E Pluribus Unum
out of many, one

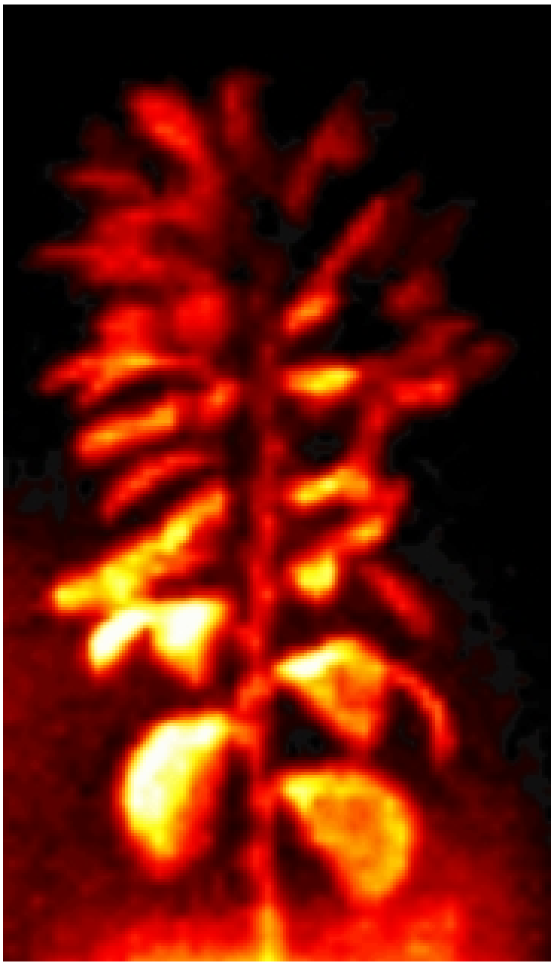
seasonal rains

RURAL ALLIANCE IN NUCLEAR SCINTIGRAPHY

Volume 1, Number 2

SPRING EDITION 2007

99mTc DTPA



NEWS

CPD

INFORMATION

The official quarterly newsletter of the Rural Alliance In Nuclear Scintigraphy

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Introduction

The Australian health care system has been described or defined by the ‘inverse care law’; those Australians in the most need of health services receive the least. This might equally reflect life for rural Nuclear Medicine professionals; those with the greatest need for support and representation actually have the least. It is true that the rural Nuclear Medicine professional develops unique skills and capabilities not generally manifest in metropolitan counterparts; an evolutionary adaptation (‘survival of the fittest’). Despite these attributes, rural Nuclear Medicine professionals are confronted with professional isolation that fosters a number of inequities:

- Professional representation at state and federal level.
- Accreditation and continuing professional development (CPD).
- Diffusion of innovation, technology and techniques.
- Support for training, leave (illness or recreation) and workload.
- Career development pathways.

RAINS aims to quench the thirst of rural Australia left parched by professional under representation.

RAINS Committee

President’s Report

Welcome to the second issue of Seasonal RAINS.

Welcome to the second issue of Seasonal RAINS and indeed I do hope your region enjoyed some rain throughout the winter period.

I'd like to take this opportunity to warmly welcome all of our new members. The committee has been quite stunned by the level of support from the profession. At last count our membership stands at ***51*** ordinary members and ***38*** associates which is great achievement in such a short time.

I invite you all participate in RAINS based CPD activities and offer review articles, interesting images or cases for inclusion in future newsletters. Whilst it can be a challenge to find extra time during the day, the effort is greatly appreciated and I expect you'll find the feedback from your colleagues and fellow members professionally rewarding and very worthwhile. RAINS aims to make life easier for rural practitioners to participate in CPD commitments and the more we put into this association the more we'll get out of it. Remember, at the end of the year RAINS will provide each member a RAINS CPD certificate listing all the activities and points accrued.

Finally, many thanks again to our hard working committee members. This association has a solid platform of talented people, each with strong focus towards strengthening the provision of nuclear medicine in the bush and their time is greatly valued.

Pete Tually

Visit our website:

http://rains.asn.au

Start Collecting Your CPD Points With RAINS Now!

Purpose of RAINS

The purpose of RAINS is to offer a support network for rural and remote Nuclear Medicine professionals. The support network aims to engage with and develop strategies to overcome the unique professional difficulties encountered in rural and remote Australia.

RAINS does not stand as an alternative to ANZSNM state branch membership, but as an adjunct to it.

RAINS offers a seamless representation of rural and remote Nuclear Medicine professionals. That is, RAINS is a single unified group of individuals with common needs and philosophy. There are neither state borders nor division between the private and public sectors nor delineation based on corporate ownership. RAINS does respect and honour commercial in-confidence and intellectual property rights.

Vision

Equitable provision of representation and professional opportunities for rural and remote Nuclear Medicine professionals. Strategic networking and support to foster professional development, continuing education and collaborative solutions to issues of isolation. Recognition and exploitation of distinctive competencies of rural practitioners.

Building A Future For Rural Nuclear Medicine

RAINS Core Values

- Innovate, adapt, overcome.
- Be committed, meet our commitments.
- Perform beyond industry norms.
- Invest in our work, invest in ourselves.
- Improve, continually. Embrace innovation, embrace challenge.
- Support CPD.
- Demand equity for rural Australia.
- Offer support, ask for support.
- Exploit strengths, overcome weaknesses.

RAINS Mission

- Provide a voice and representation
- Overcome barriers to CPD
- Promote equity of service provision
- Undertake research on rural issues
- Respect issues of commercial in-confidence BUT remove borders on core rural activities
- Highlight and exploit the distinctive competencies of the rural Nuclear Medicine professionals
- Provide a network for support and collaboration
- Integrate student clinical placements
- Lobby professional bodies on rural issues
- Promote Nuclear Medicine services in the rural health sector
- Inform and lobby, where appropriate, legislative and regulatory processes impacting on rural Nuclear Medicine

Membership

Membership to RAINS is open to those Nuclear Medicine professionals sharing the needs and philosophies characteristic of rural Australia; underpinned by "professional, social and cultural isolation". To that end, membership is open to those Nuclear Medicine professionals employed in a Nuclear Medicine practice that satisfies any one of the following criteria:

1. Practice located in a centre that the Federal Government Rural, Regional and Metropolitan Area (RRMA) classification deems either rural or remote.
2. Practice located in a centre that is more than 200 km from the state capital.
3. Practice located in a centre that is more than 100 km from nearest other nuclear medicine practice.

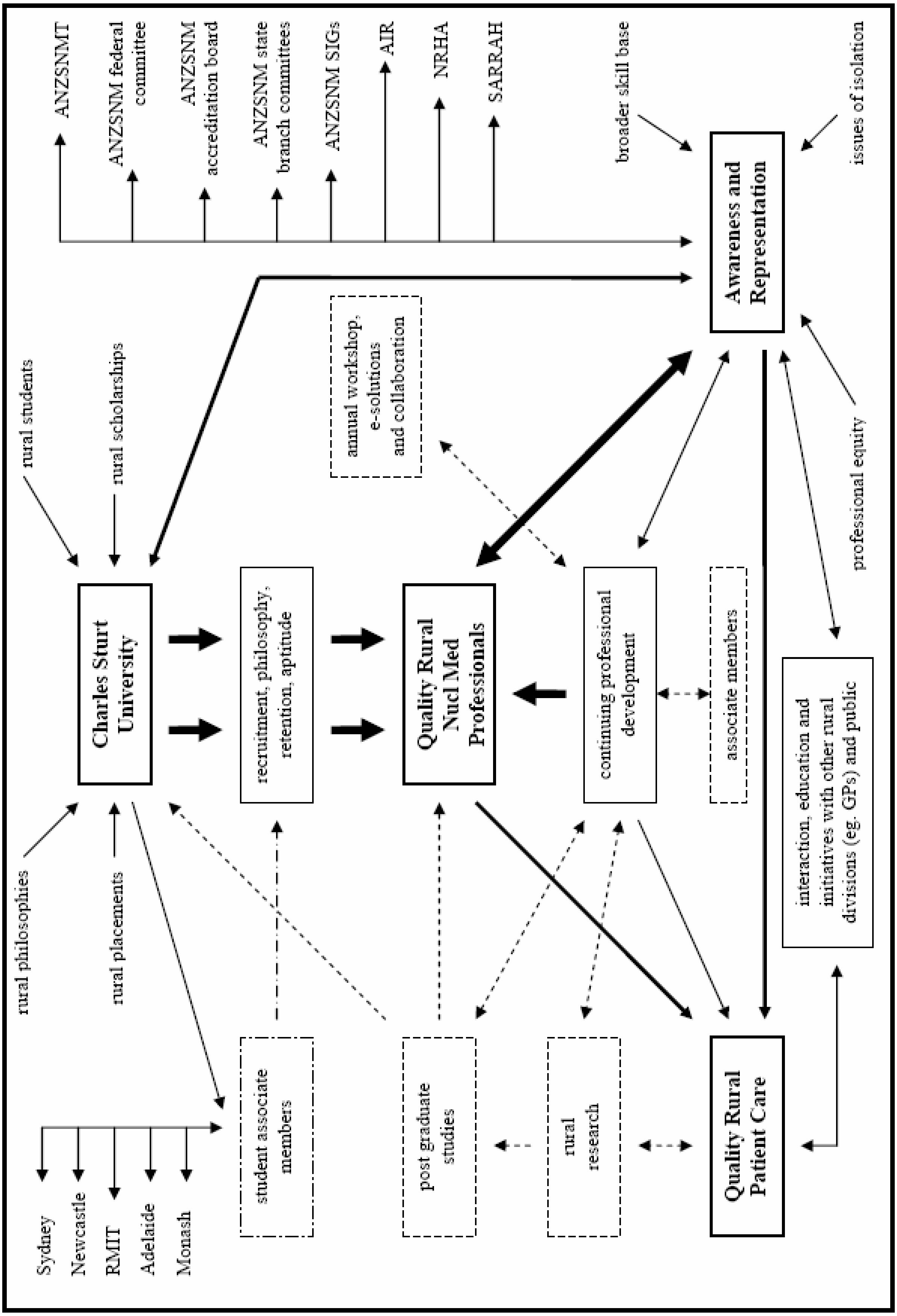
Associate membership to RAINS is open to:

1. Students not actively employed in Nuclear Medicine who are undertaking undergraduate or post graduate studies in Nuclear Medicine at any Australian university and who come from a RRMA classified rural or remote centre.
2. Nuclear Medicine professionals employed in a Nuclear Medicine centre that does not meet the criteria for ordinary membership but who believe issues of professional isolation have a deleterious impact on professional development. Examples of such isolation include, but are not limited to; academics, researchers, company representatives and regional isolation with a small Nuclear Medicine network (e.g. Newcastle, Central Coast, Gold Coast).

