GUIDELINES FOR UNDERGRADUATE NUCLEAR MEDICINE EDUCATION IN THE MBCHB PROGRAMMES IN SOUTH AFRICA

by

MARIA GLAUDINA NEL

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STUDY LEADER: DR J. BEZUIDENHOUT

CO-STUDY LEADER: DR S. BRÜSSOW

DECLARATION

I hereby declare that the work submitted here is the result of my own independent investigation. Where help was sought, it was acknowledged. I further declare that this work is submitted for the first time at this university/faculty towards a Magister degree in Health Professions Education and that it has never been submitted to any other university/faculty for the purpose of obtaining a degree.

……………………………………. ………………………..

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DEDICATION

I dedicate this 'mini-dissertation' to:

My daughter, Anria Rabie, who supported me throughout the course of the research project. Sus, thank you very much, I appreciate all you have done and the time and energy you spent assisting me with this project.

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TO GOD ALONE THE GLORY!

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GLOSSARY

ALARA principle:	ALARA is an acronym for "As Low As Reasonably Achievable". This is a radiation safety principle for minimizing radiation doses by employing all reasonable methods
Assessment:	This is the process whereby the competency level of students is determined. It should be performed through a variety of methods, over a period of time and in a variety of contexts
Blackboard:	Blackboard Learn™ is an educational Learning Management System
ClickUP:	Learning Management System (LMS) for the use of web-supported learning, computer-assisted assessment, and creating interactive multimedia delivered via DVD-ROM and mobile devices.
Community service doctors:	A one year period of community service has to be done to ensure improved provision of healthcare services to all the citizens of the country. This year also provides the young medical doctors with an opportunity to develop their skills, acquire knowledge, behaviour patterns and critical thinking that will help them in their professional development
Curriculum:	A curriculum consists of related modules from different disciplines that form part of the programme over the specified period in which students must achieve the stated learning outcomes
Directives:	This is regarded as an order or instruction, especially one issued by a central authority. Serving to direct, indicate, or guide
Discipline:	A specialised and demarcated field of study
DNA:	Nucleic acid that is the main constituent of chromosomes, consists of two polynucleotide chains in the form of a double helix, and is responsible for the transmission of hereditary characteristics from parents to offspring
EvaSyS:	Is a sophisticated and automated educational web-based survey-management system
Et al.	An abbreviated form of et alia, Latin for "and others"
EvaSys education research system:	This is a sophisticated internet-based survey management system with which the evaluation of academic programmes can be carried out quickly and efficiently

Excel format:	Excel is a spreadsheet programme from Microsoft, allowing you to use columns and rows to organize data
Gamma camera:	Is a camera that detects the gamma-ray photons produced by radionuclide decay and is used especially in medical diagnostic scanning to create a visible record of a radioactive substance injected into the body
Guidelines:	Any guide or indication of a future course of action
Impact Factor:	The 5 year Impact Factor is the average number of times articles from scientific journals published in the past two years have been cited in the Journal Citation Reports (JCR) year
ISI Web of Knowledge:	Institute for Scientific Information's academic citation indexing and search service, which is combined with web linking and is provided by Thomson Reuters
Learning outcomes:	A learning outcome refers to the contextually demonstrated end product of the learning process. An exit-level outcome is the learning outcome that the qualifying student must achieve at the stage of exiting the programme leading to the particular qualification. A specific learning outcome is contextually demonstrated knowledge, skills and values that support one or more critical outcomes and represents a particularisation of the exit-level outcomes
Learning programme:	A learning programme refers to the structure for cumulative learning that a student is required to successfully complete in mastering the exit-level outcomes of a qualification. This structure consists of a related combination of modules/learning units, expressed in an outcomes-based format, and which have an academic and/or professional/career-related focus
Medical interns:	Doctors who have just obtained their MBChB qualification and have to complete a twenty-four month internship training before they can be registered as a medical practitioner with the HPCSA
Medline*:*	Medline is an authoritative bibliographic database, created by the U.S. National Library of Medicine, that contains citations and abstracts for biomedical and health journals used by health care professionals, nurses, clinicians and researchers engaged in clinical care, public health and health policy development.

Module:	A module is a coherent, self-contained learning unit designed to achieve a set of particular learning outcomes. A module can fulfil a fundamental, core and elective function in a programme. . Modules refer to all of the teaching and learning components that are part of a learning programme and are sometimes refer to as subjects
MP 0271772:	Number of medical practitioners (including specialists) when registered with HPCSA in South Africa
Nuclide:	Nuclides are atoms or ions characterised by the contents of their nuclei
PubMed**:**	PubMed is a free search engine accessing primarily the MEDLINE database of references and abstracts on life sciences and biomedical topics at the U.S. National Institutes of Health's National Library of Medicine (NIH/NLM).
Qualification:	In an outcomes-based approach, a qualification refers to the certification of the achieved learning outcomes of a programme, expressed as an accumulation of credits at specific levels. A qualification represents the demonstrated performance of a student in a planned and goal-directed combination of learning outcomes which are aimed at equipping students with applied competence and a foundation for further learning
Radio-nuclides:	A radio-nuclide or radio-isotope is a nuclide that is radio-active
s.a.:	If the year of publication is unknown, the abbreviation 'sinne anno' (without year) is used
SPPS-format:	This is the Saint Paul Public Schools' version of Google's computer programme/applications used for educational statistical analysis
Syllabus:	A grouping of learning material of a specific module methodically spread over the semesters/years
Scintigram:	An image of an internal part of the body produced by scintigraphy
Scintigraphy:	A form of diagnostic test used in nuclear medicine, where radio-isotopes/radiopharmaceuticals are taken internally, and the emitted radiation is captured by external detectors (gamma cameras) to form two-dimensional images
Web of Science^{TM}:	An online subscription-based scientific citation indexing service that provides a comprehensive citation search

LIST OF ACRONYMS AND ABBREVIATIONS

ABNM:	American Board of Nuclear Medicine
ALARA:	As Low As Reasonably Achievable
ANMP:	Association of Nuclear Medicine Physicians
BSc:	Bachelor of Science
BSc Hons:	Bachelor of Science Honours
CBE:	Community-Based Education
CEO:	Chief Executive Officer
CHE:	Council on Higher Education
CMC:	Conventional Medical Curriculum
CMSA:	Colleges of Medicine of South Africa
CNP:	College of Nuclear Physicians
CT:	Computed Tomography
DEXA:	Dual-energy X-ray absorptiometry
DiplPEC:	Diploma in Primary Emergency Care of the College of Emergency Medicine of South Africa: Dip PEC(SA)
DHET:	Department of Higher Education and Training
DNA:	Deoxyribonucleic Acid
DoE:	Department of Education
DoH:	Department of Health
ECUFS:	Ethics Committee of the Faculty of Health Sciences at the UFS
EQ:	Essay questions
Er-169:	Erbium-169
ESR:	European Society of Radiology
Et al.	An abbreviated form of et alia, Latin for "and others."
FCNP(SA):	Fellowship of the College of Nuclear Physicians of South Africa
FDG-PET/CT:	Fludeoxyglucose Positron-Emission Tomography and Computed Tomography
FoHS:	Faculty of Health Sciences
FS:	Free State
FWACS:	Fellowship of the West African College of Surgeons
GEMP:	Graduate Entry Medical Programme

GMC:	General Medical Council
HEQF:	Higher Education Qualifications Framework
HPCSA:	Health Professions Council of South Africa
HPE:	Health Professions Education
HREC:	Human Research Ethics Committee of the Faculty of Health Sciences at the University of Cape ownT
IAEA:	International Atomic Energy Agency
ICMC:	Integrated contextual medical curriculum
IF:	Impact Factor
ISI:	Institute for Scientific Information
I-131:	Iodine-131
JCR:	Journal Citation Reports
LMS:	Learning Management Systems
MBBCh:	Bachelor of Medicine, Bachelor of Surgery
MBBS:	Medicinae Baccalaureus, Baccalaureus Chirurgiae
MBChB:	Bachelor of Medicine and Bachelor of Surgery
MCQ:	Multiple-Choice Question
MD:	Doctor of Medicine
Medline:	Medical Literature Analysis and Retrieval System Online
MFAM.MED:	Master of Family Medicine and Primary Care
MIBG:	Meta-iodobenzylguanidine
MIBI:	Methoxy-Isobutyl-Isonitrile
MMed:	Master of Medicine
MMed (Nuclear Medicine):	Master of Medicine in Nuclear Medicine
MP:	Medical Practitioners
MPharmMed:	Master of Pharmacy/Clinical Pharmacology
MRI:	Magnetic Resonance Imaging
MRS:	Medical Radiation Science
MSc:	Master of Science
NAS:	National Academy of Sciences
NACOR Report:	National Advisory Committee on Radiation Report
NET:	Neuro Endocrine Tumour
NQF:	National Qualifications Framework
NuclMed:	Nuclear Medicine

OBE:	Outcomes-based Education
OSCE:	Objective Structured Clinical Examinations
PBL:	Problem-Based Learning
PC:	Personal computer
PCE:	Patient-based clinical examinations
PET:	Positron-Emission Tomography
PET/CT:	Positron-Emission Tomography and Computed Tomography
PET/MRI:	Positron-Emission Tomography and Magnetic Resonance Imaging
PhD:	A Doctor of Philosophy degree
POE:	Problem-based oral examinations
POME:	Practice of medicine
Rad:	Radiology
RCR:	Royal College of Radiologists
Re-186:	Rhenium-186
RIT:	Radio-immunotherapy
RSA:	Republic of South Africa
s.a.:	sinne anno
SA:	South Africa
SAQ:	Short-answer questions
SAQA:	South African Qualification Authority
SASNM:	South African Society of Nuclear Medicine
SCARD:	Society of Chairmen of Academic Radiology Departments
SNM:	Society of Nuclear Medicine
SNMMI:	Society of Nuclear Medicine and Molecular Imaging
SoM:	School(s) of Medicine
SPECT:	Single-Positron-Emission-Computed Tomography
SPECT/CT:	Single-Positron-Emission-Computed Tomography and Computed Tomography
SPICES MODEL:	Student-centred learning, Problem-based learning, Integrated or inter-professional teaching, Community based education, Elective studies, and a Systematic or planned approach to curriculum development
SPPS-format:	Saint Paul Public Schools' version of Google Applications for Education
Sr-89:	Strontium-89

SUN:	University of Stellenbosch
TAT:	Targeted alpha therapy
TIDHSA MODEL:	Teacher-centred, Information gathering, Discipline-based, Hospital-based, Standard programme and Apprenticeship-based or opportunistic approach to curriculum development
UCT:	University of Cape Town
UFS:	University of the Free State
UKZN:	University of KwaZulu-Natal
UL:	University of Limpopo
UP:	University of Pretoria
U.S.:	United States
USA:	United States of America
WHA:	World Health Assembly
WHO:	World Health Organisation
WITS:	University of Witwatersrand
WNA:	World Nuclear Association
WoK:	Web of Knowledge
WoS:	Web of Science
WSU:	Walter Sisulu University
Y-90:	Yttrium-90
18F-FDG:	Flu-deoxyglucose (18F)
153Sm-EDTMP:	Samarium-153-ethylene-diamine-tetramethylene-phosphonic acid

SUMMARY

KEY WORDS: undergraduate medical nuclear medicine education/teaching, diagnostic imaging, clinical imaging, medical imaging, radiology, education and teaching

Only six of the eight Schools of Medicine in South Africa are currently involved in presenting medical nuclear medicine education programmes. Nuclear medicine is traditionally taught at postgraduate level and no nationally accepted undergraduate medical nuclear medicine education guidelines exist. Due to the poor quality and inadequacy of referral letters to the local Nuclear Medicine Department, a need was identified to empower newly qualified doctors to utilise nuclear medicine imaging procedures more effectively.

The researcher's intention was to investigate undergraduate medical nuclear medicine modules if they existed at the Schools of Medicine in South Africa. The aim was to use the research results to provide guidelines for a nationally accepted undergraduate medical nuclear medicine module. These guidelines could guide academic Nuclear Medicine Departments in ensuring that all medical students and future medical interns are exposed to the same level of undergraduate nuclear medicine education. The answers to specific, fixed questions regarding undergraduate medical nuclear medicine education, and the opinions of all academic and private nuclear medicine experts in South Africa were obtained.

The value of the research for medical students will mainly be empowerment – they will be able to utilise nuclear medicine imaging studies effectively in their day-to-day patient care, though it will not turn them into "mini" nuclear medicine physicians. The research will also serve as a benchmark for the module during semester 6 of the MBChB programme of the School of Medicine, Faculty of Health Sciences at the University of the Free State.

The research tool that accomplished the measurement and conceptual analysis of the required data best was a semi-structured survey questionnaire consisting of both closed and open-ended questions, combining a quantitative study with qualitative components. A Likert-type frequency scale was used to identify specific undergraduate level topics to be included in such an educational module.

Key persons were identified in each academic Nuclear Medicine Department to complete the main questionnaire on the existing medical curriculum and each department's undergraduate educational module. A shortened questionnaire, excluding the sections on the curriculum and the existing undergraduate nuclear medicine module, was also distributed electronically via the *EvaSys* system of the UFS, to all other academic and privately practising nuclear medicine experts in South Africa.

This study was conducted in the inter-disciplinary fields of Health Professions Education and Nuclear Medicine Imaging education in the undergraduate MBChB programmes in South Africa. The focus was on compiling and providing guidelines for a standardised and uniform undergraduate medical nuclear medicine educational module that could be included in MBChB programmes in South Africa.

Results and findings, comprising of existing secondary data (Study Objective 1) and the opinions of key persons (Study Objective 2) and expert nuclear medicine practitioners (Study Objective 3), were applied to compile and provide guidelines (Study Objective 4) for the required educational modules as benchmark to Schools of Medicine in South Africa to bridge the gap identified. This research study makes a significant contribution to the body of knowledge in the field of undergraduate medical nuclear medicine education in South African.

OPSOMMING

SLEUTELWOORDE: voorgraadse mediese kerngeneeskundige opleiding of onderrig, diagnostiese beelding, kliniese beelding, mediese beelding, radiologie, opleiding of onderrig

Net ses van die agt Skole vir Geneeskude in Suid-Afrika is tans by mediese Kerngeneeskunde onderrigprogramme betrokke. Kerngeneeskunde word tradisioneel op nagraadse vlak aangebied en daar bestaan nie nasionaal aanvaarde onderrigriglyne vir voorgraadse mediese kerngeneeskunde nie. Weens die swak gehalte van verwysingsbriewe wat aan die plaaslike Kerngeneeskunde Departement gerig word, is 'n behoefte geïdentifiseer om pasgekwalifiseerde dokters te bemagtig om kerngeneeskundige beeldingsprosedures meer doeltreffend aan te wend.

Die navorser se mikpunt was om ondersoek in te stel na voorgraadse mediese kern-geneeskunde modules (indien sulke modules bestaan) by die Skole vir Geneeskunde in Suid-Afrika. Die doel was om die navorsingsresultate te gebruik om rigline vir 'n nasionaal aanvaarde voorgraadse mediese kerngeneeskunde module saam te stel. Hierdie riglyne sou leiding kon verskaf aan akademiese Kerngeneeskunde Departemente, sodat hulle kan verseker dat alle mediese studente en toekomstige Intern dokters aan dieselfde vlakke van voorgraadse kerngeneeskundige opleiding blootgestel word. Die antwoorde vir spesifieke, vasgestelde vrae oor voorgraadse mediese kerngeneeskunde opleiding, en die menings van alle akademiese en privaat praktiserende deskundiges in die veld van Kerngeneeskunde in Suid-Afrika, is bekom.

Die waarde van die navorsing vir mediese studente sal hoofsaaklik bemagtiging wees – hulle sal in staat wees om Kerngeneeskundige beeldingstudies doeltreffend aan te wend in hul daaglikse pasiënt hantering, hoewel dit hulle nie in "miniatuur" Kerngeneeskundiges sal verander nie. Die navorsing sal ook dien as 'n standaard vir die module wat gedurende semester 6 van die MBChB program van die Skool vir Geneeskunde van die Fakulteit Gesondheidswetenskappe by die Universiteit van die Vrystaat aangebied word.

Die navorsingsmetode wat die meting en konseptuele ontleding van die vereiste data die beste ondervang het, was 'n kwantitatiewe halfgestruktureerde oorsigvraelys. Die halfgestruktureerde oorsigvraelyste het sowel oop as geslote vrae behels en daardeur is 'n kwantitatiewe studie met kwalitatiewe komponente gekombineer. 'n Likert-tipe frekwensieskaal is gebruik om spesifieke onderwerpe op voorgraadse vlak, wat in so 'n program ingesluit sou kon word, te identifiseer.

'n Sleutelpersoon is in elke akademiese Kerngeneeskunde Departement geïdentifiseer om die hoofvraelys oor die bestaande mediese kurrikulum, en oor elke department se voorgraadse Kerngeneeskundige opvoedkundige module, te voltooi. 'n Verkorte vraelys, sonder die dele oor die kurrikulum en die bestaande voorgraadse mediese kerngeneeskunde-module, is elektronies, via die *EvaSys* navorsingsisteem van die Universiteit van die Vrystaat, aan alle ander akademiese en privaat praktiserende mediese kerngeneeskunde deskundiges in Suid-Afrika gestuur.

Hierdie studie is uitgevoer in die inter-dissiplinêre velde van Gesondheidsberoepe-onderwys en Kerngeneeskundige-beeldingsopvoedkunde in voorgraadse MBChB programme in Suid-Afrika. Die fokus was om riglyne saam te stel vir 'n gestandaardiseerde en gelykvormige opleidingsmodule vir voorgraadse mediese kerngeneeskunde, wat in MBChB programme in Suid-Afrika ingesluit sou kon word.

Die navorsings resultate en bevindinge, bestaande uit sekondêre data (Studie doelstelling 1), die menings van sleutelpersone (Studie doelstelling 2) asook die menings van alle ander akademiese en privaat praktiserende mediese kerngeneeskunde deskundiges in Suid-Afrika (Studie doelstelling 3), is gebruik vir die samestelling en verskaffing van riglyne vir die voorgraadse mediese kerngeneeskunde opleidingsmodule (Studie doelstelling 4) om te dien as maatstaf vir Skole vir Geneeskunde in Suid-Afrika om die geïdentifiseerde behoefte te oorbrug. Hierdie navorsingstudie maak 'n betekenisvolle bydrae op die gebied van voorgraadse mediese kerngeneeskunde onderwys in Suid-Afrika.

GUIDELINES FOR UNDERGRADUATE NUCLEAR MEDICINE EDUCATION IN MBChB PROGRAMMES IN SOUTH AFRICA

CHAPTER 1

ORIENTATION TO THE STUDY

1.1 INTRODUCTION

In this research project, an in-depth study was undertaken by the researcher with a view to compiling guidelines for undergraduate nuclear medicine education in the Bachelor of Medicine and Bachelor of Surgery (MBChB/MBBCh) degree programmes in the Republic of South Africa (RSA).

Nuclear medicine forms an integral part of patient care and has contributed worldwide to the well-being of patients since its recognition as a medical speciality in the United States of America (USA), in 1971 (Educational Content 2012:online). Together with radiology, nuclear medicine is regarded as a medical, clinical, and diagnostic imaging modality and it is traditionally taught at postgraduate level (Di Ianni & Walker 2006:48-50; Graham & Metter 2007:257; Jensen 1977:482-483). Nuclear medicine is the branch of medical imaging that uses radionuclides for diagnostic purposes, and to a lesser extent, for the treatment of diseases (Van Heerden 2012:online). The American Board of Nuclear Medicine (ABNM) defines nuclear medicine as "the medical specialty that uses the tracer principle, most often with radiopharmaceuticals, to evaluate molecular, metabolic, physiologic and pathologic conditions of the body for the purposes of diagnosis, therapy and research" (ABNM 2012:online).

Only six of the eight Schools of Medicine (SoM) in South Africa (SA), a substitute term for RSA throughout the study, currently offer the postgraduate Master of Medicine in Nuclear Medicine [MMed (Nuclear Medicine)] programme, and not all of them offer undergraduate level nuclear medicine education (Ellmann 2008:online). For undergraduate medical students to understand the basic principles of nuclear medicine, they must have prior knowledge of anatomy, physiology, physics and pathology as well as some clinical knowledge. In their pre-clinical, basic-sciences years they have very little exposure to clinical medical practices and the clinical years are already overloaded with information, leaving little time for any clinical medical imaging education.

By implementing a standardised, structured undergraduate medical nuclear medicine educational module, medical students can acquire the necessary knowledge and skills and the desired attitude directly from nuclear medicine physicians and other nuclear medicine personnel, who are actually doing and interpreting the radionuclide studies. Students can be provided with more accurate and unbiased knowledge, skills and expectations rather than second-hand teaching they would receive during ward rounds from inexperienced and poorly informed medical interns, community-service doctors or other clinical physicians (Buckenham 2005:1-3; Ell 1997:1081-1082).

The aim of this first chapter is to orientate the reader to the study. It provides background to the research problem and the problem statement, including the research questions, the overall aim, goal and objectives of the study. This is followed by a demarcation of the study, which highlights the significance and value thereof. Thereafter, a brief overview of the research design and methods of investigation is presented. The chapter is concluded by setting out the content of subsequent chapters and providing a short summative conclusion.

1.2 BACKGROUND TO THE RESEARCH PROBLEM

The problem (cf. Paragraph 1.3.1) that initiated the research study was that the local Nuclear Medicine Department at the University of Free State's (UFS) experienced problems when patients were referred for diagnostic imaging studies and radioactive therapy by newly qualified doctors. The poor quality and inadequacy of referral letters to the local UFS Nuclear Medicine Department, at the beginning of each year, exposes the lack of basic knowledge, skills and desired attitude towards nuclear medicine (cf. Paragraph 1.3.1). The newly qualified medical interns and community-service doctors who are responsible for ordering and booking nuclear medicine examinations do not have the theoretical knowledge, practical experience or skills necessary for effective utilisation of nuclear medicine imaging procedures (Ell 1997:1081-1082; Subramaniam, Hall, Chou & Sheehan 2005:1-3).

Medical students, as future referring clinicians, should be exposed to the imaging modalities as early as possible in their careers. Their knowledge or lack of knowledge regarding nuclear medicine can have an impact on their utilisation of nuclear medicine procedures for diagnosis of and therapy for their patients (Lass & Scheffler 2003:1018). Most general practitioners have limited knowledge of nuclear medicine imaging, due to a lack of appropriate undergraduate nuclear medicine education, and they regard nuclear medicine as a specialist modality only (Zakavi, Pourzahed & Derakhshan 2004:55-57).

The Health Professions Council of South Africa's (HPCSA's) minimum curriculum requirements for MBChB programmes include Nuclear Medicine, together with Medical Imaging (Radiology), Radiation Oncology and Radiation Protection as an ancillary subject (cf. Tables 2.5 and 2.6) to be taught with the main subjects (HPCSA 2012:online). Despite this prescription, no formal directives currently exist to guide programme directors or Nuclear Medicine Departments on an appropriate undergraduate medical nuclear medicine educational module. The more specific outcomes of the HPCSA for the MBChB programmes also require students to be able to utilise special investigations and new technologies in an appropriate and cost-effective way and to acquire the necessary skills to interpret findings, make diagnosis, communicate well, work in multi-disciplinary teams and acquire referral skills (HPCSA 2012:online; RCR 2012:6,8).

The exit-level outcomes of the South African Qualifications Authority (SAQA) specify that medical students must be able to demonstrate the ability to utilise diagnostic aids and work as team members (cf. Tables 2.5 and 2.6). They must be able to interpret findings, diagnose and treat diseases, ensure quality health care and communicate well with their patients and colleagues (SAQA 2012:online).

Undergraduate medical students must understand where nuclear medicine fits into the diagnostic pathways and be empowered to utilise diagnostic modalities in the diagnostic workout of their patients effectively. This will reduce unnecessary examinations and patient exposure, to ionising radiation (Branstetter, Faix, Humphrey & Schumann 2007:W9-W14; Jensen 1977:482-483; Kourdioukova, Valcke, Derese & Verstraete 2011:309-318; Mubeen, Abbas & Nisar 2008:120).

Sternberg (1965:694) proposed the introduction of nuclear medicine as part of the regular undergraduate curriculum of medical students as long ago as 1965. The intention of presenting such a basic undergraduate nuclear medicine module is not to make medical students 'mini' nuclear medicine specialists, but to familiarise them with nuclear medicine and to provide basic knowledge, skills and attitude towards this clinical medical imaging modality (Jensen 1977:482-483; Sternberg 1965:694). Taking all this information into consideration, it is evident that the current undergraduate medical teaching of nuclear medicine imaging in South Africa is unstructured and insufficient, with the following problem emanating from this state of affairs.

1.3 PROBLEM STATEMENT AND RESEARCH QUESTIONS

1.3.1 Problem statement

According to the experience of the Nuclear Medicine Department at the UFS, newly qualified medical interns and some of the community-service doctors do not know how to use nuclear medicine imaging in the diagnostic workout of their patients (cf. Section 1.2). The problem is that this lack of knowledge and skills regarding nuclear medicine impacts negatively on service delivery and patient care. For the clarity of this study 'research problem' will be used as substitute term for the problem that initiated the research study.

1.3.2 Research question and sub-questions

Nuclear medicine education at undergraduate level in South African Schools of Medicine is not yet standardised and no directives or guidelines exist to ensure uniformity and higher-educational standards as expected for the MBChB (Professional Medical) programmes.

The implementation of nationally accepted guidelines for undergraduate medical nuclear medicine education in South Africa will contribute to the effective utilisation of nuclear medicine as an imaging modality by newly qualified interns and community-service doctors. The research question that emanated from this postulate was as follows:

- ***What will the guidelines be for an undergraduate nuclear medicine educational module in the MBChB programmes in South Africa?***

To develop such guidelines, the current status of undergraduate medical nuclear medicine education in South Africa must be known. The answers to several other sub-questions regarding such an educational module are required to answer the research question as such. The questions below include editorial corrections and might slightly differ from those in the questionnaires (cf. Appendix E2 and E4).

- ***WHY*** is it necessary to implement an undergraduate medical nuclear medicine educational module in the MBChB programme? Who or what will benefit from such a module?

- ***WHEN*** will be the most effective time to introduce such a basic nuclear medicine module in the already overloaded undergraduate MBChB programme – in the pre-clinical, clinical or in both phases of the existing programme?

- ***WHICH*** nuclear medicine topics or subjects will be most appropriate at undergraduate level?

- ***WHAT*** should the extent of the contents for each subject or topic be at undergraduate level?

- ***By WHOM*** should this module be taught – by nuclear medicine physicians or by other clinical physicians during ward rounds?

- ***HOW*** should the undergraduate nuclear medicine module be presented to the students? ***WHAT*** teaching and learning and assessment strategies and methods should be used?

- ***HOW*** should the module be incorporated into the existing programmes – integrated with other clinical or imaging disciplines, as an independent module in an independent nuclear medicine discipline or a combination of both?

1.4 OVERALL AIM, GOAL AND OBJECTIVES OF THE STUDY

1.4.1 Aim of the study

The aim of this study is to provide guidelines for an effective, nationally accepted, undergraduate nuclear medicine education, as part of a module, in MBChB programmes in South Africa. For the clarity of this study 'module' will be used as substitute term for 'educational module'.

1.4.2 Overall goal of the study

The goal of this study is two-fold. First, the goal is to investigate national educational trends in nuclear medicine for undergraduate medical students in the different Schools of Medicine in South Africa and, second, to investigate international educational trends in nuclear medicine education for undergraduate medical students.

1.4.3 Objectives of the study

In order to address the aim of the study, namely, to provide guidelines for an undergraduate nuclear medicine module in MBChB programmes in South Africa, the following objectives will be pursued:

Objective 1: To gain a deeper insight into current worldwide trends of undergraduate medical nuclear medicine education, to provide the necessary context of the study. **(Theoretical literature perspective and document analysis)**

Objective 2: To obtain information about the current trends of undergraduate medical nuclear medicine education in the Schools of Medicine in South Africa. **(Theoretical literature perspective and document analysis, as well as semi-structured survey questionnaires with both closed and open-ended questions to key academic nuclear medicine educators)**

Objective 3: To obtain the opinions of nuclear medicine experts in South Africa regarding the sub-questions asked, in order to answer the main research question.
(Semi-structured survey questionnaires with both closed and open-ended questions, completed by academic and private nuclear medicine experts in South Africa)

Objective 4: To use the results from Objectives 1, 2 and 3 to provide guidelines for undergraduate medical nuclear medicine education for MBChB programmes in South Africa.

1.5 DEMARCATION OF THE FIELD AND SCOPE OF THE STUDY

This study will be done in the inter-disciplinary fields of Health Professions Education (HPE) and Nuclear Medicine Imaging in the undergraduate MBChB programmes. It lies in the domain of academic programme design and delivery. The focus will be on providing guidelines for standardisation and uniformity of the undergraduate medical nuclear medicine education in MBChB programmes in South Africa. The findings of this study could be applied in the Schools of Medicine in South Africa as part of their clinical medical imaging education in the existing MBChB programmes.

The participants in the semi-structured survey questionnaires in this study will be the six key persons from academic Nuclear Medicine Departments, who currently present undergraduate medical nuclear medicine modules in their MBChB programmes. All other academic and private nuclear medicine experts in South Africa will be given the opportunity to participate in the study by completing the expert questionnaire (cf. Paragraph 1.7.1.2).

In a personal context, the researcher in this study is a qualified medical practitioner registered with the HPCSA (MP 0271772). On completion of a MBChB degree, the researcher worked in the Community Health Department of the Free State (FS) Department of Health (DoH), attending to its staff members' health, while also presenting clinical lectures to students at the Ambulance College of the National Hospital in Bloemfontein, South Africa.

The researcher received no formal nuclear medicine education during her undergraduate medical studies and her experience of this clinical medical imaging modality was limited to the ordering of thyroid scintigrams (radioactive scans of the thyroid) during the internship year and working as a medical officer in the Oncology Department of the FS DoH from 1988 to 1990.

The researcher started working as a principal medical officer in the Nuclear Medicine Department of the FS DoH in 1990 and is still in their employment, giving her 23 years of in-service experience in the Nuclear Medicine Department. In addition to providing clinical services, the researcher has also been involved in undergraduate medical nuclear medicine education at the School of Medicine at the UFS since 1991. As a qualified medical practitioner, the researcher does not have any formal background in student teaching and learning, which were therefore incorporated from a clinical perspective only. The researcher developed an interest in HPE in 2009 after attending various staff-development sessions at the HPE Department of the Faculty of Health Sciences (FoHS) at the UFS. As far as the timeframe for this research study is concerned, it commenced in 2012 as part of the Masters of Health Professions Education degree, with the empirical phase taking place from February 2013 to June 2013 (cf. Figure 1.1).

1.6 THE VALUE AND SIGNIFICANCE OF THE STUDY

The overall value of this study is related to providing guidelines for a more structured and standardised undergraduate medical nuclear medicine module in the MBChB programmes in South Africa. The value and significance of the study are presented on three (3) levels namely:

- Undergraduate medical students;
- Nuclear Medicine Departments and Private Nuclear Medicine Practices; and
- National value.

1.6.1 Undergraduate medical students

The main value of the study lies in the empowering of undergraduate medical students to utilise nuclear medicine effectively during their diagnostic workout of patients. The intention is not to make them 'mini' nuclear medicine physicians, as previously mentioned, but to ensure that they acquire the necessary knowledge, skills and perspective towards nuclear medicine as a medical, clinical and diagnostic imaging modality (Jensen 1977:482-483). It is important for them to know what to expect from the physiologically-orientated nuclear medicine scan and to know how it complements the more anatomically-orientated radiology procedures.

Students will be familiarised with the basic workflow of the Nuclear Medicine Department, so that they can communicate effectively with their patients, the families and other healthcare workers (Buckenham 2005:1-3; Mosier, Olson & Smith 1981:555-559; Rogers 2003:1201). Students will, in addition, be made aware of the effects of ionising radiation and of radiation-protection procedures (cf. Paragraphs 2.2.3 and 2.5.2.2) necessary to minimise unnecessary exposure for their patients (Gunderman & Stephens 2009:859-861;

Mosier *et al*. 1981:555-559; Mubeen *et al*. 2008:120). The importance of the cost aspects of the different radionuclide studies will furthermore also be brought to their attention.

The issuing of high-quality and adequate referral letters and effective communication with the local Nuclear Medicine Department regarding patient preparation prior to the imaging procedures will be strongly emphasised. This may contribute to the improvement of students' service delivery and patient care. Students' conceptualisation of the vocabulary of nuclear medicine will be important for interpreting reports and preventing misunderstandings.

1.6.2 Nuclear Medicine Departments and Private Nuclear Medicine Practices

The value and significance of the study for the Nuclear Medicine Department will be on two levels. It will involve service delivery and educational functions.

At the service delivery level, the education will improve the referrals and preparation of patients prior to nuclear medicine imaging procedures. Improved communication will also contribute to better patient care and satisfaction. If the referring doctor can communicate to the patient what to expect, patients will be better prepared for the procedures. If these future referring medical doctors are familiar with nuclear medicine scans and understand where the scans fit into the diagnostic pathways, they will be more willing to utilise the services from their private practices and not regard it as a specialised modality only (Di Ianni & Walker 2006:48-50; Gunderman, Siddiqui, Heitkamp & Kipfer 2003:1239-1242).

At undergraduate educational level, the acquired information can serve as a benchmark to compare existing undergraduate programmes with national and international standards. Guidelines for undergraduate level teaching of nuclear medicine could be developed from all the experts' opinions, to ensure a more uniform and standardised module in the MBChB programmes (ESR 2011:363-374; McAfee, Powell, O'Mara, Friedman, Holmes & Nelp 1973:22-31; RCR 2011:online).

1.6.3 National value

At national level, the value of the module will be to provide guidelines for all the Schools of Medicine in South Africa for implementing a formal, standardised, undergraduate medical nuclear medicine module. Medical students and future medical interns from the different Schools of Medicine will consequently be exposed to the same level of undergraduate medical nuclear medicine teaching and will know where, when and how to utilise nuclear medicine imaging services for the benefit of their patients. It may also increase interest in nuclear medicine as a specialisation field and attract students for postgraduate studies. The increasing utilisation of nuclear medicine imaging procedures, can, in turn, secure the future of nuclear medicine as an independent clinical imaging modality (Gunderman *et al.* 2003:1239-1242).

1.7 RESEARCH DESIGN OF THE STUDY AND METHODS OF INVESTIGATION

1.7.1 Design of the study

To answer the research question and to achieve the objectives, a non-empirical theoretical literature perspective will provide an indication of current national and international trends in undergraduate nuclear medicine education. For the empirical study, primary data will be acquired by making use of semi-structured survey questionnaires with both quantitative and qualitative components.

This research study is a descriptive study with situation-analysis components. The analytical component will analyse and explain the current situation regarding undergraduate medical nuclear medicine education in South African Schools of Medicine.

1.7.1.1 *Theoretical literature perspective and documentary analysis*

The literature perspective will have the specific aim of investigating undergraduate medical nuclear medicine educational trends, both nationally and internationally (cf. Section 2.1 and Paragraph 3.3.1). It provides the necessary background and context to the stated research question. It also forms the basis of the development of the semi-structured survey questionnaires and will eventually contribute to the development of guidelines for undergraduate medical nuclear medicine education in South Africa.

