changes in workflow as a result of this new role will have a positive impact on the delivery of patient services, and in a combined modality setting improve patient outcomes.

The steering committee expressed concerns that a small number of radiographers may see this change as a potential threat. In the evaluation of the project this concern was put to those interviewed. The consensus view was that after the project was fully explained and people understood the roles of the different health professionals, there was general acceptance of the program. In fact some commented that it helped to build relationships.

The ability to undertake this educational package needs to be broadened to all nuclear medicine technologists. There is considerable interest in this project within the profession with many nuclear medicine technologists expressing a desire to undertake the program. The prior learning required to enter the program needs to be considered. Nuclear medicine technologists who completed their undergraduate training before CT

was introduced to the RMIT curriculum would be required to undertake some type of bridging course before commencing the program. Defining the required prior learning would be a task for the VSNMT in consultation with academics from the profession. In the initial stages, entry to the program would be confined to nuclear medicine technologists with recent qualifications.

The pilot program as outlined in the funding submission has been completed. Due to the regulatory requirements for registration, nuclear medicine technologists are not currently registered to perform diagnostic CT. The VSNMT plans to approach the Medical Radiation Practice Board of Victoria with a proposal to register nuclear medicine technologists on the basis of competency and parity with radiographer training. In addition, the VSNMT intends to advise the Radiation Advisory Committee of this change to traditional roles. It is important that the Radiation Safety Section of the Victorian government is aware and comfortable with these changes.

The clinical rotation to CT was more difficult to organise than originally expected. The demand for CT training is high for both undergraduate students and Professional Development Year graduates for both radiographers and nuclear medicine technologists. Students undertaking the program in the future would be required to submit to the VSNMT a plan for their clinical training. The VSNMT would need to be assured the clinical placement was finalised and supervision was in place. The aims of the program would need to be understood and agreed to by the CT clinical supervisor at the site.

The CT rotation appeared to be well received within the radiography groups at two of the placements. Some difficulties were experienced at the remaining placement. This was in part due to a lack of understanding about the aims of the project and particular issues associated with that organisation. This situation could occur elsewhere if the program were to be rolled out, however a greater emphasis on informing staff should minimise these issues. It is important to stress the low impact this change in role would have on the traditional radiographer role in CT.

One of the strengths of the project was the ability of the four nuclear medicine technologists to absorb the CT material. The VSNMT hoped that their undergraduate studies would give a sound theoretical basis for the program. This proved to be correct with the candidates coping well with the demanding theoretical component of the educational package.

The project appeared to be accepted within organisations where the two professional groups were already fully integrated. Nuclear medicine and radiology services have been integrated to a greater or lesser extent in most facilities over the last 10 years. This is true in both the public system and corporate practices. In addition, the professional relationship between radiographers and nuclear medicine technologists is close as a result of the undergraduate program. It is difficult to imagine that, given the relationships, this improvement to patient care will meet significant prolonged resistance.

The data collected indicated that the effect on the patient journey was positive. One attendance for patients who require both tests is a significant improvement. Performing a CT scan on patients as a result of the molecular imaging SPECT or PET scan also saves considerable time and resources. These changes could be introduced immediately (subject to registration). The challenge is to identify and utilise all of the improvements this change in traditional roles could deliver. The potential improvements associated with significantly altering hospital-wide referral practices are worth exploring. This would require a long-term strategy for change and the involvement of the quality departments from each organisation wishing to capitalise on the redesign of referrals.

Performing diagnostic CT on hybrid systems will have implications for how results are generated. In integrated departments with dual qualified medical staff, the CT and molecular imaging test will be easily assimilated into the reporting process, with both tests being reported by the one medical specialist. In organisations where the two modalities, CT and SPECT-PET, are separated, the reporting process will require change. In the USA, the Society of Nuclear Medicine has published a *Procedure Guideline for SPECT-CT 1.0*. The guideline addresses the reporting of CT by nuclear medicine physicians. A collaborative working group of physicians and radiologists recommended a specific training program.

In Australia, physician reporting of CT is being addressed by the Australian and New Zealand Association of Physicians in Nuclear Medicine (ANZAPNM) and the Royal Australian and New Zealand College of Radiologists (RANZCR). The VSNMT has no view on how the reporting of the CT studies produced by nuclear medicine technologists should be performed.

An important issue highlighted when evaluating the project is how the competencies attained by nuclear medicine technologists undertaking the program would be maintained. Nuclear medicine technologists who complete the program and perform diagnostic CT should ideally be mentored by senior CT radiographers. In addition, as new technologies and techniques are introduced, nuclear medicine technologists will need to have contact with the CT community and be included in the roll-out of the latest advances. Patients will be best served by diagnostic CT scans being easily integrated into routine practice and systems. This should occur routinely. As with all CT, supervision of practice must be provided by a radiologist.

In order to maximise the benefit to patients a change in culture will be required. First, in individual organisations, the relationships within medical imaging will need to be further enhanced. This will require effort on the part of senior members of both the radiography and nuclear medicine technologist staff to enhance working relationships and maximise the benefits to patients.

Secondly, the professional groups representing the two professions will need to work together to ensure the benefits to patients are maximised as this equipment is deployed. It may mean nuclear medicine technologists who have completed this program join the Victorian CT users group. The VSNMT is eager to ensure continuing education in CT becomes an integral part of performing CT in the hybrid environment.