Membership entitlements include, but are not limited to:

- Newsletter (electronic)
- Networking (eg. research, problem solving, reduce professional isolation)
- CPD activities (e-journal club, e-grand rounds, conferences)
- Representation
- Support
- Full voting rights (ordinary members only)

Flow Chart of RAINS Activity

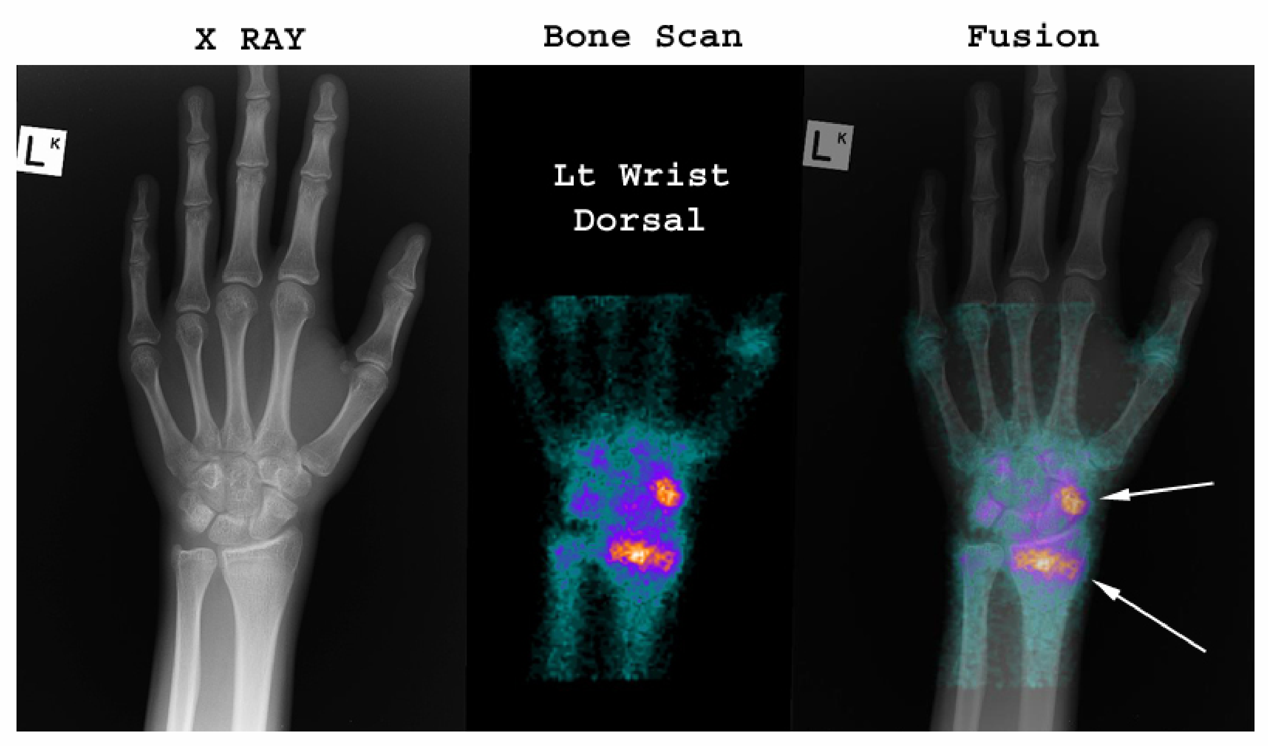


Interesting Image

Image Fusion of Planar Images to Xray

Geoff Currie[1], Russell Pearce[2] and Janelle Wheat[1]

[1] School of Biomedical Sciences, Charles Sturt University, Wagga Wagga.
[2] Gosford Nuclear Medicine, Gosford.



While the use of SPECT/CT and PET/CT image fusion has been well documented in the literature, the potential role of planar image fusion (e.g. planar scintigraphy and radiograph) is not well documented.

The planar image fusion was performed using Merge version 2.0, a fully functional freeware program readily downloadable over the internet.

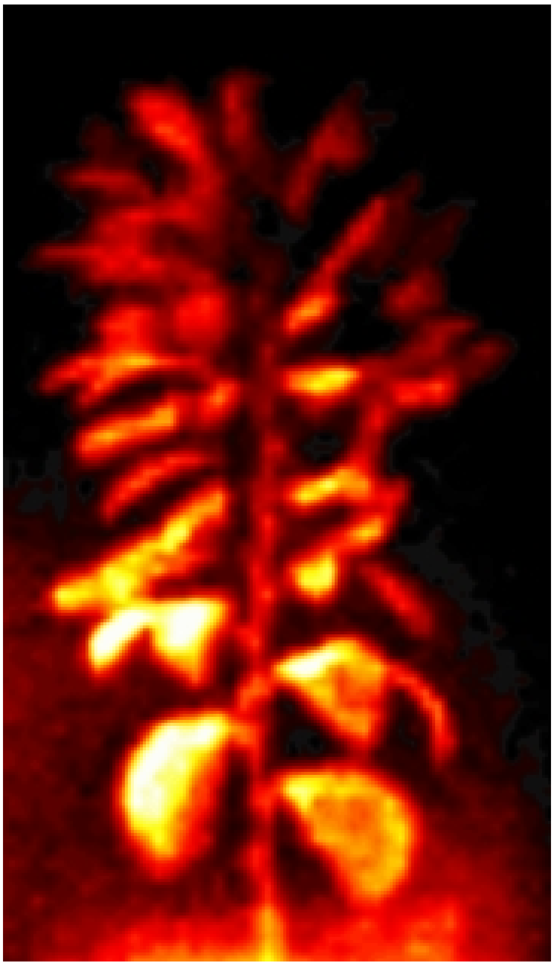
Merge 2.0 is a simple graphic utility designed to merge graphic images, including batch merging to a reference image. While these features were initially conceived for manipulation of graphics and watermarking images more easily, they readily lend themselves to merging planar scintigraphy with radiographs and applying an anatomic reference image to a dynamic scintigraphic data set.

Do you have an interesting image to share? Email the image and brief overview with author details to seasonal@rains.asn.au

What The ……. ?

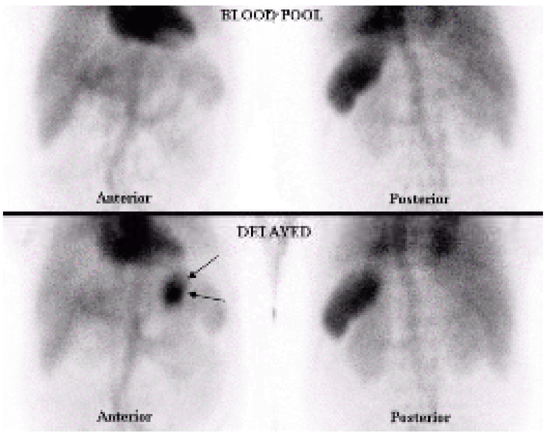
Geoff Currie, Charles Sturt University, Wagga Wagga.

The following images were taken with 99mTc DTPA. What are we looking at? Solution in the next issue.



Send your 'What The …… ?' image, solution and author details to seasonal@rains.asn.au

What The …..? Solution For Winter Edition



The planar images demonstrated a large anterior increased accumulation of activity left of midline on the delayed study in the presence of an unremarkable initial blood pool study. Diffuse stomach accumulation on ^{99m}Tc RBC scintigraphy would be most commonly associated with either free ^{99m}Tc pertechnetate or gastrointestinal haemorrhage. In this case, however, patient history revealed an episode of frank epistaxis (nose bleed) caused by trauma shortly before the delayed acquisitions. Clearly, the patient swallowed a large volume of blood.

Continuing Professional Development

Is stress only gated myocardial perfusion SPECT following normal stress scintigraphy findings a viable strategy.

Mitchell Holmes[1,2], Janelle Wheat[2] & Geoff Currie[2]

[1]Toowoomba Nuclear Imaging, Toowoomba.
[2]School of Biomedical Sciences, Charles Sturt University, Wagga Wagga.

ABSTRACT

In Australia, approximately 70000 myocardial perfusion SPECT studies are performed annually, costing in excess of $51 million.

Methodology: This study was a retrospective cost effectiveness analysis that examined the potential of eliminating the rest study when the initial gated stress study is normal in both perfusion and function. Decision tree analysis was performed to determine the cost effectiveness of this approach compared to rest and stress.

Results: 100% (174/174) of normal stress studies were associated with a normal rest study. Decision tree analysis demonstrated a potential saving of $3600000 annually without compromising patient management or outcomes.

Conclusion: Eliminating the rest image when the initial stress image is normal in both perfusion and function provides a positive cost benefit relationship without risking diagnostic integrity of the procedure. Additionally, eliminating the rest study reduces radiation exposure, reduces the time commitment of patients and potentially reduces waiting lists in busy department; increasing marginal profits.

INTRODUCTION

The rise in health care expenditure in Australia has seen the evolution of economic rationalism in health. While gated myocardial perfusion single photon emission computed tomography (SPECT) offers the benefit of both perfusion and functional assessment, it remains an expensive procedure. Cost effectiveness analysis is an analytical approach that integrates a tests economic value with its clinical effectiveness (*1*). The calculation of marginal or incremental cost effectiveness provides a rational means to balance health care quality and clinical value in terms of best outcomes at a reasonable cost (*1*). In this manner a cost effectiveness analysis relates the economic resources consumed in relation to the benefits attained (*1*).

Myocardial perfusion studies are the most commonly performed cardiac examination in clinical nuclear medicine practice. In Australia, approximately 70000 myocardial perfusion studies are performed annually (*2*).

Demonstration of normal perfusion and function in a stress study may eliminate the need for a corresponding rest study. Guerra et al. (*3*), Schroeder-Tanka et al. (*4*), Snapper et al. (*5*) and Worsley (*6*) have each investigated the use of stress only myocardial perfusion SPECT. None of these studies examined the potential economic benefits of this policy. Each demonstrated that a normal stress myocardial perfusion study corresponded to a normal rest study in 100% of patients (table 1) (*3-6*). This might be largely attributed to the use of ^{99m}Tc based radiopharmaceuticals where, in contrast to ^{201}Tl thallous chloride, reverse redistribution offers no diagnostic or prognostic value.