1.7.1.2 *Semi-structured survey questionnaires*

Semi-structured survey questionnaires were used to collect standardised, fixed data from all the relevant key persons and nuclear medicine experts (cf. Section 1.5). The same sets of questions were asked in the same order and ways, to collect the same information from all the participants (cf. Appendices E2 and E4).

A formal list of semi-structured questions, including both closed and open-ended questions was sent via email to six key person participants. These key persons completed the main questionnaire comprising five sections (cf. Section 4.2). The questionnaire was shortened to three sections, the questions on undergraduate medical curricula and the nuclear medicine module were removed, and it was sent to all other nuclear medicine experts in South Africa (cf. Section 4.2).

The questionnaires were provided only in English in order to standardise specific themes of opinions and trends used by the participants in the open-ended questions. The format and contents of the questionnaires were sourced from applicable studies that had been done in Europe (Kourdioukova *et al*. 2011:309-318; Lass & Scheffler 2003:1018-1023; McAfee *et al*. 1973:22-31; Oris, Verstraete & Valcke 2012:121-130; RCR 2012:online).

1.7.2 Methods of investigation

The research method selected to accomplish the measurement and conceptual analysis of the required data is a survey questionnaire. As pointed out above, the semi-structured survey questionnaires consisted of both closed and open-ended questions, combining a quantitative study with qualitative components (cf. Paragraph 3.3.2 and Section 4.2) (Joubert, Ehrlich, Katzenellenbogen & Karim 2010:109-110).

A Likert-type frequency scale (McLeod 2008:online) was used to identify specific undergraduate level nuclear medicine subjects and topics to be included in a proposed module as part of the programme. Participants were asked to rate each subject and topic on a 1-to-3 response scale.

The targeted survey population and the sample were the same and consisted of academics and experts in private practice in the field of nuclear medicine imaging (cf. Paragraph 3.3.3). The key persons in each academic Nuclear Medicine Department were identified by the Deans of the FoHSs during the approval phase of the study; their names were provided to the researcher. A situation of quasi-anonymity existed, as the identities of the key participants were known to the researcher (cf. Paragraph 3.5.4).

The *EvaSyS* educational internet-based survey-management system of the UFS was utilised for questionnaire distribution and for the data-collection process (cf. Paragraph 3.3.5 and Section 4.2). The hyperlink to the questionnaires was provided in the email and regular updates were provided on questionnaire completions (cf. Paragraph 3.3.5). The pilot study was done with two individuals who met the same criteria as those in the survey population (cf. Paragraph 3.3.4).

Ethical considerations (cf. Section 3.5) received high priority throughout the study, and involved obtaining approval from the Ethics Committees of the respective FoHS at UFS (cf. Appendix A1) and the University of Cape Town (UCT) (cf. Appendix B1), as well as approval from the Deans of other South African FoHSs (cf. Appendices C1 – C9). Ensuring the quality of the study and participants' right to privacy and confidentiality was a high priority and all possible means were utilised to ensure the validity and reliability of the study results.

1.8 IMPLEMENTATION OF THE FINDINGS

This mini-dissertation, which contains the findings of the research, will be brought to the attention of FoHS and SoM in South Africa so that it may serve as a benchmark for current (or, in certain cases, non-existent) undergraduate nuclear medicine modules in MBChB programmes. These guidelines, compiled from the opinions of the nuclear medicine experts who completed questionnaires, may ensure a more uniform and standardised module in MBChB programmes in South Africa, thereby addressing the lack of knowledge and skills of newly qualified doctors regarding nuclear medicine imaging.

The research findings will be presented at appropriate conferences and submitted to academic journals with a view to publication, as the researcher hopes to make a contribution to undergraduate medical nuclear medicine education in South Africa.

A summary and overview of the study process is given in Figure 1.1.

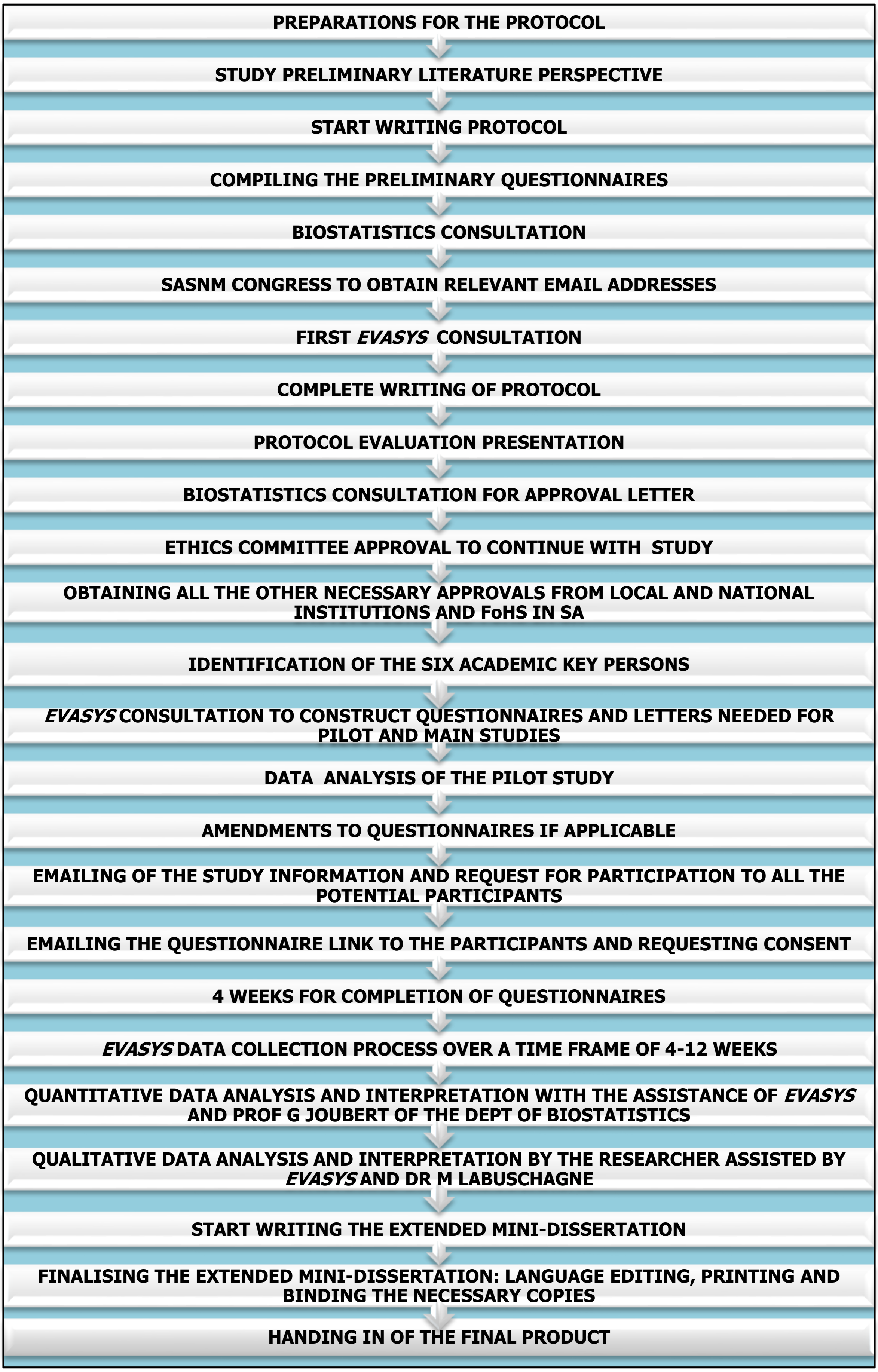


FIGURE 1.1: SCHEMATIC OVERVIEW OF THE STUDY [Compiled by the researcher, Nel 2013]

1.9 ARRANGEMENT OF THE MINI-DISSERTATION

To provide more insight into the topic, the methods used to find solutions and the final outcome of the study, the mini-dissertation is set out as follows:

In this chapter, Chapter 1, **Orientation to the study**, the background to the study was provided and the problem, including the research question, was stated. The overall aim, goal and objectives were stated and the research design and methods that were employed were discussed briefly to give the reader an overview of the content of the report. It further demarcated the field of the study and the significance of guidelines for undergraduate nuclear medicine education in MBChB programmes in South Africa.

Chapter 2 will be discussing the **Theoretical perspective on undergraduate medical nuclear medicine education nationally and internationally.** Current national trends in undergraduate nuclear medicine education will be compared with international trends and this comparison will serve as the theoretical framework of the study. The answers to the sub-questions of why, what, when, how, by whom and in which way will be addressed and attention will be given to the clarification of what the guidelines for such undergraduate medical nuclear medicine education should be.

In Chapter 3, the **Research design and methodology** will be described in detail. The data-collecting methods and data analysis will be discussed. This discussion will include the way in which the questionnaires were constructed and distributed by means of the sophisticated *EvaSys* educational research system of the UFS. The *EvaSys* system not only provided an email-based hyperlink to the questionnaires, but also contributed to the data gathering and processing.

In Chapter 4, the **Quantitative analysis of the semi-structured survey questionnaire results,** will be reported and discussed. The key persons' and nuclear medicine experts' results will be reported and discussed separately according to the questionnaires sections.

In Chapter 5, the **Qualitative analysis of the semi-structured survey questionnaire results** will be reported and discussed. The key persons' and the nuclear medicine experts' results will be reported and discussed separately according to the questionnaires sections.

In Chapter 6, **Guidelines for undergraduate nuclear medicine education in the MBChB programmes in South Africa**, the guidelines as the final outcome of the study will be provided, contextualised and discussed in full.

In Chapter 7, an overview of the study's **Conclusions, recommendations and limitations** will be provided.

1.10 CONCLUSION

This chapter, Chapter 1, provided the background and introduction to the research undertaken regarding the provision of guidelines for undergraduate nuclear medicine education in MBChB programmes in South Africa. The value of this study, put forward in previous paragraphs, will be to provide all the Schools of Medicine in South Africa with guidelines to implement a formal, standardised undergraduate medical nuclear medicine educational module. Medical students and future medical interns from the different Schools of Medicine will then be exposed to the same level of undergraduate medical nuclear medicine teaching and will know where, when and how to utilise nuclear medicine imaging to the benefit of their patients.

The next chapter, Chapter 2, titled **Theoretical perspective on undergraduate medical nuclear medicine education nationally and internationally** will provide a study of the relevant literature and documents consulted to generate the theoretical perspective and form the basis of the research study.

CHAPTER 2

THEORETICAL PERSPECTIVE ON UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION NATIONALLY AND INTERNATIONALLY

2.1 INTRODUCTION

At undergraduate level, medical nuclear medicine education at Schools of Medicine in South Africa has not yet been standardised and no directives or guidelines exist to ensure uniformity and higher education standards as could be expected of such professional medical programmes.

The aim (cf. Paragraph 1.4.1) and national value (cf. Paragraph 1.6.3) of this study was to provide guidelines to all the Schools of Medicine in South Africa regarding the implementation of a formal, standardised undergraduate medical nuclear medicine module in their existing medical curricula. As previously mentioned, medical students and future medical interns will then be exposed to the same level of undergraduate medical nuclear medicine teaching and will know where, when and how to utilise Nuclear Medicine Imaging services to the benefit of their patients (cf. Paragraph 1.6.1).

The previous chapter, Chapter 1, provided the introduction (cf. Section 1.1) and the background (cf. Section 1.2) to the research study undertaken regarding the guidelines for undergraduate nuclear medicine education in MBChB programmes in South Africa.

This chapter, Chapter 2, provides a theoretical perspective based on literature and documents on aspects pertaining to this research study. The aim of the theoretical literature perspective was to investigate educational trends pertaining to undergraduate medical nuclear medicine teaching nationally and internationally (cf. Paragraphs 1.7.1.1 and 3.3.1). It provided the background of the study and a foundation for the research design and content of the semi-structured survey questionnaires, and will eventually contribute to the development of guidelines for an undergraduate medical nuclear medicine module in existing undergraduate medical curricula in South Africa (cf. Paragraph 1.8 and Section 6.3).

The assistance of library personnel and resources were utilised to obtain relevant research literature; preference was given to articles from accredited international and national journals. Electronic search engines like PubMed and Medline were used; the keywords used were undergraduate medical nuclear medicine education/teaching, diagnostic imaging, clinical imaging, medical imaging, radiology, education and teaching. Additional references (cf. Paragraph 3.4.5) were sourced from all the acquired nuclear medicine related websites and by scanning the references from the published articles relevant to the research topic.

The topics that were under investigation are mainly the following:

1. Other research studies done on the same research problem;
2. The latest literature available on the research subjects;
3. Theoretical perspectives on Medical Radiation Science (MRS) and clinical radiological imaging, including radiology, nuclear medicine and molecular imaging, as well as their complementary roles in total patient care (cf. Section 2.2);
4. Theoretical perspective on higher education principles and practices applicable to this study (cf. Section 2.3);
5. Expectations of newly qualified doctors;
6. Expectations of medical educators;
7. Theoretical perspectives on higher education and medical education in South Africa;
8. The place of medical, clinical and diagnostic imaging education, and specifically undergraduate nuclear medicine education, in undergraduate medical curricula;
9. The research question and sub-questions to be answered regarding undergraduate nuclear medicine education; and
10. Relevant guidelines, identified from a study of theoretical literature that may be implemented in a formal, standardised undergraduate medical nuclear medicine module that complies with international trends and standards. Chapter 6 will discuss these guidelines in more detail.

Figure 2.1 provides a diagrammatic overview of the main elements applicable to this study as mentioned in the previous section, stipulating the different points from three to ten.

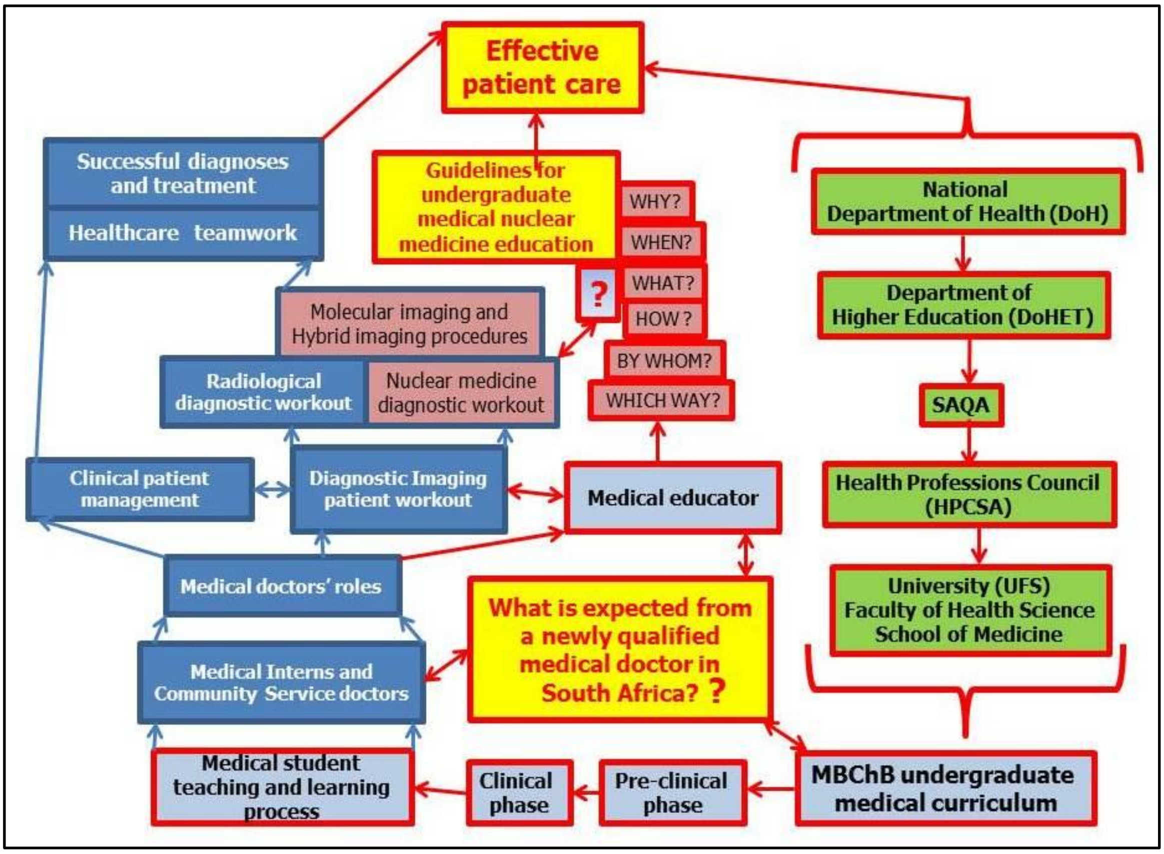


FIGURE 2.1: A DIAGRAMMATIC OVERVIEW OF THE DIFFERENT ASPECTS OF THE RESEARCH [Compiled by the researcher, Nel 2014]

Note: The colour coding in Figure 2.1 represents the different elements referred to, as follows:

Clinical nuclear medicine service delivery (cf. Paragraph 2.2 and 2.3) General clinical service delivery	3. Theoretical perspectives on Medical Radiation Science (MRS) and clinical radiological imaging, including radiology, nuclear medicine and molecular imaging, as well as their complementary roles in total patient care (cf. Paragraph 2.2)
Undergraduate nuclear medicine teaching and learning [module] (cf. Paragraph 2.5, Chapter 4, 5 and 6)	8. The place of medical, clinical and diagnostic-imaging education, and specifically undergraduate nuclear medicine education, in undergraduate medical curricula 9. The research question and sub-questions to be answered regarding undergraduate nuclear medicine education 10. Relevant guidelines, identified from a study of theoretical literature that may be implemented in a formal, standardised undergraduate medical nuclear medicine educational module that complies with international trends and standards
Undergraduate medical teaching and learning (cf. Paragraph 2.3 and Chapter 4)	4. Theoretical perspective on higher education principles and practices applicable to this study (cf. Paragraph 2.3) 8. The place of medical, clinical and diagnostic-imaging education, and specifically undergraduate nuclear medicine education, in undergraduate medical curricula
Regulatory and legislating bodies for Undergraduate medical education in SA (cf. Paragraph 2.4)	5. Expectations of newly qualified doctors 6. Expectations of medical educators 7. Theoretical perspectives on higher education and medical education in South Africa
Main research problem, question and sub-questions in undergraduate medical education	5. Expectations of newly qualified doctors 9. The research question and sub-questions to be answered regarding undergraduate nuclear medicine education 10. Relevant guidelines, identified from a study of theoretical literature that may be implemented in a formal, standardised undergraduate medical nuclear medicine educational module that complies with international trends and standards (cf. Chapter 6)

2.2 THEORETICAL PERSPECTIVE ON MEDICAL RADIATION SCIENCE AND CLINICAL RADIOLOGICAL IMAGING TECHNIQUES

This section of the theoretical perspective deals with existing knowledge and information regarding Medical Radiation Science (MRS) and radiological imaging in patient care.

2.2.1 Introduction

MRS is considered as the study of ionising radiation energy in the diagnosis, treatment and follow-up of medical diseases (U.S. Department of Health, Education, and Welfare 1966:1). According to the National Advisory Committee on Radiation (NACOR) Report (U.S. Department of Health, Education and Welfare, 1966:1-25) the use of X-rays in the diagnosis and treatment of medical and surgical diseases led to the emergence of various radiological imaging sub-divisions known as *"diagnostic roentgenology"* and *"clinical radiation therapy "* (U.S. Department of Health, Education, and Welfare 1966:1). Artificially created radionuclides, on the other hand, were discovered between 1934 and 1940 and has led to the development of the clinical radiological discipline known as *"nuclear medicine"*, where radioactive materials were used in clinical medicine (U.S. Department of Health, Education, and Welfare 1966:2).

According to the NACOR Report clinical radiological imaging modalities or diagnostic imaging modalities were sub-divided into the following clinical medical disciplines (U.S. Department of Health, Education, and Welfare 1966:3):

- ***Diagnostic "roentgenology" (radiography/radiology)***: Refers to the usage of X-rays in the diagnosis of disease;
- ***Nuclear medicine***: Refers to the usage of radioactive materials to study physiological processes in the diagnosis and treatment of disease (WNA 2011:online); and
- ***Clinical radiation therapy***: Refers to the usage of ionising radiation, including that produced by X-ray machines, particle accelerators and radioactive materials, in the treatment of disease.

Diagnostic radiography, nuclear medicine and ***clinical radiation therapy*** are often collectively referred to as ***'radiology'*** (U.S. Department of Health, Education, and Welfare 1966:3).

2.2.2 Nuclear medicine imaging techniques, technologies, procedures or investigations (radionuclide or radioisotope imaging)

Diagnostic and therapeutic radiological techniques currently incorporate several medical imaging procedures and play an important role in making clinical diagnoses for patient management (Barrett, Shaida & Shaw 2010:online; U.S. Department of Health, Education, and Welfare 1966:1-25; SNMMI 2011:online). The American Board of Nuclear Medicine (ABNM) defines nuclear medicine as "the medical specialty that uses the tracer principle, most often with radiopharmaceuticals, to evaluate molecular, metabolic, physiologic and pathologic conditions of the body for the purposes of diagnosis, therapy and research" (ABNM 2012:online). Nuclear medicine includes diagnostic and therapeutic aspects of disease management and differs from other clinical medical imaging modalities because it determines the presence of disease on the basis of biological and pathophysiological changes (Ellmann 2013:279) rather than changes in morphology and anatomy.

2.2.2.1 *Diagnostic applications of radionuclides in conventional nuclear medicine imaging techniques*

Widespread clinical use of nuclear medicine imaging procedures started in the early 1950s. In addition to the treatment of thyroid cancer in 1946 with radioactive iodine (cf. Paragraph 2.2.2.3) smaller doses of radioactive iodine is used to measure thyroid functions, diagnose thyroid diseases and treatment of hyperthyroidism/Graves' disease. Nuclear medicine techniques still in use today include, among others, the diagnosis and treatment of hyperthyroidism or Graves' disease, bone scans for musculoskeletal problems, cardiac stress tests to analyse heart function (myocardial perfusion imaging), gated blood pool studies, hepatic-biliary imaging, lung scans for pulmonary emboli with accompanying aerosol ventilation studies, labelled white-blood cells, octreo-scans, meta-iodo-benzyl-guanidine (MIBG), and parathyroid imaging. Nuclear medicine imaging procedures are therefore an integral part of daily patient care in medical specialties ranging from paediatrics, cardiology, oncology and psychiatry (Brink 2013:406-407; Libhaber 2013:304-306; SNM 2012:online).

2.2.2.2 *Radionuclide-radiology: integrated, hybrid nuclear medicine and diagnostic radiology technologies*

More modern forms of nuclear medicine imaging techniques include SPECT (single-positron-emission-computed tomography) and PET (positron-emission tomography) imaging. The combination of functional dual-headed gamma cameras with CT (Computed Tomography) scanners is regarded as integrated, hybrid, fusion-imaging techniques named SPECT/CT. In this way, highly detailed images of both anatomy and function of bodily organs and tissues are produced (SNMMI 2011:online).

FDG-PET (Fludeoxyglucose Positron-Emission Tomography) images can also be viewed either in combination with CT or MRI (Magnetic Resonance Imaging) as PET/CT or PET/MRI scans. FDG-PET offers functional information and MRI and CT scans provide high-resolution anatomical information (NAS 2007:online; Warwick & Lotz 2013a:298-303). PET/CTs most important clinical role is in oncology, cardiac and brain imaging (Ellmann 2013:279-283; Kotze 2013:284-288; Libhaber 2013:304-306; Sathekge, Warwick, Vangu, Ellmann & Mann 2006: 598, 600-601; Warwick 2013:307-311; WNA 2011:online). These new techniques are currently frequently used in the advancing field of molecular imaging, regarded as the next generation of nuclear medicine imaging technologies.

2.2.2.3 *Therapeutic applications of radionuclides (Internal radionuclide therapy)*

As mentioned in Paragraph 2.2.2.1, the treatment of thyroid cancer with radioactive iodine was one of the earliest therapeutic applications of nuclear medicine. The "atomic cocktail" was first used to treat thyroid cancer in 1946 (Educational Content 2012:online).

Radionuclide therapies that are currently available are listed by Sathekge (2013:289-294) and include:

- Radioactive iodine therapy to treat hyperthyroidism;
- Radioactive iodine therapy to treat differentiated thyroid cancer (follicular and papillary);
- I-131-meta-iodobenzylguanidine (I-131-MIBG) to treat neuro-endocrine tumours (NET), carcinoid and medullary thyroid carcinomas;

- Neuro-endocrine peptide receptor radionuclide therapy in adult patients with neuro-endocrine cancer;
- Bone-seeking radionuclides like samarium-153-ethylene-diamine-tetramethylene-phosphoric acid (153Sm-EDTMP) and Strontium Sr-89 in metastatic bone pain for pain palliation;
- Radioisotope joint synovectomies with the radionuclides Y-90, Re-186 and Er-169 in chronic synovitis with recurrent joint effusions and haemarthrosis in haemophilia patients;
- Radio immunotherapy (RIT) in non-Hodgkin's lymphomas;
- Selective internal radiation therapy for primary and secondary liver cancer;
- Targeted alpha therapy (TAT) or alpha radio immunotherapy where the radio therapeutic pharmaceutical "selectively deliver radiation" to specific tumour cells and cancer tissue "with minimal toxicity to surrounding normal tissues".
- Short-range radiotherapy or brachytherapy is also regarded as a means of radioactive treatment (WNA 2011:online).

2.2.3 The role of ionising radiation in diagnostic and therapeutic procedures

The application of ionising radiation in clinical medicine, either through the use of X-rays or the administration of radioactive materials during the diagnosis and treatment of disease, mostly benefit patient management (U.S. Department of Health, Education, and Welfare 1966:1-25). The radiation risks involved in these procedures is very low if compared with the potential benefits. There are no known long-term adverse side effects from nuclear medicine procedures (Barrett *et al*. 2010:online; SNMMI 2011:online).

The amount of radiation from diagnostic nuclear medicine imaging procedures should be kept within a safe limit according to the ALARA ("as low as reasonably achievable") principle (Munro, Ostensen, Ingolfsdottir & World Health Organization 2004). The increasing use of FDG-PET/CT scanning creates a greater awareness as to the contribution of medical imaging techniques to increase patients' radiation exposure.

The functional nature of nuclear medicine scans and the low doses of radiation used, make it a safe and effective diagnostic tool for children (Brink 2013:406-407). Pregnant and breast-feeding patients should inform the nuclear medicine physician or technologist prior to having a nuclear medicine procedure, because some of the pharmaceuticals used in nuclear medicine techniques may pass into a lactating woman's breast-milk and subsequently to the child. Legislation places a legal responsibility on clinicians who refer patients for investigations that involve radiation exposure. Legal requirements relating to informed consent are relevant to some referrals, especially referred children (RCR 2012:online). It is therefore the responsibility of all healthcare providers to equip themselves with current and appropriate knowledge about ionising and non-ionising radiation.

Mubeen *et al.* (2008:118-121) state that medical students lack knowledge about various aspects of radiation sources, the risk involved and protection against this risk. Providing medical students with sufficient and precise knowledge regarding different aspects of radiation will improve their communication with patients and this would leads to better healthcare outcomes (Mubeen *et al*. 2008:online).

2.2.4 Clinical imaging education in undergraduate medical education

The practice of clinical medicine and surgery has changed dramatically over years with an increasing reliance on diagnostic tests, whether biochemical, haematological or radiological. In the current era of sophisticated imaging modalities, radiological investigations (including nuclear medicine) play a central role in patient management and in healthcare delivery. No other medical specialty comes in contact and work together with such a wide range of medical disciplines as imaging departments (Di Ianni & Walker 2006:48-50).

It is therefore necessary that medical practitioners and specialists, as well as medical students, should be provided with a basic knowledge of the imaging departments, as well as an understanding of clinical imaging procedures. They should understand the values, indications, advantages and disadvantages and, to a certain extent, also the costs and financial implications of these technologies, procedures, investigations or examinations, so that they can optimise its utilisation and improve their communication with patients in the clinic or the ward (Barrett *et al.* 2010:online; Pascual, Chhem, Wang & Vujnovic 2011:321; U.S. Department of Health, Education, and Welfare 1966:1-25).

Gunderman *et al*. (2003:1239-1242) emphasise that it was in imaging departments' own interest to contribute to the education of the next generation of medical doctors, and no longer "willingly cede" teaching of clinical imaging procedures to other clinical disciplines involved in medical education. If imaging departments play a significant role in undergraduate medical education, they will ensure that students learn clinical radiological imaging principles and techniques directly from imaging specialists, who can teach clinical diagnostic imaging better than anyone else.

Subramaniam *et al.* (2005:1-3) point out that although radiological imaging has undergone significant changes, these changes were still not fully included and implemented in undergraduate medical school curricula. Despite the enormous changes, radiological imaging training is still not a 'core' subject matter in medical school curricula; it is considered only as an adjunct or ancillary (cf. Tables 2.5, 2.6 and 6.2) subject to clinical modalities.

Kourdioukova *et al*. (2011:309-318) give an indication of existing information regarding such undergraduate imaging educational involvement in European Schools of Medicine. They firstly reported on the lack of undergraduate radiological imaging educational programs in European medical schools and secondly emphasise the lack of uniformity in existing undergraduate clinical imaging educational programs. They pointed out that according to a White Paper by the European Society of Radiology (ESR 2011:363-374) on undergraduate radiological education, a "critical core" curriculum for undergraduate radiological imaging was recommended to be integrated across the existing medical curricula.

The ESR White Paper (ESR 2011:363-374) also suggests that medical schools should ensure that such an important undergraduate imaging 'core' curriculum must be delivered to students according to outcomes-based-education (OBE) strategies. They suggested that a 'core plus' curriculum option might also be included (ESR 2011:363-374).

2.2.5 Concluding remarks

The next paragraphs will elaborate on current higher education principles and strategies applicable to current medical education, followed by a theoretical and documentary perspective on undergraduate medical education, including undergraduate nuclear medicine education, in South African Schools of Medicine. Another theoretical perspective will follow in Section 2.5 regarding the specific research sub-questions (cf. Paragraph 1.3.2) on undergraduate medical nuclear medicine education that need answering.

2.3. THEORETICAL PERSPECTIVE ON HIGHER EDUCATION PRINCIPLES IN MEDICAL EDUCATION

The previous section gave a theoretical perspective on MRS and clinical radiological imaging techniques, including the role nuclear medicine plays in patient care. Clinical imaging techniques play an important role in clinical service delivery and have undergone significant changes, but as mentioned previously in a variety of contexts, these changes have not been incorporated fully into undergraduate medical school curricula. This has led to a call for the improvement of radiological imaging education. Medical students should be properly educated in imaging principles to prepare them for medical practice in a progressively expanding imaging milieu.

2.3.1 Introduction

Changing modes of healthcare delivery need new educational curricula and educational strategies that impact on existing teaching and learning practices (Harden and Crosby 2000:334-347). The need to standardise and improve the teaching of radiological imaging techniques at undergraduate level was identified and it was suggested that medical schools should ensure that a 'core' imaging curriculum (ESR 2011:363-374) was delivered to undergraduates according to outcomes-based educational (OBE) strategies (cf. Paragraphs 2.3.4.2, 2.3.4.5, 2.5.2.4, 2.5.4.3 and 2.5.7).

Nandi, Chan, Chan, Chan and Chan (2000:301-306) emphasises that undergraduate medical education needed on-going improvements to meet the changing demands of medical practice in the 21st century. They pointed out that, although the complexity of medical care had increased dramatically over the last century, the methods of teaching medicine had changed little (ESR 2011:363-374).

Medical education at the level of higher education is regarded as a discipline on its own, requiring professionalism and scholarship of its teaching practices (Dent & Harden 2009:8). The authors suggest that medical teachers involved in curriculum planning and choosing curriculum content and educational strategies, needed to learn more about the latest educational techniques and theories.

In the following paragraphs, attention will be paid to the theoretical aspects of what is expected of medical students and newly qualified doctors, the roles of the medical teacher/educator, the role of curriculum types and theoretical aspects of curriculum planning and principles relevant to the development of educational programmes/modules/courses. This information is provided not only as theoretical background to the study, but also to familiarise future undergraduate medical nuclear medicine module developers with the steps to follow in developing an undergraduate medical nuclear medicine module/course that fits their institutions' requirements and needs. In Chapter 6, these steps will be followed in compiling and providing guidelines for an undergraduate medical nuclear medicine module according to the acquired study results (cf. Section 6.3 and Tables 6.1 to 6.9).

To ensure clarity and uniform interpretation, the specific meanings of education terminology used in this section are explained in the glossary section.

2.3.2 What is expected of medical students and newly qualified doctors?

The goal of medical education is to produce highly qualified doctors who meet the needs of their patients and the larger community. Several international institutions have provided sets of exit-level outcomes applicable to newly qualified doctors and some of these outcomes will be presented in the following paragraphs to provide additional context for the proposed guidelines.

2.3.2.1 *The "Five Star Doctor" (1994)*

Boelen (Boelen 1994:online) of the World Health Organisation (WHO) describes the concept of the "five-star doctor" as the ideal profile of a doctor who will meet the health needs of patients. The five sets of attributes of the "five-star doctor" are summarised as care provider, decision-maker, communicator, community leader and manager.

2.3.2.2 *Tomorrow's doctors (1993, 2003, 2009)*

The British General Medical Council (GMC) regulates doctors and ensures good medical practices. They have published outcomes and standards for undergraduate medical education under the concept of "Tomorrow's Doctors" since 1993 (GMC 2009:online).

These themes are classified under three headings: those relating to the doctor as a scientist and a scholar, as a practitioner and as a professional. These categories cover the development of ***knowledge, skills and behaviour*** that students must demonstrate by the time they graduate.

2.3.2.3 *CanMEDS principles (1996, 2005.5)*

The "CANMEDS PHYSICIAN COMPETENCY FRAMEWORK" describes the knowledge, skills and abilities that physicians need if they are to achieve better patient outcomes (Frank 2005:online). Table 2.1 illustrates the mentioned essential abilities that doctors need for achieving improved patient care and that impacts on the 'core' curriculum (cf. Paragraphs 2.3.4.5 and 2.5.7) content needed for students to accomplish the exit-level outcomes.

TABLE 2.1: CANMED PRINCIPLES [Adapted from Frank 2005:online]

CANMED PRINCIPLES	
THE SEVEN ROLES	**Description**
Medical expert	**Applying medical knowledge, clinical skills and professional attitudes in the provision of patient-centred care**
Communication	**Facilitating effective doctor-patient relationships**
Collaborators	**Achieving optimal patient care by effective work within a health care team**
Managers	**Participating in healthcare organisations and contributing to the effectiveness of the healthcare system**
Health advocates	**Influencing advancement of health and well-being of individual patients, communities and populations**
Scholars	**Demonstrating a lifelong commitment to reflective learning as well as the creation, dissemination, application and the translation of medical knowledge**
Professionals	**Applying ethical practice, profession-led regulation, and high personal standards of behaviour**

(Table 2.6 includes the adapted 'AfriMED' competencies for South African physicians)

2.3.3 The role of medical educators in medical education

Most clinical medical doctors are involved in clinical teaching at some point in their careers; however, earlier generations of medical doctors have little or no formal background in education and very few received any formal training in teaching skills. Medical doctors have learned how to teach largely from watching other educators in action and from their own experience of how they were taught. In the past it was assumed that if someone knows a lot about a subject he or she will be able to teach others about it. In reality, although subject expertise is important, it is currently not sufficient.