The VSNMT has had several professional forums where this project has been discussed. There are some nuclear medicine technologists who query why any additional training is required. As a radiographer completing the Professional Development Year can perform CT without further training, they argue that, given the same undergraduate program and the Professional Development Year, further training is unnecessary.

The VSNMT has promoted the view that additional training is required, and that in most CT facilities a junior radiographer would be expected to undertake additional clinical training before working unsupervised or performing on-call. This educational and clinical program is essential for nuclear medicine technologists to perform safe, competent CT studies.

Some in the nuclear medicine technologist community have expressed concerns that if individuals complete this program, the qualification will become an essential requirement for employment. The VSNMT does not share this view; the program has been designed because there is a need for these skills in some workplaces.

The VSNMT will need to communicate its philosophy regarding CT to the general nuclear medicine community. The course that has been developed will be available for those who

wish to add this skill to their scope of practice. Undertaking the program will be completely voluntary. In addition the VSNMT does not set out to prescribe how individual practices should use CT in their specific environment. This is a decision for the medical staff and the organisation.

Possible Barriers to Implementing Change

- The profession will need to ensure educational institutions are part of any enhancement of the CT program. Undergraduate education is critical in providing the foundation for advanced roles within the workplace.
- The importance of maintaining currency in CT for nuclear medicine technologists who complete the program is essential and may present a challenge. The VSNMT will need to investigate ways of obtaining continuing education for these nuclear medicine technologists.
- As part of rolling out this change in work practices, nuclear medicine technologists will need to have access to a senior CT radiographer. This radiographer would act as a mentor and ensure the nuclear medicine technologists had access to advanced expertise. Similarly, access to a medical physicist would support the nuclear medicine technologist in ensuring any variance in QC results was investigated and addressed.
- The VSNMT will need to provide a way for all interested nuclear medicine technologists to access this program. This includes those who completed their undergraduate studies before it included CT. This will require the establishment of a bridging course to prepare nuclear medicine technologists to undertake the program.
- The culture of some medical imaging departments may need to be addressed. This can be done by champions within both professional groups encouraging staff to embrace change and view this as a major benefit to patients.
- The attitude of the specialist medical staff in some institutions could be a barrier to introducing change. Some in the radiology community could see this as a threat to their traditional role as the administrator of CT within institutions. There may be some nuclear medicine physicians who do not want to perform diagnostic CT with their hybrid systems but feel they are having change forced upon them by this development. The VSNMT is of the view that nuclear medicine technologists should have the opportunity to undertake this program. How people who possess these skills are used is an issue for each employer.
- The VSNMT will need to establish stronger links with equipment manufacturers. It will be important to be aware of new developments in technology in order to assure trained nuclear medicine technologists are available to implement improved procedures.
- It will be important to ensure nuclear medicine technologists with these skills are not exploited in the workplace. The VSNMT does not support nuclear medicine technologists performing CT outside the specific environment of hybrid systems. It will be important the Medical Radiation Practice Board of Victoria specifies these limitations if it agrees to register nuclear medicine technologists to perform CT.
- CT currently performed for anatomical correlation or attenuation correction attracts an additional rebate on Medicare. If a standard diagnostic CT is

performed as part of a hybrid study the full rebate for CT can be claimed. Reimbursement would depend on satisfying the referral and supervision requirements associated with routine CT practice. The economics of the changes to work practices may be a barrier to change for some physician-based practices.

- An issue highlighted by the project was how radiology information systems accommodated the changes required to manage hybrid imaging tests. While this seems a trivial problem, the difficulties associated with trying to incorporate separate modalities into the one episode have implications. This will need to be discussed with technical support staff from the relevant companies.

Current and Future Developments

- As discussed earlier, a bridging course will need to be developed for nuclear medicine technologists who graduated prior to CT being included in their course. The VSNMT has already had preliminary discussions with organisations and educational institutions with a view to introducing such a course. Further discussions can proceed if the project is rolled out to the nuclear medicine community.
- As a result of this pilot, many of the current PET-CT and SPECT-CT protocols will need to be changed. In PET-CT, integrated protocols will be developed that differ from existing PET and CT protocols. Some PET-CT studies will be performed in a way that enhances assessment of radiotherapy treatments. Patient positioning for hybrid imaging will evolve from traditional PET and CT. In hybrid SPECT-CT, if a CT is required the protocol may be modified to examine a small area of interest rather than a traditional protocol that examines a larger area. The CT may be performed with modifications to technique which lowers the patient radiation dose but still delivers full diagnostic information. The pilot has suggested these developments are possible.
- Integrated hybrid imaging is still evolving and the effect on the reporting process is the subject of much research. Initial reports in the literature suggest that performing hybrid studies produce more diagnostic information than CT and molecular imaging study alone.
- A review of the literature suggests that there are few limitations associated with hybrid CT in comparison to conventional CT. There are some reports in the literature specifically relating to cardiac imaging being more difficult on hybrid CT, however no definitive view has been reached. The use of hybrid technology in the way that is being proposed is new and some limitations may eventuate in the future.

Summary

- The pilot fulfilled the stated objectives of the project.
- The pilot program was successful in that it was able to deliver an educational package that equipped nuclear medicine technologists to perform CT studies in the hybrid environment.
- The pilot program produced nuclear medicine technologists who were considered competent to perform CT.
- The pilot measured improvements to the patient journey and offered the potential for further gains.

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Attachments:

Educational package on CD

Hard copy of the Course Guide for Candidates

Project evaluation report

Final audited accounts + tax invoice for balance of funds – to be submitted as soon as available