The aim of this investigation was to evaluate the cost effectiveness of routine use of a two day stress / rest myocardial perfusion protocol where the rest study is only performed when the stress study demonstrates either a perfusion or functional abnormality.

METHODOLOGY

Decision tree analysis was utilised to model direct costs and the potential risks of procedures for the two diagnostic strategies. All diagnostic strategies were based on the diagnostic algorithm depicted in figure 1. The decision tree analysis was based on a hypothetical population of 2000 subjects presenting for scintigraphic evaluation of coronary artery disease (CAD). Each diagnostic strategy evaluated 1000 randomly allocated patients with homogenous variables. All transition probabilities and outcome rates were derived from previously cited data (Table 2). Costs were estimated based on the Commonwealth Medicare Benefits Schedule (*2*).

Additionally, a decision tree analysis was performed on a hypothetical population of 1000 subjects presenting for scintigraphic evaluation of CAD using a stress-only strategy (figure 2). Variables were only acquired from data that included gated stress acquisition. Table 3 provides a summary of the key information utilised in the decision tree analysis and cost effectiveness analysis.

Table 1: Stress only versus stress/rest procedures in normal stress findings.

Study	Stress Only Normal	Stress-Rest Normal
Guerra et al. (*3*)	12	12
Snapper et al. (*5*)	22	22
Worsley et al. (*6*)	46	46
Schroeder-Tanka et al. (*4*)	94	94

Table 2: Summary of stress and rest data used on analysis.

Variable	Value
Mortality rate for normal study*	0.35% (*7,8*)
Mortality rate for abnormal study*	1.98% (*7,8*)
Myocardial Infarction rate for normal study*	0.63% (*7,8*)
Myocardial Infarction rate for abnormal study*	3.64% (*7,8*)
Normal stress	45.3% (*3-6,9-12*)
Abnormal stress	54.7% (*3-6,9-12*)
True Positive Stress	53.3% (*5*)
False Positive Stress	4.0% (*5*)
True Negative Stress	41.3% (*5*)
False Negative Stress	1.4% (*5*)
Normal Stress with abnormal rest	0% (*3-6*)
Normal Stress with normal rest	100% (*3-6*)
Abnormal Stress with normal rest	70.8% (*3-6*)
Abnormal Stress with abnormal rest	29.2% (*3-6*)
Coronary Angiography mortality rate	0.20% (*13*)
Coronary Angiography complication rate	2.42% (*13*)
Stress Only scintigraphy cost	$559.70 (*2*)
Rest and stress scintigraphy cost	$826.65 (*2*)
Coronary Angiography cost	$1,151.70 (*2*)

* within the first 12 months after diagnosis

Table 3: Summary of stress only data used for analysis (*3,5*).

Variable	Value
Significant Wall Motion & Wall Thickening	80.8%
No Significant Wall Motion & Wall Thickening	19.2%
Reversible defect with Significant Wall Motion and Wall Thickening	91%
Reversible defect with No Significant Wall Motion and Wall Thickening	9%
Fixed defect with Significant Wall Motion and Wall Thickening	25%
Fixed defect with No Significant Wall Motion and Wall Thickening	75%

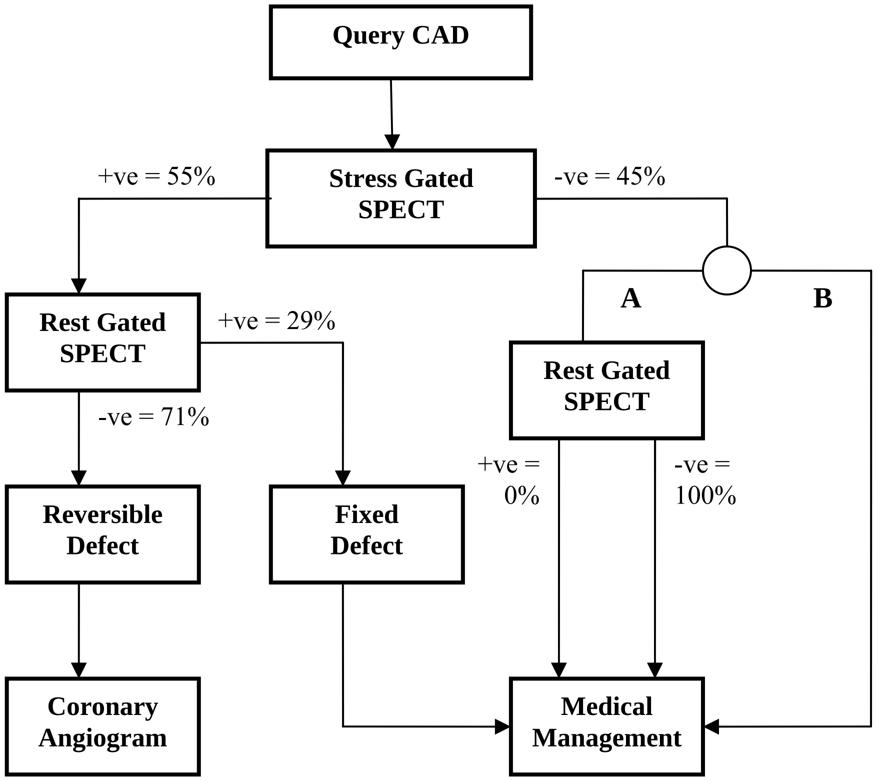


Figure 1: A composite diagnostic algorithm for rest and stress gated myocardial perfusion SPECT where A and B are defined as the alternative diagnostic strategies.

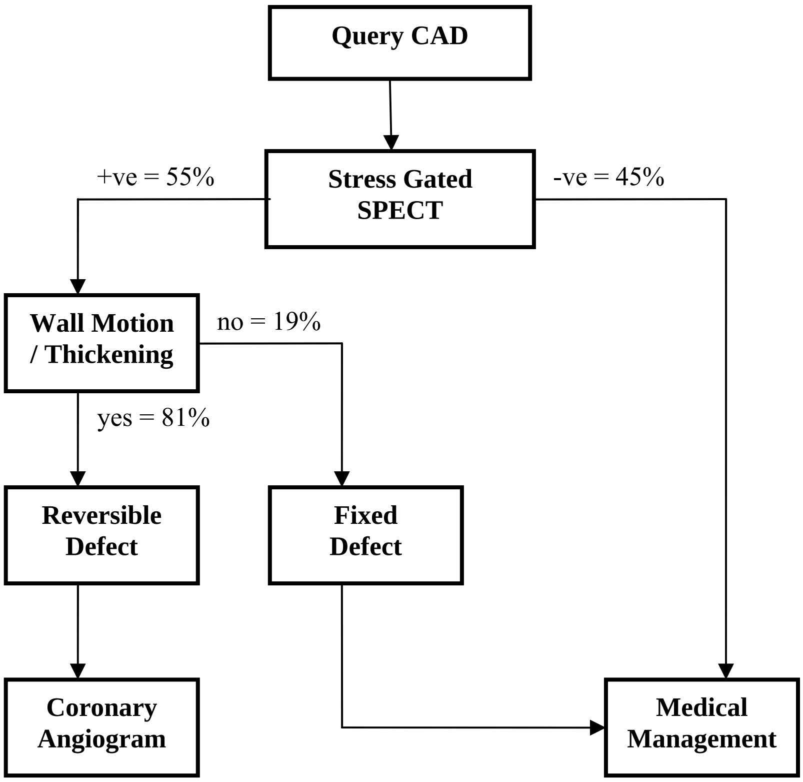


Figure 2: A composite diagnostic algorithm for stress only gated myocardial perfusion SPECT.

RESULTS

The decision tress analysis for the cohort where rest studies were only performed if the stress study was abnormal (figure 3) demonstrated a total of 12 deaths, 24 myocardial infarctions, 10 complications and a total cost of $1179889. Three deaths and six myocardial infarctions were associated with true positive (TP) studies presenting with a fixed defect. Eight deaths, 14 myocardial infarctions and three complications were attributed to TP studies demonstrating a reversible defect and who underwent coronary angiography. One death and three myocardial infarctions were associated with the true negative (TN) group.

Decision tree analysis for the 1000 patients evaluated with both rest and stress myocardial perfusion SPECT (figure 4) demonstrated a total of 12 deaths, 24 myocardial infarctions, 10 complications and a cost of $1294004. Eight deaths, 14 myocardial infarctions and nine complications were attributed to performing coronary angiography on TP studies with a reversible defect. A further three deaths and six myocardial infarctions were associated with TP studies with a fixed defect. The TN cohort was associated with one death and three myocardial infarctions. While no reduction in deaths or complications was noted, the total costs were higher for the rest and stress cohort. The addition of the rest acquisition in 54.7% of patients increased the overall cost by $114115 ($114 per patient).

Decision tree analysis of the 1000 patients representing the stress only myocardial perfusion cohort (figure 5) demonstrated a total of 14 deaths, 23 myocardial infarctions, 11 complications and a cost of $1076605. Ten deaths, 15 myocardial infarctions and nine complications were attributed to patients who underwent coronary angiography for TP studies with a reversible defect. Three further deaths and four myocardial infarctions were associated with a fixed defect from a TP study. An increase of one death was noted compared to traditional rest and stress imaging. The total reduction in cost was $217399 ($217 per patient), primarily due to the elimination of the rest study for all patients.

DISCUSSION

Significant myocardial wall motion and wall thickening in an area of decreased perfusion has been shown to indicate stress-induced ischaemia (*3,5*). Myocardial infarction is characterised by significantly reduced myocardial wall motion and wall thickening in an area of decreased perfusion (*3,5*). Stress-only imaging with gating, even in the presence of an abnormal stress study, has been proposed to eliminate the need for any resting studies (*3,5*). Stress-only imaging was shown to increase deaths by 0.1% each (7000 Australians per year) offset by a potential saving of $217 per patient ($15.1 million annually across Australia) compared to traditional rest and stress imaging.

Eliminating the rest study when the stress study is normal in both perfusion and function, however, produced a cost reduction ($114 per patient or $8 million annually across Australia) without increasing deaths or cardiac events. This strategy is also consistent with the principles of ‘as low as reasonably achievable’ (ALARA) with respect to both patient and staff dosimetry. There may also be a benefit to individual departments. The elimination of the rest study in a proportion of patient will allow higher throughput of myocardial perfusion patients; reducing waiting lists and potentially capturing additional patients lost to competition. In busy departments, this may indeed increase marginal profit because the stress component (minus the stress test component) attracts a $560 rebate and the rest component only $267.