Currently, effective clinical teachers/educators in healthcare science need additional educational teaching and learning knowledge and skills to fulfil their roles as curriculum planners, assessors and learning facilitators. Effective teaching techniques are a requirement for educating doctors, therefore educational excellence, along with clinical excellence, is increasingly being recognised (Ralhan, Bhogal, Bhatnagar, Young & Green 2012:online).

Clinician educators as Health Professions Educators are responsible for the education and training of medical students, who will become the doctors of tomorrow. The WHO (WHO 1996:online) emphasises the importance of health science education as part of improving the training of medical doctors. Divisions of Health Science Education provide training and qualifications in health professions education, providing training in curriculum development and in new educational approaches.

Medical education has seen major changes over the past decade and these changes are one of the reasons for the changing roles of medical teachers. The ultimate goal of education is not for educators to teach well, but for learners to learn well. It is essential for medical educators to ensure that educational methods used are improving the patient care practice of future doctors.

Other roles for the medical teacher include duties related to clinical and administrative work and research. These roles place additional demands and pressures on the lecturer. The expectations of the 21st century teacher of medicine are often too many and unrealistic, but medical teachers constantly strive to fulfil their roles.

2.3.4 Cyclical curriculum development and delivery process

Dent and Harden (2009:10,17) regard a curriculum as "everything that should happen in a teaching programme" and describe several steps through which a curriculum can be planned, developed and delivered. Curriculum planning and development is important in order to match what is expected of young doctors, and the competencies they gain from medical training programmes (Dent & Harden 2009:10).

Taking into consideration Dent and Harden's (2009:18) main curriculum planning elements and the research sub-questions that needs answering in order to answer the main research question (cf. Paragraph 1.3.2), a cyclical curriculum development process was developed to include all elements necessary to eventually compile and provide guidelines as final outcome for this study (cf. Section 6.3 and Figure 6.2). Figure 2.2 illustrates the cyclical curriculum development process.

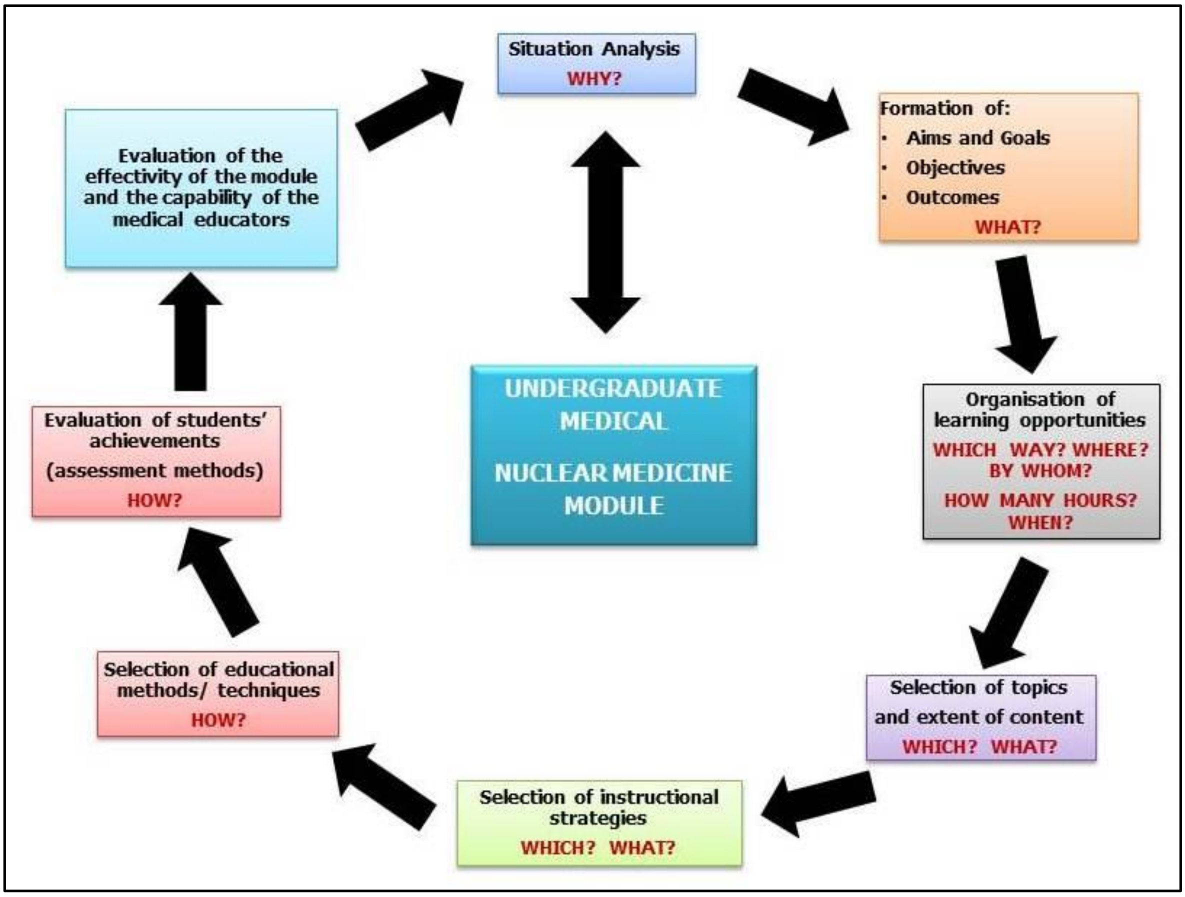


FIGURE 2.2: CYCLICAL CURRICULUM DEVELOPMENT PROCESS [Compiled by the researcher, Nel 2014]

The theoretical aspects of each step in the curriculum planning, development and delivery process will now be discussed separately according to the 2009 and 2013 editions of Dent and Harden's ***"A practical guide for medical teachers"***.

2.3.4.1 *Situation analysis and identification of the need for curriculum planning and development*

A need for curriculum planning and development is usually identified when there is a "mismatch" between what is expected of newly qualified doctors and the competencies they gain from their teaching and learning programme. According to Dent and Harden

(2009:10) such a need is recognised to emphasise various problems or limitations in healthcare and patient care management. To address the identified "mismatch" and solve the service delivery problem, certain educational decisions are needed to improve medical students' knowledge; skills and attitudes/perceptions/behaviour regarding the identified problem (cf. Paragraphs 6.3.1 and 6.3.2).

2.3.4.2 *Formulation of aims, goals, objectives as well as defining and formulating exit-level outcomes*

Curriculum/programme/module planning begins with identification of aims, goals, objectives and learning outcomes for the programme.

Figure 2.3 illustrates the differences between aims, goals, objectives and outcomes.

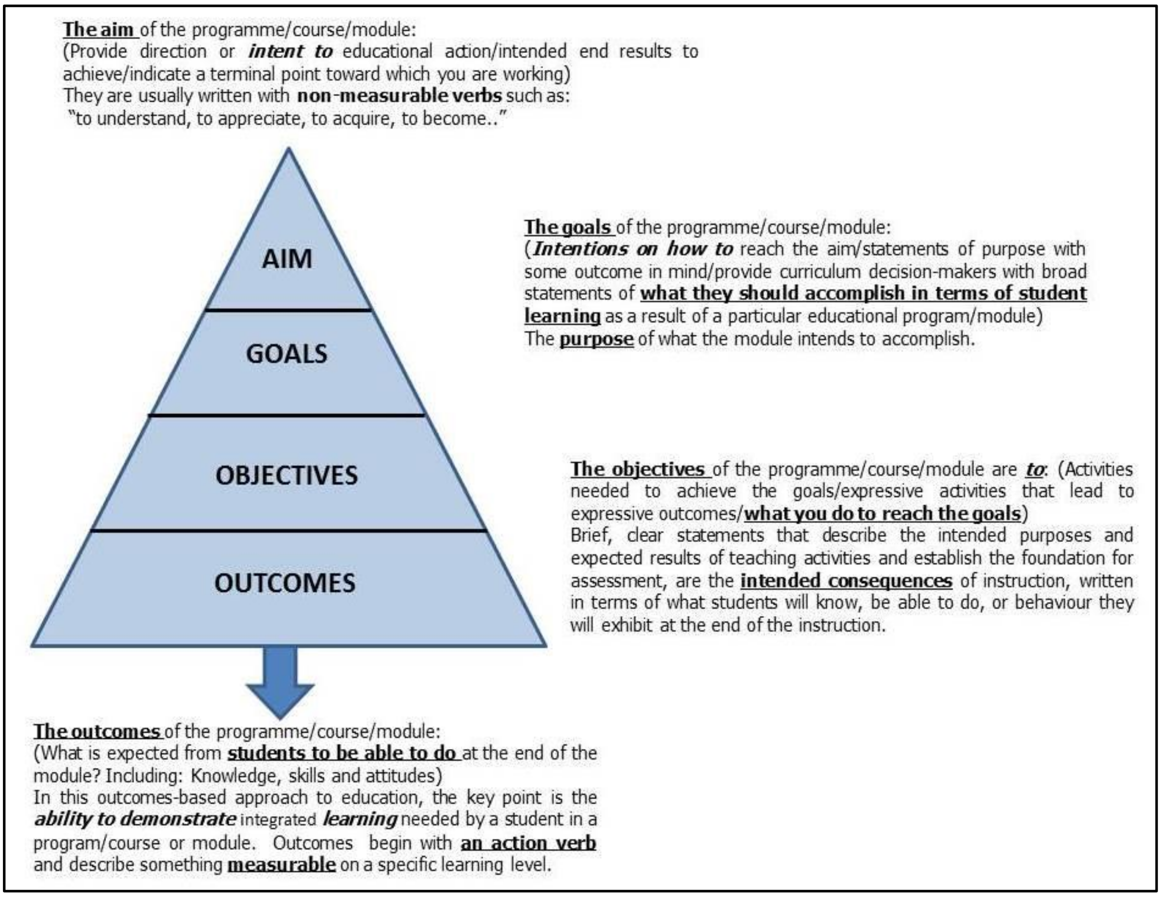


FIGURE 2.3 DIFFERENCES BETWEEN AIMS, GOALS, OBJECTIVES AND OUTCOMES [Compiled by the researcher, Nel 2014]

Spady (1994:12), the developer of Outcomes-based Education (OBE), defines OBE according to its objective as "to focus and organise everything in an educational system around what is essential for all students to be able to do successfully at the end of their learning experiences".

Davis (2003:217-232) on the other hand, defines OBE as "an approach to education in which decisions about the curriculum are driven by the exit learning outcomes that the students should display at the end of the course". Defining learning outcomes for a programme/course/module emphasises "what students can do" rather than "what the students know". Students need to know what is expected from them and what they will be able to do at the end of the course.

Medical school curricula not only equip students with *knowledge* and *skills* to become future physicians, but also ensure that their *attitudes* and *behaviour* enable students to become responsible and competent physicians who are honest and trustworthy and who act with integrity. Benjamin Bloom (Overbaugh & Schultz *s.a.*:online) identified three main categories of educational activities, namely ***knowledge, skills* and *attitudes*,** which serve as outcomes of the learning process in medical schools.

- ***Knowledge****:* Represents the mental and intellectual skills that curriculum planners need to specify clearly – which skills are necessary and to what level each should be displayed by the students (Dent & Harden 2009:18,19).
- ***Skills****:* Represents the manual and physical skills involving the usage of motor-skills to perform certain tasks under supervision or independently (Dent & Harden 2009:18,19).
- ***Attitudes***: Represents the affective or emotional areas that enable competent and responsible performance by physicians.

Outcomes are only valid if the required action can be observed, assessed and measured. When defining and developing outcomes, "action" verbs like *describe, explain, design* or *produce* must be used. The "*know*" and "*understand*" levels of Blooms' taxonomy are not regarded as useful as outcomes, the other higher-order thinking skills of Blooms' taxonomy are more useful for testing outcomes on specific education levels. As mentioned previously, this information will be used in compiling and providing envisaged guidelines for an undergraduate medical nuclear medicine module in Chapter 6 (cf. Paragraphs 6.3.2 and 6.3.3 as well as Table 6.2).

2.3.4.3 *Educational environment and resources*

Students must have opportunities to develop and improve their clinical and practical skills in an appropriate environment. The educational facilities and infrastructure should be appropriate for delivering the curriculum and students need access to appropriate learning resources and facilities, including libraries, computers, lecture theatres, seminar rooms and appropriate environments for developing and improving their knowledge, skills and behaviour.

The type of curriculum will determine specific physical and human resources needed. Large lecture halls and tutorial rooms may be needed, depending on whether a lectured-based or problem-based curriculum is implemented. Sufficient staff members from appropriate disciplines with the necessary skills and experience to deliver teaching and support for student learning are needed. Teaching staff and time available for teaching are some of the greatest resource constraints (Dent & Harden 2013:21).

2.3.4.4 *Curriculum structure: The influence of the type of medical curriculum on formal teaching*

According to Oris *et al.* (2012:121-130) the spectrum of medical curricula shifted over time, from:

- First generation conventional, traditional or "classic" curricula since the beginning of the 20th century;
- Second-generation problem-based-learning (PBL) curricula from around the mid 20th century; to
- Third generation outcomes/competence-based (OBE) curricula since the late 20th century; and
- Hybrid medical curriculum.

Nowadays, both curriculum design and curriculum delivery processes must take into account modern educational theories and evidence-based practices. The structure and content of courses as well as attachments to clinical disciplines should integrate basic medical sciences and clinical sciences on both horizontal and vertical integration levels (Dent & Harden 2009:20,21).

2.3.4.5 *Planning and organising curriculum content*

Identifying curriculum content relates to the "scope of the curriculum". The identified learning outcomes determine what is taught, and all courses must contribute in some way to existing curriculum outcomes. By linking outcomes of each discipline to the overall outcomes of the existing curriculum, the content and outcomes of every discipline is integrated into the main curriculum.

It is impossible for students to learn all that there is to learn, so each discipline needs to identify its own ***specific hard 'core' knowledge*** (cf. Paragraphs 2.4.5 and 2.5.4.3) that students need to master in order to understand and manage clinical problems (Dent & Harden 2009:19). This 'core' knowledge defines the curriculum content and by defining learning outcomes for the course the students will know what is expected of them at the end of the course (ESR 2011:363-374). The ***'core plus'*** approach (cf. Paragraph 2.2.4) option includes special study modules and elective periods in the imaging departments. The conditions under which the students are expected to perform tasks also need to be defined.

Curriculum content is found in the pre-determined syllabus and traditionally the emphasis was on knowledge. These days, more emphasis is placed on skills and attitudes (Dent & Harden 2009:11). This content can be presented or organised in various ways, including:

- Clinical subjects or disciplines: representing older traditional curricula;
- Bodily systems: as part of an integrated curriculum;
- Life cycles: including childhood, adulthood and old age;
- Problems to be addressed: problem-based curriculum; and
- Clinical presentations or tasks to be done: case or task-based curricula.

2.3.4.6 *Educational strategies*

Nowadays medical schools prefer new innovative integrated and problem-based curricula to produce doctors who can solve problems and care about community needs. The SPICES model of curriculum planning is a tool that can be used in the development of integrated curricula and in situations that require answers to specific questions or issues relating to the curriculum strategies (Harden, Sowden & Dunn 1984:284-285), for instance:

- Deciding whether the curriculum should be integrated or community-based;
- Deciding on the 'core' curriculum and elective possibilities;
- Deciding about the teaching methods and resources needed for each method; and
- Considering appropriate assessment methods.

The model consists of six educational strategies (Harden *et al.* 1984:297) and is presented as a spectrum between two extremes:

- A traditional curriculum (TIDHSA); or
- A 'newer' strategy for curriculum development (SPICES).

TABLE 2.2: EDUCATIONAL STRATEGIES IN CURRICULUM DEVELOPMENT: THE SPICES MODEL [Compiled by the researcher, Nel 2014]

EDUCATIONAL/LEARNING STRATEGIES			
TRADITIONAL STATEGIES		NEWER STRATEGIES	
T	Teacher-centred	Student-centred	S
I	Information gathering	Problem-based	P
D	Discipline-based	Integrated	I
H	Hospital-based	Community-based	C
S	Standard programme	Electives	E
A	Apprenticeship-based or opportunistic	Systematic approach	S

Educational strategies need to be decided on before decisions are taken about teaching methods.

2.3.4.7 *Teaching methods*

Teaching methods selected will depend on the required outcomes, and the best way to teach students is by making use of a range of teaching methods (Dent & Harden 2013:12), including:

- Problem-based learning;
- Independent student learning, where students take responsibility for their own learning;
- Large group or whole-class teaching by lecturers using formal lectures;
- Small-group work in the integrated learning area where students learn from each other;
- Clinical skills sessions;
- Ward-based teaching;
- Practical sessions in practice;
- Computer-based learning;
- "Image-based" learning: where "every picture tells a story"; and

- Clinical teaching and learning, which focuses on and is directly concerned with patients and their problems.

2.3.4.8 *Student learning assessment and feedback*

Students' educational outcomes regarding knowledge, skills and professional behaviour/attitudes should be assessed at appropriate points during the curriculum, ensuring that only students who meet these outcomes are permitted to graduate. Assessments need to be valid, reliable, generalisable, feasible and fair.

The assessment methods chosen for each curriculum will relate to the required outcomes and the best way to assess students is by making use of two types of assessment during student training, namely:

- ***Formative/continuous assessment***, which is a day-to-day assessment method to decide if the students are ready for summative assessment. Portfolios, logbooks, presentations, self-assessed questions or small-group and peer-assessments can be used to track progress. Feedback to students is necessary so that they know which areas they need to work on.
- ***Summative/formal assessment*** takes place at the end of the learning experience to determine if students have acquired the predetermined minimum outcomes. Formal assessment methods for testing student performance include:

— Written or computer-assisted large group tests or examinations comprising of short answer questions, multiple choice questions (MCQ's) or essay questions;
— "Mini" practical sessions in the form of objective, structured, clinical examinations (OSCE's) ensuring integrated assessment for clinical disciplines;
— Patient-based clinical examinations; and
— Problem-based oral examinations.

Constructive feedback needs to follow soon after the formal assessment so that students can focus on the final examination results and areas where students need to improve. Feedback from students provides teachers with information on how to shape and improve the curriculum.

2.3.4.9 *Communication with stakeholders*

Effective communication between lecturers, students and institutional curriculum developers contributes to the success of curriculum/programme/module delivery (Dent & Harden 2013:14). Empowering and informing lecturers and educators about the curriculum and its educational implications is a prerequisite for successful delivery of the curriculum. Staff development sessions involving departmental academic meetings or individual discussions can be utilised to keep staff informed of current developments.

Study guides with relevant curriculum and course information is necessary for effective communication with and among students. Student handbooks and implementation of a student induction period at the start of each year are also necessary. These guides play an important role in informing students of what are expected from them to achieve at the end of the specific learning experience.

2.3.5 Concluding remarks

This section discussed the theoretical perspectives on current educational principles as well as curriculum planning and development. Attention was given to expectations placed on newly qualified doctors and the changing roles of medical educators in current medical education. An international shift from a conventional curriculum to newer, more 'modern' curricula, with the aim of improving student teaching and learning as well as its impact on improved patient care, was emphasised. Educational information discussed and reiterated in this section is crucial to answer the research question and sub-questions of this study and contribute to providing the necessary guidelines for undergraduate medical nuclear medicine education (cf. Section 6.3).

2.4 THEORETICAL AND DOCUMENTARY PERSPECTIVE ON MEDICAL EDUCATION IN SOUTH AFRICA

In the previous section, attention was paid to theoretical aspects of higher education principles and strategies as they relate to current medical school curricula. Standardising and improving undergraduate teaching of nuclear medicine imaging and developing a 'core' imaging module according to OBE principles require careful planning (cf. Paragraphs 2.3.1, 2.3.4.2, 2.3.4.5 and 2.5.7). In the following section, medical education at South African Schools of Medicine will be elaborated on, with emphasis on national regulatory institutions governing the training of medical practitioners (CHE 2013:online; HPCSA 1999:online; RSA DoE 1997:online; RSA DoE 2013:online; RSA DoH 1997b:online; SAQA 2013:online).

2.4.1 Introduction

In this section, the second objective of the research study, namely to obtain information about the current trends of undergraduate medical nuclear medicine education in South African Schools of Medicine is pursued (SAQA 2013:online). Theoretical aspects and a documentary analysis will be used to obtain information regarding undergraduate medical curricula and the presence or absence of undergraduate nuclear medicine education. Results and findings of the semi-structured survey questionnaires, containing the same questions as part of the second objective, will be presented and discussed in Chapters 4 and 5.

The role of national policies and regulations governing training of medical practitioners in South Africa will also be documented; this record is particularly important in light of the major curriculum reforms that took place after the first democratic elections in South Africa in 1994. Both higher education and healthcare transformation impacted on the curriculum reform that took place thereafter (RSA DoE 1997:online).

2.4.2 South African Schools of Medicine up to June 2013

Medical education in South Africa commenced in 1912 in Cape Town, South Africa, after the first medical school had opened its doors in 1900. South Africa is divided into nine provinces, with eight Schools of Medicine to educate and train future healthcare professionals to serve the population. Table 2.3 illustrates the distribution of Schools of Medicine in South Africa up to June 2013.

[Tables in the next sections were compiled by the researcher, Nel 2013 and 2014]

TABLE 2.3: SOUTH AFRICA'S EIGHT MEDICAL SCHOOLS UP TO JUNE 2013

INSTITUTION	PROVINCE
University of Cape Town (UCT)	Western Cape
University of the Witwatersrand (WITS)	Gauteng
University of Pretoria (UP)	Gauteng
University of Stellenbosch (SUN)	Western Cape
University of the Free State (UFS)	Free State
University of Kwa-Zulu Natal (UKZN)	Kwa-Zulu Natal
Walter Sisulu University (WSU)	Eastern Cape
University of Limpopo – Medunsa Campus (UL) (cf. Appendix C5)	Limpopo

2.4.3 Medical education at South African Schools of Medicine

According to yearbooks and websites of Schools of Medicine in South Africa, medical curricula currently in use at the different FoHSs in South Africa showed differences not only in length but also in structure; instruction and evaluations. Each institution's undergraduate curriculum committee determines what their needs are regarding undergraduate imaging and specifically undergraduate nuclear medicine imaging education in the existing curriculum.

Table 2.4 provides information about Schools of Medicine, existing undergraduate medical curricula, academic Nuclear Medicine Departments, and nuclear medicine education.

TABLE 2.4: SCHOOLS OF MEDICINE IN SOUTH AFRICA

UNIVERSITIES	A	B	C	D	E	F	G	H
SCHOOLS OF MEDICINE								
Founded	1912	1919	1943	1950	1955	1969	2005 (1976)	2005 (1976)
Undergrad. degree	MBChB	MBBCh	MBChB	Medical B.Sc. & MBChB	MBChB	MBChB	MBChB	MBChB
Instruction language	English	English	Double medium	English	Double medium	Parallel medium	English	English
UNDERGRADUATE MEDICAL CURRICULUM								
Curriculum duration	6 years	6 years	6 years	6 years	6 years	5 years	6 years	6 years
Pre-clinical phase duration	Semesters1-6 Years 1-3	MBBCh I and II	Years 1 and 3	Years 1-3 Medical BSc	Phase I Year 1	Phase I and II Semesters 1-5 (2 and half years)	Years1 and 2	Phase IA: Level I Phase IB: Level II Phase II: Level III
Clinical phase duration	Semesters 7-12 Years4-6	MBBCh III to VI $$ GEMP I-IV	Years 4-6	Medical school Years 4-6	Phase II to VI Years2-6	Phase III Semesters 6-10 (2 and half years)	Years 3-6	### Clinical Clerkship Phase
Educational strategies	PBL	PBL Integrated GEMP	Clinical integrated		Integrated clinical rotations	OBE Combination: Independent and integrated	OBE Clinical integration (modular)	PBL
NUCLEAR MEDICINE IMAGING DEPARTMENTS								
Departmental structure	Radiation medicine dept	Radiation science dept	Nuclear dept	Nuclear medicine Service delivery only	Dept medical imaging and clinical oncology	Dept of Nuclear Medicine and Isotope Dept	Nuclear Dept	Nuclear medicine Service delivery only
Sub divisions	Nuclear medicine Radiation oncology Radiology Medical physics	Nuclear medicine Radiation oncology Diagnostic radiology Medical physics Radiation protection	Nuclear medicine		Nuclear medicine Radiation oncology Radio- diagnosis Medical Physics Radio-biology	Nuclear medicine	Nuclear medicine Diagnostic radiology Medical physics Diagnostic radiography	
NUCLEAR MEDICINE EDUCATION								
Postgraduate **Undergraduate:**	4 years	4 years	4 years	None None	4 years	4 years	4 years	None None
Pre-clinical Phase			Lecture and assessment 3rd years		Practical induction to 1st years		**POME I 1st year part of family medicine scope of medicine	
Clinical Phase	Lecture to 5th years	Renal lecture as part of urology rotation	First semester Year 6 Imaging Forming		Clinical integrated from 2nd year Integrated practical in middle rotations	Semester 6 lectures to 3rd years, practical and test Semester 10 imaging session 5th years Integrated thyroid session	Year IV 1x/year: thyroid lecture POME 502 Year V: integrate Surgery Radiology orthopaedics Optional 2 week electives	
Educational strategies	PBL	PBL Integrated GEMP	Clinical integrated		Integrated clinical rotations	OBE Combination: Independent and integrated	OBE Clinical integration (modular)	PBL

****POME: Practice of medicine**
###Phase III: Clinical clerkship
Phase IIIA/Level IV: Clinical rotations
Phase IIIB/Level V: Integrated rural clerkship
Phase IIIB/Level VI: Student internship
$$GEMP: Graduate Entry Medical Programme

(SUN 2013:online; UCT 2013:online; UFS 2013:online; UKZN 2013:online; UL 2013:online; UP 2013:online; WITS 2013:online; WSU 2013:online).

2.4.3.1 *South African undergraduate medical curricula*

Undergraduate medical education in South Africa is presented at eight Schools of Medicine located within campus-based universities. According to Burch (2007:61-108) all South African Schools of Medicine have undertaken major curriculum reform over the past years, these changes, as well as the differences between the existing curricula, are reflected in Table 2.4. Despite the curriculum differences, the exit-level outcomes for healthcare professionals are the same, as prescribed by the various regulatory bodies. Table 2.5 lists the applicable regulatory bodies and summarises their roles in medical education in South Africa.

The introduction of the OBE approach to education in South Africa brought about major changes in the traditional way in which teachers approached the process of teaching (Beets & Van Louw 2005:online). Initially known as "*Curriculum 2005*" in South African primary and secondary schools (later also in higher education), this educational strategy revolved around learner-centred, outcome-orientated activities. Emphasis is placed on an integrated teaching and training approach, human development and lifelong learning (De Vos, Strydom, Fouché & Delport 2011:16-18).

2.4.3.2 *Academic Nuclear Medicine Departments and nuclear medicine education*

Only six of the eight Schools of Medicine in South Africa currently offer the postgraduate MMed (Nuclear Medicine) programme, and not all of them offer undergraduate level nuclear medicine education (Ellmann 2008:online). Two of the eight Schools of Medicine are not involved in any medical nuclear medicine education, although clinical nuclear medicine services are rendered and teaching of radiographers or radiation science technologists does take place in some of the Nuclear Medicine Departments (cf. Table 2.4)

The differences in medical curricula and the absence of nuclear medicine education in two of the eight Schools of Medicine indicate a problem regarding the implementation of a structured undergraduate medical nuclear medicine module, which results in newly qualified doctors who have no exposure to any nuclear medicine imaging procedures. It is expected from newly qualified doctors working in clinical environments with or without nuclear medicine educational facilities, to order nuclear medicine studies in their day-to-day patient care. The absence of academic nuclear medicine education does not necessarily mean that newly qualified doctors do not need any education regarding nuclear medicine imaging.

2.4.4 Regulatory bodies and legislation impacting on medical education in South Africa

Soon after the first democratic election took place in South Africa in 1994, the government embarked on a process of radical reform and transformation of healthcare and higher education systems. As part of this process, both the National Department of Health (DoH) and the HPCSA issued regulations governing the training of medical practitioners in South Africa (HPCSA 1999:online). These reforms resulted from transformation in both healthcare and higher educational sectors.

Schools of Medicine in South Africa are government-funded higher education institutions providing tertiary education to future healthcare professionals. Clinical undergraduate and postgraduate medical training is located in and takes place on the public healthcare service platform therefore funding, size and service demands of the public healthcare service are critical determinants of the quality of medical training programmes. The redistribution of financial resources required to improve primary healthcare services in South Africa has had a severe impact on academic training-centre resources, particularly human resources and in-patient services (Burch 2007:62-65).

Burch (2007:62-65) emphasises that South African public-sector doctors make a major contribution to medical education. The critical shortage of doctors working in the South African public health sector has led to tension between teaching, learning and service delivery in the poorly funded, overburdened public healthcare system of South Africa (Burch 2007:62-65).

Table 2.5 summarises the regulatory and legislative institutions responsible for medical education in South Africa. Providing an overview of the applicable regulatory bodies and their impact on medical education provides a backdrop for development of the envisaged guidelines. The 'purple text' refers to the exit-level outcomes that play a role in the development of the proposed guidelines.

TABLE 2.5: SOUTH AFRICAN UNDERGRADUATE MEDICAL EDUCATION LEGISLATIONS AND REGULATIONS (Table continues on the next pages)

REGULATORY BODIES		LEGISLATIONS	REGULATIONS
Constitution of the Republic of South Africa	(Constitution)	Act No. 108 of 1996	• Required educational transformation and democratisation (1994)
			• Gives everyone the right to access to health • Long and healthy life for all South Africans
			• Expresses the nations' social values and its expectations of the roles, rights and responsibilities of citizens in a democratic South Africa.
			• Critical generic/core outcomes or competencies derived from 'the constitutions' *ubuntu'* principle
Bill or Rights			• Value is placed on equality, human dignity, life, freedom and security
			• Specific learning outcomes in specific learning area needed to be demonstrated
National Department of Higher Education and Training	(DHET)	Higher Education Act No. 101 of 1997	• Restructuring/regulating higher education in South Africa. • Responsible for norms and standards in higher education • Responsible for qualifications structure for the higher-education system
			• (cf. Paragraph 2.4.3)
			• Responsible for SAQA and NQF
South African Qualifications Authority	(SAQA)	South African Qualifications Authority Act No 58 of 1995 (SAQA Act)	• Registration of qualifications • Recognition of professional bodies • Collaborate with international counterparts • National learners' records database
			• Critical cross field outcomes: (essential, core, critical skills)
			• Exit-level outcomes
			• Integrated outcomes

National Qualification Framework	(NQF)	National Qualifications Framework (NQF) Act, 2008 (Act 67 of 2008)	• Provide and establish a national learning system • Curriculum development • Committed to OBE and training • Registered qualifications and standards on the NQF in terms of learning outcomes (what students must be able to “do”) • Education and training quality

Council on Higher Education	(CHE)	Higher Educational Act, 1997 (Act 101 of 1997)	• Quality assurance in higher-education • Advise the minister on any aspect of higher education • Accredit programmes • Promote the access of students to higher education

Higher Education Qualifications Framework	(HEQF)	HEQF, No. 508, No. 30353 October 2007	• Generation and setting of standards for all higher education qualifications • Ensuring that such qualifications meet SAQA’s criteria for registration on the NQF
			• Strengthening the quality assurance system • Credit accumulation and transfer • Requirements for entry into new programmes
		Government Gazette (No. 928,5 October 2007)	• NQF levels

Higher Education Qualifications Sub-Framework	(HEQSF)	Government Gazette (No. 36721 August 2013)	• Is a substitute for the older HEQF • NQF levels • Generation and setting of standards for all higher education qualifications • Credit accumulation and transfer

Higher Education Quality Committee	(HEQC)	Higher Education Act, 1997 (Act 101 of 1997)	• Quality assurance in higher education • Accredits courses • Conducts national reviews • Promotes quality • Develops capacity

National Department of Health	(DoH)	White Paper on transformation of South African Health Notice 667 of 1997 in the Government Gazette No. 17910	• Set policies and principles for a unified National Health System in South Africa • **Shift of financial, infrastructural and human resources from tertiary health to primary and secondary health care systems** • Improved primary healthcare services
			• Free healthcare services for pregnant women and children under the age of six years
			• Training institutions: Appropriate, multidisciplinary community-problem and OBE programmes
		Health Act No. 63 of 1997	• Adoption of the primary-healthcare approach • Transformation of the public health system • District healthcare system
			• Regulations governing the training of healthcare professionals • (cf. Paragraph 2.4.5) • 2-year period of internship • 1-year of compulsory community service

Health Professions Council of South Africa	(HPCSA) Health Professions Act, 1974 (Act No. 56 of 1974)	• Quality healthcare standards • Control over training, registration and practices of practitioners • Setting healthcare standards for training and discipline • Enhance the quality of health • Protect the public • Guide the professions • Ensure on-going professional competence
		Regulations governing the training of medical students • Accreditation of South African medical school training programmes • Guidelines regarding medical practitioner training programmes • Basic requirements of undergraduate medical training programmes
		• Accrediting all undergraduate and postgraduate healthcare practitioner training • Annual registration and renewal of registration of all healthcare practitioners
		Ethical rules of conduct for practitioners
		SCOPE of the profession of medicine: (Minimum curriculum for medical education) • Basic science subjects • Pathology • Main clinical subjects
		• Ancillary subjects, including • Medical imaging • Radiation oncology • Radiation protection • Nuclear medicine

	AfriMED principles Adapted from the Canadian CanMED Physician Competency Framework (cf. Paragraph 2.3.2.3)		Graduate attribute expanded roles including competencies as a: • Healthcare scientist/practitioner • Communicator • Collaborator • Leader and manager • Health advocate • Scholar • Professional (cf. Table 6.2)
The Medical and Dental Professions Board			• Registers practitioners falling under the professions medical, dental and medical science • Framework of core competencies and exit concerns for medical-science practitioners • Guide and inform curriculum development processes • Ethical rules of behaviour and conduct
Higher Education Institutions	Universities, Faculties of Health Sciences; Schools of Medicine.	Policies Regulations Curricula	• Teaching and learning policies • Assessment policies • Plagiarism policies

(CHE 2004:online; CHE 2013:online; HPCSA 1999:online; HPCSA 2012:online; HPCSA 2014:online; RSA 1995:online; RSA 1996:SS.26-28; RSA DoE 1997:online; RSA DoE 2002:online; RSA DoE 2007:online; RSA DoE 2013:online; RSA DoH 1997a:online; RSA DoH 1997b:online; RSA DoH 2003:online; RSA DoH 2009:online; SAQA 2000:online; SAQA 2012:online; SAQA 2013:online; UFS 2006:online; UFS 2008:online).

2.4.5 What is expected of South African medical students?

Medical education in South Africa has undergone major changes since 1994, as previously mentioned. Educational systems moved away from a teacher-centred transmission of information, to more learner-centred teaching and learning approaches (Beets & Van Louw 2005:online). Table 2.6 outlines outcomes required from newly qualified South African doctors by regulatory institutions, including; SAQA and HPCSA.

According to the HPCSA's scope of the medical profession and the minimum curriculum for medicine "the aim of undergraduate medical education is to train medical students so that, as medical practitioners, they will be sufficiently equipped to render a competent professional service in the community they serve" (HPCSA 2012:online).

Clear indications of what is expected of medical students will direct module planners and developers to incorporate a 'core' undergraduate medical nuclear medicine module.