CONCLUSION

Eliminating the myocardial perfusion rest study when the stress study is normal in both perfusion and function provides a cost effective approach to myocardial perfusion SPECT imaging. Patient outcomes are not adversely affected while significant health cost reductions might be produced. The extended benefits of appropriate elimination of the rest study includes reduced radiation exposure, reduced time commitment of the patient, reduced waiting lists and the potential to improve marginal profit. Patients demonstrating an abnormal gated stress study should be further evaluated at rest. A two day stress / rest protocol provides an optimal approach.

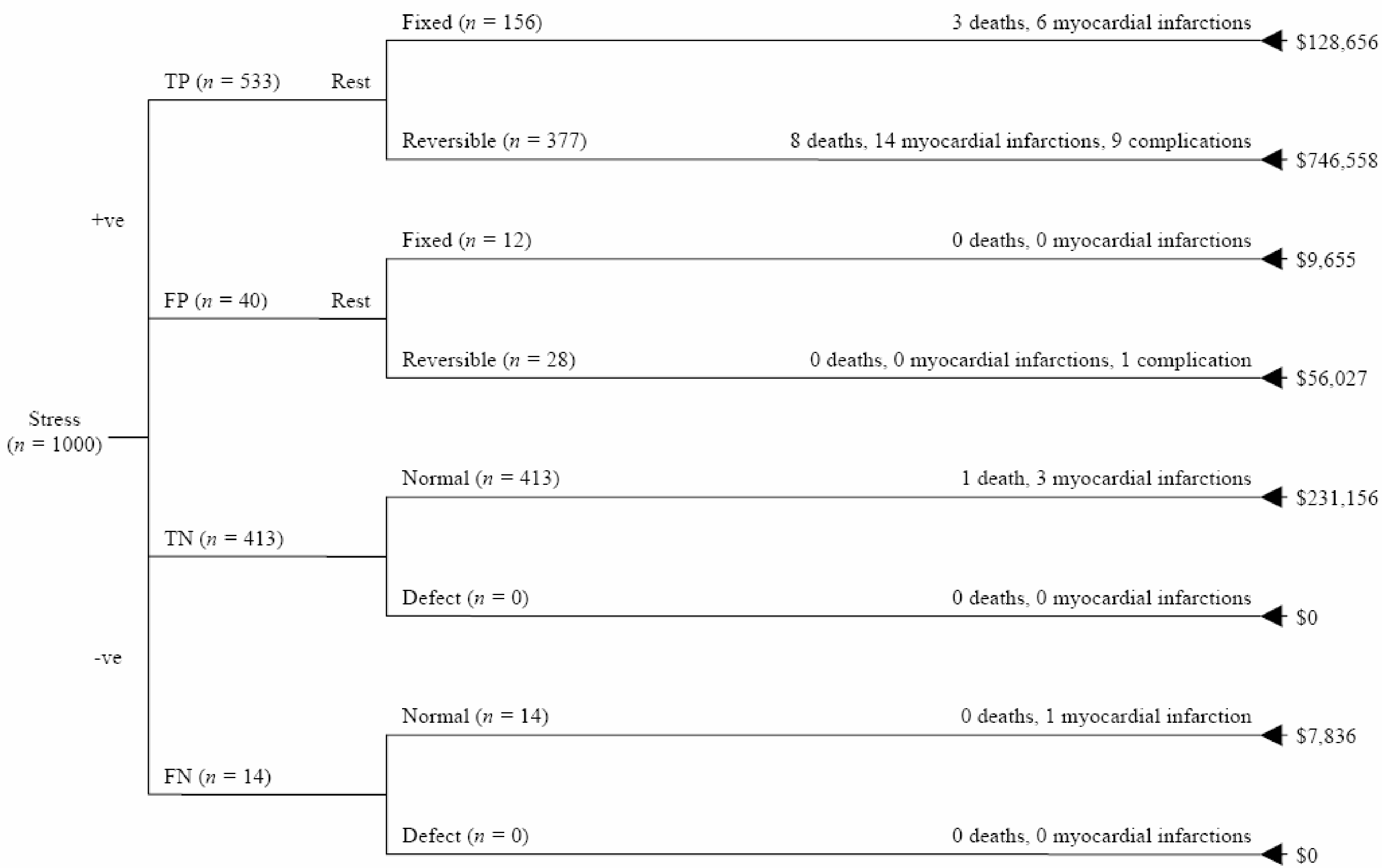


Figure 3: Decision tree analysis for rest only when stress is abnormal with a total of 12 deaths, 24 myocardial infarctions and costs of $1179889. True negatives (TN), false negatives (FN), true positives (TP) and false positives (FP).

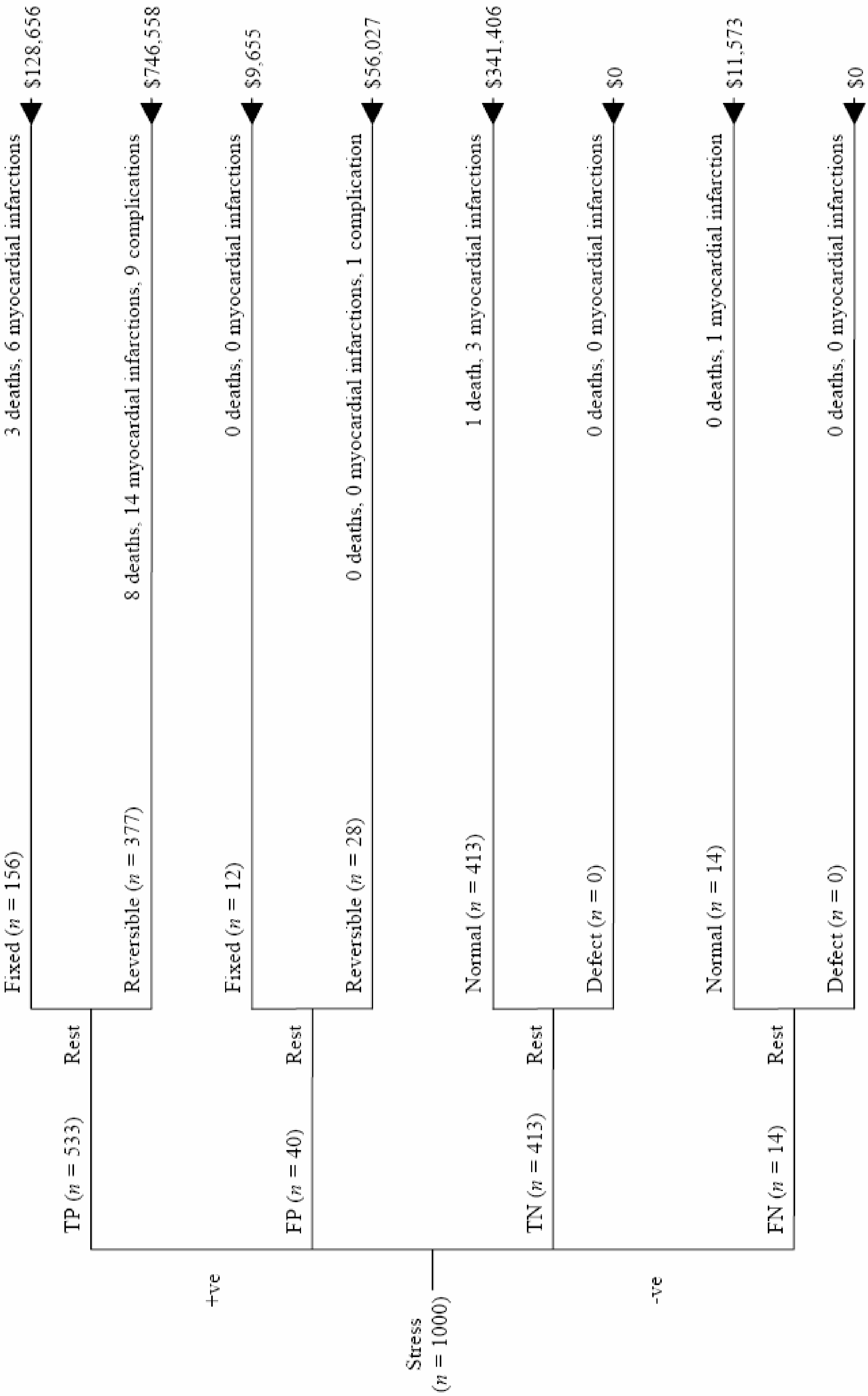


Figure 4: Decision tree analysis for rest and stress with a total of 12 deaths, 24 myocardial infarctions and costs of $1294004.

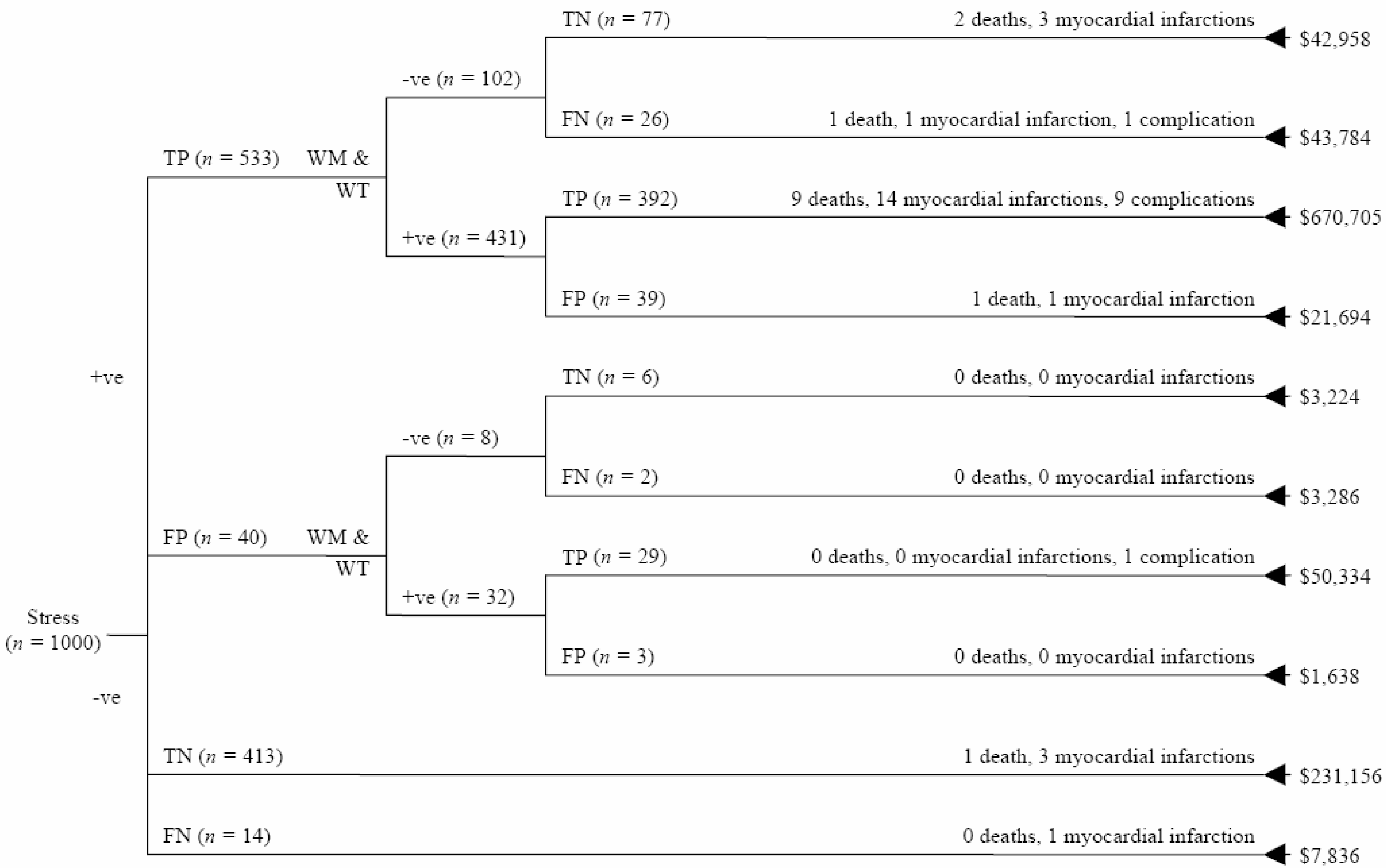


Figure 5: Decision tree analysis for stress only with a total of 14 deaths, 23 myocardial infarctions and costs of $1076605. Wall motion (WM) and wall thickening (WT) are represented.

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Continuing Professional Development – Question and Answer Sheet

Article title: Is stress only gated myocardial perfusion SPECT following normal stress scintigraphy findings a viable strategy.

Your name: ______________________________________

RAINS Member Number: ___________________________

Answer the following questions and return the completed sheet before the middle of the month to: RAINS

PO Box U102
Charles Sturt University
Wagga Wagga NSW 2678

or

seasonal@rains.asn.au

1. Why has economic rationalism in health evolved?

2. What is cost effectiveness analysis?

3. In the presence of a normal stress gated study, what percentage of patients go on to have abnormal rest studies using 99mTc based radiopharmaceuticals?

4. What is the mortality rate within the first 12 months after a normal myocardial perfusion scan?

5. What is the patient management option after a fixed perfusion defect is detected?

6. Using the decision tree data in this study, what was the cost (lives lost) and benefit (dollars saved) of a no rest study following a normal stress study strategy?

7. In a busy nuclear medicine department, why might eliminating the rest study following normal stress studies increase profit?

The Doctor of Health Science

CHARLES STURT
UNIVERSITY

Introduction
The Doctor of Health Science (DHlthSc) at CSU is a professional doctorate that allows candidates to pursue a research higher degree of the same standard as the PhD but within a structure that is aimed at improving professional practice. Specifically, it offers a research based approach for provision of solutions relevant to the professions and industry.

Professional doctorates aim to provide a tool for advanced research enabling candidates to contribute in a significant way to the knowledge and practice in their profession or discipline area. Consequently, candidates enrolled in professional doctorates tend to be more intrinsically motivated aiming to improve professional practice and enhance job satisfaction.

Course Structure
The DHlthSc is offered by part-time distance education mode and is composed of coursework and an applied research/professional component. Student's progress through the research/professional component of the DHlthSc is monitored by the requirement that students complete subjects in sequence thus meeting pre-defined milestones. The applied research/investigation allows students to develop a research question or topic for investigation by conducting an intensive literature review, critique and reflecting on their professional practices.

The DHlthSc culminates in a professional portfolio (including an exegesis), which integrates the research/investigation within their professional practice. The professional portfolio incorporates reports, papers and publications prepared throughout the course with an exegesis to link the results back to the profession and professional practice, and original question on which the research or investigation is based. The professional portfolio with exegesis is subjected to external examination in accordance with University regulations.

The duration of the DHlthSc is the equivalent of 4.5 years part time enrolment.

Enrolment Pattern
HSC700 Research Critique and Publication
HSC701 Reflective Practice in Health Science
HSC702 Proposal For Applied Research
HSC703 Research Project and Report 64 Points
HSC704 Health Science Portfolio / Exegesis

Admission Requirements
For admission to the DHlthSc applicants would need to demonstrate that they:

- are working in an appropriate field within, or relevant to, the Health Professions and can demonstrate they have the opportunity and facilities to complete the applied research/investigation components of the course; and
- have had a minimum of five years of relevant professional and/or vocational experience (with relevance being determined by the DHlthSc Course Coordinator in conjunction with the proposed principal supervisor); and
- normally hold a Masters degree or equivalent (by coursework) in an approved area of Health Sciences, with credit grades or above in all subjects undertaken.

Course Aims and Objectives
The DHlthSc promotes an advanced, critical reflection on professional practice in the health sciences and aims to:

- provide opportunity for the candidates to continue lifelong learning in keeping with the university's mission statement;
- satisfy the educational needs of professionals working in or aspiring to work in the most senior tiers of the health sciences and related sectors;
- promote the acquisition of advanced analytical and problem solving skills and conceptual insights that enhance the capacity of the candidate to undertake positions of significant responsibility in the health sciences;
- encourage excellence in scholarship and focused research within the candidates discipline area.

Course Coordinator
Dr Janelle Wheat
Senior Lecturer, Faculty of Science
Telephone: 61 2 69332750
Email: jwheat@csu.edu.au

For all inquiries please contact info.csu on:
Telephone: 1800 334 733 (free call within Australia)
Telephone: 61 2 6338 6077 (outside Australia)
Email: inquiry@csu.edu.au
Web inquiry: www.csu.edu.au/student/contact

Continuing Professional Development

Dose variation with TLD position.

Sharon Mosley[1,2] and Geoff Currie[2]

[1]Department of Nuclear Medicine, The Canberra Hospital, Canberra.
[2]School of Biomedical Sciences, Charles Sturt University, Wagga Wagga.

ABSTRACT

Introduction: Anecdotally, Australian Nuclear Medicine staff wear a single thermoluminescent dosimeter (TLD) for monitoring purposes and tend to wear their TLD in a variety of body positions including but not limited to the chest, waist and shoulder. There is a paucity of published data directly relating to the effect of placement of the TLD on whole body dose measurements.

Methodology: A survey was undertaken of current protocol and procedures employed for personal radiation monitoring of occupationally exposed staff in Nuclear Medicine departments across Australia. The study design utilised a self-administered questionnaire to provide participant confidentiality. The experimental study utilised a quasi-experimental, repeated measure (within subjects) design of eight Nuclear Medicine staff volunteers. TLD data was collected for two consecutive monitoring periods of two months duration each. All participants wore two TLDs simultaneously, one positioned on the chest and the second positioned at the waist.

Results: The position for the primary TLD of staff was predominantly at the waist (92.8%) with the remainder (7.2%) placing their primary TLD at the chest. A further 34.8% use a second TLD on the chest, 15.9% on the finger, 5.8% on the collar and 1.4% each for the pocket, umbilicus and under the apron. The mean x-ray / gamma ray dose for TLDs positioned at the chest was 287.5 μSv while the corresponding waist dose records had a mean of 178.8 μSv. The matched pairs *t* test demonstrated a statistically significant difference between matched pairs ($P = 0.001$) with a mean decrease in recorded doses for the waist of 108.8 μSv (95% CI of 50.2 to 167.3 μSv).

Conclusion: Comparing occupational radiation doses within Nuclear Medicine departments and amongst Nuclear Medicine departments is fraught with danger. There is a need for the development of uniform policy and practice in relationship to TLD position.

INTRODUCTION

There are many occupations that routinely expose employees to varying types of radiation. Medical occupational radiation exposure covers both diagnostic and therapeutic exposures to both humans and animals (*1*). Occupational radiation studies have been an important topic since the early 1940's (*2*) with an increase in mortality from leukaemia and other cancers being noted in a range of occupationally exposed groups (*2-6*). The current estimate of the probability of induction of a fatal cancer for radiation workers exposed to low levels of ionising radiation (within occupational standards) is four cancers per hundred persons exposed per Sievert (*7*).

A person working in a Nuclear Medicine department on average receives an annual effective dose of about 2.0 mSv, which may be increased to around 3.0 mSv if they work in a positron emission tomography (PET) facility (*1*). Over a working lifetime (assuming 2.0 mSv per year) the average risk per year is calculated at 0.8 in 10000, equivalent to a total lifetime risk of 3.7 in 1000 (*8,9*). These figures can be converted to a loss of life expectancy (LLE) of 17 days (*9*). This compares favourably to a pilot travelling 400000 kilometres over a period of 40 years with a LLE of 64 days and unemployment with a LLE of 500 days (*8,9*). Smoking 20 cigarettes per day or being overweight by 15% produces a LLE of six years and two years respectively (*10*).

The first and perhaps most obvious objective of personal (or personnel) monitoring is to provide information of external radiation exposures of the individual working with radioactive materials and / or radioactive devices (*1,11,12*). This information then assists in work planning and rostering of staff allowing control of the workplace as well as providing exposure information relating to accidental exposures, changes in practice and changes in dosage types (*1,11-13*). Personal radiation monitoring and dose assessment also enables optimisation of procedure and protocol (*13*).

Anecdotally, Australian Nuclear Medicine staff wear a single thermoluminescent dosimeter (TLD) for monitoring purposes and tend to wear their TLD in a variety of body positions including but not limited to the chest, waist and shoulder. A number of factors may affect the choice of TLD position. Firstly, the employee may consider the radiosensitivity of critical organs and elect to wear their TLD in a place that is representative of radiation burden to these organs. An example could be a dosimeter worn on the waist to provide an approximation of the radiation dose received by the gonads. Secondly, the weight, design and attachment mechanism may favour one body location over others.