TABLE 2.6: EXPECTATIONS OF NEWLY QUALIFIED DOCTORS
(Table continues on the next page)

REGULATORY BODY	OUTCOME TYPE	OUTCOME
SAQA	Critical cross-field outcomes: essential, core, critical skills	• Work effectively with others as a team member • Identify and solve problems • Communicate effectively • Use science and technology effectively
	Exit-level outcomes	• Be capable to demonstrate the skills necessary to diagnose, treat and manage disease/injury • Knowledgeable of the development of disease and pathology • Ability to work as a team member • Understanding of medico-legal and ethical practices
	Integrated outcomes	
HPCSA	SCOPE of the profession of medicine	CORE curriculum consisting of: • Basic science subjects; • Pathology; • Main clinical subjects; and • Ancillary subjects.
	Minimum curriculum for medicine education	ANCILLARY subjects include: Medical imaging; Radiation oncology; Radiation protection; and Nuclear medicine.
	Exit-level outcomes	• Knowledge and understanding of diagnostic and therapeutic procedures for decision making and problem solving • Knowledge and understanding needed to use medical-scientific terminology with confidence • Ability to utilise diagnostic aids, and clinical skills to interpret the findings • Ability to render a service as members of the healthcare team • Ability to communicate well • Appropriate attitude and behaviour to ensure quality healthcare
	Specific outcomes	• Recognition, investigation, prevention and treatment of disease • Appropriate and cost-effective utilisation of special investigations and new technologies • Ethical and legal issues relevant to the practice of medicine • Clinical skills to interpret findings and make a diagnosis • Referral skills • Communication skills • Ability to work in a multi-disciplinary team • Awareness of moral and ethical responsibilities • Ensure highest possible patient care

	AfriMED principles adapted from the Canadian CanMEDS Physician Competency Framework (cf. Paragraph 2.3.2.3)	Graduate attribute expanded roles include key competencies as a: • Healthcare scientist/practitioner • Communicator • Collaborator • Leader and manager • Health advocate • Scholar • Professional (cf. Table 6.2)
	Ethical rules and regulations	• Act in the best interest of patients • Maintain the highest standards of personal conduct and integrity • Provide adequate information about patient diagnosis, treatment, costs and any other pertinent information to enable patients to exercise choice and informed decision-making pertaining to their health and that of others • Obtain informed consent from a patient • Maintain effective communication with patients and other healthcare professionals • Communicate and cooperate with other physicians in the diagnosis and treatment of a patient

2.4.6 Concluding remarks

Creating an environment in which students can learn and practise what is expected from them is the responsibility of medical educators. In producing healthcare professionals with knowledge, skills and commitment to utilise available opportunities to function in their patients' best interests will contribute to "a better health for all" (RSA 1996:SS.26-28).

A summary of information obtained from the theoretical perspective on undergraduate medical nuclear medicine education nationally in order to answer the main research question (Study Objective 2) are included in the appendices section (cf. Appendix F2).

With knowledge of what is expected of newly qualified South African doctors, and evidence of the great variation that is currently presented to the undergraduate medical students, the next section will attempt to obtain international answers to the specific research question and sub-questions relating to an undergraduate medical nuclear medicine module.

2.5 RESEARCH QUESTION AND SUB-QUESTIONS TO BE ANSWERED REGARDING UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION IN EXISTING MEDICAL CURRICULA

In this section, the first objective of the research study, namely to gain a deeper insight into current worldwide trends of undergraduate medical nuclear medicine education is pursued to provide the necessary context of the study (cf. Paragraph 1.4.3). Attention will be paid to a theoretical perspective on the research question and sub-questions. The research question to be answered is:

- ***What will the guidelines be for undergraduate nuclear medicine education in the MBChB programmes in South Africa?***

To compile such guidelines the answers to several sub-questions relating to such a module are required; answers to the sub-questions will, in turn, answer the research question (cf. Paragraph 1.3.2).

2.5.1 Introduction

The Head of the Radioisotope Unit of the University of Montreal in Canada, describes nuclear medicine in 1965 as a "liaison discipline" that overlaps and cooperates with several related clinical disciplines that provides additional information to each other (Sternberg 1965:691-698). In addition to this, the National Advisory Committee on Radiations' (NACOR) Report points out in 1966 that, historically, diagnostic "roentgenology", nuclear medicine and radiation therapy were often collectively referred to as "radiology", so confirming the "liaison" role these disciplines play (U.S. Department of Health, Education and Welfare 1966:1-25).

Radiological imaging disciplines are therefore involved in almost all patient and clinical diseases (Rogers 2003:1201-1203); as a result, most clinical physicians rely on radiological investigations to diagnose diseases and determine the extent of diseases in patients. According to Gunderman *et al*. (2003:1239-1242) investigations are sometimes ordered even before the clinician meets the patient.

Given these facts, Buckenham (2005:1-3) emphasises that current medical graduates should have a working knowledge of imaging procedures from the clinical perspective of both the referring physicians and referred patients. But, despite the significant role that radiological imaging studies play in current clinical medicine, and the importance of radiological disciplines as part of the healthcare team, medical students still receive very little formal training in radiological imaging (Bhogal, Booth, Phillips & Golding 2012:1146). Zakavi *et al*. (2004:55-57) emphasise and confirm that most general practitioners lack knowledge regarding nuclear medicine imaging modalities because of a lack of the necessary undergraduate nuclear medicine training and they consider nuclear medicine only as a specialist modality (cf. Section 1.2).

As a result of the absence of radiological imaging curricula in undergraduate medical training programmes students may be left with the wrong perception that clinical imaging procedures, including nuclear medicine, are not essential in clinical patient handling. This perception is false because of the regular widespread interaction between imaging and clinical disciplines. For these reasons, Gunderman *et al.* (2003:1239-1242) recommend that medical students should be properly trained and prepared to practice clinical medicine in a constantly changing clinical imaging environment.

In the following paragraphs, the theoretical perspective on undergraduate medical nuclear medicine education as part of radiological imaging education will be investigated and discussed. In general, not much national and international literature on undergraduate medical nuclear medicine education is available. Literature on undergraduate radiological education proved to be more readily available and, as mentioned previously, "radiology" could include nuclear medicine (cf. Paragraph 2.2.1).

2.5.2 WHY is it necessary to implement an undergraduate medical nuclear medicine educational module? Who or what will benefit from such a module?

The identified problem or need in this study is the inability of newly qualified medical doctors to effectively refer patients to the local Nuclear Medicine Department for diagnostic or therapeutic procedures. As previously mentioned (cf. Section 1.2 and Paragraph 1.3.1) inadequate referrals may be due to a lack of knowledge, skills and wrong perceptions regarding imaging procedures, as a result of inadequate 'core' undergraduate medical imaging education, and result in negative effects on both nuclear medicine service delivery and patient care. Nuclear Medicine Departments are therefore responsible for promoting optimal clinical imaging service delivery by addressing poor patient care due to inadequate referrals.

It is the responsibility of medical nuclear medicine imaging educators to empower and equip referring physicians with the necessary knowledge and skills to make use of both imaging and therapeutic procedures effectively. Essential in this problem-solving process is the identification of all stakeholders and clinical governance systems that will benefit from the empowerment process.

Figure 2.4 identify these stakeholders and clinical governance systems, and include:

- Medical students and newly qualified doctors (cf. Paragraphs 1.6.1 and 7.3.1) to be empowered to utilise imaging procedures more effectively;
- Nuclear medicine imaging service delivery and clinical practises that need to be optimised (cf. Paragraphs 1.6.2 and 7.3.3);
- Undergraduate medical imaging education to be optimised and standardised to ensure a successful empowerment process (cf. Paragraphs 1.6.3 and 7.3.4); and
- Patient care and management that need improvement (cf. Paragraphs 1.6.1 – 1.6.3 and 7.3.2).

FIGURE 2.4: STAKEHOLDERS AND CLINICAL GOVERNANCE SYSTEMS INVOLVED IN ADDRESSING THE RESEARCH PROBLEM [Compiled by the researcher, Nel 2014]

Attention will now be paid to each stakeholder's contribution to the research problem and possible solutions from the existing body of knowledge will be presented.

2.5.2.1 *Improvement of patient care*

Modern organ imaging has become one of the core aspects in patient care and early exposure of students to imaging procedures will result in improved patient care (Barrett *et al*. 2010:online; Jensen 1977:482-483). Undergraduate medical students, as tomorrow's newly qualified doctors, should be taught the necessary knowledge, skills and right attitude towards imaging facilities in order to increase patient care standards (RCR 2011:online). According to Graham and Metter (2007:257-268) as well as Gunderman *et al*. (2003:1239-1242), medical students need to use what they have learned effectively to solve their patients' healthcare problems appropriately.

Zakavi *et al*. (2004:55-57) argue that a lack of imaging knowledge, and specifically nuclear medicine imaging knowledge, had a negative impact on diagnosis and the treatment of patients. Subramaniam *et al.* (2005:1-3) therefore felt strongly that because of imaging procedures' important role in patient management, a basic understanding of these procedures and investigations were necessary for all medical doctors in this current era of modern clinical organ imaging.

2.5.2.2 *Nuclear medicine imaging service delivery and clinical practices*

Clinical diagnostic imaging modalities form an integral part of almost every patient's clinical management. Both Rogers (2003:1201-1203) and Buckenham (2005:1-3) expressed concern over the rapid and continued developmental expansion in all types of imaging modalities, including conventional diagnostic radiography, CT scanning, MRI imaging, nuclear medicine and ultrasound. Increasing sophistication of imaging modalities such as SPECT/CT and PET/CT makes it difficult for physicians to order appropriate and cost-effective imaging procedures.

Buckenham (2005:1-3) emphasises that referring physicians should be sufficiently instructed on the benefits and limitations of new imaging examinations and procedures to understand their roles in specific clinical situations. Newly qualified doctors should therefore have a working knowledge of imaging studies to be able to address patients' concerns about radiation exposure and the health risks associated with it (cf. Paragraphs 1.6.1 and 2.2.3), (Mubeen *et al*. 2008:118-121). Despite clinical diagnostic imaging modalities' obvious importance in patient care, undergraduate medical students still receive very little formal imaging education (Rogers 2003:1201-1203).

2.5.2.3 *Empowering medical students and newly qualified doctors*

A "mismatch" between what is expected of newly qualified doctors and the competencies they gained during their teaching and learning programmes negatively affects their ability to care for their patients. As mentioned previously, students should be exposed to diagnostic imaging procedures early in their careers, so that they can learn the optimum utilisation of imaging procedures and spare their patients unnecessary examinations. In terms of the literature, it is, therefore, essential for newly qualified clinicians to have a basic understanding of imaging procedures (Barrett *et al*. 2010:online; Mosier *et al*. 1981:555-559).

The main goal of imaging educators is not to turn medical students into "junior or mini" radiological specialists, but to provide them with a basic imaging procedure framework of which they can make good use in their handling of patients. Medical students should be taught and prepared to develop and have a working knowledge of applicable clinical radiological examinations, including nuclear medicine procedures, for various clinical situations (Gunderman & Stephens 2009:859-861). They must be familiarised with specific imaging vocabulary to understand key radiological terminology in order to prevent misinterpretations of imaging reports and to improve inter-departmental communication skills.

2.5.2.4 *Implementation and standardisation of formal undergraduate medical nuclear medicine education*

As previously mentioned, Dr Joseph Sternberg from Canada (Sternberg 1958:501-504; Sternberg 1965:691-698) recognised the need for a training period for the introduction of nuclear medicine fundamentals as part of a regular medical curriculum, as early as 1958 and 1965 (cf. Paragraph 2.5.1). Years later, Jensen (1977:482-483) concurred and urged medical school administrators to acknowledge imaging education at all levels within the medical school curriculum, not to make the students "mini radiologists" but to familiarise them with the manner in which pathology appears radiographically.

When he asked why medical students receive so little formal training in radiological imaging despite its importance in patient care, Rogers (2003:1201-1203) received reasons such as crowded medical school curricula and clinicians who claim that they already teach imaging as an integral part of all patient ward rounds. As early as 1997, Ell (1997:1081-

1082) presented the view that the amount of undergraduate medical education in the fields of radiology and nuclear medicine were often insufficient due to overcrowded and overloaded medical curricula. He believed and stated that "modern", integrated curricula, like those following the PBL model, were not really delivering effective undergraduate medical nuclear medicine imaging education.

In agreement with the previous author, both Gunderman *et al.* (2003:1239-1242) and Subramaniam *et al*. (2005:1-3) commented on the overcrowded undergraduate medical curricula and medical students reeling under the increasing load of information. Subramaniam *et al*. (2005:1-3) insisted that in spite of these overcrowded curricula it is still necessary to teach students about important practical aspects of clinical imaging in patient management.

During the ninth Asia-Oceania Congress on Nuclear Medicine Education and Training held in New Delhi, India on 1 November 2008, a paper was presented entitled "Getting the interest of students into the specialty: Promoting Nuclear Medicine in the undergraduate curriculum and clinical rotations". The presenter suggested that, "to achieve greater understanding and awareness of undergraduate nuclear medicine teaching, the best approach would be to discuss the subject within the international nuclear medicine community" (Ellmann 2008:online).

International research on undergraduate medical nuclear medicine education and undergraduate medical radiological imaging education was done respectively by Lass and Scheffler (2003:1018-1023) and Kourdioukova *et al.* (2011:309-318).

Lass and Scheffler (2003:1018-1023) investigated undergraduate medical nuclear medicine education in European Universities and their research results showed a high level of variation in:

- Approaches to undergraduate teaching of nuclear medicine;
- Number of hours spent on undergraduate teaching of nuclear medicine;
- Duration of the educational programmes; and
- Methods of teaching (independent or integrated).

Kourdioukova *et al.* (2011:309-318) working together with the European Society of Radiology (ESR) also accepted and acknowledged that conditions in universities differ significantly and that it was not possible to prescribe a standardised approach to undergraduate medical nuclear medicine teaching. At the same time they suggested that every Medical School adhere as closely as possible to a standard 'core' curriculum with the aim of teaching students radiological imaging in a clinical context (ESR 2011:363-374).

2.5.2.5 ***Nuclear medicine as a future career option***

An additional advantage of student exposure to imaging modules is that it improves their impression of diagnostic imaging and increases their interest in diagnostic imaging as a career option. According to Di Ianni and Walker (2006:48-50) medical students will never think of clinical imaging modalities as a career option if undergraduate clinical imaging teaching is weak or is not taught at all. Several other authors also regarded effective and efficient undergraduate medical and clinical imaging education as "very important for the future of radiology as a profession" (Branstetter *et al*. 2007:W9-14; Kourdioukova, Valcke & Verstraete 2010:326-333).

2.5.2.6 ***Summary***

To summarise the theoretical perspective on ***WHY*** an undergraduate nuclear medicine educational module should be implemented, the following reasons were identified:

- Empowerment of medical students and newly qualified doctors: Main aim is equipping students with the necessary knowledge, skills and attitude to utilise nuclear medicine imaging effectively and to practice competently as future referring doctors;
- Improvement of patient care: Main aim is to teach nuclear medicine as a 'core' subject in patient management;
- Nuclear medicine imaging service delivery and clinical practises: Improving understanding of nuclear medicine procedures to understand its place in clinical patient care settings;
- Implementation and standardisation of undergraduate medical nuclear medicine education: Constant emphasis is placed on the role and extent of undergraduate nuclear medicine education in existing medical curricula; and
- Nuclear medicine as a future career option: Early exposure to imaging practices increases students' interest in imaging as a career.

2.5.3 WHEN will be the most effective time to introduce such a basic nuclear medicine module in the already overloaded undergraduate MBChB programmes? (In pre-clinical, clinical or both phases of the existing programme?)

The best time to implement an undergraduate medical nuclear medicine module will be determined by the curriculum length, content and structure. In conventional or traditional medical curricula, teaching takes place according to different disciplines and pre-clinical basic-sciences subjects are taught separately from the clinical subjects. Current integrated curricula, schedule lectures on the same body systems, by different disciplines within the same time frame (Dent & Harden 2013:20,21).

According to Oris *et al*. (2012:121-130) students receive their first radiological imaging experience during the first year of pre-clinical medical training in 41% of institutions that follow modern medical curricula versus only 2% of students at institutions that follow a conventional medical curriculum. In conventional curricula, medical imaging education is mostly presented in the third and fourth years, with the possibility of a visit to a radiology department during the first and second year, or later in the fourth year. Both modern and traditional medical curricula regard the presentation of radiological imaging teaching in third, fourth and fifth years as equally important.

2.5.3.1 *Pre-clinical phase of the medical curriculum*

As mentioned previously, Sternberg (1965:691-698) describes nuclear medicine as a "liaison" discipline that work together with other clinical disciplines in effective patient care. He recommends that nuclear medicine should be introduced early in the medical learning programme to make the necessary impact on students. Jensen (1977:482-483) as well as Gunderman and Stephens (2009:859-861) are also advocates for early exposure of students to diagnostic imaging procedures to learn and understand the basic principles and appropriate indications for such radiological imaging procedures. Branstetter *et al.* (2007:W9-14) and Branstetter, Humphrey and Schumann (2008:1331-1339) explain that dedicated teaching of radiological imaging by an academic radiological specialist during the first year of medical student education, leave students with a greater interest in, and appreciation for radiological imaging disciplines.

2.5.3.2 *Transition from pre-clinical to clinical experience*

Jensen (1977:482-483) explains that the transitional phase between pre-clinical and clinical phases is a time for students to acclimate themselves to the clinical setting. Using this phase to teach a diagnostic imaging course will familiarise students with the manner in which pathology appears radiographically, though it is not intended to make them 'mini' radiological specialists.

2.5.3.3 *Clinical phase of the medical curriculum*

A well-structured, formally organised, integrated, multi-disciplinary imaging course involving physicians, diagnostic radiologists (including nuclear medicine specialists), pathologists and other clinicians in the last or final year of medical education, is considered the most effective teaching method of imaging training during the clinical phase (Buckenham 2005:1-3; Jensen 1977:482-483; Subramaniam *et al.* 2005:1-3).

Buckenham (2005:1-3) suggests that medical student education in imaging modalities should run as a golden "thread through each clinical rotation" and this can only be achieved through the integration of imaging education programmes with the rest of the existing medical curriculum. Those in charge of undergraduate medical curricula should provide specific space for this imaging studies offered by imaging specialists.

The length of medical curricula in most European countries varied between five and seven years, with most over six years (Kourdioukova *et al.* 2011:309-318). The clinical phase years (years three, four and five) were considered the most important years for teaching and learning imaging procedures. Kourdioukova *et al.* (2011:309-318) reported that radiological imaging education in most European countries took place in the fourth year (73.5%). Only 20% of the European institutions offered radiological imaging teaching in the first year of medical training.

2.5.3.4 *In both phases*

Rogers (2003:1201-1203) suggest that academic radiology departments should be more actively involved in the formal training of medical students during all four years of the medical curriculum, while Kourdioukova *et al.* (2011:309-318) reported on European countries where the teaching of imaging modalities formed a constant part of each year of medical education. They also suggested that teaching clinical radiological imaging should ideally be integrated and taught in medical curricula as a continuous thread throughout the programme.

2.5.3.5 *Summary*

To summarise the theoretical perspective on ***WHEN*** to implement an undergraduate nuclear medicine educational module, the following aspects were identified:

- ***Pre-clinical phase of the medical curriculum:***
  - In current medical curricula, students receive their first exposure to radiological imaging in their first year of medical training;
  - Early imaging instruction deepens students' understanding of basic imaging principles and concepts;
  - Students' should be taught how to utilise imaging studies effectively and optimally in clinical conditions;
  - Increased awareness of radiological studies enhances students' confidence in utilising and ordering radiological investigations when entering their clinical years; and
  - Students' interest in and appreciation of the radiological imaging field increases.
- ***Transition from pre-clinical to clinical experience:***
  - Students are familiarised with the manner in which pathology appears radiographically; and
  - The intention is not to make them "mini" nuclear medicine physicians.
- ***Clinical phase of the medical curriculum:***
  - A well-structured, organised, formal, integrated imaging course is the most effective formal teaching method during the clinical phase;
  - Teaching of imaging modalities must run as a thread through each clinical rotation;
- ***In both phases:***
  - Incorporating radiological imaging teaching as a regular part of each year of medical education is regarded as the ideal situation; and
  - Both modern and traditional curricula consider the clinical years ranging from the third to fifth years, as equally important for teaching radiological imaging.

2.5.4 WHICH nuclear medicine topics will be most appropriate at undergraduate level?

Mosier *et al.* (1981:555-559) point out that in order to practice medicine today, a medical doctor should have certain knowledge of diagnostic imaging procedures. The ESR White Paper (ESR 2011:363-374) supports this by emphasising that medical students should have some basic and general knowledge and skills to understand and utilise diagnostic imaging procedures effectively. They ask the question, what is considered "***basic***" imaging knowledge and skills?

In the next paragraphs, particular attention will be paid to suggestions by a few imaging experts regarding '***basic core'*** imaging content required at undergraduate level, which include:

- Introduction to the imaging department by Buckenham (2005:1-3);
- General educational objectives by Mosier *et al*. (1981:555-559) and Subramaniam and Gibson (2007:42-45); and
- Critical core knowledge suggested by the ESR in their White Paper (ESR 2011:363-374).

2.5.4.1 *Introduction to the Imaging Department*

Buckenham's (2005:1-3) preferences regarding imaging topics to be taught to medical students, include mostly imaging service delivery topics like:

- The role of diagnostic imaging disciplines as part of the healthcare team, including both diagnostic and therapeutic aspects;
- The role of the modern imaging specialist (nuclear medicine specialist and radiologists) as part of the clinical healthcare team;
- The proper usage and limitations of imaging facilities;
- No attempts to teach students to interpret imaging procedures;
- A working knowledge and correct expectations of the imaging process;
- How to provide imaging knowledge to patients undergoing radiological procedures and treatment;
- Preventing diagnostic imaging procedures replacing good clinical assessment;
- By referring a patient, the clinicians ask a diagnostic question that needs to be answered by the imaging procedures' results;

- Current and appropriate knowledge about ionising and non-ionising radiation, and an understanding of the physics, chemistry and biology of radiation, in order to communicate about it effectively;
- Correct information and appropriate answers and response about radiation to be given to any potential radiation recipients and know what to do if a patient is pregnant or lactating and breastfeeding;
- Radiation risks and limitations of imaging procedures and investigations; and
- Specific radiation objectives are necessary to change and influence any misconceptions and wrong beliefs regarding radiation exposure risks.

2.5.4.2 *General educational objectives*

Mosier *et al.* (1981:555-559) as well as Subramaniam and Gibson (2007:42-45) propose general objectives and student assessment practices that could be used as a basis for what is expected of medical students. The objectives (also called outcomes) should clearly indicate what students should know and be able to do at the end of the course. Their suggestions include:

- ***Knowledge level:***

— Recognising and recalling learned information regarding basic medical radiation physics, radiation protection and radiation effects on bodily tissues; and

— Basic principles of imaging modalities and procedures, including nuclear medicine examinations.

- ***Skills level:***

— Ordering the most appropriate and cost-effective radiological imaging investigations for common clinical conditions;

— Distinguishing between normal and abnormal imaging patterns in certain common clinical disorders;

— Recognising gross abnormalities on examinations;

— Applying (and appropriately acting upon) an imaging report and findings in the differential diagnoses and clinical workout of patients;

— Identifying strengths and weaknesses of radiological imaging studies;

— Obtaining informed consent from patients for specific imaging investigations/procedures by explaining what the study entails and pointing out the radiation risks before the studies are carried out; and

— Asking a specific question regarding the patient’s clinical condition from the imaging specialist to answer and so contribute to overall patient care.

- ***Attitudinal levels:***
— Acknowledging the role of radiological disciplines as part of the healthcare team and the special relationship they have with other clinical disciplines; and
— Respecting the imaging specialists' need for an indication and explanation of the reason(s) for requesting specific studies as well as a clear and complete clinical history and details of the patient's clinical condition.

2.5.4.3 *Critical 'core' knowledge*

The ESR White Paper (ESR 2011:363-374) supports the proposition that a clinical imaging 'core' curriculum for undergraduate medical students should be presented by medical schools as part of the existing formal curriculum and according to OBE strategies. Such 'core' teaching programmes and teaching abilities of lecturers should be tailored in accordance with student feedback, to ensure that it is in a form that students appreciate.

According to this ESR White Paper (ESR 2011:363-374) 'critical core' knowledge, skills and attitudes include:

- Empowering students with a knowledge base of imaging principles and techniques;
- Basic-sciences (anatomy, physiology pathology);
- Clinical management of disease and therapy;
- Usage of pictures or images of normal and pathological anatomy or physiology to explain and clarify the nature of disease processes;
- Providing an understanding and appreciation for the importance and benefits of imaging procedures, including nuclear medicine procedures, in daily patient care;
- Highlighting the role of new imaging developments and costs involved in their future medical practices;
- Raising the profile of radiological imaging, including nuclear medicine, as a career choice among undergraduates;
- Creating awareness in newly qualified doctors of their legal obligations with respect to patient care and safety as well as obtaining informed consent for radiological imaging and therapeutic procedures.

2.5.4.4 *Summary*

A summary of 'basic core' imaging subjects that students need to know and understand in order to utilise imaging procedures effectively in patient care and management, include:

- The role of imaging specialists as part of clinical healthcare team;
- Clinical uses of each imaging technique (clinical physicians will only utilise imaging techniques they are familiar with);
- Ordering the most appropriate imaging tests for a patient's clinical condition (which tests to order) and what to do if a patient is pregnant or lactating and breastfeeding;
- Essential information needed and given when ordering a nuclear medicine study;
- Indications, advantages and disadvantages as well as strengths and weaknesses of the different imaging techniques;
- Emphasis on cost-effective use of new imaging and therapeutic procedures for highlighting normal and pathological anatomy and physiology in the nature and behaviour of diseases;
- Basic skills in common and urgent imaging interpretation to recognise urgent findings;
- Distinguishing the information and answers given by the radiologist's report that is truly relevant to the patients' care;
- Legal responsibilities that new legislation put on clinical staff referring patients for radiological and nuclear medicine imaging studies, including obtaining informed consent for referrals and ensuring optimal patient care and protection during imaging procedures;
- Patient exposure to radiation during nuclear medicine procedures;
- The overall position and status of imaging education in existing medical curricula in both pre-clinical and clinical training years; and
- New imaging developments that can form part of future clinical practices.

2.5.5 WHAT should the extent of contents be for each subject at undergraduate level?

Graham and Metter (2007:257-268) emphasise clear definitions of the type of knowledge, specific skills, behaviours and attitudes required of students, while Gunderman *et al*. (2003:1239-1242) emphasise that teaching imaging must be conducted on the students' undergraduate knowledge level.

Students should be able to do/demonstrate what is expected of them according to the specific outcomes for the course/module. Outcomes expected of students may include:

- Specific medical knowledge and skills for effective and appropriate application of patient care and treatment of disease;
- Interpersonal skills for effective communication and cooperation with patients, their family members and other professional healthcare staff;
- Ability to work as part of a team in a variety of healthcare settings, with an understanding of inter-professional relationships between different healthcare professionals;
- Ability to investigate and critically evaluate scientific evidence of improved patient care in practice or evidence-based learning;
- Ability to work as part of a system-based practice, effectively calling on other resources to provide optimal healthcare; and
- Be dedicated to carrying out professional responsibilities, comply with ethical principles and be sensitive and empathetic to patients of diverse backgrounds.

2.5.6 By WHOM should this course be taught? (By nuclear medicine physicians or other clinical physicians during ward rounds or both?)

Jensen (1977:482-483) emphasises that Radiological Imaging Departments at academic teaching hospitals have a variety of responsibilities. Because clinical imaging procedures are involved and used in almost all clinical patient care circumstances, the major responsibility of a Radiological Imaging Department is clinical service delivery. Academic teaching is, besides clinical service delivery, one of their primary functions; therefore, provision must be made for staff for both clinical service delivery and academic teaching. Academic imaging departments are responsible for ensuring that they are adequately equipped for efficient and effective teaching in an ideal imaging learning environment and at an appropriate undergraduate level.

Staff shortages are regarded as one of the main obstacles in academic teaching programmes, and need to be addressed. The ESR (ESR 2011:363-372) suggests that only a few dedicated imaging educators were necessary to provide effective undergraduate imaging education; this means that the number of undergraduate teachers should be limited to only one or two in order to maintain the teaching and learning strategies and methods.

The question of who should be doing the teaching and who are best qualified to be medical imaging educators arises. Attention will now be paid to the types of staff that are responsible for undergraduate medical radiological (including nuclear medicine) imaging education.

2.5.6.1 *Radiological imaging specialists, including nuclear medicine specialists*

Jensen (1977:482-483) proposes that the imaging education role is best filled by practicing imaging specialists or medical imaging educators. The presentation of diagnostic imaging courses by dedicated imaging specialists gives students the opportunity to learn utilisation of imaging procedures directly from the imaging physicians who is actually doing and interpreting these studies, rather than from non-imaging physicians requesting diagnostic and therapeutic procedures.

Gunderman *et al*. (2003:1239-1242) and Subramaniam *et al.* (2005:1-3) emphasise that it was the duty of educating imaging specialists who were in charge of teaching imaging to medical students to ensure and make room for an organised, integrated imaging teaching programme, rather than expecting students to learn imaging principles passively (by "osmosis") from their attachment to other clinical disciplines. Subramaniam *et al.* (2005:1-3) regard active learning, which took place when undergraduate nuclear medicine imaging lectures were integrated into the academic programmes of the other clinical departments, as being better than passive exposure during their ward rounds.

Kourdioukova *et al.* (2011:309-318) state that clinical imaging specialists seems to be the most successful clinical imaging educators. They have the knowledge and ability to create an improved and deeper level of imaging understanding in students. They can also answer questions from students and solve clinical queries from a patient's perspective. The ESR White Paper (ESR 2011:363-374) emphasises that students should be able to see that radiological and nuclear medical imaging specialists were enthusiastic about their imaging modalities and topics.

A small number (not more than one or two) of dedicated imaging educators or imaging specialists and super/sub-specialised imaging specialists are the best people to teach imaging to medical students. However, there is a risk involved in that they could be teaching at a too high level and in such detail that could fall outside the learning goals or outcomes of undergraduate students (ESR 2011:363-374). It was suggested by the ESR that imaging educators should be encouraged to use student feedback to evaluate their own teaching and learning abilities as well as re-evaluating the imaging course itself.

2.5.6.2 *Other radiation workers*

Kourdioukova *et al.* (2011:309-318) point out that other medical specialists are also able to participate in and contribute to undergraduate medical imaging education of medical students. Imaging educators and imaging specialists may call upon the assistance of medical physicists, radiographers and postgraduate nuclear medicine students in undergraduate medical nuclear medicine education. Medical physicists could assist with teaching radiation and radiation protection while radiographers could help with practical sessions in the department promoting inter-professional collaboration.

2.5.6.3 *Other clinical/non-clinical physicians*

As previously mentioned, in response to a query by Rogers (2003:1202-1203) on why medical students receive so little formal imaging training, reasons provided were limited curriculum time and other clinical disciplines that already teach imaging training during ward rounds and clinics. Subramaniam *et al.* (2005:1-3) spoke strongly against this trend of medical students learning clinical imaging during their residencies in clinical departments such as internal medicine, general surgery and family medicine. They consider such an imaging teaching method as passive learning by means of "osmosis" and strongly advocated that such sub-standard clinical imaging teaching to medical students should be discontinued in favour of active learning during integrated teaching sessions. In his response to Subramaniam *et al.'s* (2005:1-3) suggestions, Buckenham (2005:1-3) stressed that clinical specialists will definitely not receive it favourably, because their limited clinical training time in already crowded medical curricula will then be cut even further.

Di Ianni and Walker (2006:48-50) confirm that most undergraduate imaging teaching were done by non-imaging physicians/clinicians during academic ward rounds and in clinics. They also considered this type of undergraduate imaging training as informal, sub-optimal and sometimes contrary to the real contemporary modern imaging trends and situations.

Gunderman *et al*. (2003:1239-1242) express their support to the previous authors regarding the stance that undergraduate medical students should not be taught clinical imaging facts and interpretation by clinical specialists ***only***. According to Gunderman and Stephens (2009:859-861) "it is difficult to teach imaging as a discrete entity"; they suggested that teaching undergraduate clinical imaging in most medical schools needed to run like a golden thread throughout each clinical rotation. The Royal College of Radiologists (RCR) suggests that multi-disciplinary clinical imaging teaching should be integrated with existing medical curricula (RCR 2011:online).

2.5.6.4 ***Summary***

To summarise the theoretical perspectives on who qualifies to be a medical imaging educator, most of the quoted literature confirmed that the imaging specialist, whether diagnostic radiologist or nuclear medicine physician, was the person best qualified to teach imaging to undergraduate medical students. The assistance of medical physicists, radiographers and postgraduate registrars may be acquired. The expectations of students to learn imaging from their attachment to other clinical departments only was strongly condemned as sub-standard practice.

2.5.7 HOW should the undergraduate nuclear medicine module be presented to students? (Including teaching, learning and assessment strategies and methods)

Ell (1997:1081-1082) investigated European undergraduate teaching of radiology and nuclear medicine. He reported on the variation in the degree of formal teaching of medical imaging specialities of radiology and nuclear medicine at undergraduate level. In addition to this, Di Ianni and Walker (2006:48-50) confirm that teaching of radiological imaging in undergraduate medical education was often inconsistent and informal.

Lass and Scheffler (2003:1018-1023) raise the issue of whether undergraduate nuclear medicine teaching and learning should be mandatory or optional, or perhaps a mixture of both. They suggest that the mandatory part of the course could consist of formal classes and lectures covering the main 'hard core' of nuclear medicine knowledge. An optional course of additional lectures could be offered as a 'core plus' option and elective or practical sessions should be available for interested students. Their research data on undergraduate nuclear medicine education in European universities showed great variation in approaches to teaching clinical imaging, the number of hours spent on 'core' nuclear medicine education and the length of the course. Variation in teaching and presentation methods in existing undergraduate medical curricula also existed.

2.5.7.1 *Teaching methods and strategies: How to present and teach undergraduate nuclear medicine modules to medical students*

Several authors have reported on the teaching methods used in undergraduate medical nuclear medicine teaching:

According to the Society of Chairmen of Academic Radiology Departments' (SCARD) study of 1972, as reported on by McAfee *et al*. (1973:22-31), the teaching methods used in undergraduate medical nuclear medicine teaching in 1972 included the following:

- Lectures;
- Seminars or small-group tutorials;
- Audio-visual aids; and
- Electives available in Nuclear Medicine Departments.

Di Ianni and Walker (2006:48-50) also described numerous ways of teaching fundamentals of imaging practises to students, including:

- Formal instruction/didactic lectures;
- Dedicated teaching at the reporting station/view box;
- Elective programme for students who are interested; and
- Student-only conferences.

According to both Gunderman *et al*. (2003:1239-1242) and the RCR (RCR 2012:online) medical students can study the human body and its diseases by making use of clinical functional and anatomical imaging without cutting open the patient's body. Gunderman *et al*. (2003:1239-1242) describe the utilisation of radiological pictures and images enabling students to see disease processes and internal anatomy in their patients' organs and tissues. Not only anatomy, but physiology and pathology too, can be correlated with patient histories and physical examination findings. The RCR (RCR 2012:online) also regarded medical images as powerful tools for enhancing learning in the medical curriculum. Making use of archived imaging material with adequate equipment to display the images, diseases can be illustrated and students' interpretation skills improved.