The Australian Radiological Protection and Nuclear

Safety Authority (ARPANSA) recommends that the TLDs they provide be worn at waist or chest height to determine doses typically received by the body (*1*). Landauer recommends that the TLD should be worn on the chest (*14*). Guidelines for wearing the TLD, however, are usually the responsibility of the institution in which the radiation worker is employed. While the best position for TLD placement tends to be left for individuals to decide, physical principles suggest a variation in TLD position could correspond to a variation in dose recorded.

There is a paucity of published data directly relating to the effect of placement of the TLD on whole body dose measurements. Harbottle et al. (*15*) reported up to 50% variability between TLD measurements worn on the breast pocket compared to the waist. More recently, variations in TLD measurements have been reported between the waist and collar positions (*16*).

Despite guidelines provided by TLD manufacturers, there is no universally accepted consensus on TLD positioning. Moreover, there is anecdotal evidence to suggest inter and intra departmental variability in TLD placement. This investigation may contribute to the collective knowledge of industry, providing justification or impetus to develop universal strategies for TLD use, reducing variability and error in radiation monitoring and, thus, providing a more accurate and effective planning instrument.

METHODOLOGY

Industry Survey

The study was a survey of current protocol and procedures employed for personal radiation monitoring of occupationally exposed staff in Nuclear Medicine departments across Australia. The study design utilised a self-administered questionnaire to provide participant confidentiality. A structured questionnaire was employed in order to collect unambiguous answers for quantitative evaluation.

In August 2006, 122 questionnaires were sent to the Chief Technologists of each Nuclear Medicine department in the sampling frame. The sampling frame included all Australian departments accredited by the Australia and New Zealand Society of Nuclear Medicine (ANZSNM) in addition to those departments identified under a 'nuclear medicine' search query of the online telephone directory. A reply paid envelope was included for the return of the completed questionnaire. Department identity remained anonymous since the questionnaire contained insufficient information to identify individual departments.

Position Experimentation

The experiment utilised a quasi-experimental, repeated measure (within subjects) design. A total of eight volunteers participated with a mean age of 33 years. All participants were current employees of the Nuclear Medicine section of the Medical Imaging department at the Canberra Hospital. Data was collected for two consecutive monitoring periods of two months duration each and, thus, data collection occurred between June and November in 2006. The participants were either Nuclear Medicine technologists or worked in the Nuclear Medicine radiopharmacy laboratory. For the four month duration of data collection, each participant was supplied with two ARPANSA TLDs to be worn during the normal course of their daily duties. One positioned on the chest and the second positioned at the waist. The dose results were provided in µSv (micro-Sieverts) and accounted for both X and γ (gamma) rays. The sum total of the radiation exposure to the participants was equal to that they were ordinarily exposed during normal work practices.

Statistical Analysis

A P value less than 0.05 was considered significant. The difference between independent means and proportions was calculated with a 95% confidence interval (CI). CIs without an overlap and / or those which did not include zero were considered to support a statistically significant difference while confidence intervals with an overlap and/or included zero represented differences for which chance could not be excluded as the cause.

RESULTS

Industry Survey

At the completion of the data collection period, 69 of the 122 questionnaires had been returned completed. Another four questionnaires were returned unopened with a postal notation that the addressee was unknown. Thus, a minimum compliance rate of 58.5% (69/118) was determined. Responder compliance for this self-administered postal questionnaire was considered to have an excellent response. Responders comprised 65.2% private and 34.8% public departments. While all Australian states and territories were represented, NSW (43.5%) and Victoria (17.4%) made up the bulk of respondents.

The mean number of staff per department that are issued with TLDs was 12 (median of 10) with a range of one to 45. No statistically significant difference was noted in the mean number of staff per department monitored across states ($P = 0.960$), which suggests the distribution of various department sizes is similar across states; perhaps just the number of departments varies. There was, however, a statistically significant increase in the

mean number of staff monitored per department for department type; from private centres (eight) to public departments (20) ($P < 0.001$). Table 1 provides a summary of the percentage of departments that use TLD monitoring of different staff types.

Table 1: Monitoring of staff types.

Staff Type	Percentage Monitored
Technologists	100
Doctors	95.7
Nurses	75.4
Physicists	27.5
Secretaries	24.6
Other	20.3

Four suppliers were used by Australian departments for monitoring services including Landauer (43.5%), ARPANSA (36.3%), Australian Radiation Services (ARS) (11.6%) and Queensland Monitoring Service (QMS) (5.8%) while a further 2.8% of departments employed multiple suppliers. No statistically significant difference was noted for TLD supplier versus the department type (P = 0.391). Not surprisingly, there was a statistically significant difference in TLD supplier versus state (P = 0.003) with NSW departments favouring Landauer and ARPANSA, Queensland departments favouring QMS, South Australia / Western Australia favouring Landauer and Victoria leaning away from Landauer. No statistically significant relationship was noted for TLD supplier versus the mean number of staff monitored per department (P = 0.467). The mean contribution of reasons for departments to chose one supplier over another included the accuracy of the devices (39.4%), cost (23.0%), practice/department policy (22.6%), device design (9.4%) and other reasons (5.7%). Other reasons included continuity of service, service/support and being 'Australian'. Accuracy showed a statistically higher contribution to decision making ($P < 0.001$) while device design showed a statistically lower contribution ($P <$ 0.001). Generally there was no statistically significant difference to contribution based on state or department type (public versus private) or the number of staff monitored. Victoria did, however, report a lower contribution of accuracy to the decision process than other states (P = 0.006). Furthermore, the contribution of cost to decision making increased as the number of staff monitored increased (P = 0.127) (Figure 1) and there was a matching decrease in the contribution of accuracy as staff numbers increased (P = 0.151) (Figure 2). Policy had a statistically greater contribution to departments using ARS (P = 0.007) and device design for Landauer users (P = 0.023).

The position for the primary TLD of staff was predominantly at the waist (92.8%) with the remainder (7.2%) placing their primary TLD at the chest. A further 34.8% use a second TLD on the chest, 15.9% on the finger, 5.8% on the collar and 1.4% each for the pocket, umbilicus and under the apron. The mean contribution of reasons for staff to chose one position over another included convenience (29.1%), representative of gonad dose (24.1%), representative of the whole body dose (14.3%), the department policy (13.6%), manufacturer guidelines (8.6%), device accuracy (5.7%), evidence (3.6%) and other reasons (0.9%). Convenience and representative of gonad dose were reasons with a statistically higher contribution to choice ($P < 0.001$) while evidence and accuracy were reasons with statistically lower contributions to choice ($P < 0.01$). Tradition / habit represented the other reason for position choice. Generally, no statistically significant relationships were noted for reasons for staff choosing TLD position by the state, department type, the number of staff issued with TLDs per department, the TLD supplier or the principle TLD position. There was, however, a statistically higher contribution of the position being reflective of the gonad dose for private centres (30.8%) compared to public departments (1.7%) (P = 0.014).

The monitoring period for TLDs ranged from one to three months with a mean of 2.2 months and a median of three months. No statistically significant relationship was noted between the monitoring period and department type (P = 0.245), the number of staff monitored (P = 0.618) or the supplier used (P = 0.083). Surprisingly, there was no statistically significant difference in monitoring period for departments identifying cost as an issue for choosing a supplier over other departments (P = 0.967) since a three month monitoring period reduces overall costs.

Position Experimentation

TLD reports included both x-ray / gamma ray dose and beta doses. On all records the beta dose was recorded as zero. Both control readings were also reported as zero. The mean x-ray / gamma ray dose for TLDs positioned at the chest was 287.5 µSv with a 95% CI of 168.0 to 407.0 µSv. The corresponding waist dose records had a mean of 178.8 µSv with a 95% CI of 100.9 to 256.6 µSv. No statistically significant difference was noted between the means (P = 0.071) and this is supported by the overlap of the 95% CIs. The matched pairs t test, however, demonstrated a statistically significant difference between matched pairs (P = 0.001) with a mean decrease in recorded doses for the waist of 108.8 µSv (95% CI of 50.2 to 167.3 µSv). The absence of zero in the 95% CI supports a statistically significant difference between matched pairs. As illustrated in Figure 3, the difference between the two readings increases with an increasing recorded dose.

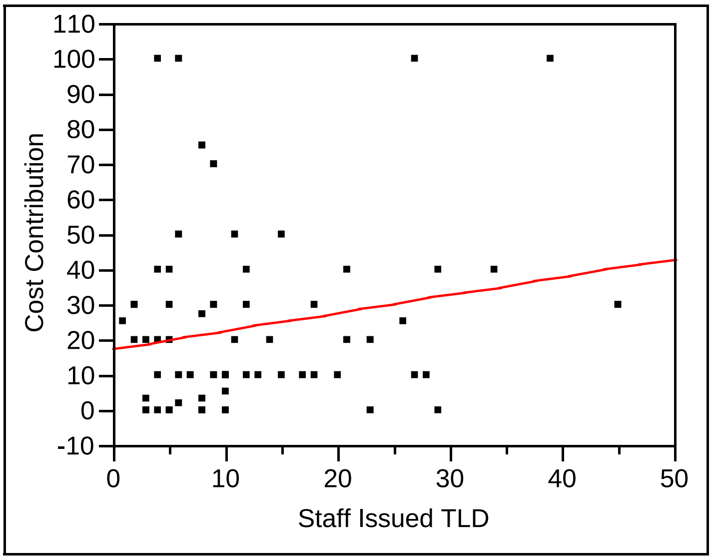

Figure 1: Bivariate fit of the cost contribution to supplier choice by the number of staff issued with TLDs.

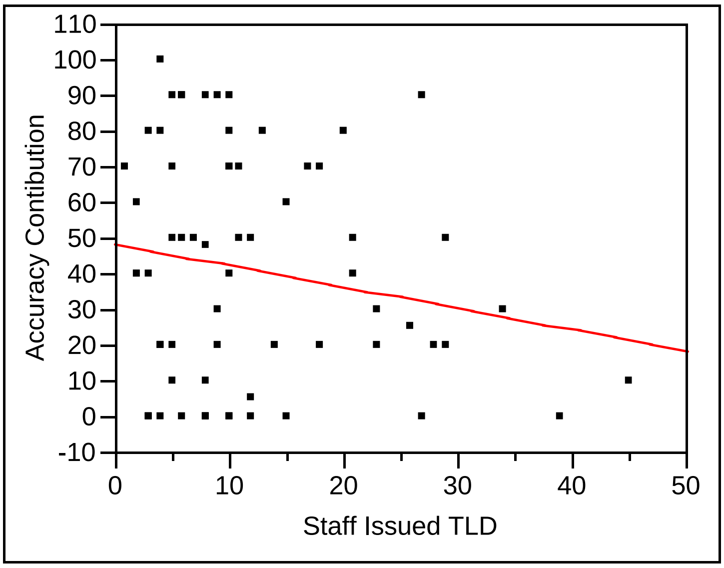

Figure 2: Bivariate fit of the accuracy contribution to supplier choice by the number of staff issued with TLDs.

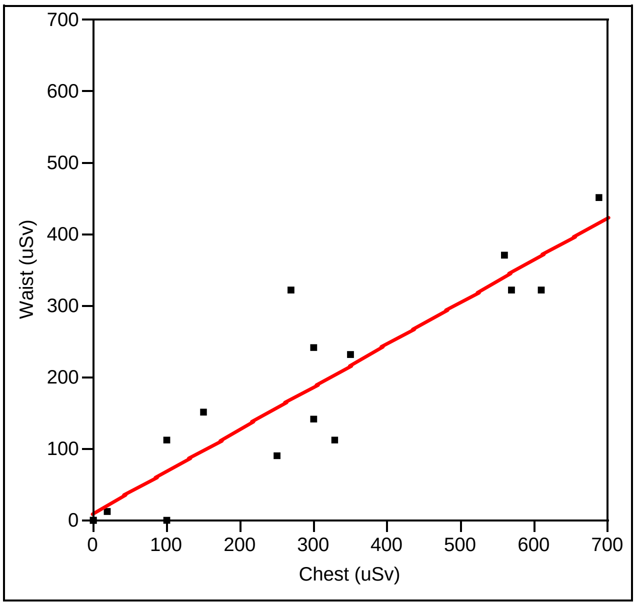

Figure 3: Bivariate fit of the chest dose by the waist dose.

DISCUSSION / CONCLUSION

The industry survey revealed a number of interesting findings. The majority of staff monitored (92.8%) elected to wear their dosimeter on the waist primarily for reasons of convenience (29.1%) and the representativeness of the dose to the gonads (24.1%). These findings suggest that accuracy of the whole body dose was not a major consideration. For private industry, gonad dose was reported to be of most importance and this may reflect the mean age of those in the private sector or a gender bias, although neither was extracted in the survey.

The questionnaire also revealed that as the number of staff monitored in a department increased, the decision to choose one dosimeter supplier over another varied. The contribution of cost to the decision making process was found to increase while the accuracy contribution of the dosimeter decreased. These findings suggest that in the larger departments, personal monitoring is governed by decisions of cost and convenience, perhaps reflecting a general belief that accuracy of TLDs is fairly uniform across suppliers. Interestingly, there was no statistically significant increase in the monitoring period for departments who indicated that cost was an important factor in choosing a supplier. While cost is important in choosing a supplier, these results suggest that optimal radiation practice is not cost prohibitive. That is, despite increased costs, some departments employ a shorter sampling frame, presumably to offer a better tool for monitoring and controlling exposure.

The accuracy of the dosimeter reading may have a significant impact upon the dose recorded for each employee. This study highlighted a number of factors that contribute to the accuracy of the dosimeter. Primarily, the position that the dosimeter was worn was found to provide variability in the dose results obtained with a mean decrease in waist measurements over chest measurements of 108.8 μSv (40% mean difference). The investigation also showed that as the dose recorded increased so did the difference between chest and waist doses.

It is important to consider that the mean 40% difference may represent an increase in accuracy for the whole body radiation dose of chest TLD placement. If this were correct, current Australian practice to wear dosimeters on the waist would be producing markedly decreased occupational radiation dose estimates. It is not unreasonable to consider that the chest TLD overestimates whole body dose, especially given the nature of some Nuclear Medicine activities that have the chest disproportionately close to the source (e.g. bending forward to inject a patient). Indeed, the chest TLD might gain greater exposure because it has a poorer protective effect of lead glass shielding in the radiopharmacy; valuable in reflecting eye exposure but not necessarily representative of whole body exposure. Perhaps the choice of TLD position is governed less by the whole body radiation dose it is meant to indicate and more by the perceived 'critical organ' identified by individuals (gonads versus eyes).

A lack of universal guidelines for dosimeter use means that the responsibility of radiation monitoring lies with each individual. In turn the overall accuracy and effectiveness of personal monitoring as a planning instrument is compromised. Variable TLD positioning within Nuclear Medicine departments and amongst Nuclear Medicine departments is, thus, fraught with danger. There is a need for the development of uniform policy and practice in relationship to TLD position.

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RAINS CPD Initiatives.

The following initiatives have been developed by RAINS to facilitate achievement of the 30 CPD points for RAINS members. These are proposed activities that mirror activities approved by the ANZSNM with some modification for more ready use in the rural environment. While the activities are transparently equivalent to those approved in the traditional CPD environment, they are yet to be formally approved by the ANZSNM. RAINS will lobby for said approval and make a full report in the next issue of Seasonal RAINS.

Activity	**Description**	**CPD Points**
E-Journal Club	RAINS members can submit a power point presentation of a relevant journal article in Nuclear Medicine of 20-30 minutes. View, read and submit review questions (80% pass mark).	2 presenter points 1 attendee point
E-Grand Rounds	RAINS members can submit a power point presentation of one or more clinical cases. Content should include patient history, scan methodology, other imaging procedures, relevant technical information, final report and patient outcomes of 20-30 minutes View, read and submit review questions (80% pass mark).	2 presenter points 1 attendee point
Continuing Education Articles and Tests	Each issue of Seasonal RAINS will contain 1 or more continuing education articles with tests. Completion of the tests and submission back to RAINS with an 80% pass mark will attract CPD points.	2 per test
Writing CPD articles/tests	RAINS members are encouraged to write fully referenced and scientific continuing education articles accompanied by 10 'test' questions and submit for distribution in Seasonal RAINS.	3 per article published
Short Courses and workshops	CSU in conjunction with RAINS and the ACT Branch of the ANZSNM organise an annual 2 day CE workshop in Wagga.	4 points
In-service Education	Provide 30 minute power point presentation with narration for inclusion on CPD CD, including written question). View, read and submit review questions (80% pass mark).	2 presenter 1 attendee
Book review	Write a considered book review (nuclear medicine) for inclusion in Seasonal RAINS (1 page).	2 points
Professional Development Plan	RAINS will develop and circulated a professional development plan template for members wishing to use it.	1 point pa

Continuing Professional Development – Question and Answer Sheet

Article title: Dose variation with TLD position.

Your name: ______________________________________

RAINS Member Number: ___________________________

Answer the following questions and return the completed sheet before the middle of the month to: RAINS
PO Box U102
Charles Sturt University
Wagga Wagga NSW 2678

or seasonal@rains.asn.au

1. When did occupational radiation exposure become important?

2. What is the current estimate of the probability of induction of a fatal cancer for radiation workers exposed to low levels of ionising radiation?

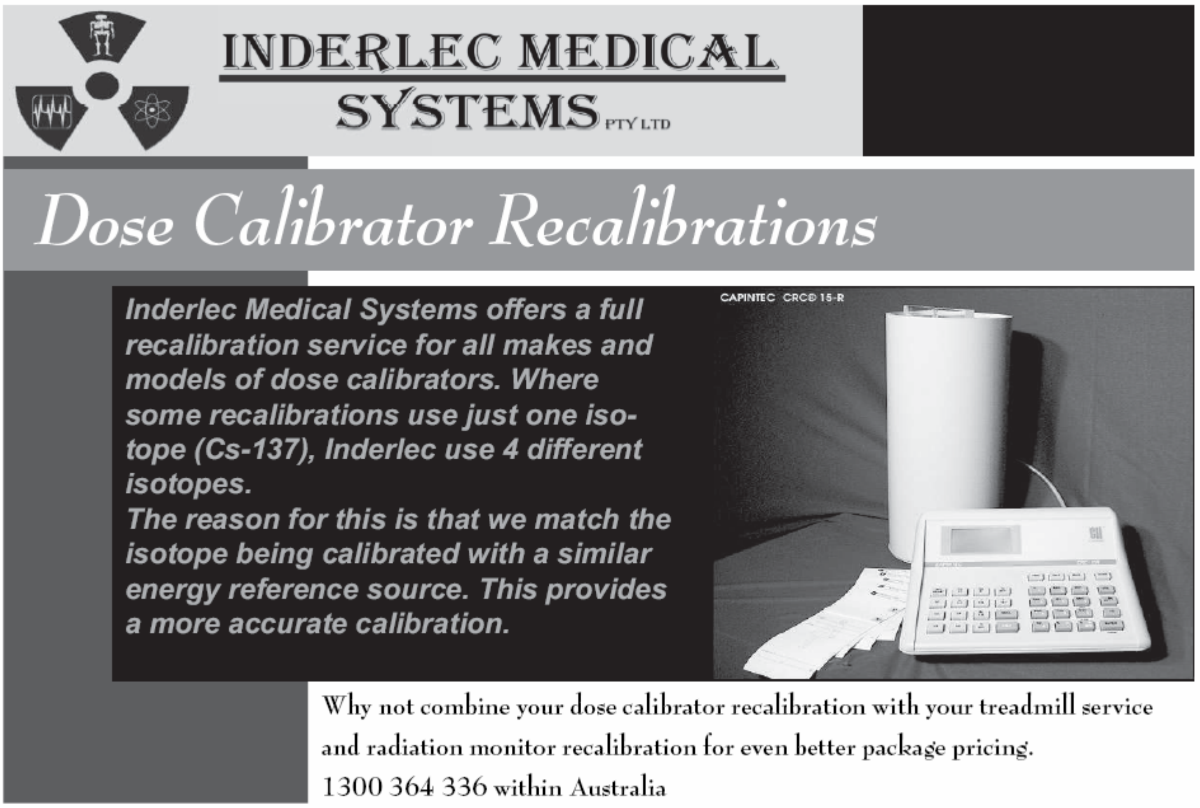
3. What is the total lifetime risk (years lost) of a career in nuclear medicine?

4. What is the purpose of personal monitoring?

5. What factors affect TLD wearing position?

6. What factors decide the choice of TLD supplier?

7. What is the discrepancy in TLD reading between the chest and waist?



GRADUATE NUCLEAR MEDICINE TECHNOLOGIST

Applications are sought for the position of Professional Development Year (PDY)/ Intern Nuclear Medicine Technologist.