Apart from this Kourdioukova *et al.* (2011:309-318) also report on the large variation in radiological imaging education in academic institutions in the USA, Canada and Europe. During curriculum reforms that took place in European medical schools, changes in the content (what) and instruction methods (how) of curricula were implemented with the main objectives of:

- Improving the efficiency and effectiveness of teaching approaches; and
- Reaching better learning achievements.

2.5.7.2 *WHERE should the undergraduate nuclear medicine be taught and at what level? (The educational and teaching environment)*

The teaching and learning environment in which the educational process takes places consists of the place where students should be taught and the level at which the content must be delivered. The learning environments of the pre-clinical and clinical training years help students understand the place and role that diagnostic imaging modalities play in the overall medical curriculum.

According to the RCR (RCR 2011:online) teaching should be provided within the imaging department, thereby enabling students to observe interaction between imaging specialists and referring doctors. Students need to see that imaging specialists were enthusiastic about their subject and appropriate teaching on at undergraduate level must be ensured.

2.5.7.3 *HOW many teaching hours are allocated for undergraduate nuclear medicine teaching in existing medical curricula?*

As mentioned previously, the European research studies of Ell (1997:1081-1082) (2003:1018-1023), as well as those of Lass and Scheffler (2003:1018-1023), were primarily carried out to obtain an impression of the scope of formal undergraduate level training in clinical radiology and nuclear medicine imaging modalities. The length of medical curricula and the hours dedicated to undergraduate nuclear medicine teaching were investigated. It seemed that the time available for undergraduate medical teaching of nuclear medicine imaging represented only about 5% of the teaching time of conventional radiology (McAfee *et al.* 1973:22-31). The actual numbers of undergraduate medical nuclear medicine teaching hours per year were very low (mean 29 hours) and the majority of centres would have liked to double their teaching time.

Kourdioukova *et al*. (2011:309-318) confirm the European variation in the total number of teaching hours that focussed on undergraduate radiological imaging. They confirmed that the hours varied considerably between countries and depended on the radiological topic. Their research data showed great variation in the number of hours spent annually on formal undergraduate radiological and nuclear medical lectures, with a further time variation depending on the different teaching methods. The length of undergraduate radiological curricula ranged from:

- 0 hours in each subject;
- 88 hours in radiology; and
- 32-62 hours in nuclear medicine.

2.5.7.4 ***Assessment strategies and methods: How to assess students' achievement of the module outcomes***

Examining students on radiological imaging usually forms part of and is integrated with main modular clinical examinations; it is, therefore, the responsibility of imaging departments to ensure that they are involved in these integrated assessment programmes with the other clinical disciplines as part of larger clinical examinations. In addition to this, the ESR White Paper (ESR 2011:363-374) emphasises the necessity for imaging departments to provide separate radiological and nuclear medicine imaging assessment practices within their imaging departments.

Subramaniam *et al*. (2005:1-3) accordingly emphasised the importance of both summative and formative assessment methods as an integral part of the learning process. During the course, formative assessment was done to monitor students' progress. From this assessment, feedback could be provided to students regarding aspects of their professional competence, including their attitudes, dedication and ability to work together as a team. Individual learning styles were identified and more effective learning was stimulated. Summative assessment took place at the end of a particular module or course to evaluate students' achievements and to allocate final marks or qualifications.

Evaluations of students' imaging learning are mostly done through written tests and/or oral examinations, but a mixture of methods can also be considered. Clinical radiological images can be used in medical students' final year exams as an examination instrument as part of multiple-choice questions (MCQ) and Objective Structured Clinical Examinations (OSCE). Other forms of questions that may be used are single best answer questions, short answer questions, extended matching items, and viva topics (Barrett *et al*. 2010:online). Computer-based assessment and/or OSCE evaluation is possible, but according to this ESR White Paper (ESR 2011:363-374) it was not commonly used. Constructive feedback should be given to students after each assessment.

2.5.8 HOW should the undergraduate nuclear medicine module be incorporated in the existing medical curricula? (Integrated with other clinical or imaging departments, as an independent module in an independent nuclear medicine discipline or a combination of both?)

The way in which an undergraduate nuclear medicine module should be incorporated into existing medical curricula have been debated since the early years (cf. Paragraph 7.4) when Sternberg (1958:501-504) and Sternberg (1965:691-698) suggested options for structuring or presenting undergraduate nuclear medicine modules, such as:

- Creating a separate and independent Nuclear Medicine Department;
- Incorporating/integrating nuclear medicine into the framework of already existing medical departments; or
- Combining independent and integrated structures.

He points out that the mode of presentation varies greatly, depending on the attitude of the parent institution towards this new radiological imaging discipline and personality of the teacher and his or her own imaging training.

Years later, Lass and Scheffler (2003:1018-1023) report on various nuclear medicine teaching methods ranging from independent 'core' medical courses to nuclear medicine teaching mostly integrated with radiology or other clinical modules, which may include radiation and radiation safety, endocrinology and clinical physiology.

2.5.8.1 *As an independent module in an independent nuclear medicine discipline*

McAfee *et al.* (1973:22-31) report that the decision or preference to establish an independent Nuclear Medicine Department is influenced by the background specialty of the Head of the Nuclear Medicine Division. Those with internal medicine training tended to favour the creation of an independent department more than those with backgrounds in radiology**.**

Buckenham (2005:1-3) on the other hand, is convinced that it is difficult to teach clinical imaging as a separate entity to students; he points out that most medical schools teach radiological imaging as a golden thread that runs through each clinical rotation and the courses were offered by radiologists themselves. On the contrary, the ESR White Paper

(2011:363-374) reports that more than 50% of European Academic Imaging Departments, present radiological imaging as an independent discipline with its own examination, according to the "classical" education model.

2.5.8.2 *Integrated with other clinical or non-clinical departments*

In 1973, McAfee *et al.* (1973:22-31) state that those who favoured the continuance of nuclear medicine as a part of radiology believed that the development of an independent Nuclear Medicine Department would be premature and unrealistic, but "could be feasible in the future". According to them, three medical directors believed that nuclear medicine should remain a division of Internal Medicine because this is generally the strongest department within the Medical School. They also thought that a complete residency, including nuclear medicine and bedside experience, could then be offered within a single department.

On the other hand, Jensen's (1977:482-483) opinion is that the most effective method for teaching radiological imaging is a multi-disciplinary presentation where physicians, pathologists, imaging specialists and other clinical doctors were involved in clinical decision making and treatment options. While this may be true, Ell (1997:1081-1082) was of opinion that although medical doctors and specialists consider 'modern' integrated curricula, such as PBL, to be the best teaching methods (in 1977) in an already overburdened medical programme, these methods are actually inadequate for radiological imaging (including nuclear medicine) training. He argues that, when the inadequacy of referrals by newly qualified doctors, is monitored, one could not help feeling that the so-called 'integrated teaching' really did not deliver what is required and expected for clinical imaging disciplines. A further disadvantage of integrated teaching methods was that the number of hours available for nuclear medicine imaging training, were reduced, since it rarely provides minimum imaging coverage.

Kourdioukova *et al.* (2010:326-33) explain that during the extensive, wide-ranging curriculum reform in 1999, the University of Ghent changed their conventional medical curriculum to an "integrated contextual medical curriculum" with both horizontal and vertical integration. This new curriculum helped students see the "big picture" and to understand the place of radiological imaging teaching in pre-clinical and clinical years of medical training.

The ESR White Paper (ESR 2011:363-374) supports the integration of radiological imaging teaching within thematic clinical teaching modules. This "modular" type of instruction, studies the various body systems, such as chest, abdomen, musculoskeletal, nervous and genitourinary systems, separately. In this modular approach, the teaching of radiological imaging is not offered as a separate discipline; therefore, it is relatively under-represented in clinical examinations. However, only 20% of the academic teaching centres in Europe relied on this type of teaching method. As mentioned previously, more than 50% of European academic imaging departments present radiological imaging according to the "classical" education model as an independent discipline (ESR 2011:363-374).

2.5.8.3 *As a combination or hybrid of both independent and integrated ways*

According to the ESR White Paper (ESR 2011:363-374) 32% of academic teaching centres in Europe practice a combination or hybrid type of classic and modular teaching methods. In comparison to the practice of modular (20%) and hybrid (32%) types of medical curricula, conventional or traditional medical curricula, based on "classic building blocks" is predominantly used in 62% of academic teaching centres in Europe. Kourdioukova *et al*. (2011:309-318) emphasised that these findings actually "neglects the findings from other research showing that an integrated approach of radiological education leads to more effective radiological education and helps to develop a positive attitude towards radiology" (cf. Table 6.4).

The ESR White Paper (ESR 2011:363-374) emphasises that conditions in European universities were so significantly different from each other that it was not possible to have a standardised approach to undergraduate clinical imaging education. Since the purpose of undergraduate clinical radiological imaging education is to study the role of radiological imaging in the context of clinical disease management, every Medical School should adhere as closely as possible to a standard 'core' curriculum for undergraduate radiology (including nuclear medicine) imaging education (ESR 2011:363-374). .

2.5.9 Conclusion

Kourdioukova *et al.* (2011:309-318) conducted the first international, comparative study on undergraduate radiological imaging curricula in European Medical Schools. They identified major differences and thus a lack of uniformity in the European medical curricula content and teaching methods. According to this international comparative study, educational programmes, and in particular undergraduate radiological imaging training, were clearly not yet standardised in either European or USA Medical Schools.

An international need was identified for undergraduate teaching of radiological imaging (including nuclear medicine) to be improved and standardised according to international, national and institutional needs. These differences and problems experienced internationally with undergraduate radiological imaging education were not only similar to the research problem and question of this research study conducted in South Africa in 2013, but also strongly reiterated the significance and value of such a study.

A summary of information obtained from the theoretical perspective on undergraduate medical nuclear medicine education internationally in order to answer the main research question (Study Objective 1) are included in the appendices section (cf. Appendix F1).

In the next chapter, Chapter 3, titled **Research Design and Methodology** the emphasis will be on theoretical perspectives relating to the research design and methods applicable to this study.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

Chapter 1 provided background information on the patient referral problem as experienced by the Nuclear Medicine Department of the UFS. The insufficient quality of patient referral letters, issued by newly qualified doctors (cf. Section 1.2) may be related to the absence of standardised guidelines for undergraduate medical nuclear medicine education in existing MBChB programs in South Africa (cf. Paragraph 1.3.1) and served as motivation for this investigation.

In order to provide guidelines to address the research problem, it is necessary to determine the current status of undergraduate medical nuclear medicine education, not only in South Africa, but also internationally. Chapter 2 provided an overview of the secondary information available on undergraduate medical nuclear medicine education nationally and internationally. To answer the research question and all the sub-questions and to fulfil Objectives 1, 2 and 4 of this study (cf. Paragraph 1.4.3) this secondary information was used to direct the researcher in selecting the research design and methods.

In this chapter, Chapter 3, the emphasis will be on theoretical perspectives relating to the research design and methods applicable to this study. Attention will be paid to theoretical aspects in existing literature, questionnaire survey and data management; to conclude quality-control methods and ethical considerations will also be discussed.

3.2 THEORETICAL PERSPECTIVE ON THE RESEARCH DESIGN

Theoretical perspectives on theory building, strategy of inquiry and research approaches will be explored and discussed in this section.

3.2.1 Theory building on the research design process

Research design acts as a framework for the empirical part during which accurate and reliable information or data are gathered and analysed for problem-solving.

Figure 3.1 presents a diagrammatic overview of the research design process.

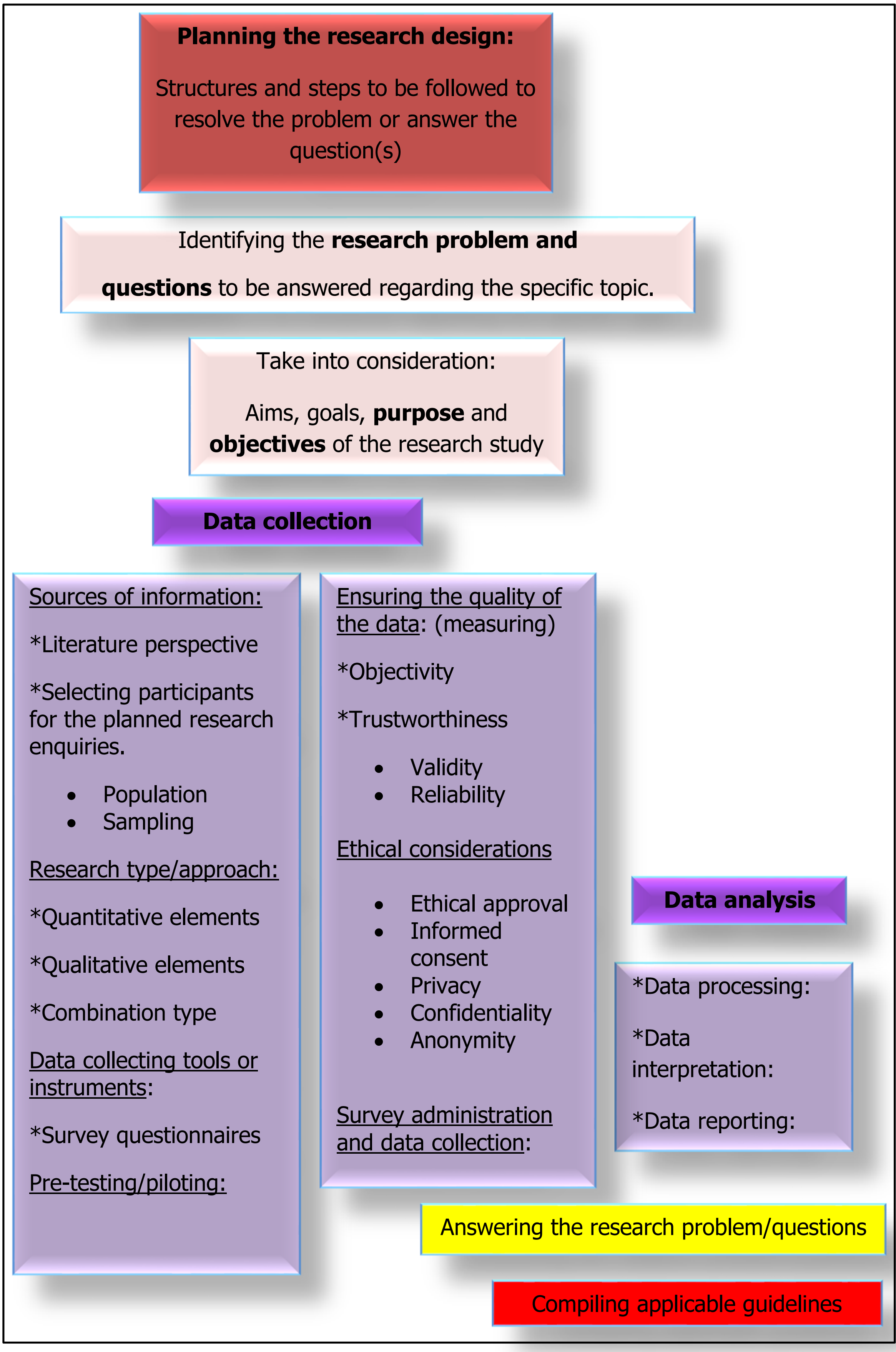


FIGURE 3.1: A DIAGRAMMATIC OVERVIEW OF THE STEPS OF THE RESEARCH DESIGN PROCESS [Compiled by the researcher, Nel 2013]

3.2.2 Strategy of inquiry and the research approach

The most accepted classification of research methods includes quantitative and qualitative methods. Structured quantitative research is carried out by means of experimental or non-experimental descriptive research design in which the relationship between variables is quantified. As a non-experimental descriptive study with situation-analysis components (cf. Paragraph 1.7.1), the current situation and trends applicable to undergraduate medical nuclear medicine education, nationally and internationally, were analysed and explained.

For the empirical study, primary data on the scope of undergraduate medical nuclear medicine education at the Schools of Medicine in South Africa were gathered by means of semi-structured online survey questionnaires with both quantitative and qualitative components. Combining closed and open-ended questions provided the best understanding of the research problem (Creswell 2014:online).

By utilising a Likert-type scale, as part of the research questionnaire, participants were requested to rate items on a response or frequency scale in order to evaluate their attitudes towards these items. The results could then be measured with descriptive statistical methods (Mouton 2009:126). A Likert-type frequency scale (McLeod 2008:online) was used to identify specific undergraduate-level topics to be included in such a module.

3.3 THEORETICAL PERSPECTIVE ON THE RESEARCH METHODOLOGY, METHODS AND MEASURING INSTRUMENTS

Research methodology refers to the way the research is actually carried out during the empirical phase. Data-collection methods described by Mouton (2009:110-111) include:

- ***Literature perspective***, consisting of the literature overview and document analysis;
- ***Survey questionnaires*** or ***focus groups*** for either interviewing or observing the selected participants; and
- ***Scaling or psychometric testing*** with Likert scales as part of the questionnaires.

Theoretical perspectives on literature perspective, survey questionnaires and Likert-like scales will be explored and discussed in the following paragraphs.

3.3.1 Extensive literature perspective

Collecting data from research studies of other researchers provides access to secondary information on the research problem and questions. Mouton (2009:119,121) explains that "the reviewing of existing literature is essential for researchers to familiarise themselves with the available body of knowledge in the research topic".

To answer the research question and to achieve the study objectives, a non-empirical theoretical literature perspective, as the situation-analysis component (cf. Paragraph 1.7.1), made use of existing secondary data, to provide a theoretical perspective and background to the study and gave an indication of the current national and worldwide trends in undergraduate medical nuclear medicine education. Chapter 2 provided the overview and discussion on the currently available existing body of knowledge on the research topic.

Documentary analysis on the other hand is regarded by De Vos *et al.* (2011:376-377) as a separate data-collection method. The content of existing documents is studied to understand their meaning and importance in the research topic's existing body of knowledge. The documentary analysis applicable to this study included official regulation and legislation documents from professional regulatory bodies, higher education institutions and national higher education and healthcare departments relevant to the research topics. These documents, their contents and applicability to the study were also discussed in Chapter 2 (cf. Paragraph 2.4.4 and Table 2.5).

In this study, the extensive theoretical literature perspective had the specific aim of:

- Investigating undergraduate medical nuclear medicine educational trends, nationally and internationally (cf. Paragraph 1.7.1.1 and Section 2.1).
- Expanding the researcher's knowledge and understanding of the research area and subject (De Vos *et al*. 2011:120; Mouton 2009:119,121; Singleton & Straits 1999:544);
- Bringing clarity and focus to the research problems;
- Providing background information and answers to the research questions (Docstoc 2006:online);
- Placing the research findings in the context of what is already known on the research subject (Singleton & Straits 1999:544);
- Identifying gaps in the existing body of knowledge;

- Preventing unnecessary duplication of studies (Joubert *et al.* 2010:66);
- Improving the researcher's understanding of appropriate research methodology (De Vos *et al*. 2011:134) by emphasising problems that others have encountered, and provide examples of reliable and valid questionnaires; and
- Providing other resources (cf. Section 2.1 and Paragraph 3.4.5) from which secondary information can be obtained.

3.3.2 The questionnaire survey

Joubert *et al.* (2010:107) describe a questionnaire as "a list of questions which are answered by the respondent, and which give indirect measures of the variables under investigation".

As mentioned previously primary data were acquired with an empirical study that made use of semi-structured survey questionnaires with both quantitative and qualitative components (cf. Paragraph 1.7.1.2) to collect standardised, fixed data from the participants to provide quantitative, qualitative and attitudinal overviews of the research population. The format and contents of the questionnaires were originally sourced from various applicable studies that had been done in Europe (Kourdioukova *et al.* 2010:18; Kourdioukova *et al*. 2011:309-318; Lass & Scheffler 2003:1018-1023; McAfee *et al*. 1973:22-31; Oris *et al*. 2012:121-130; RCR 2012:online).

The services of *EvaSys*, a sophisticated and automated educational web-based survey system, in use at the UFS, were utilised to construct and distribute the survey questionnaires. A formal list of structured closed and open-ended questions was sent by email to participants. The *EvaSys* system provided an email-based hyperlink to the questionnaires (cf. Paragraph 3.3.5) which were provided only in English in order to standardise specific themes of opinions and categories referred to by the participants when they gave their opinions and viewpoints in response to the open-ended questions. Each questionnaire was accompanied by a cover letter containing information about the study, instructions for giving consent for participation and for completing of the questionnaires. Contact details of the relevant ethics committee and researcher were also provided.

Examples of both questionnaires are included in the appendices section (cf. Appendix E2 and E4).

3.3.3 Targeted survey population and sample selection

The targeted survey population of this study consisted of academic and private nuclear medicine physicians, South African registrars and international postgraduate nuclear medicine students or fellows undergoing their postgraduate studies in South Africa. The sample, target and research population were identical.

Nuclear medicine (cf. Paragraph 2.4.3.2) is currently presented at only six of the eight Schools of Medicine in South Africa, and not all of them offer undergraduate nuclear medicine education. The Deans of the six Faculties of Health Sciences (FoHSs) were asked to identify the key persons involved in undergraduate medical teaching of nuclear medicine at their institutions, and these key persons were asked to complete the main questionnaire. These key persons were not necessarily the Heads of the Nuclear Medicine Departments but the lecturers who are actually involved in undergraduate teaching of nuclear medicine to medical students.

Due to the relatively small number of nuclear medicine physicians in South Africa, the second questionnaire was completed by members of the rest of the nuclear medicine expert population who consented to participate in the study.

The email databases of the South African Society of Nuclear Medicine (SASNM) and the Association of Nuclear Medicine Physicians (ANMP) were utilised to identify the relevant nuclear medicine experts in South Africa. The official websites of the Schools of Medicine with nuclear medicine facilities were also used to identify the expert participants.

The Directorate: Radiation Control of the South African Department of Health provided the researcher with a list of private nuclear medicine practices in South Africa, and this was used to identify privately practicing nuclear medicine specialists to be included in this study. During the 15th biennial SASNM Congress that was held in Parys, Free State, in September 2012, the necessary email addresses were obtained from some of the South African nuclear medicine physicians who attended the event.

The total number of selected participants consisted of two pilot persons, six key persons and 88 nuclear medicine experts.

3.3.4 Pilot study

A pilot study was done before the researcher embarked on the main study. The pilot study was necessary to ensure that the questionnaires were well structured, with clear and non-biased questions, and to determine the time needed for completion. To achieve this, and because of the relatively small target population, only two individuals, who meet the same criteria as those in the survey population, were asked to complete the questionnaires. They gave consent for participation in the pilot study.

The pilot study was done in precisely the same way as planned for the main study, making use of the services of the *EvaSys* educational online research system of the UFS. Analysing the data of the pilot study identified all possible problems and the necessary changes to the questionnaires were made prior to the main study. Only the expert pilot participants' responses were finally incorporated into the main study. The key persons' pilot responses were excluded from the main study because of the changes needed to be made to the questionnaire and because the key persons' pilot participant was at the time not actively involved as a key person in one of the six Nuclear Medicine Departments with nuclear medicine educational facilities.

3.3.5 Data-collection and gathering

The electronic internet survey, which involves respondents answering survey questionnaires online, is currently very popular due to new and specialised software products available, which makes it easy to conduct online surveys, obtain rapid responses, lower costs and achieve higher response rates. The researcher is also assisted in data administration and management since the internet and web survey software inserts the survey responses into data spread sheets automatically.

As mentioned previously, the services of the *EvaSys* educational online research system of the UFS were utilised for the main data-collection process. After acquiring approval from the appropriate authorities at higher education institutions in South Africa to conduct the research in their Nuclear Medicine Departments, a personalised email with information regarding the research study was sent to all potential participants, informing them about the research and requesting their participation in the study.

EvaSys emailed the questionnaire hyperlink (cf. Paragraph 3.3.2) to the participants with specific instructions regarding consent, completion and submission of the completed questionnaires. *EvaSys* provided regular updates on the rate of questionnaire completion and weekly reminder emails were sent to non-responders. The hyperlink to the questionnaire was provided with each follow-up email (cf. Paragraph 1.7.2 and Section 4.2).

Participants were given a maximum of six weeks to complete the questionnaires. After allowing maximum completion and follow-up time, the *EvaSys* system closed down the study. The raw data were provided for analysis in both Excel and SPPS formats to the researcher, the study leaders and the Biostatistics Department of the FoHS at the UFS. *EvaSys'* own analysis of the acquired data was also provided to the researcher and the study leaders (cf. Appendix E6, E7, E9 and E10).

The key person questionnaire was initially sent to eight key participants representing the six Schools of Medicine in South Africa offering medical nuclear medicine education, as well as the two Schools of Medicine that are not involved in medical nuclear medicine education. The latter two are only involved in nuclear medicine service delivery at tertiary academic hospitals/complexes. The key persons at those two Schools of Medicine were identified by the chief executive officers (CEO) of hospitals, the CEOs also granted permission for the study to be done at their hospitals. The researcher decided to exclude those two key persons from the study because formal medical nuclear medicine education did not form part of their institutions' undergraduate medical curricula. These changes were brought under the attention of the UFS Ethics Committee and they acknowledged and accepted it as such at their February 2014 meeting. Their letter of recognition is attached in the appendices section (cf. Appendix A2).

A summary of the participants who received and completed the email questionnaires is given in Table 3.1.

[Figures and Tables in the next sections were compiled by the researcher, Nel 2013 and 2014]

TABLE 3.1: TOTAL NUMBER OF QUESTIONNAIRES SENT TO AND RECEIVED BACK FROM THE SURVEY PARTICIPANTS

Research study	Academic Heads Of Nucl Med Departments		Nuclear Medicine specialists				Post graduate Nucl Med students				Totals			
			Academic		Private		National registrars		International fellows		Frequency		Percentage %	
	Send	Completed	Send	Completed	Send	Completed	Send	Completed	Send	Completed	Send	Completed	Send	Completed
Pilot			2	2							2	2		100%
Main	7	6	17	12	32	13	16	6	22	14	94	51		54.7%
Totals:	7	6	19**	14	32	13	16	6	22	14	96	53		55.2%
	85.7%		73.7%		40.6%		37.5%		63.6%		55.2%			
Key persons (n=5)	3	2	3	3							6	5		83.3% 83%
Nuclear medicine experts (n=47)	4	4	15**	10	32	13	16	6	22	14	89	47		52.8% 53%
Totals:	7	6	18	13	32	13	16	6	22	14	95	52		54.7%

****Results of the key pilot participant was excluded from the main study's results**

3.3.6 Data-analysis and interpretation

As mentioned previously, the acquired raw data and the data dictionaries of this study were provided by the *EvaSys* system and the quantitative data were processed and analysed with the assistance of the *EvaSys* systems' own analysis program and the Biostatistics Department at the FoHS at the UFS (cf. Appendix E11 and E12).

Descriptive statistics of the personal characteristics or demographical data of participants is necessary to decide whether the selected sample of participants is representative of the targeted research population. Descriptive numerical statistical results were organised into frequency and percentage Tables or Figures to produce a clear picture of the data, enabling the reader to interpret the findings. Each Table and Figure required textual interpretation and discussion for the reader to understand the meaning of the data it contains. These descriptive statistical results will be presented in Chapter 4.

Qualitative data-analysis required the researcher to classify the raw data into main themes and categories that emerge from the coding of respondents' responses. Specific themes of opinions and trends were identified by the researcher from answers to the open-ended qualitative questions; in this she was assisted by the *EvaSys* data-analysis capabilities. All the participants' views regarding the applicability and contents of an undergraduate medical nuclear medicine module were analysed and will be presented and discussed in Chapter 5.

The complete *EvaSys* report on the study is provided in the appendices section (cf. Appendix E10). The data dictionaries of both key persons and experts results are included in the appendices section (cf. Appendix E3 and E5).

3.4 ENSURING THE QUALITY OF THE STUDY

Mouton (2009:36,37) describes a third group of research methods, which include quality control or verification methods to evaluate the accuracy of the results obtained. In the next paragraphs the theoretical aspects of the quality-control indicators and their applicability to this study will be discussed.

3.4.1 Internal validity or accuracy or credibility

Joubert *et al.* (2010:155-156,160,313) regard research validity as an indication of the extent to which a research instrument measures what it is supposed to measure. In this study, internal validity was ensured by making use of:

- Educational and clinical nuclear medicine professionals as participants from a variety of backgrounds in South Africa;
- Appropriate key persons to answer the questionnaire on undergraduate medical curricula;
- Standardised research processes to ensure that the experience for each of the participants is the same;
- A pilot study for pre-testing of the structured survey questionnaires;
- Questionnaires without leading questions that could influence participants to answer in a specific way; and
- All variables, such as age, gender, qualifications and role in the Nuclear Medicine Departments that could affect the study results.

3.4.2 Reliability and precision

Reliability or precision refers to the repeatability or reproducibility of study findings and whether the same results would be found with each attempt to complete the questionnaire (De Vos *et al*. 2011:177,178; Katzenellenbogen, Joubert & Karim 1999:117). In this study, reliability was ensured by making use of:

- Participants who were knowledgeable about the research topic, to ensure that they were all representative of the research topic (cf. Paragraphs 4.3.1.2 and 4.4.1.3);
- Appropriate key persons who were knowledgeable about the undergraduate medical curricula at their Schools of Medicine (cf. Paragraph 4.3.2);
- *EvaSys* a trusted and reliable internet-based survey-management system (cf. Paragraphs 1.7.2);

- A user-friendly hyperlink to the survey questionnaires;
- Two or more questions in the same questionnaire to measure the participants' opinions and attitudes towards an undergraduate medical nuclear medicine module and guidelines (De Vos *et al.* 2011:177);
- Questionnaires and frequency scales without leading questions;
- A pilot study to test the quality of the semi-structured survey questionnaires (De Vos *et al*. 2011:177); and
- Several methods, including follow-up personalised emails and phone calls, to ensure a higher response and completion rate (Joubert *et al*. 2010:155-156).

3.4.3 Trustworthiness in qualitative research

Trustworthiness is used in qualitative research as a parallel term to "rigour" (Morse, Barrett, Mayan, Olson & Spier 2002:5) and validity in quantitative research. Verification strategies that ensure both reliability and validity or trustworthiness of data in this study include:

- Sampling of appropriate key and nuclear medicine expert participants who best represents and has knowledge of the research topics;
- Emphasising the confidentiality of the respondents' answers to ensure that questions are answered honestly and without fear of consequences;
- Establishing a trustworthy and confidential relationship between the researcher and participants to ensure maximum participation rates;
- The trustworthiness of collected data is increased if quantitative and qualitative data-collection and analysis approaches are combined rather than used separately;
- The questionnaires were provided only in English in order to standardise specific themes of participant opinions;
- Themes of opinions were identified by the researcher; in this she was assisted by *EvaSys* data-analysis capabilities, experienced study leaders and an independent evaluator of the results; and
- Direct quotes from respondents' qualitative responses and explanations to qualitative questions were used to support quantitative calculations and findings of quantitative responses.

Research study quality is only as good as the investigator. It is therefore important to keep in mind that the researcher's ability and skills in using verification strategies also determines the trustworthiness, validity and reliability of the research study.

3.4.4 External validity and generalisations

For effective generalisation, the targeted population should be clearly defined and the sampling method must ensure that the chosen sample is as representative as possible of the population (Mouton 2009:133). As mentioned previously the sample and targeted population in this study were the same and consisted of academics and experts in private practice in the field of nuclear medicine imaging (cf. Paragraph 3.3.3).

3.4.5 Authenticity

De Vos *et al.* (2011:419) regard authenticity as part of the credibility of secondary internet sources. Verification strategies to ensure reliability, validity and trustworthiness of secondary internet data in this study included activities such as:

- Utilising the assistance of library personnel and resources to obtain relevant research literature;
- Giving preference to articles from accredited international and national journals;
- Evaluating of scientific journals' five (5) year impact factor (IF);
- Using Electronic search engines like PubMed and Medline;
- Using additional references sourced from nuclear medicine related websites; and
- Scanning the references from published articles relevant to the research topic.

3.5 ETHICAL CONSIDERATIONS

Ethics can be defined as "a set of moral principles which is widely accepted and which offers rules and behavioural expectations about the most correct conduct towards research subjects, respondents, other researchers and all other people involved in the research" (De Vos *et al.* 2011:114,129). In the next paragraphs ethical matters applicable to this study will be discussed.

3.5.1 Ethical approval

In this study, ethical approval was obtained from the Ethics Committee of the FoHS at the UFS in November 2012. The allocated ECUFS number is 198/2012 to be used in all research documents. Institutional approval was necessary before personnel and students of the UFS could be included in research studies; therefore, other necessary approvals were obtained from the Dean of the FoHS, the Head of the SoM and the Vice Rector:

Academic at the UFS. Approval of the Deans of the respective FoHSs' Faculties of Health Sciences in South Africa was obtained to gain information regarding their MBChB programmes, and specifically their undergraduate medical nuclear medicine educational modules. They were also asked to appoint an appropriate key person in their Nuclear Medicine Departments to represent their Institutions.

The University Cape Town (UCT) required approval from their own Ethics Committee before granting permission for the study to be done at their institution. Their allocated HREC REF number is 070/2013. The CEOs of the two academic hospitals that only render clinical nuclear medicine services without providing formal medical nuclear medicine education also granted permission to involve their nuclear medicine physicians.

All the approval letters are included in the appendices section (cf. Appendix A1-A3, B1 and C1-C9).

3.5.2 Informed consent

Accurate and adequate information is necessary to enable research participants to make voluntary informed decisions to participate in research studies (De Vos *et al.* 2011:117-118). A short overview of this study and its purpose were provided to potential participants in an initial email. In the follow-up emails, the *EvaSys* hyperlink to the questionnaire was provided and each questionnaire was accompanied by an introductory paragraph that included all the above-mentioned informed consent information as well as statements assuring anonymity or confidentiality. By completing the questionnaire, the participants gave their consent to voluntary participation in the study.

Examples of the emailed requests to participate in the research study with and without the hyperlink to the questionnaires are included in the appendices section (cf. Appendix D1-D3 and E1).

3.5.3 Voluntary participation

Participants should be allowed to choose to participate in the study and their decisions should be respected by the researcher. In this study, personalised emails with information regarding the research study were sent to all potential participants, informing them about the research and requesting their participation. As mentioned, the Deans of the six FoHSs Faculties of Health Sciences in South Africa were asked to each identify a key person who would complete the main questionnaire (cf. Paragraphs 3.3.3 and Section 4.2). Non-responding individuals were contacted personally by the researcher on several occasions by means of personal emails and phone calls, to request their participation and to emphasise the importance of their participation to the overall study quality. No participant was forced to participate and no incentives were provided to ensure participation.

3.5.4 Right to privacy, confidentiality and anonymity

Participants also have a fundamental right to personal privacy and it is the researcher's ethical responsibility to protect the privacy, confidentiality and anonymity of his or her participants. In this study, a written guarantee was included, stating that all personal information would remain confidential and anonymous to anybody except the researcher and her supervisors.

According to Mouton (2011:243) the participants' right to ***privacy*** include the right to refuse to complete questionnaires. In this study only five of the six appointed key persons completed and submitted the questionnaire (n=5).

'***Confidentiality***', on the other hand, refers to handling information in a confidential manner. In this study, the key persons were numbered on the raw data provided by *EvaSys* as KEY 1-5 and the experts as EXP 1-47. The participants were asked, in writing, to refrain from discussing the contents of the questionnaires and their opinions with each other.