Based at Central Gippsland Health Service (CGHS), Sale Hospital, the position will require working closely with the Nuclear Medicine Manager, Physicians and Department Managers.

The full-time position will involve working in a multi-modality department in a busy rural public hospital. CGHS offers fantastic working conditions where you will have the opportunity to be part of a highly skilled, professional, friendly team who pride themselves in providing high quality service.

This position is for a motivated, enthusiastic person who is self directed and possess excellent time management and communication skills.

The position will provide ongoing support for your career/academic development and aims to provide a high standard of clinical training and CPD.

Further information and a position description can be obtained by phoning:
Michael Coleman (Practice Manager) or
Narelle Harrison (Nuclear Medicine Manager) on (03) 51438620

Closing Date for application: Monday 8th of October, 2007

Central Gippsland Health Service
The provision of quality integrated health services

Please forward applications, along with an up to date CV to:
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Human Resource Department
155 Guthridge Parade
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For more information about our organization, we invite you to visit our website at www.gha.net.au/cghs.

Guidelines for Submissions to Seasonal RAINS

Seasonal RAINS is a newsletter with four issues per year. Issues will be sent to RAINS members during Winter, Spring, Summer and Autumn.

Seasonal RAINS will accept a number of types of submissions. All work must be written in English and submitted in Microsoft Word. All submission must be accompanied by a cover letter (email is sufficient) indicating the type of submission, details of authors and departments, contact details of the corresponding author and a statement indicating that the submission is not subject to copyright elsewhere.

All submissions will be reviewed for appropriateness and accuracy (where relevant). Inclusion in Seasonal RAINS remains the discretion of the editorial board. Preference will be given to submissions consistent with the philosophy and purpose of RAINS.

All submissions should be sent by email to: seasonal@rains.asn.au

Letter To Editor

300-500 word limit.

Interesting Image

1 JPG image and 300 word limit case presentation.

What The … ?

1 JPG image and 100 word limit solution.

News and Events

Summary of recent or upcoming events. Update RAINS member achievements; publication, conference presentation or scholarship.

Book Review

Review of a recently released nuclear medicine text. Minimum of 1 page.

E-Journal Club

20-30 minute power point presentation of a relevant journal article in Nuclear Medicine. Submissions should include written text and discussion for each slide plus 10 test questions.

E-Grand Rounds

Submit a 20-30 minute review summary and presentation (power point) of one or more clinical cases. Content should include patient history, scan methodology, other imaging procedures, relevant technical information, final report and patient outcomes. Submissions should include written text and discussion for each slide plus 10 test questions.

In-Service Education

Seminars should be submitted as power point presentations with audio narration. Audio recordings should be embedded in the power point presentation (not linked) using a radio quality setting (22kHz, 16 bit, mono). Ensure sound quality is suitable for circulation. Valuable presentation might only be included if narration is re-recorded. Accepted presentations will be included on the RAINS CPD in-service CD. All presentations should be accompanied by 10 review questions. Presentations should be sent by mail to: The Editor, PO Box U102, CSU, Wagga Wagga, 2678.

CPD Articles

Submissions should provide an educational review of an area of interest. The reviews should be well researched and present all valid perspectives. CPD articles may be accepted after review by the editorial board. Alternatively, the submission may be accepted with some suggested revision or deemed not suitable for the purpose intended (CPD). All submission must adhere to the guidelines provided by the *Journal of Nuclear Medicine Technology*; available on the SNM web site (www.snm.org).

CPD articles should be made available for publication without copyright authority elsewhere. Submitting authors accept responsibility for ensuring manuscripts do not breach copyright laws. Seasonal RAINS does not, however, ask that you transfer copyright to RAINS. Thus authors are free to re-publish manuscripts in whole or in part in subsequent journals.

Advertising

Advertisement of activities, products or events consistent with the philosophy and purpose of RAINS will occur without charge (including positions vacant).

Commercial advertisements may be included at a cost of $100 per half page (190x125 mm landscape) and $200 per full page (190x270 mm portrait).

Advertisements will not be reformatted. Advertisements should be submitted electronically in PDF or JPG. This is an electronic newsletter so colour is permitted at no additional cost.

Advertisements should be emailed to: seasonal@rains.asn.au no later than 4 weeks prior to issue release.

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- **The ACT Branch of the ANZSNM,**
- **Regional Imaging Riverina and**
- **Rural Alliance In Nuclear Scintigraphy (RAINS)**

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THE 4TH ANNUAL

CONTINUING EDUCATION WORKSHOP 2007

CHARLES STURT UNIVERSITY WAGGA WAGGA

WAL FIFE LECTURE THEATRE

10:30 am Saturday 10th November

until

12:00 noon Sunday 11th November

KEY NOTE SPEAKERS

Prof Hosen Kiat
Cardiac Health Institute, Sydney

Prof Hosen Kiat is the Medical Director of the Cardiac Health Institute and Professor of Cardiology at the Australian School of Advanced Medicine at Macquarie University. Prof Kiat is a medical graduate of Monash University in Melbourne and completed his cardiology training in 1985, spending 10 years as a full-time staff cardiologist and Research Director at the prestigious hospital, Cedars-Sinai Medical Centre, with a Professorship from the UCLA School of Medicine, Los Angeles. He is also a specialist in nuclear medicine and a Diplomate of the American Boards of Internal Medicine, Cardiology and Nuclear Medicine. Prof Kiat has over 200 scientific publications. Prof Kiat practices as a Consultant Physician with various clinical, academic and hospital positions.

A/Prof Paul Roach
Royal North Shore Hospital, Sydney

A/Prof Paul Roach is the Head of the Department of Nuclear Medicine at Sydney's Royal North Shore Hospital and a Clinical Associated Professor in the Faculty of Medicine at the University of Sydney. He undertook advanced training in Nuclear Medicine at Royal North Shore Hospital, Royal Prince Alfred Hospital in Sydney and then Harvard Medical School in Boston. He has published over 50 manuscripts and case reports in peer reviewed journals, most recently in the fields of the clinical utility of SPECT/CT and new techniques in VQ SPECT imaging (including the use of fusion imaging, new methodology to generate planar images from SPECT data and novel quantitative techniques to assess pathophysiology in pulmonary embolism and other respiratory conditions).

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TENTATIVE PROGRAM

SATURDAY 10TH NOVEMBER

10:30 Morning tea and coffee on arrival

10:45 Welcome
A/Prof Lyndall Angel and Mr Matthew Bellairs

11:00 **Session One – Key Note Speakers**

11:00 SPECT/CT: do we need it?
A/Prof Paul Roach

11:40 Is stress echo better than sestamibi in CAD?
Prof Hosen Kiat

12:20 V/Q SPECT: is it vital?
A/Prof Paul Roach

12:40 Nuclear cardiology, today and tomorrow
Prof Hosen Kiat

13:00 Lunch and poster display

14:00 **Session Two – Student Research Presentations**

14:00 Image quality and the elution to elution time
Katherine Roy and Mark Lee

14:15 Efficacy of gastric empty food labels
Tahnee Hodgkin and Kristy Lee Allen

14:30 Topic to be advised
Leshen Padayachee

14:45 Topic to be advised
Brianne Paulsen

15:00 TLD position and dose discrepancy
Sharon Mosley

15:15 Afternoon tea

15:45 **Session Three – SPECT/CT**

15:45 Chest Cross Sectional Anatomy
Dr Rashid Hashmi

17:00 Close for day 1

SUNDAY 11TH NOVEMBER

8:30 Tea and coffee

9:00 **Session Four – Delegate Presentations**

9:00 Pitfalls in Gated Myocardial Perfusion SPECT
Dr Janelle Wheat

9:30 SPECT/CT initial experience
Mr Michael Crook

10.00 Phyto-scintigraphy
Dr Geoff Currie

10:15 The threat of nuclear terrorism
Dr Geoff Currie

10:45 Morning tea and coffee

11:00 **Session Five – Society Business**

11:00 Update of Rural Alliance In Nuclear Scintigraphy
Pete Tually, Matt Ayers, Carla Robinson, Michael Crook & Narelle Harrison

11:15 Presentation of 3rd Year Student Research Prize
Global Medical Solutions

11:15 Presentation of 2nd Year Student Case Study Prize
ACT Branch of ANZSNM

11:20 ACT branch meeting

12:00 Close

POSTERS

Saturday Lunch

During lunch on Saturday, student posters will be on display.

We also invite those considering attending to submit an abstract for a poster by 30 September 2007.

SOCIAL

Saturday

18:00 Pre-dinner drinks

19:00 Dinner

Sunday

12:15 CSU Wine and Cheese tasting

Collect CPD points

No registration fee

(lunch and tea provided)

Recommended accommodation:
Country Comfort, Wagga Wagga

Maps can be downloaded at (car parks 7 or 4 and building 14):
http://www.csu.edu.au/about/maps/wagg-map.html

To finalise catering numbers, please register at: gcurrie@csu.edu.au

Rural Alliance In Nuclear Scintigraphy - (RAINS)

APPLICATION FOR MEMBERSHIP

There are no membership fees for RAINS in 2007.

Please send complete forms to:
RAINS
PO Box U102
Charles Sturt University
NSW 2678

Or email to:
membership@rains.asn.au

I wish to apply for membership to RAINS and, if accepted as a member, I undertake to comply with the RAINS Charter.

See membership guidelines (please tick):
Ordinary member ………………… ☐
Associate member …………... ☐

Professional Category (please tick):
Technologist/Scientist ……………. ☐
Physicist ………………………….. ☐
Nurse ……………………………… ☐
Radiopharmacist …………………. ☐
Other (please specify) ……......... ☐
Physician ……………………... ☐
Radiologist …………………… ☐
Registrar ……………………… ☐
Student Technologist (specify uni) ☐
…………………………..…

Are you a member of (please tick):
ANZSNM ………………………… ☐
AIR …………………………... ☐

Title: _____ Given Name: _________________ Surname: ______________________

Business Address: ____
____
____

Telephone: ______________________ Facsimile: ___________________________

Email: _______________________________

I agree to have my telephone number and email address included on the RAINS database and circulated amongst RAINS members.

Signature: ____________________________ Date: _________________________

RAINS Use Only

ANZSNM Member? YES / NO
Rurality Criteria Satisfied? 1 / 2 / 3 / 0
Member number issued? __________
Issue date? ____________