'***Anonymity***' is the strictest form of privacy and it implies that the participants' names are never linked to their responses (De Vos *et al.* 2011:119-121; Mouton 2011:244). Not all studies can achieve total anonymity and in this study the key persons' identities were known to the researcher, which changed the situation to quasi-anonymity instead of total anonymity (cf. Paragraphs 3.5.1 and 3.3.2).

3.5.5 Minimising misinterpretation of results

In this study, misinterpretations were minimised by:

- Piloting the measurement instruments to prevent any misunderstandings;
- Checking of the quantitative results by the biostatistician of the FoHS at UFS;
- Checking of the qualitative findings by the study leaders as well as an independent observer from the FoHS at UFS; and
- Using the *EvaSys* electronic research program, which minimised the possibility for human errors during the data gathering and handling process.

3.6 CONCLUSION

This chapter presented theoretical perspectives on the research design and methods of this study. The extensive theoretical literature perspective, structured survey questionnaires, study population, methods for data gathering, analysis and interpretation as well as ethical considerations and methods to ensure the study quality were included.

In the following chapter, Chapter 4, titled **Quantitative analysis of the semi-structured survey questionnaires results,** the quantitative results and findings of the email-administered survey questionnaires as completed by the academic key persons and the other nuclear medicine experts in South Africa will be presented separately.

CHAPTER 4

QUANTITATIVE ANALYSIS OF THE SEMI-STRUCTURED SURVEY QUESTIONNAIRE RESULTS

4.1 INTRODUCTION

To fulfil the purpose and objectives (cf. Section 1.4) of this research project and to answer the research question and sub-questions (cf. Paragraph 1.3.2), which relate to providing guidelines for an undergraduate nuclear medicine educational module, the current status of undergraduate medical nuclear medicine education in South Africa had to be determined.

The previous chapter, Chapter 3, discussed the theoretical background to the research design, and methods used to pursue the objectives. In this chapter, Chapter 4, quantitative results of the emailed, survey questionnaires, will be presented and discussed. The results, findings and discussions will be organised separately according to the sections of the key person and nuclear medicine expert questionnaires (cf. Appendix E2 and E4).

4.2 THE SEMI-STRUCTURED SURVEY QUESTIONNAIRES

As mentioned previously, the research method selected to best accomplish the measurement and conceptual analysis of the required primary data was a semi-structured survey questionnaire (cf. Paragraphs 1.7.1.2 and 1.7.2) comprising both quantitative and qualitative components (cf. Paragraphs 3.2.2) to collect the required standardised, fixed data from all relevant nuclear medicine participants.

The raw data acquired from key persons and nuclear medicine experts were constructed and managed by the automated web-based *EvaSys* survey system of the UFS (cf. Paragraphs 1.7.2, 3.3.2 and 3.3.5). The quantitative data were processed and analysed with the assistance of *EvaSys* and the Biostatistics Department of the FoHS at the UFS.

Six key person participants were identified at the South African academic Nuclear Medicine Departments; they were responsible for teaching undergraduate medical nuclear medicine modules. They had to answer the main questionnaire consisting of five sections (cf. Figure 4.1):

- ***Section A***: Demographic information;
- ***Section B***: Closed and open-ended questions on the trends and contents of existing MBChB programmes and their current specific undergraduate medical nuclear medicine module;
- ***Section C***: Human resources and educational problems;
- ***Section D***: Research sub-questions that needed answering (why, when, which topics, to what extent, by whom, how presented and assessed and in which way presented in the existing undergraduate curricula); and
- ***Section E***: Medical nuclear medicine course content on an undergraduate level, requiring responses on a Likert- type frequency scale (cf. Paragraph 3.3.2).

The same questionnaire, shortened to three sections by excluding questions on the undergraduate medical curricula and nuclear medicine modules, was emailed to all other academic and private nuclear medicine experts in South Africa (cf. Paragraph 3.3.3). The experts' questionnaire was organised into the following sections (cf. Figure 4.1):

- ***Section A***: Demographic information;
- ***Section B***: Research sub-questions that needed answering (why, when, which topics, to what extent, by whom, how presented and assessed and in which way presented in the existing undergraduate curricula); and
- ***Section C***: Medical nuclear medicine course content on undergraduate level requiring responses on a Likert-type frequency scale.

The Likert-type frequency scale (McLeod 2008:online) focused on nuclear medicine topics applicable to an undergraduate-level medical module and the scale items referred to all the available diagnostic nuclear medicine investigations and applicable radio-active therapies. These items were created by the researcher on the basis of an understanding of the subjects (cf. Paragraphs 1.7.2, 3.2.2, 4.3.5.3 and 4.4.3.3). The participants were asked to rate each item on a 1-to-3 response scale.

[Figures and Tables in the next sections were compiled by the researcher, Nel 2013 and 2014]

Figure 4.1 illustrates the organisation of acquired data in the next sections.

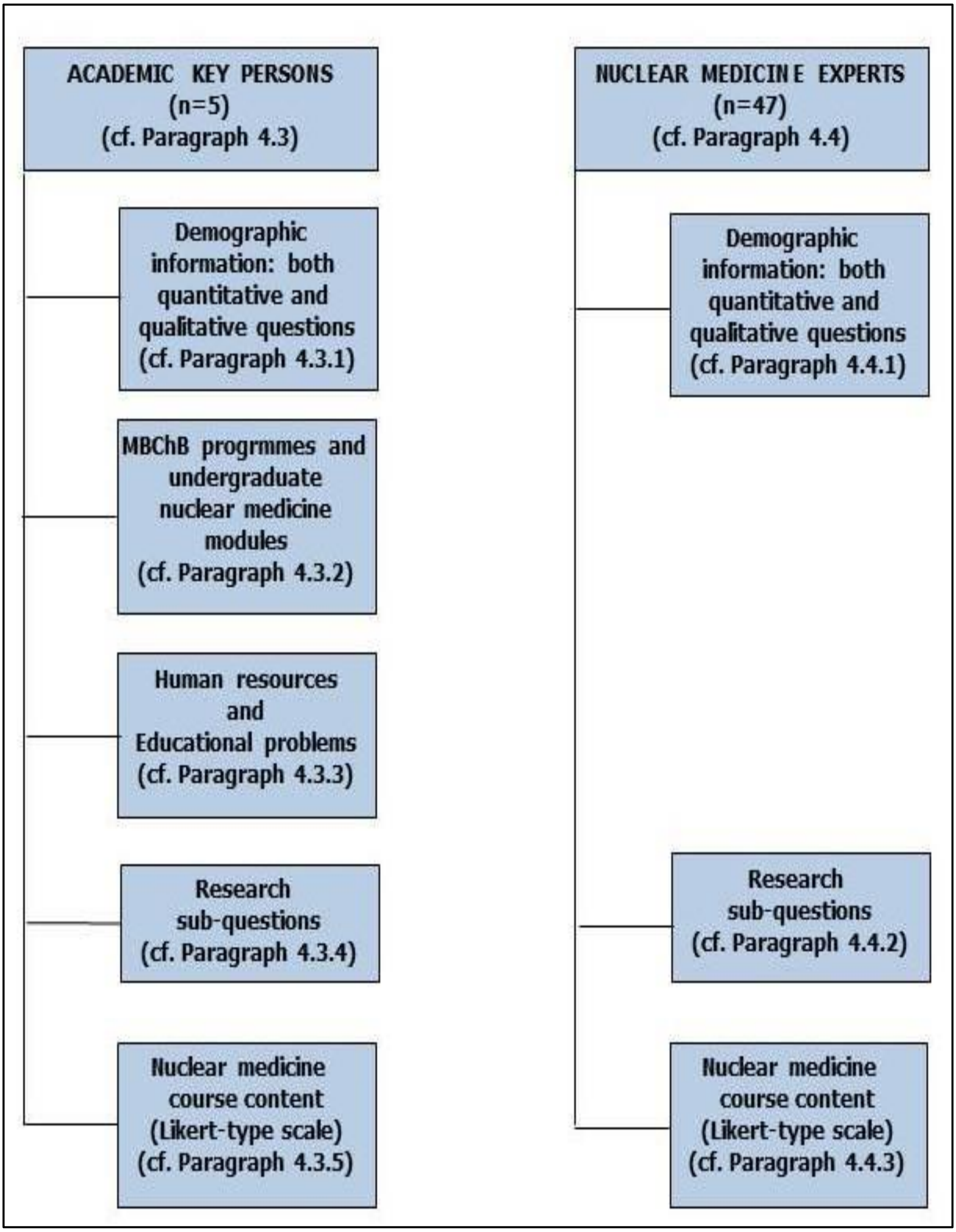


FIGURE 4.1: SEMI-STRUCTURED SURVEY QUESTIONNAIRE SECTIONS

Appointing appropriate key persons were crucial for the reliability, validity (cf. Paragraphs 3.4.1 and 3.4.2) and trustworthiness (cf. Paragraph 3.4.3) of the study. As mentioned, the Deans of the six FoHSs' in South Africa were asked to identify a key person each who would complete the main questionnaire (cf. Paragraphs 1.7.2 and 3.3.3).

Only five of the six appointed key persons completed and submitted the questionnaire (n=5). A response rate of 83% was obtained for the key person survey and 53% for the nuclear medicine expert survey. The final response rates of this study according to *EvaSys* on 6 August 2013 are presented in Figure 4.2.

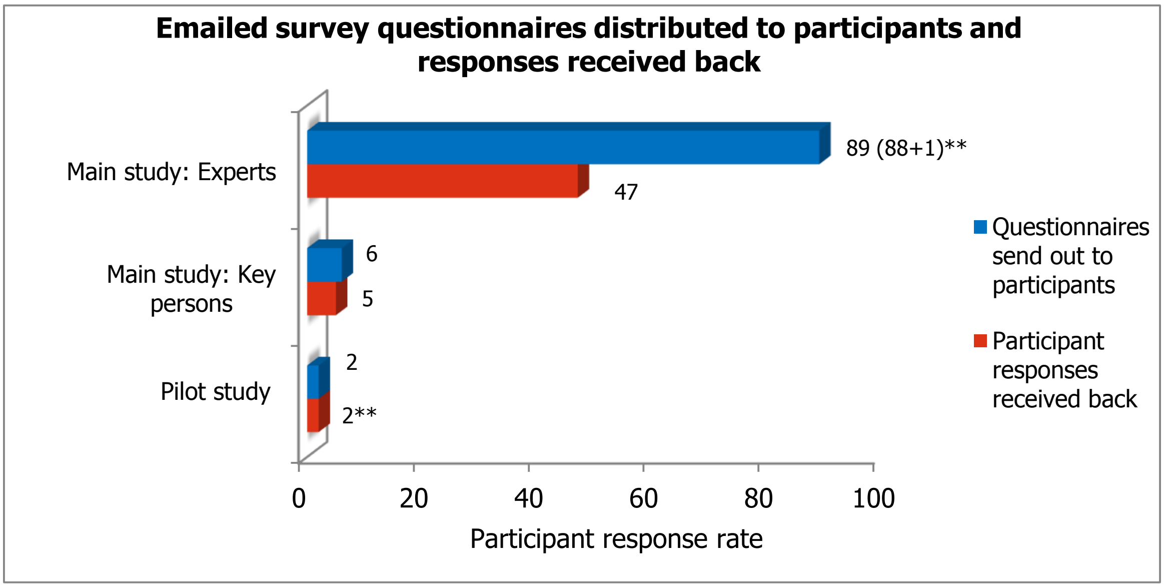


FIGURE 4.2: EMAILED SURVEY QUESTIONNAIRES DISTRIBUTED TO PARTICIPANTS AND RESPONSES RECEIVED BACK
****Only the expert pilot participants' responses were included in the main study (cf. Paragraph 3.3.4).**

4.3 QUANTITATIVE RESULTS, FINDINGS AND DISCUSSION OF RESPONSES BY ACADEMIC KEY PERSONS TO THE SEMI-STRUCTURED SURVEY QUESTIONNAIRE

In the following paragraphs the results, findings and discussions will be organised according to the questionnaire sections. To simplify the analysis process, each question in this section will be analysed and discussed separately (cf. Figure 4.1). Participants' demographic information will be presented first, followed by an analysis and description of the quantitative results of questions in each section. Results will be presented in schematic form, followed by a short discussion of each variable.

4.3.1 Section A: Demographic information of the key persons

Information acquired from participants' demographical data confirms the reliability and trustworthiness of their responses and ensures that these participants truly represent the entire targeted population. Demographical information of the participants was analysed and frequencies and percentages were calculated from the quantitative data.

In the following sections, the key person variables are presented schematically according to the questions asked in the key person questionnaire. The questions below include editorial corrections and might slightly differ from those in the questionnaires (cf. Appendix E2). Figures 4.3 – 4.6 and Tables 4.1 – 4.2 provide graphic presentations of the information provided and direct quotes of responses will be given to elaborate on answers and to enhance the trustworthiness of the study.

4.3.1.1 *Question 2.2: Academic positions of the key persons*

In this question, the key person participants indicate their position in their academic department.

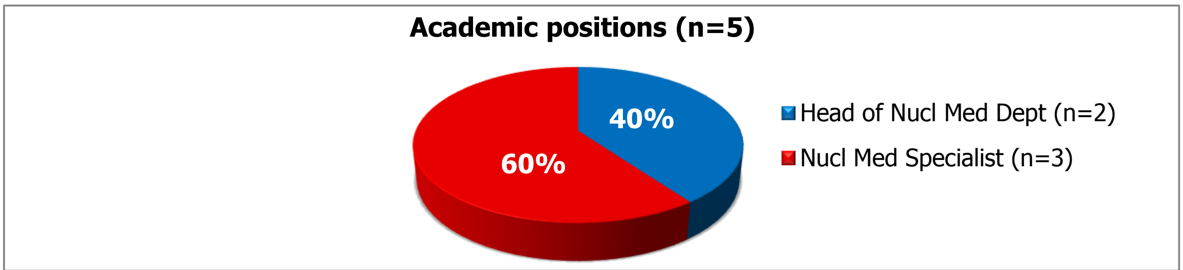


FIGURE 4.3: ACADEMIC POSITIONS OF KEY PERSONS

Data analysis and description: Academic positions of the appointed key persons are graphically displayed in Figure 4.3 (n=5). Key person questionnaires were sent to six (6) key persons, who were not necessarily the Heads of the Nuclear Medicine Department. Key persons' participants were supposed to be the actual lecturers/medical educators who are involved in teaching nuclear medicine imaging to undergraduate medical students and who are familiar with their higher education institutions' undergraduate medical curriculum. Their input regarding undergraduate medical curricula and the current teaching of undergraduate nuclear medicine in South Africa will contribute to the understanding of the research problem. Two Heads of Departments and three nuclear medicine specialists eventually completed the key person questionnaires.

4.3.1.2 *Question 2.4: Medical undergraduate and postgraduate academic qualification(s) of the key persons*

Key person participants were asked to indicate their medical academic qualifications with the aim of determining their knowledgeability of the research topic.

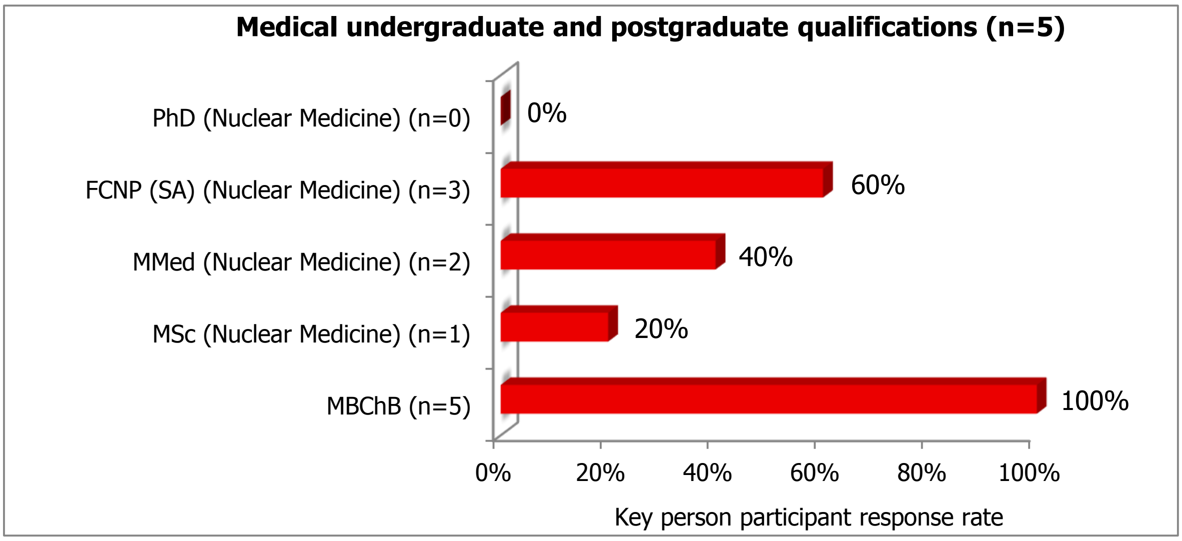


FIGURE 4.4: MEDICAL QUALIFICATIONS OF KEY PERSONS

Data analysis and description: To ensure the reliability of this study, all the participants had to be knowledgeable about the research topic. Figure 4.4 show that all the key person participants had completed their undergraduate medical studies with the MBChB exit-qualification of the HPCSA in South Africa. Only 20% (n=1) had obtained the original MSc (Nuclear Medicine) degree and 40% (n=2) were qualified as nuclear medicine specialists, with MMed (Nuclear Medicine) degrees. The remaining 60% (n=3) had completed their postgraduate nuclear medicine speciality studies by passing the final examination of the Fellowship of the College of Nuclear Physicians of South Africa [FCNP

(SA)]. Their academic qualifications confirmed their ability to represent the research population and give opinions regarding the research topic.

4.3.1.3 *Question 2.6: Age distribution of the key persons*

This question required the key person participants to indicate their age.

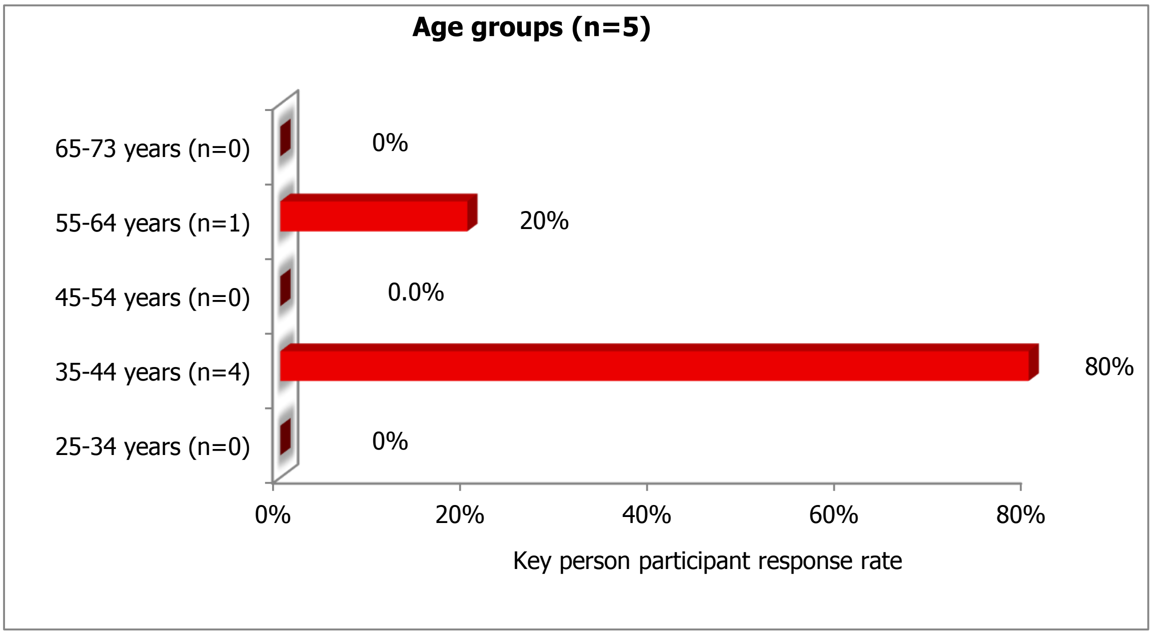


FIGURE 4.5: AGE DISTRIBUTION OF KEY PERSONS

Data analysis and description: As demonstrated in Figure 4.5 the majority of key person participants were in the age group 35-44 years, with 80% (n=4) of the participants falling in this age group. Only one of the participants was in the 55-64 years age group.

4.3.1.4 *Question 2.7: Gender distribution of the key persons*

In this question the key person participants were asked to indicate their gender.

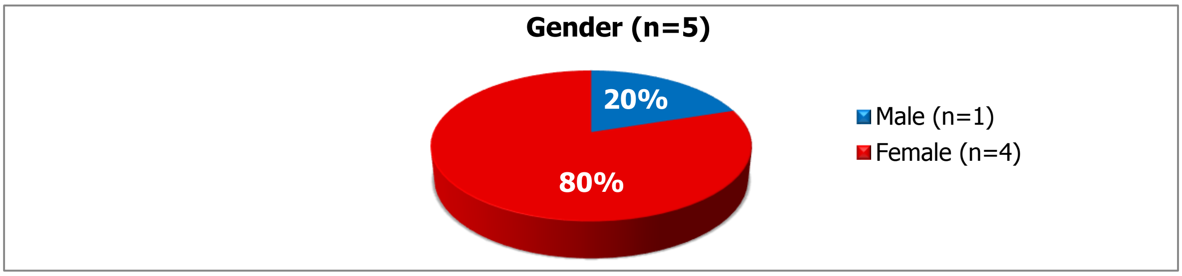


FIGURE 4.6: GENDER DISTRIBUTION OF KEY PERSONS

Data analysis and description: The collected data in Figure 4.6 show that the majority of participants who completed the key person questionnaire were female (80%) and that there was only one male (20%). According to the results obtained, female nuclear medicine specialists currently dominate the role of key medical educators in South Africa's academic Nuclear Medicine Departments.

4.3.1.5 *Question 2.8: Any formal educational (formal teaching and learning education) qualifications of the key persons*

Key person participants were asked to specify any formal qualifications obtained in the teaching and learning domain.

TABLE 4.1: TEACHING AND LEARNING QUALIFICATIONS (n=3)

No formal teaching and learning qualifications
"No/none"
"no"
Inappropriate qualification mentioned
"B.Sc. Hons"

Discussion of the qualitative responses: According to the acquired data none of the key persons had any formal teaching and learning qualifications. Most medical doctors teach medical students on the basis of their own clinical background and scholarship in their disciplines. The Bachelor of Science Honours (BScHons) degree mentioned is not a teaching qualification, but a research-orientated degree.

4.3.1.6 *Question 2.9: Educational (teaching and learning) experience of the key persons. Specify the subjects and state for how long*

Key person participants were asked to elaborate on their teaching experience and to state the subjects they have taught.

TABLE 4.2: EDUCATIONAL EXPERIENCES AND SUBJECTS TAUGHT (n=4)

No teaching and learning experience
"None"
Involvement in teaching and learning medical students
"Nucl Med: 7years"
"Teaching clinical nuclear medicine to undergraduate and postgraduate students since 1985"
"Nucl Med cardiology: For 6years, under and postgraduate students DVT and PE (V-Q): For 4 years"

Discussion of the qualitative responses: These key persons are nuclear medicine specialists in their academic Nuclear Medicine Departments. According to these results, their undergraduate and postgraduate medical teaching experience in the nuclear medicine imaging field ranges from zero to twenty-eight (28) years.

4.3.2 Section B: The MBChB programmes and current undergraduate nuclear medicine educational modules

4.3.2.1 *Question 3.1: What is the total duration of the MBChB programme in your institution (in years)?*

The key person participants were asked to indicate the duration of their institutions' undergraduate medical programmes (cf. Figures 4.7 – 4.9 as well as Tables 2.4 and 2.7).

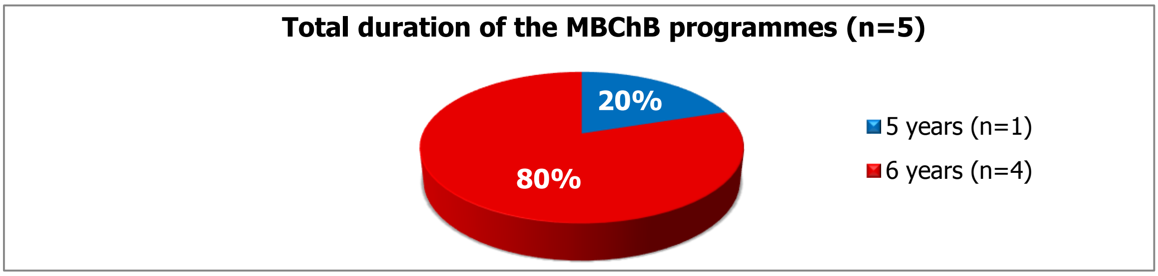


FIGURE 4.7: DURATIONS OF THE CURRENT MBChB PROGRAMMES

Data analysis and description: From the acquired data, the duration of four (4) of the undergraduate medical programmes is six years and the duration of only one (1) is five years (cf. Table 2.4).

4.3.2.2 *Question 3.3: What is the duration of the pre-clinical phase of the MBChB programme in your institution (in years);*

AND

4.3.2.3 *Question 3.5: What is the duration of the clinical phase of the MBChB programme in your institution (in years)?*

Key person participants were asked to indicate the duration (in years) of the pre-clinical and clinical phases of their institutions' medical programme.

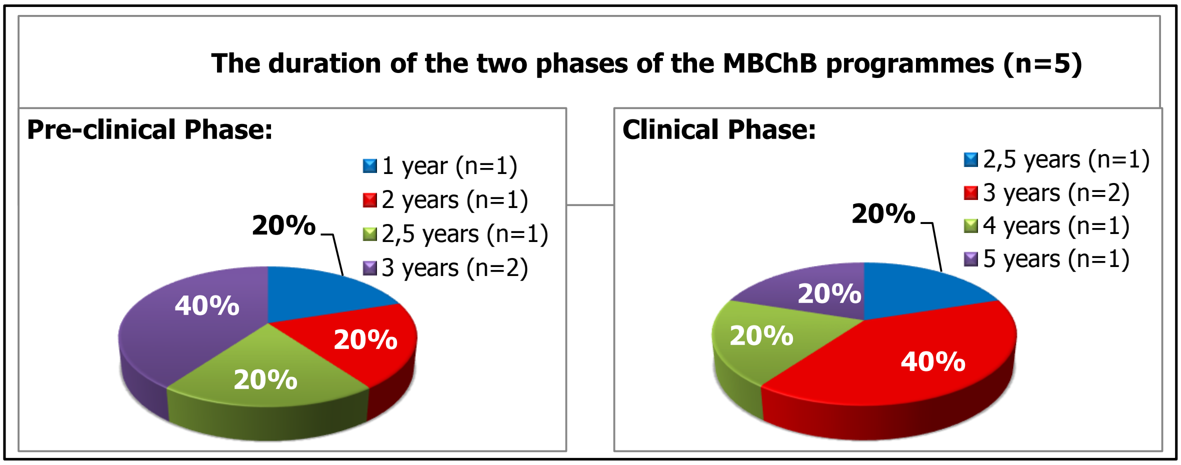


FIGURE 4.8: DURATION OF THE TWO PHASES OF CURRENT MBChB PROGRAMMES

Data analysis and description: The pre-clinical and clinical phases of the undergraduate medical programmes vary greatly in durations. The differences in total duration of the undergraduate programmes (cf. Figure 4.7) affects the phase durations.

- ***Pre-clinical phase duration***: A total of 40% of pre-clinical phases took three years, while the duration of the remaining 60% ranged from one year, to two years, and to two and a half years.
- ***Clinical phase duration***: The duration of 40% of clinical phases took three years to complete, while the duration of the remaining 60% ranged from two and a half years, to four years and five years.

No similarities exist between the different undergraduate medical programme durations. Differences are even present in some programmes with the same total duration of six years. These differences in existing undergraduate programme duration (years) are graphically displayed in Figure 4.9.

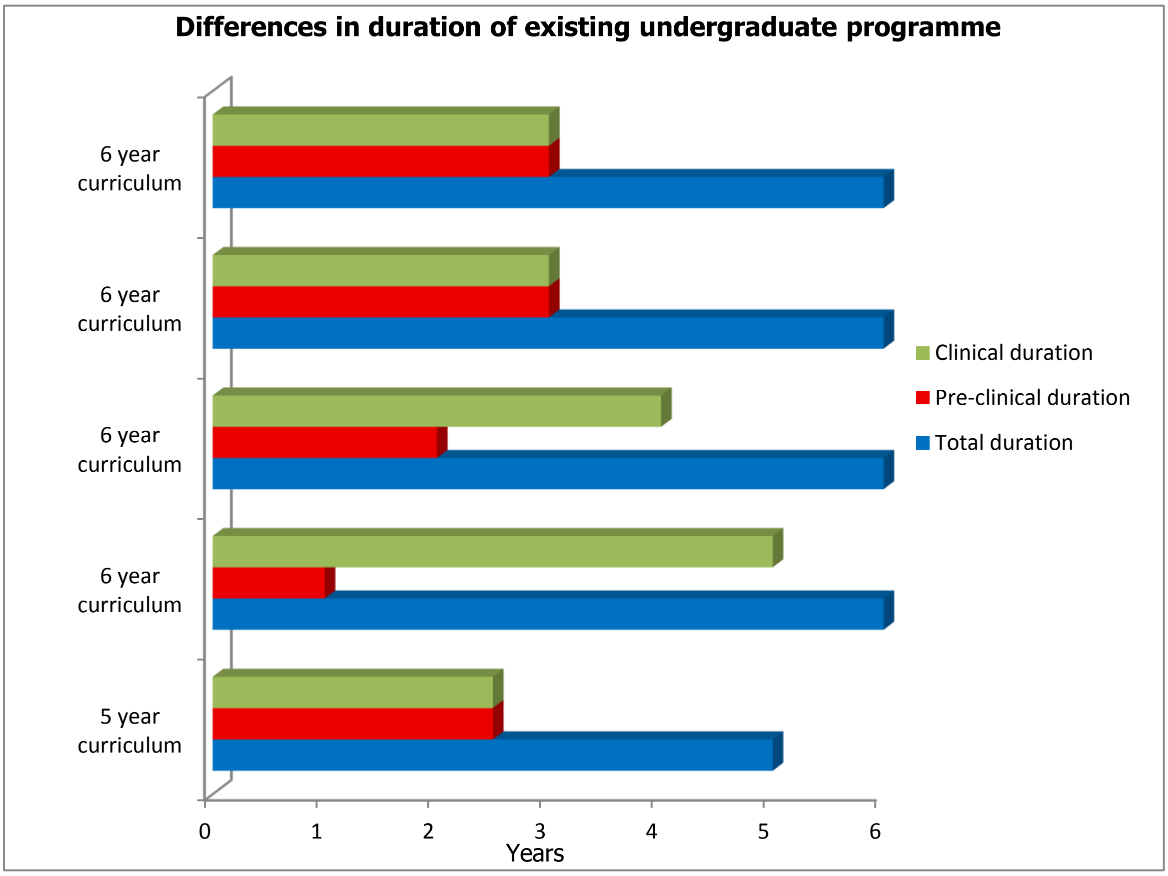


FIGURE 4.9: DIFFERENCES IN DURATION OF EXISTING UNDERGRADUATE PROGRAMMES

Data analysis and description: Figure 4.9 illustrates the variation in duration of MBChB programmes in South Africa. Only two of the six-year curricula have similar pre-clinical and clinical phase durations of three years. In the other two six year curricula the pre-clinical phase durations differ between one and two years respectively, with the clinical phase duration between four and five years. The five-year curriculum consists of two and a half years for both pre-clinical and clinical phases.

4.3.2.4 *Question 3.7: In which year(s) do medical students encounter nuclear medicine education?*

The key person participants were asked to indicate the year(s) of medical education in which undergraduate students encounter their nuclear medicine education.

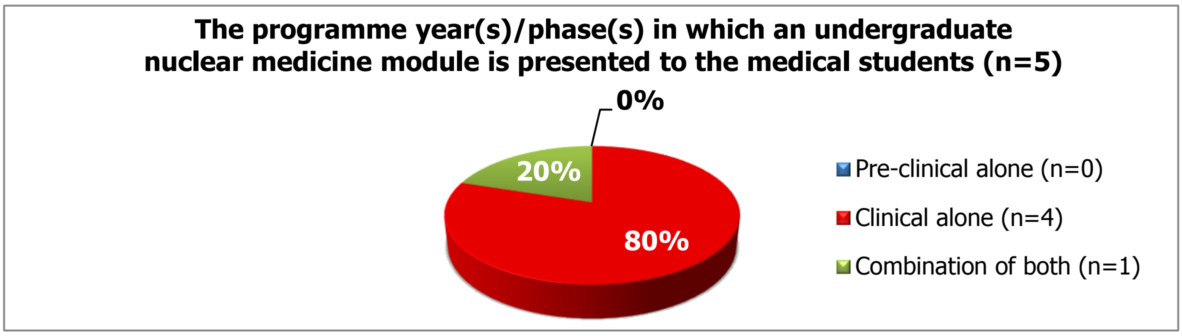


FIGURE 4.10: PHASES IN WHICH CURRENT UNDERGRADUATE NUCLEAR MEDICINE MODULES ARE PRESENTED TO MEDICAL STUDENTS

Data analysis and description: In 80% of cases undergraduate medical students are taught about nuclear medicine only in the clinical phase, with 20% of institutions educating students about nuclear medicine in both phases. There were no cases of nuclear medicine being taught only in the pre-clinical phase. Students' exposure to patients in the clinical phase makes it easier for the students to understand how nuclear medicine fits into the work of the healthcare team, thereby assisting them to diagnose and treat patients (cf. Table 2.4 and Paragraph 2.5.3.5).

4.3.2.5 *Question 3.9: How is the nuclear medicine module presented?*

Key person participants were asked to indicate whether and how their institutions' undergraduate nuclear medicine modules or presentations fit into the existing medical curriculum (cf. Table 2.4).

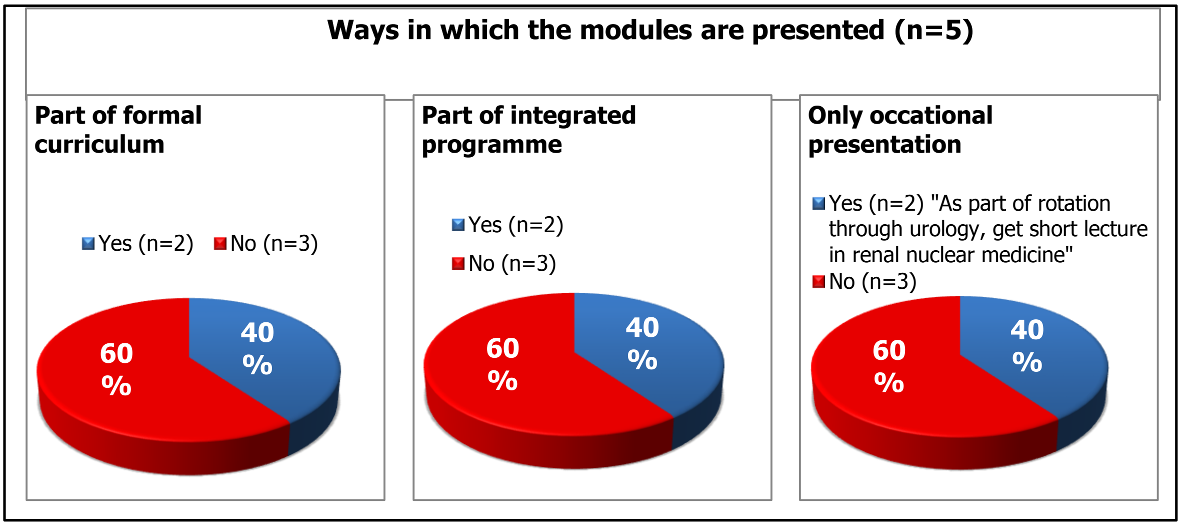


FIGURE 4.11: AN OVERVIEW OF WAYS IN WHICH THE NUCLEAR MEDICINE MODULES ARE PRESENTED

Data analysis and description: The key persons indicated in Figure 4.11 that only 40% of the undergraduate nuclear medicine presentations form part of the existing medical curricula; 40% is part of an integrated programme and another 40% is only an occasional presentation. Sixty per cent (60%) of the current modules or presentations do not form part of an integrated programme or a formal curriculum and do not contribute any credits towards other modules in the existing MBChB programme (cf. Paragraph 4.3.2.13).

4.3.2.6 *Question 3.12: How is the undergraduate nuclear medicine teaching structured?*

Key person participants were asked to indicate how the teaching of nuclear medicine modules is structured within their School of Medicine's existing medical curriculum (cf. Paragraph 2.5.8).

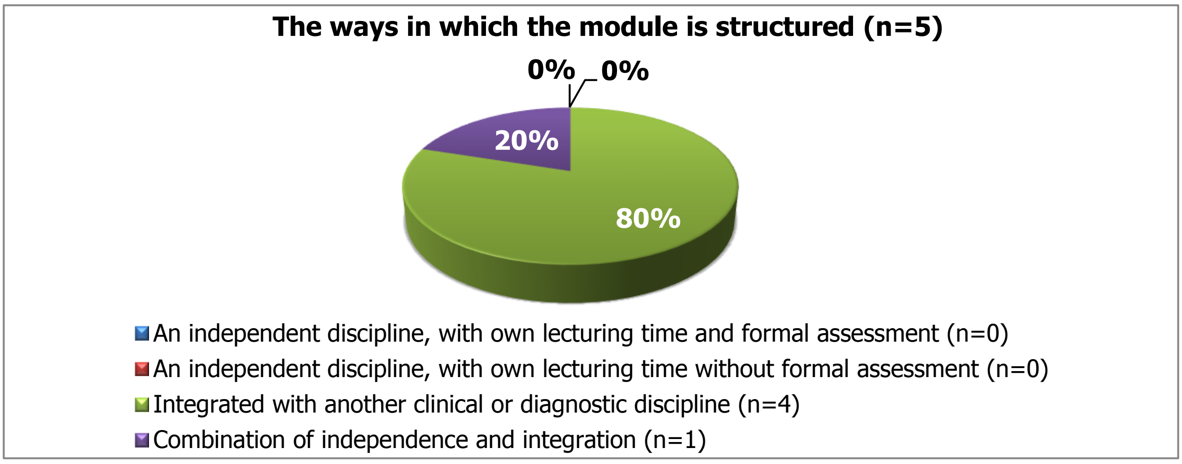


FIGURE 4.12: AN OVERVIEW OF WAYS THE NUCLEAR MEDICINE MODULES ARE STRUCTURED

Data analysis and description: Key person participants indicated in their answers to this question that 80% of undergraduate nuclear medicine presentations are integrated with another clinical or diagnostic discipline. These answers differ from those given to the previous question (cf. Paragraph 4.3.2.5) regarding integrated programmes. An occasional presentation of a nuclear medicine lecture to medical students is not necessarily part of an integrated inter-disciplinary programme. Only 20% of undergraduate nuclear medicine teaching takes place with independent as well as integrated sessions. None of the key persons reported pure, standalone nuclear medicine module offerings.

4.3.2.7 *For questions 3.14 – 3.22 please specify how many hours per year are being spent on undergraduate medical nuclear medicine education in the pre-clinical years*

Question 3.14: Formal lecturers
Question 3.15: Practical sessions
Question 3.16: Formal assessment
Question 3.17: Feedback from students
Question 3.18: E-learning
Question 3.20: Specify the hours spent in the FIRST year
Question 3.21: Specify the hours spent in the SECOND year
Question 3.22: Specify the hours spent in the THIRD year

Key person participants were asked to indicate how many hours are spent on different aspects of presenting modules in the pre-clinical years.

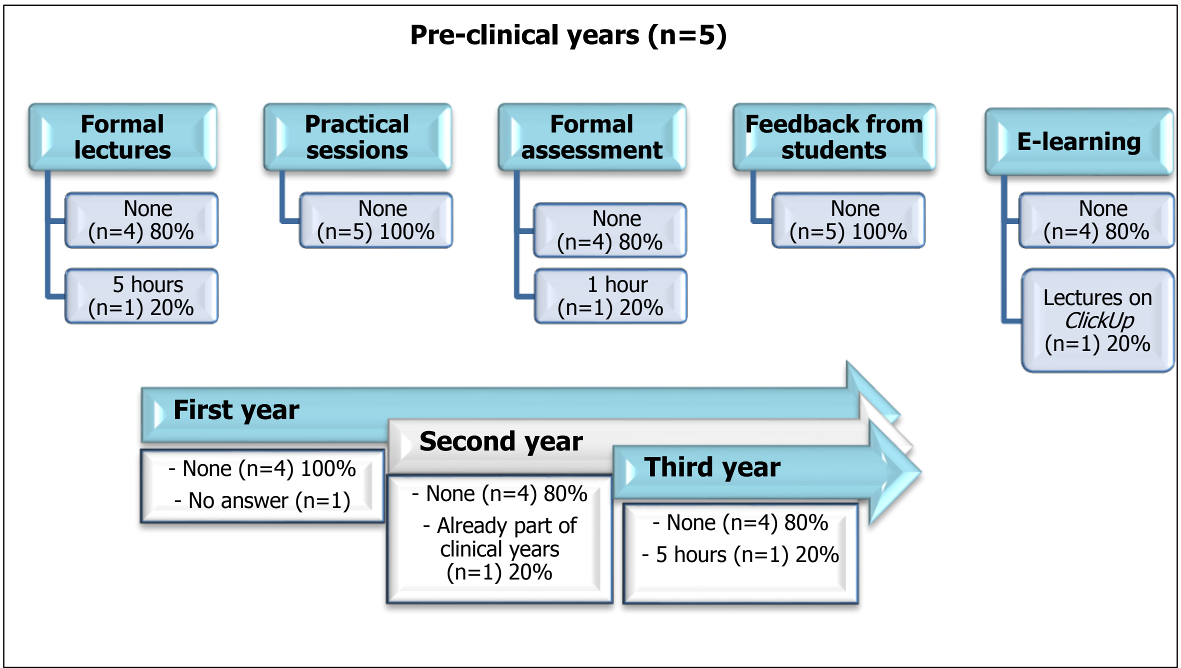


FIGURE 4.13: AN OVERVIEW OF THE TOTAL NUMBER OF HOURS PER YEAR SPENT ON UNDERGRADUATE NUCLEAR MEDICINE EDUCATION IN THE PRE-CLINICAL YEARS

Data analysis and description: To determine the proportion of time undergraduate nuclear medicine education contributes to the ***pre-clinical*** part of medical programmes, a question was asked about the number of hours spent on undergraduate nuclear medicine educational activities. As the researcher demonstrated in Figure 4.8, great differences exist between the durations of pre-clinical phases (cf. Table 2.4 and Paragraph 2.5.7.3).

The acquired data indicate that in 80-100% of cases, no time is spent on formal lectures, practical sessions, formal assessment, student feedback or e-learning in the pre-clinical phases. No time is spent on undergraduate nuclear medicine educational activities in the first or second pre-clinical years. In 20% of cases, only the first year of the medical programme is regarded as a pre-clinical year. Both second and third years are already part of the clinical years.

Only 20% of participants confirmed spending five hours on formal lectures and one hour on formal assessment in the pre-clinical years. E-learning takes place in the form of lectures placed on student portals and "Learning Management Systems" (LMS) like ***Blackboard*** and ***ClickUP:*** These pre-clinical lectures took place in the third and last pre-clinical year of a curriculum of six years.

4.3.2.8 *For questions 3.24 – 3.28 please specify how many hours per year are being spent on undergraduate medical nuclear medicine education in the clinical years*

Question 3.24: Formal lecturers
Question 3.25: Practical sessions
Question 3.26: Formal assessment
Question 3.27: Feedback from students
Question 3.28: E-learning
Question 3.30: Specify the hours spent in the THIRD year
Question 3.31: Specify the hours spent in the FOURTH year
Question 3.32: Specify the hours spent in the FIFTH year
Question 3.33: Specify the hours spent in the SIXTH year
Question 3.34: Specify the hours spent in OTHER years (SECOND)

Key person participants were asked to indicate how many hours are spent on different aspects of the presentation of modules in the clinical years.

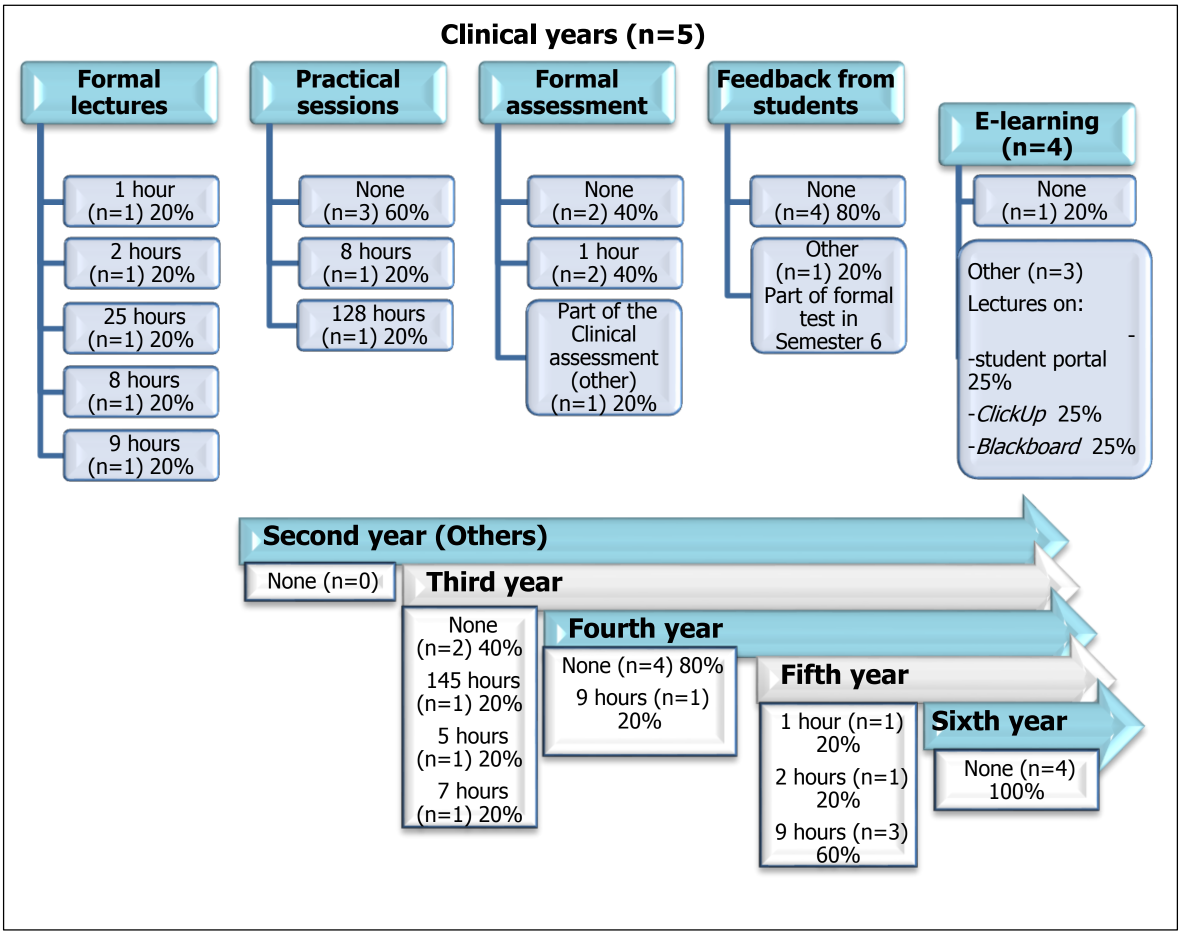


FIGURE 4.14: AN OVERVIEW OF THE TOTAL NUMBER OF HOURS PER YEAR SPENT ON UNDERGRADUATE NUCLEAR MEDICINE EDUCATION IN THE CLINICAL YEARS

Data analysis and description: To determine the proportion that undergraduate nuclear medicine education contributes to the ***clinical*** part of medical programmes, participants were asked how many hours were spent on undergraduate nuclear medicine educational activities. As demonstrated in Figure 4.8, considerable differences exist between the durations of clinical phases (cf. Table 2.4 and Paragraph 2.5.7.3).

The range of hours spent on formal undergraduate nuclear medicine educational activities in the clinical phases can be summarised as follows:

- ***Formal lectures***: between one hour and 25 hours;
- ***Practical sessions***: between zero and 128 hours;
- ***Formal assessment***: between zero and one hour;
- ***Student feedback***: between zero and part of an established one-hour test; and
- ***E-learning***: between none and placing of lectures on student portals.

This information confirms the major differences that exist between the undergraduate nuclear medicine educations at various Schools of Medicine in South Africa.

The data collected show no hours spent on undergraduate nuclear medicine education in the second clinical year and in the sixth (last) clinical year. It is important to keep in mind that in one case the final year is the fifth year.

- Hours spent in the ***third clinical*** year ranged from: zero to 145 hours;
- Hours spent in the ***fourth clinical*** year ranged from: zero to nine (9) hours; and
- Hours spent in the ***fifth clinical*** or ***last clinical*** year ranged from: one to nine (9) hours.

According to these data, most of the undergraduate nuclear medicine education in the clinical phases of medical programmes in South Africa takes place in the third, fourth and fifth clinical years depending on the total duration of the medical programme. These time periods are mostly spent on formal lectures and practical sessions in the Nuclear Medicine Departments. Time spent on formal assessment, feedback from students and e-learning is currently less significant than other modes of teaching and learning.

4.3.2.9 ***Question 3.35: Which other nuclear medicine resources are available to students?***

Key person participants were asked to indicate which study resources are available to students.

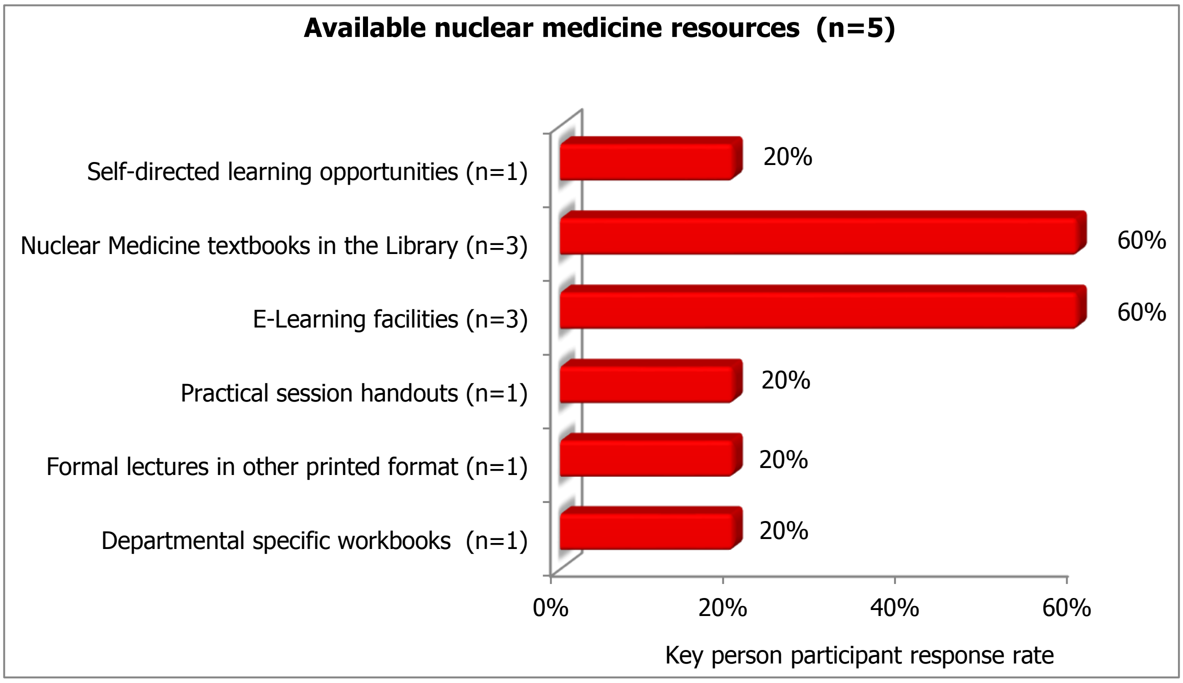


FIGURE 4.15: AN OVERVIEW OF NUCLEAR MEDICINE RESOURCES AVAILABLE TO STUDENTS

Data analysis and description: Adequate resources are necessary to present an effective undergraduate module. According to data displayed in Figure 4.15, 60% of student learning resources comprise of textbooks in libraries and formal lectures placed on student websites and LMS's like ***Blackboard*** and ***Click-Up***. Other resources, such as workbooks, practical-session hand-outs and self-directed learning opportunities are used in only 20% of cases.

4.3.2.10 *Question 3.36: Which teaching methods and strategies are used?*

Key person participants were asked to indicate which teaching strategies and methods are used for formal undergraduate nuclear medicine education.

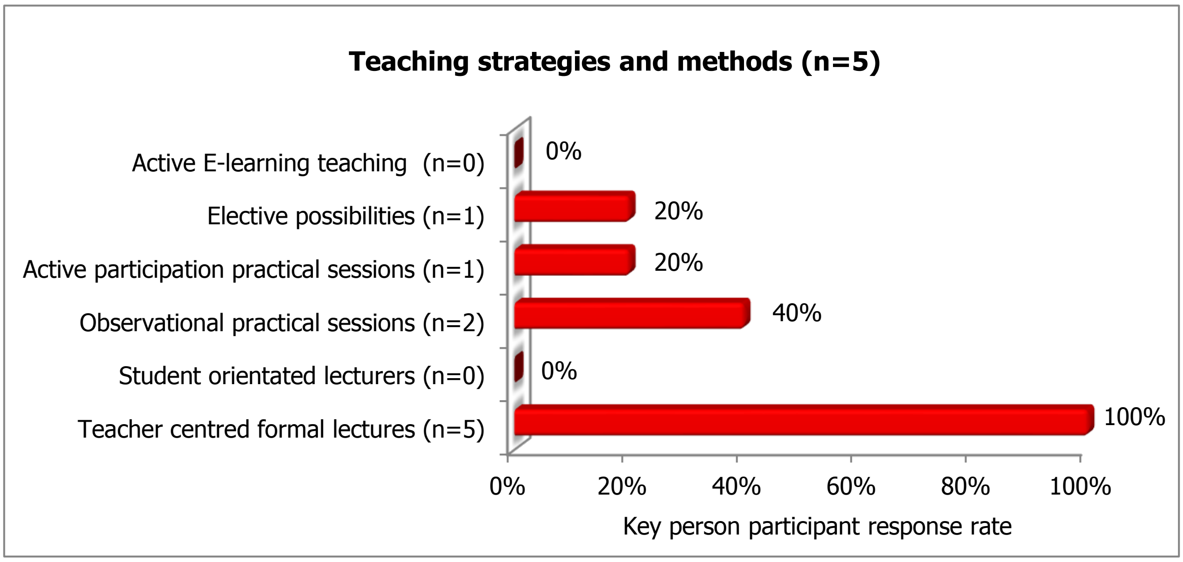


FIGURE 4.16: AN OVERVIEW OF TEACHING METHODS AND STRATEGIES USED

Data analysis and description: As demonstrated in Figure 4.16, 100% of the key person participants make use of formal, teacher-centred lectures that do not involve any active student involvement. In 40% of cases observational practical sessions take place in the Nuclear Medicine Departments while only 20% of key person participants reported that there are elective possibilities. Active, student-orientated participation in lectures as well as teaching involving e-learning are not teaching methods currently in use (cf. Paragraphs 2.5.7.1, 5.3.2.6 and 5.4.1.6). Teaching methods are determined by the availability and experience of lecturers (cf. Paragraphs 4.3.1.6, 4.4.1.7 and 5.3.1.2) as well as the hours allocated for teaching and learning activities (cf. Paragraphs 2.5.7.3, 4.3.2.7 and 4.3.2.8).

4.3.2.11 *Question 3.37: Which formative assessment methods are used?*

Key person participants were asked to indicate the formative assessment methods that are used during the presentation of the module/course

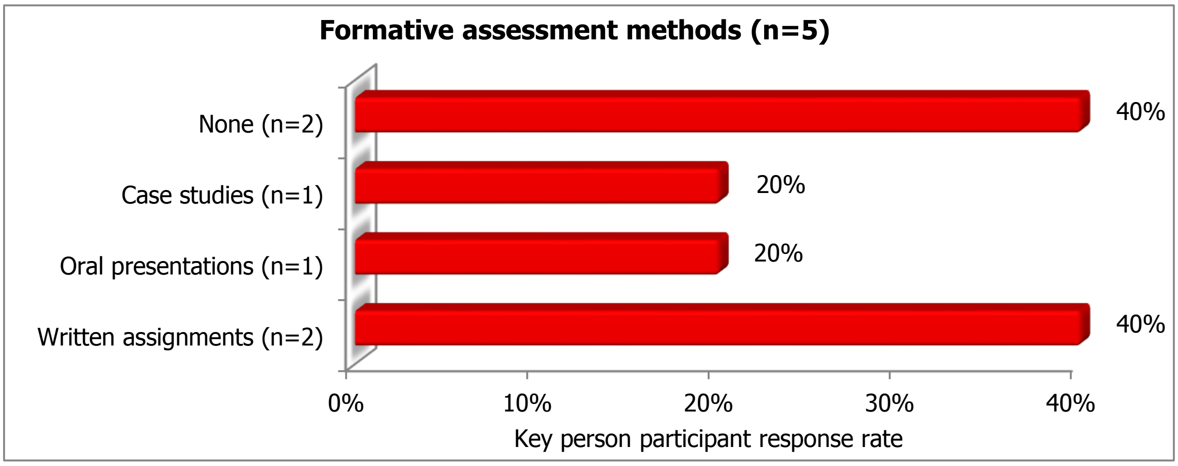


FIGURE 4.17: AN OVERVIEW OF FORMATIVE ASSESSMENT METHODS USED

Data analysis and description: Figure 4.17 shows that forty per cent (40%) of key person participants reported that the formative assessment methods ranged from written assignments to doing nothing. Oral presentations and case studies were utilised in 20% of cases (cf. Paragraphs 5.3.2.7 and 5.4.1.7).

4.3.2.12 *Question 3.38: Which summative assessment methods are used?*

Participants were asked to indicate the summative assessment methods that are used at completion of the module/course.

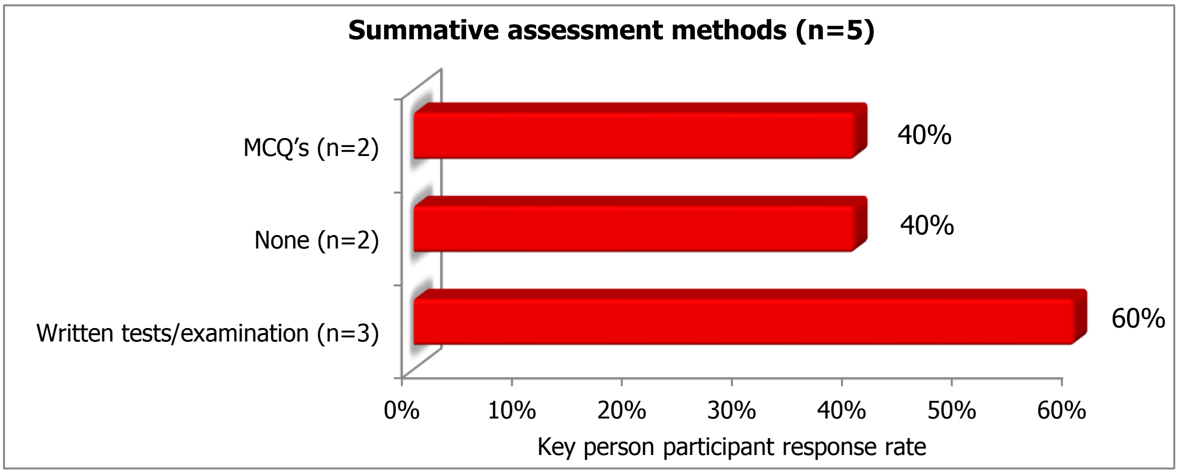


FIGURE 4.18: AN OVERVIEW OF SUMMATIVE ASSESSMENT METHODS USED

Data analysis and description: Figure 4.18 shows that written tests and examinations are used in 60% of summative assessment practices at the end of the course. Multiple-choice questions (MCQ) as questioning method are used for 40% of assessments. Forty per cent (40%) of participants reported no assessment practices.

4.3.2.13 *Question 3.39: Does this module contribute any credits towards another module in the MBChB programme?*

Key persons participants were asked to indicate whether their module/course contribute any credits towards another module in the MBChB programme.

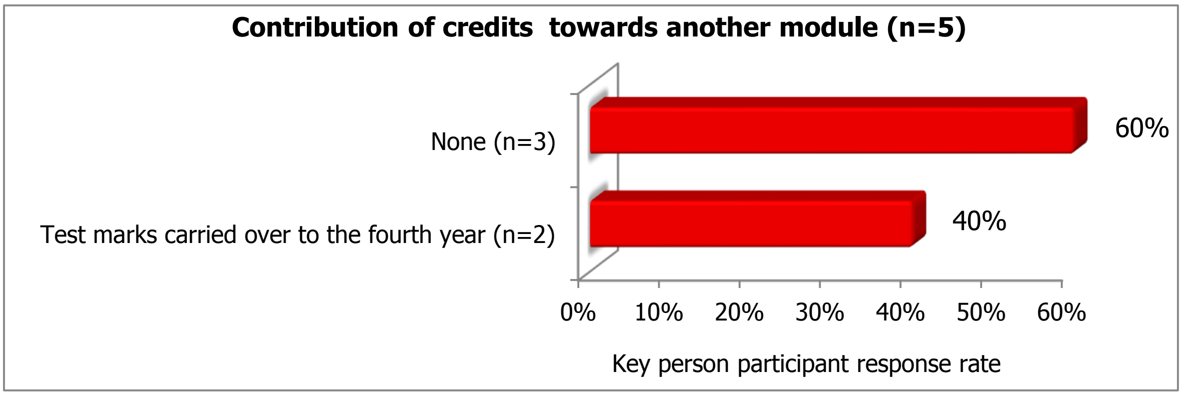


FIGURE 4.19: CONTRIBUTION OF CREDITS TOWARDS ANOTHER MODULE

Data analysis and description: Collected data in Figure 4.19 show that the majority of modules (60%) did not contribute any credits towards another module in the existing curricular programmes. Only 40% of the participating key persons confirmed that their nuclear medicine modules contributed credits to existing medical curricula (cf. Paragraph 4.3.2.5).

4.3.2.14 *Question 3.43: Which nuclear medicine topics are currently included in your undergraduate course (Lectures and practical sessions)?*

Key person participants were asked to indicate the topics that form part of the current module/course (cf. Paragraphs 2.5.4, 4.3.5, 5.3.2.3, 5.4.1.3 and Appendix F4 and F5).

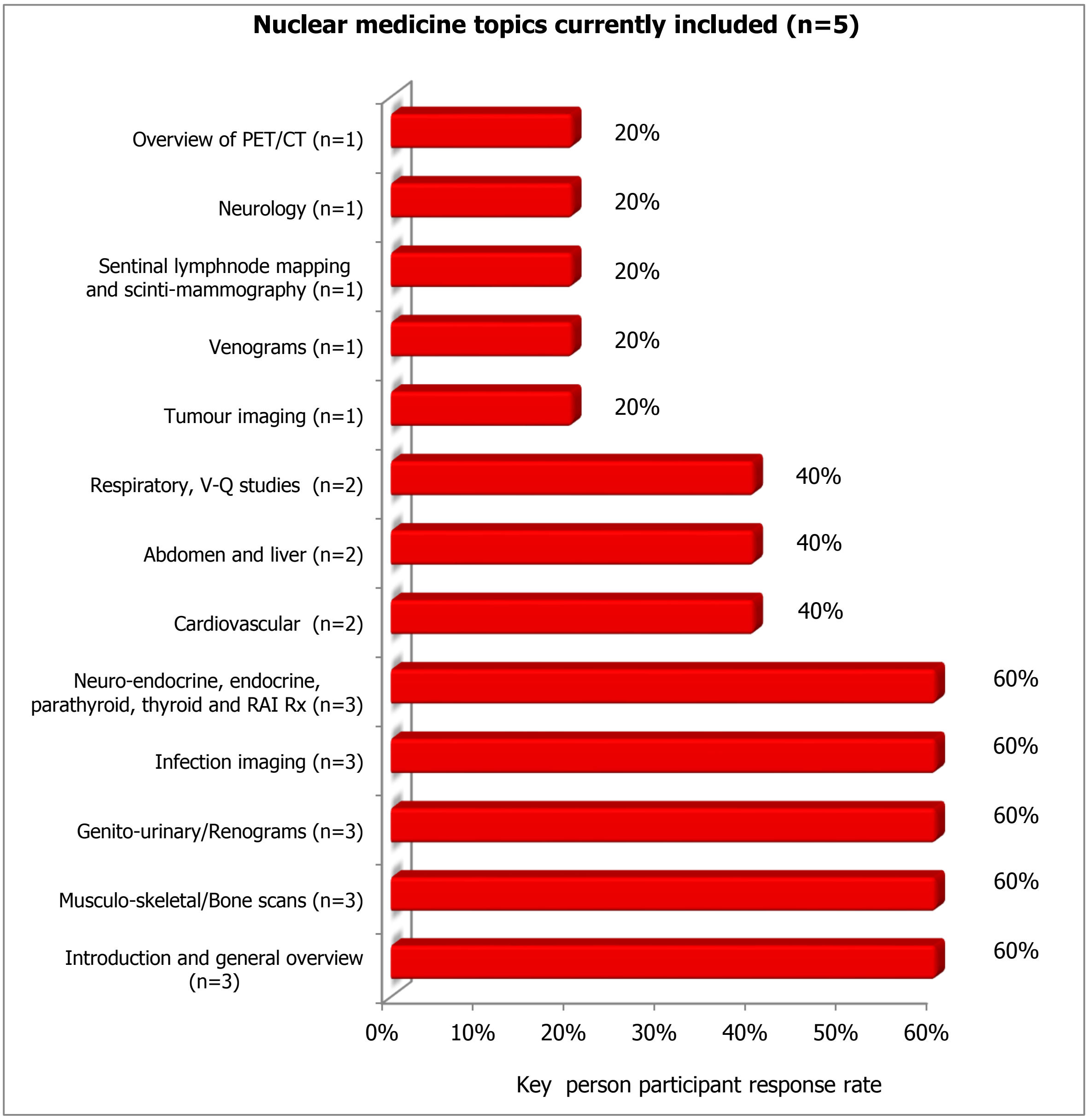


FIGURE 4.20: NUCLEAR MEDICINE TOPICS CURRENTLY INCLUDED IN UNDERGRADUATE MODULES

Data analysis and description: Figure 4.20 demonstrates the topics that are currently incorporated in undergraduate nuclear medicine modules.

The topics most commonly included in undergraduate nuclear medicine programmes are:

- Introduction and general overview (60%);
- Musculo-skeletal/Bone scans (60%);
- Genito-urinary/Renograms (60%);
- Infection imaging (60%); and
- Neuro-endocrine, endocrine, parathyroid, thyroid and RAI Rx (60%).

These topics are followed by

- Cardiovascular (40%);
- Abdomen and liver (40%); and
- Respiratory, V-Q studies (40%).

Nuclear medicine topics less commonly included are

- Tumour imaging (20%);
- Venograms associated with lung perfusion studies (20%);
- Sentinel lymphnode mapping and scinti-mammography (20%);
- Neurology (20%); and
- Overview of PET/CT (20%).

4.3.3 Section C: Human resources and educational problems

In this section, information regarding the availability of human resources for undergraduate nuclear medicine education is discussed. Service-delivery is a priority for Nuclear Medicine Departments. The educational function of an academic Nuclear Medicine Department depends on the availability of resources, including:

- ***Human resources*** such as medical educators and people responsible for service delivery;
- ***Physical resources*** such as lecture rooms, gamma cameras, and images for teaching purposes; and
- ***Financial resources***, as financial constrictions regarding the academic platform can influence human and physical resources necessary for educational purposes negatively.

The causes of educational problems will be discussed in Chapter 5 (cf. Paragraph 5.3.1).

4.3.3.1 *Question 4.1: Who is teaching clinical nuclear medicine imaging to medical students?*

Key person participants were asked to indicate who is teaching the medical students clinical nuclear medicine imaging in their Departments; and who else qualifies to be medical imaging educators?

Key person participants were asked to identify the staff members who teach nuclear medicine imaging to undergraduate medical students.

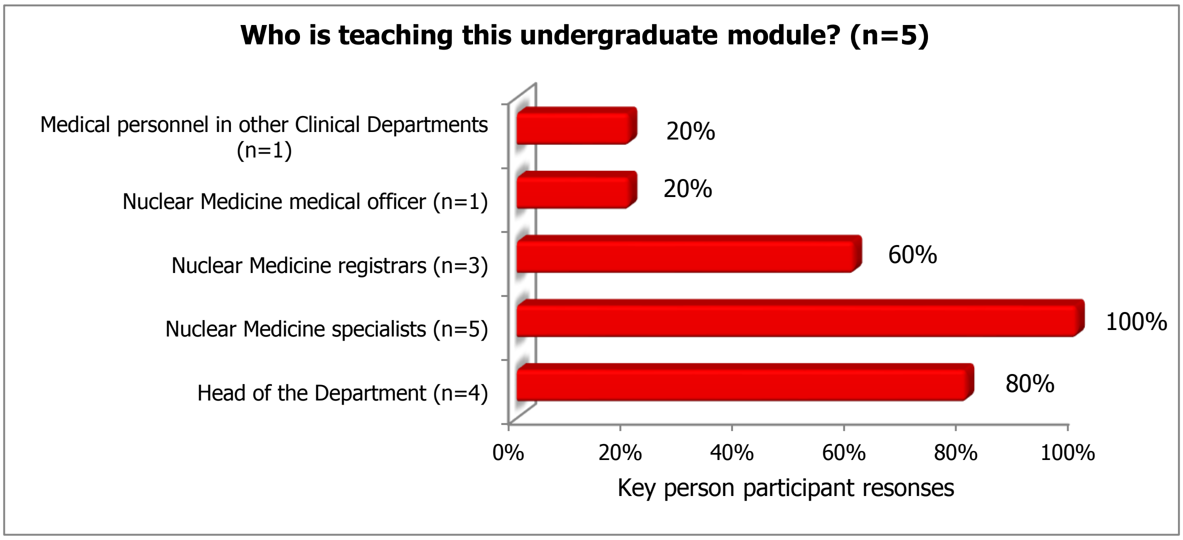


FIGURE 4.21: HUMAN RESOURCES INVOLVED IN THE TEACHING OF NUCLEAR MEDICINE AT UNDERGRADUATE LEVEL

Data analysis and description: As illustrated in Figure 4.21, the key persons report that nuclear medicine specialists most often act as medical educators – they are the people who are actually involved in executing and interpreting nuclear medicine procedures and are therefore best qualified (cf. Paragraph 4.3.1.2) to share their knowledge and experience of nuclear medicine imaging with students (cf. Paragraphs 2.5.6, 5.3.2.5 and 5.4.1.5).

Heads of Nuclear Medicine Departments are advanced scholars and nuclear medicine specialists with experience that varies from fifteen (15) to forty (40) years. Not everybody involved in nuclear medicine wants to be involved in teaching of students and different expertise within each department can be utilised to assist the nuclear medicine specialist with teaching. Postgraduate nuclear medicine registrars, medical officers working in Nuclear Medicine Departments, are named as other staff members currently involved in undergraduate medical nuclear medicine education (cf. Paragraph 2.5.6.2).

Specialists and physicians from medical and surgical disciplines are also named as imaging educators (cf. Paragraph 2.5.6.3). The literature confirms that they usually claim that they teach students about imaging as an integral part of ward rounds and while working in outpatient clinics. With this attitude they imply that formal nuclear medicine teaching by nuclear medicine specialists is not necessary (Gunderman *et al.* 2003:1239-1242; Subramaniam *et. al.* 2005:1-3).

4.3.3.2 *Question 4.5: How many teachers/lecturers are involved?*

Participants were asked to indicate the number of teachers/lecturers involved in teaching undergraduate nuclear medicine.

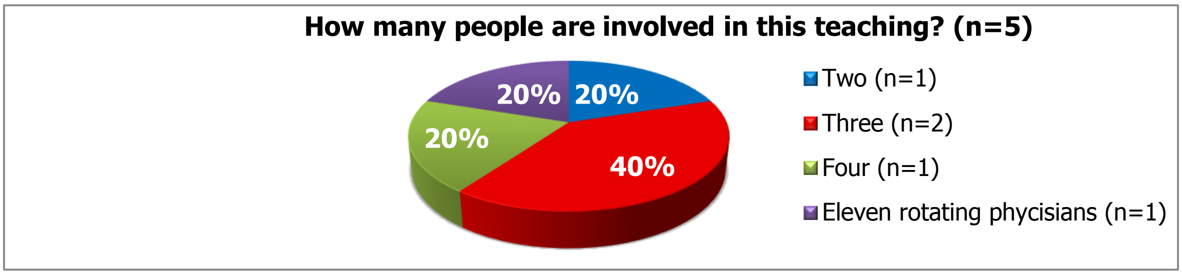


FIGURE 4.22: NUMBER OF TEACHERS/LECTURERS INVOLVED IN UNDERGRADUATE NUCLEAR MEDICINE EDUCATION

Data analysis and description: Figure 4.22 shows that in the majority of cases, three nuclear medicine lecturers are involved in undergraduate medical student education. In the other two Nuclear Medicine Departments the staff members concerned with students ranged between two and four. According to the ESR White Paper (ESR 2011:363-374) it is advisable that one or two dedicated imaging specialists act as teachers, to ensure that structure and learning methods remain the same during the educational process.

4.3.4 Section D: Research sub-questions that need answering (why, when, which topics, to what extent, by whom, how presented and assessed and in what/which way)

The results and findings of these open-ended qualitative questions will be fully discussed in Chapter 5.

4.3.4.1 *Question 5.1: Do you think it is necessary to implement an undergraduate medical nuclear medicine educational module?*

Key person participants were asked to indicate if they think such an undergraduate medical nuclear medicine module is necessary.

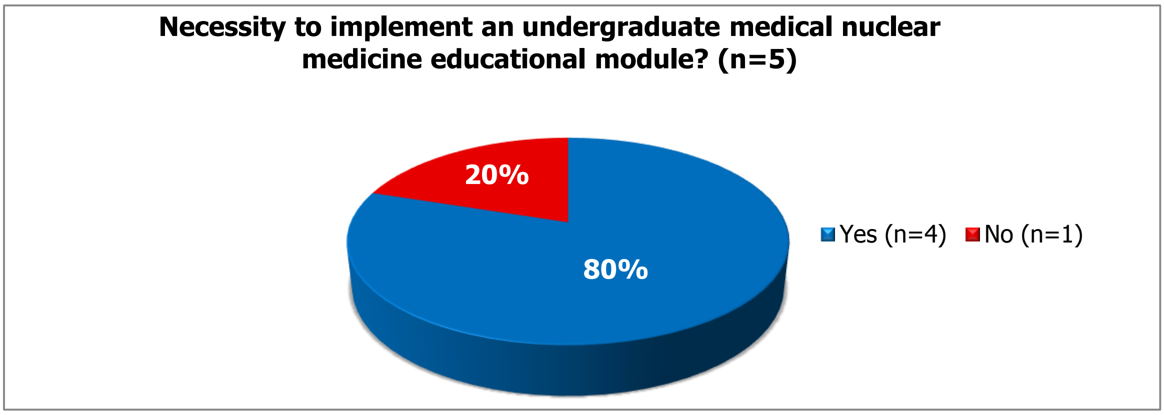


FIGURE 4.23: NECESSITY OF AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE

Data analysis and description: Data in Figure 4.23 indicate that 80% of the key person participants in this study considered an undergraduate nuclear medicine module as necessary, while 20% indicated that it is not needed. The conclusion is that the majority of the key person participants consider such a module to be a necessity (cf. Paragraphs 4.3.5.4 and 4.3.5.5).

4.3.5 Section E: Medical nuclear medicine course content at undergraduate level according to a Likert-type frequency scale

4.3.5.1 *Questions 6.1 and 6.2: The basic-science topics that could fit into an undergraduate or primary-level nuclear medicine module*

Key person participants were asked to indicate whether basic-science topics should be taught or, alternatively, referred back to as part of the undergraduate medical nuclear medicine module.

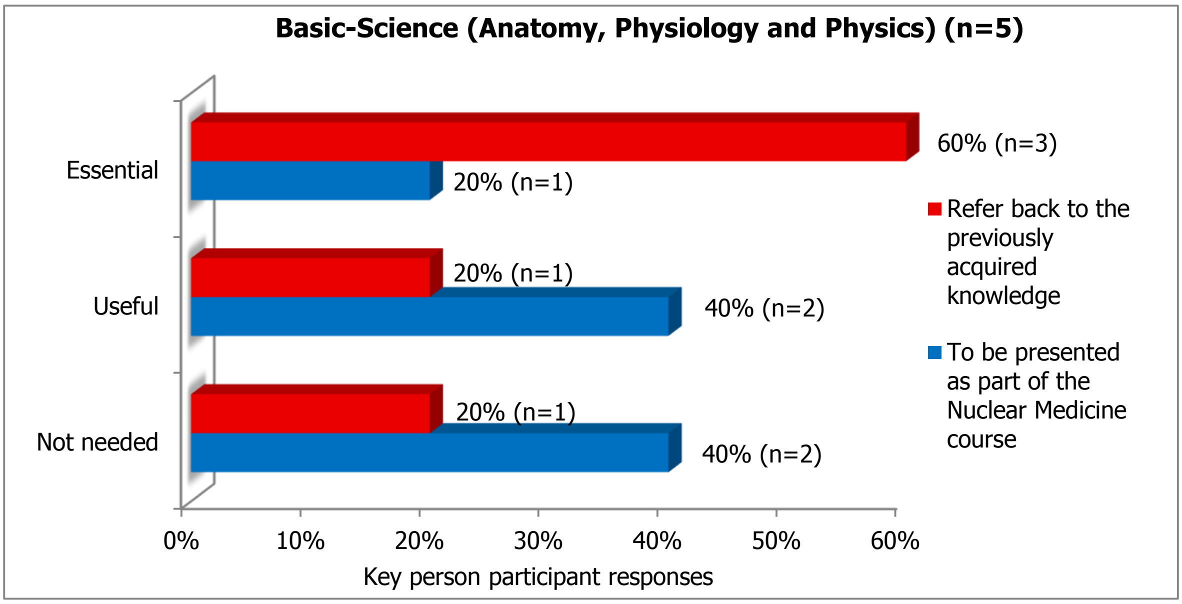


FIGURE 4.24: BASIC-SCIENCE TOPICS IN AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

Data analysis and description: For undergraduate medical students to understand what nuclear medicine is about, they need to have prior knowledge of anatomy, physiology, physics and pathology. Key person participants indicated in 40% of cases that these topics do not need to be taught during the nuclear medicine module, although it could be useful. The majority of key person participants (60%) indicated that '***referring back to'*** the already acquired knowledge during the basic-science phase is both sufficient and essential. (cf. Paragraphs 4.4.3.1 and 5.4.1.4).

4.3.5.2 *Questions 6.3 to 6.6: Basic, introductory nuclear medicine topics that could fit into an undergraduate or primary-level nuclear medicine module*

Key person participants were asked to indicate which basic introductory nuclear medicine topics should be taught as part of the undergraduate medical nuclear medicine module.

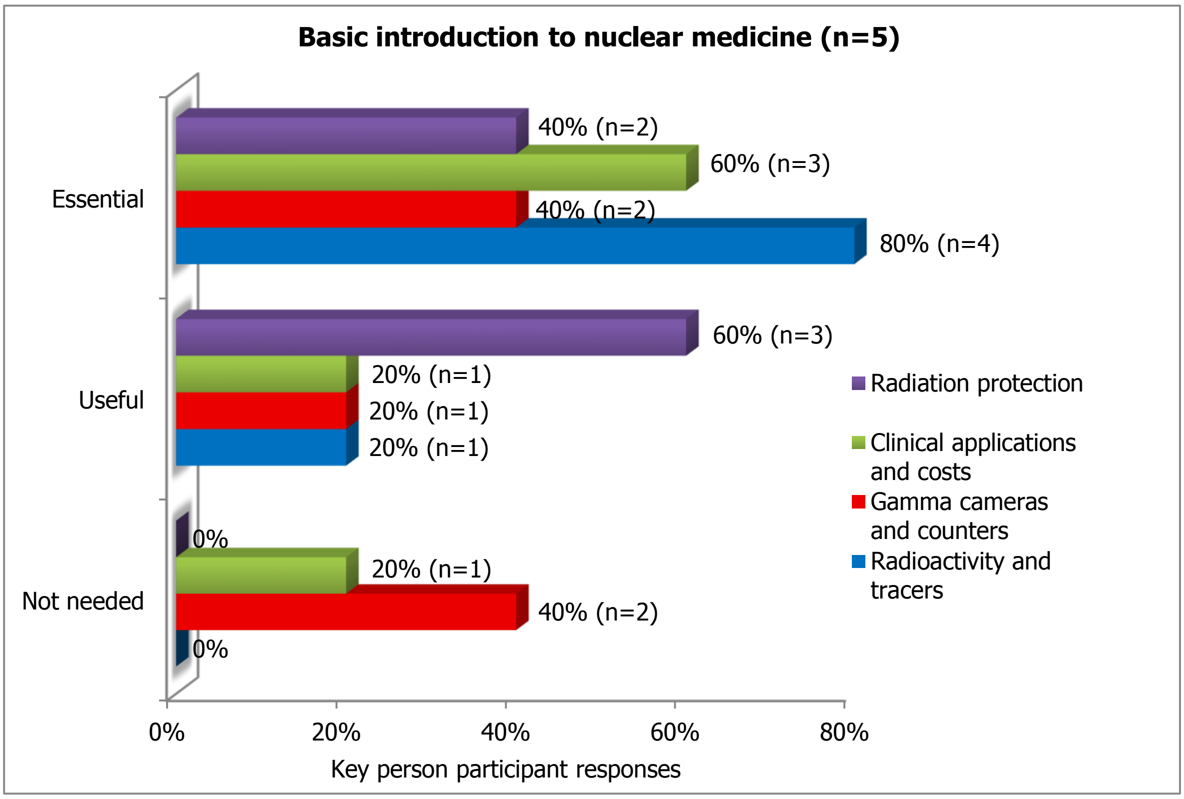


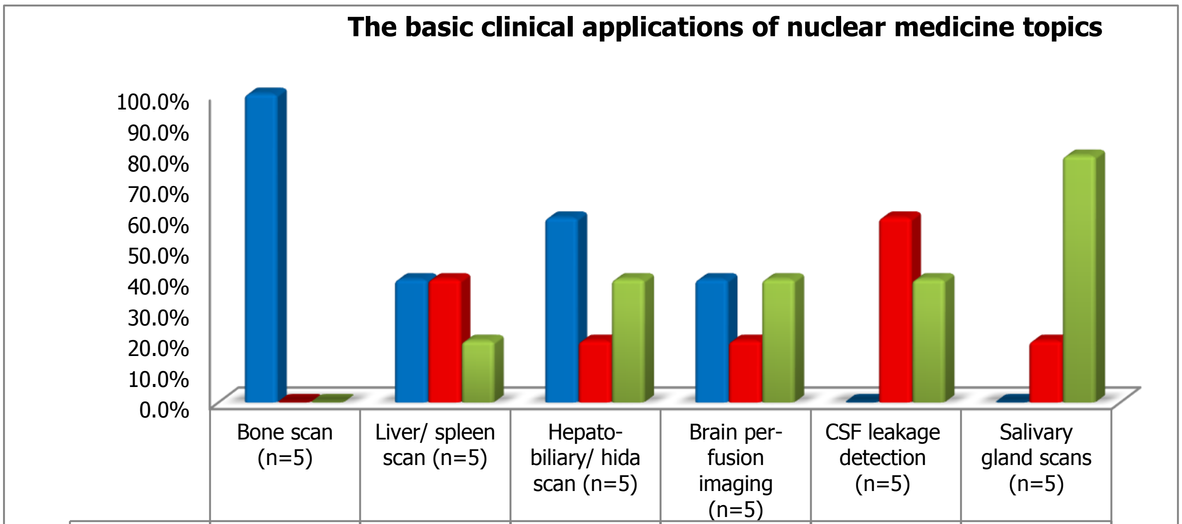
FIGURE 4.25: BASIC INTRODUCTORY NUCLEAR MEDICINE TOPICS THAT COULD FIT INTO AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

Data analysis and description: To practise modern medicine, a physician needs knowledge about the role of clinical imaging procedures in daily patient care. Key person participants indicated that knowledge about radioactive tracers (80%) and clinical indications (60%) of nuclear medicine studies are essential. Radiation protection knowledge is regarded as essential (40%) and useful (60%). Forty per cent (40%) of key persons regarded knowledge about gamma cameras as unnecessary (cf. Paragraphs 2.5.4.1 and 4.4.3.2).

4.3.5.3 *Questions 6.7 to 6.40: Basic clinical imaging procedures which could fit into an undergraduate or primary-level nuclear medicine module*

Key person participants were asked to indicate their choice of appropriate topics for the undergraduate module on a Likert-type frequency scale, rating their decisions as essential, useful or not needed.

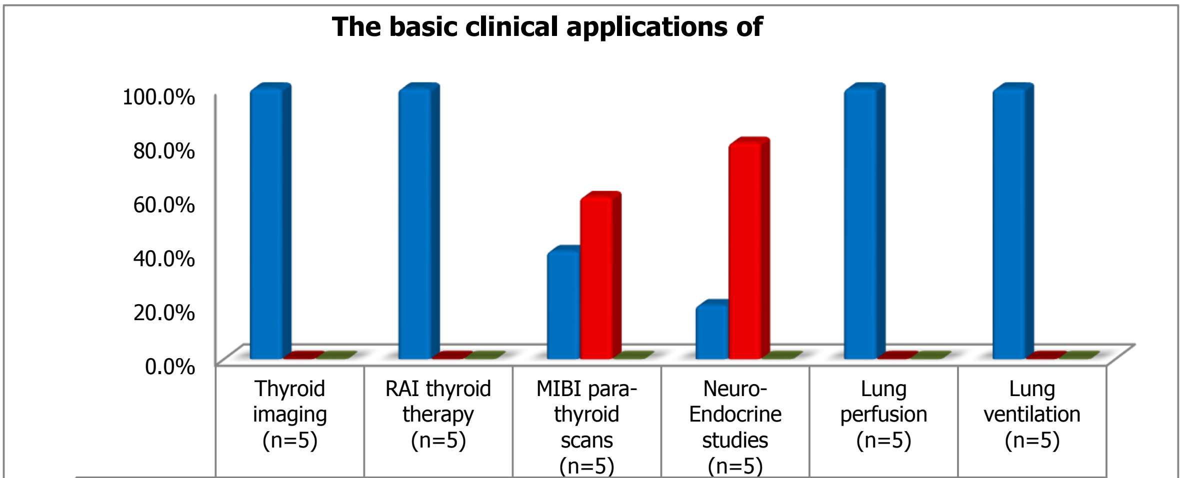
Figures 4.26 – 4.31 illustrate the key persons' choices of nuclear medicine topics suitable for undergraduate nuclear medicine module. The grouping of nuclear medicine topics were randomly chosen to prevent any bias.



	Bone scan (n=5)	Liver/ spleen scan (n=5)	Hepato-biliary/ hida scan (n=5)	Brain per-fusion imaging (n=5)	CSF leakage detection (n=5)	Salivary gland scans (n=5)
Essential	100.0%	40.0%	60.0%	40.0%	0.0%	0.0%
Useful	0.0%	40.0%	20.0%	20.0%	60.0%	20.0%
Not needed	0.0%	20.0%	40.0%	40.0%	40.0%	80.0%

FIGURE 4.26: BASIC CLINICAL IMAGING PROCEDURES SUITABLE FOR AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

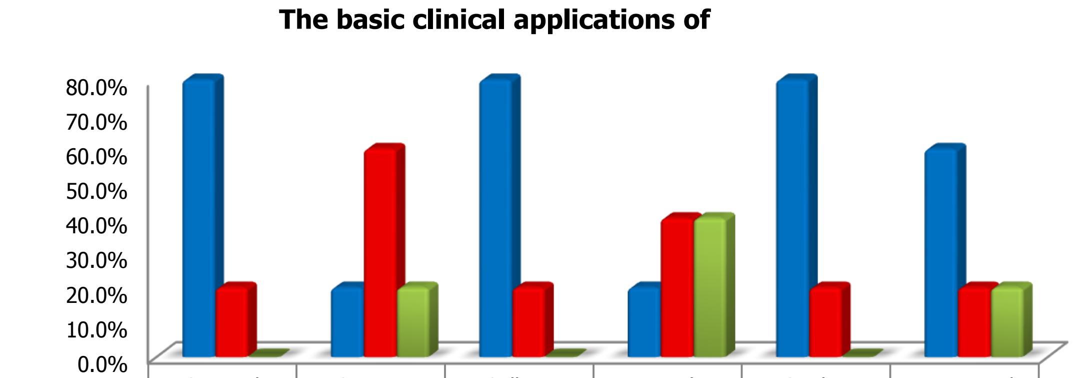
According to data in Figure 4.26 were bone scans identified as being essential by all (100%) of the key persons, while 60% indicated that salivary gland scans are not needed.



	Thyroid imaging (n=5)	RAI thyroid therapy (n=5)	MIBI para-thyroid scans (n=5)	Neuro-Endocrine studies (n=5)	Lung perfusion (n=5)	Lung ventilation (n=5)
Essential	100.0%	100.0%	40.0%	20.0%	100.0%	100.0%
Useful	0.0%	0.0%	60.0%	80.0%	0.0%	0.0%
Not needed	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

FIGURE 4.27: BASIC CLINICAL IMAGING PROCEDURES SUITABLE FOR AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

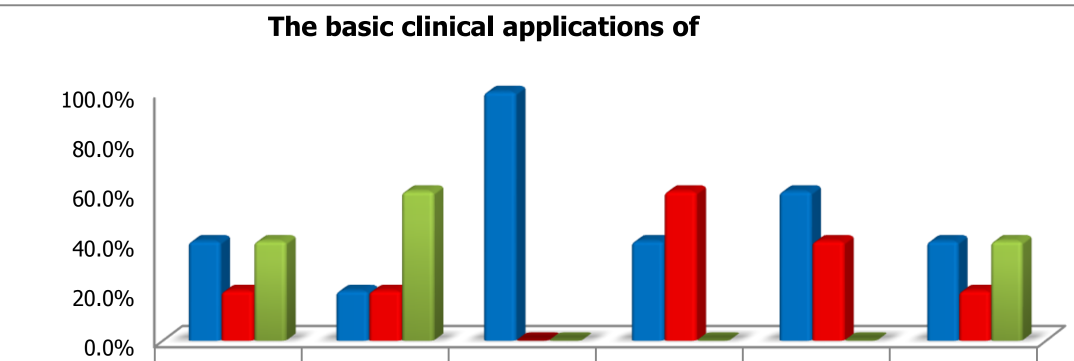
Figure 4.27 demonstrated that diagnostic thyroid imaging, radioactive iodine therapy and perfusion and ventilation studies were regarded as essential by all (100%) of the key person participants.



	Sentinel node detection (n=5)	Octreo-scans (n=5)	Gallium studies (n=5)	Testicular imaging (n=5)	Cardio-vascular imaging (n=5)	First pass/ cardiac flow (n=5)
Essential	80.0%	20.0%	80.0%	20.0%	80.0%	60.0%
Useful	20.0%	60.0%	20.0%	40.0%	20.0%	20.0%
Not needed	0.0%	20.0%	0.0%	40.0%	0.0%	20.0%

FIGURE 4.28: BASIC CLINICAL IMAGING PROCEDURES SUITABLE FOR AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

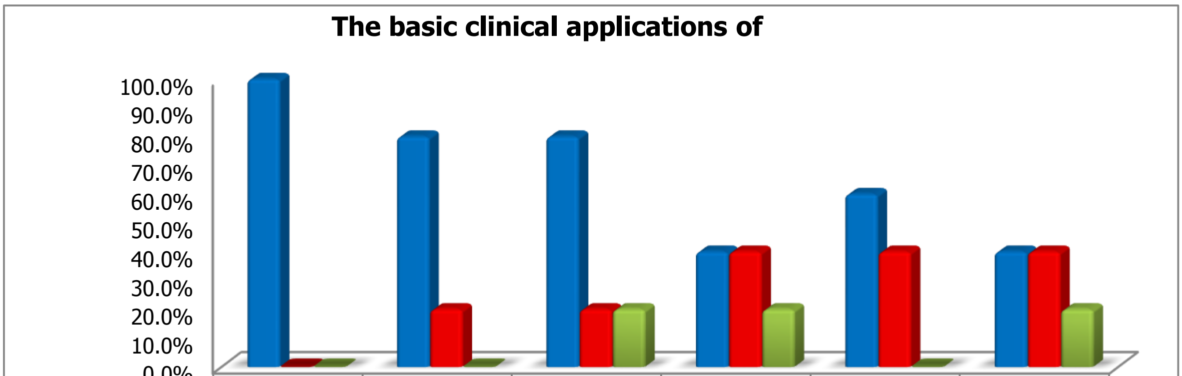
Sentinel-node detection, gallium scans and cardiovascular studies were indicated in Figure 4.28 as essential by 80% of key persons, while octreo-scans were declared to be useful by 60% of key person participants.



	Venogram (legs) (n=5)	Venogram (arms) (n=5)	Renograms (n=5)	Infection imaging tech-niques (n=5)	Tumour imaging tech-niques (n=5)	RN mammo-graphy (n=5)
Essential	40.0%	20.0%	100.0%	40.0%	60.0%	40.0%
Useful	20.0%	20.0%	0.0%	60.0%	40.0%	20.0%
Not needed	40.0%	60.0%	0.0%	0.0%	0.0%	40.0%

FIGURE 4.29: BASIC CLINICAL IMAGING PROCEDURES SUITABLE FOR AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

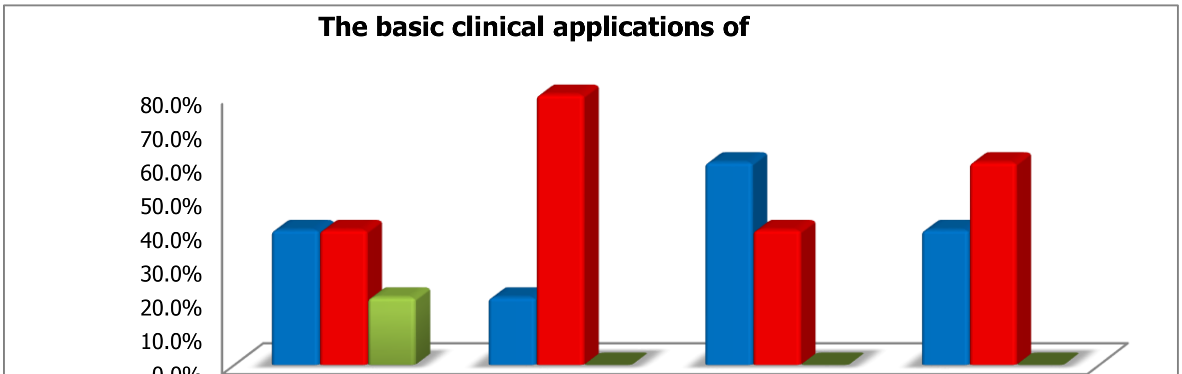
The collected data illustrated in Figure 4.28 show that renograms were considered essential by all (100%) of key person participants, and infection imaging useful by 60%. Venograms, and specifically venograms of the arms, were declared not needed by 60% of key person participants.



	Ejection fractions (n=5)	Myocardiac perfusion studies (n=5)	Gastric emptying studies (n=5)	GIT bleeding studies (n=5)	Milk scans (n=5)	Meckel's diverticulum detection (n=5)
Essential	100.0%	80.0%	80.0%	40.0%	60.0%	40.0%
Useful	0.0%	20.0%	20.0%	40.0%	40.0%	40.0%
Not needed	0.0%	0.0%	20.0%	20.0%	0.0%	20.0%

FIGURE 4.30: BASIC CLINICAL IMAGING PROCEDURES SUITABLE FOR AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

As demonstrated in Figure 4.30 the following topics were regarded as essential by key person participants: cardiac ejection fractions (by 100%), myocardial perfusion studies (by 80%) and gastric emptying procedures (by 80%).



	Lympho-scintigrams (n=5)	Other RN therapy's (e.g. MIBG) (n=5)	SPECT and SPECT/CT (n=5)	PET and PET/CT (n=5)
Essential	40.0%	20.0%	60.0%	40.0%
Useful	40.0%	80.0%	40.0%	60.0%
Not needed	20.0%	0.0%	0.0%	0.0%

FIGURE 4.31: BASIC CLINICAL IMAGING PROCEDURES SUITABLE FOR AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

The collected data show in Figure 4.31 that of the newer nuclear medicine procedures SPECT/CT was regarded as essential by 60% of key person participants, PET/CT as useful by 60% and other radioactive therapies useful by 80% of the key person participants.

Data analysis and description: Key person responses on the Likert-type frequency scale gives an indication of subjects regarded as suitable undergraduate level topics to be included in the undergraduate medical nuclear medicine module. These topics are as follows:

Regarded as essential subjects by 100% of key person participants

- Bone scans
- Thyroid imaging
- Radioactive thyroid therapy
- Lung perfusion and ventilation studies
- Renograms
- Ejection fractions

Regarded as essential subjects by 80% of key person participants

- Sentinel node detection
- Gallium studies
- Cardiovascular studies, myocardiac perfusion studies

Regarded as essential subjects by 60% of key person participants

- Hepatobiliary/HIDA scans
- MIBI parathyroid scans
- Tumour imaging
- First-pass cardiac-flow studies
- Milks cans
- SPECT/CT

Regarded as useful subjects by 60-80% of key person participants

- Infection imaging
- Octreo-scans
- Neuro-endocrine studies
- Other radioactive therapies
- PET/CT

Regarded as not needed by 60-100% of key person participants

- Salivary gland scans
- Venograms of the arms

4.3.5.4 *Question 6.41: Necessity of such an undergraduate module;*

AND

4.3.5.5 *Question 6.42: Necessity of standardised guidelines for such a module*

In the above mentioned questions, key person participants were asked to give their opinions regarding the necessity of an undergraduate medical nuclear medicine module, and the necessity of standardised guidelines for such a module.

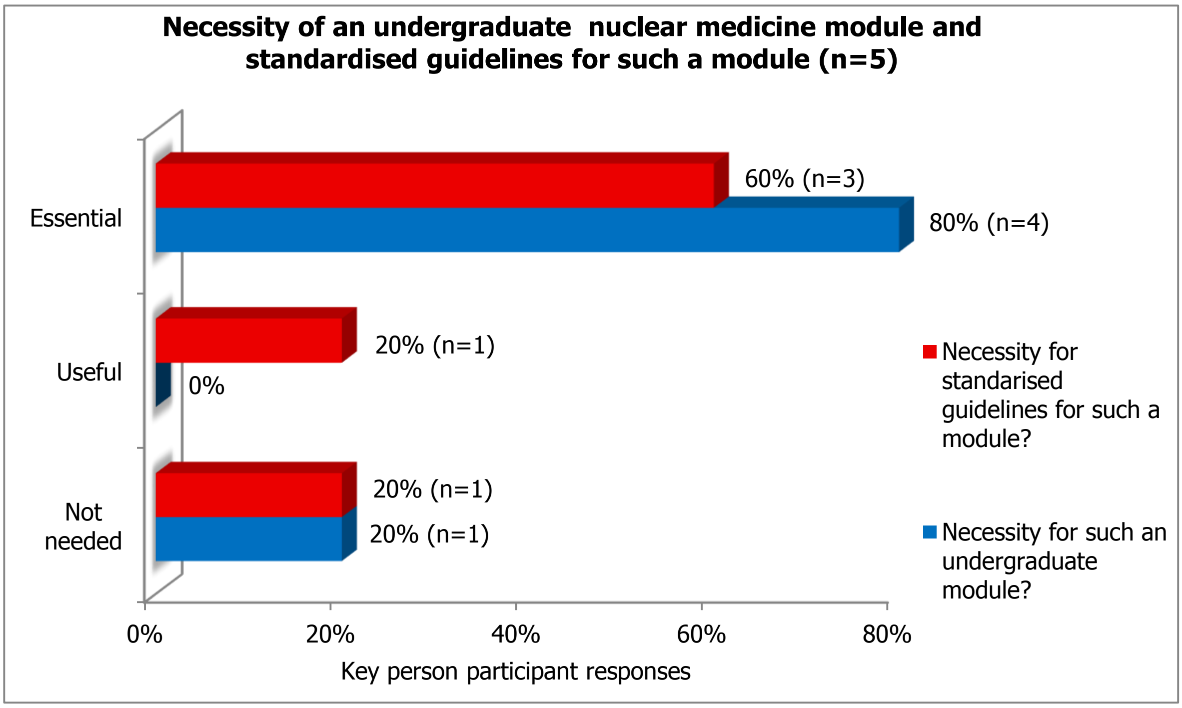


FIGURE 4.32: THE NECESSITY OF AN UNDERGRADUATE MODULE AND STANDARDISED GUIDELINES FOR SUCH A MODULE

Data analysis and description: Figure 4.32 illustrates that four of the five key person participants (80%) indicated that such an undergraduate module is essential, while only 60% stated that guidelines will be essential. One of the key person participants (20%) believes that neither the module nor the guidelines is needed (cf. Paragraphs 4.3.4.1, 4.4.2.1, 4.4.3.4, 4.4.3.5, 5.3.1.3 and 5.3.1.5).

4.4 QUANTITATIVE RESULTS, FINDINGS AND DISCUSSION OF RESPONSES BY NUCLEAR MEDICINE EXPERTS TO THE SEMI-STRUCTURED SURVEY QUESTIONNAIRE

The semi-structured survey questionnaire to the nuclear medicine experts was sent to 89 participants (including one pilot questionnaire to a nuclear medicine expert two weeks prior to the emails sent to the remaining 88 participants). Of the 89 expert questionnaires that were sent to expert participants of the study, a total of 47 were completed and submitted. A response rate of 53% was obtained for the expert survey (cf. Figure 4.2).

In the following paragraphs, the expert participants' variables will also be presented schematically according to the expert questionnaires sections (cf. Figure 4.1). The questions asked below include editorial corrections and might differ slightly from those in the questionnaires (cf. Appendix E4). Figures 4.33 – 4.37 and Tables 4.3 – 4.9 provide graphic presentations of the results, findings and discussions; and direct quotes of responses will be given to elaborate on answers and to enhance the trustworthiness of the study.

4.4.1 SECTION A: Demographic information of the nuclear medicine experts

4.4.1.1 *Question 2.1: Please indicate your place of work*

In this question the nuclear medicine expert participants had to indicate their work place, either academe or the private sector.

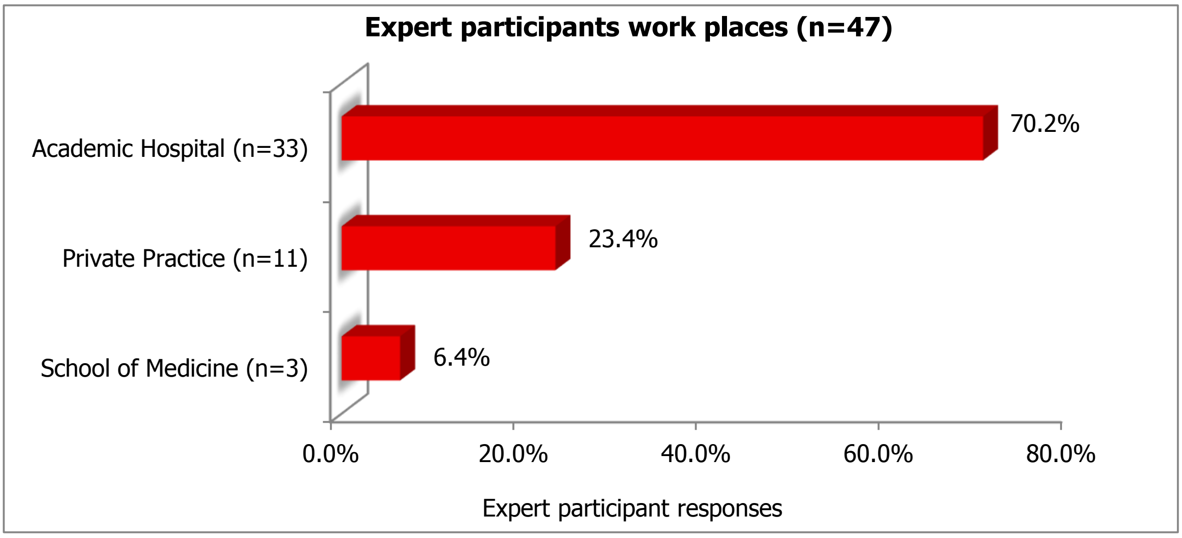


FIGURE 4.33: WORKPLACES OF THE NUCLEAR MEDICINE EXPERTS

Data analysis and description: Figure 4.33 gives an overview of the workplaces of the nuclear medicine expert participants. A total of 76.6% (n=36) of the expert participants were employed in academe, while 23.4% (n=11) were private nuclear medicine physicians.

4.4.1.2 *Question 2.2: Academic position of the expert participants*

This question asked expert participants to indicate their current academic positions.

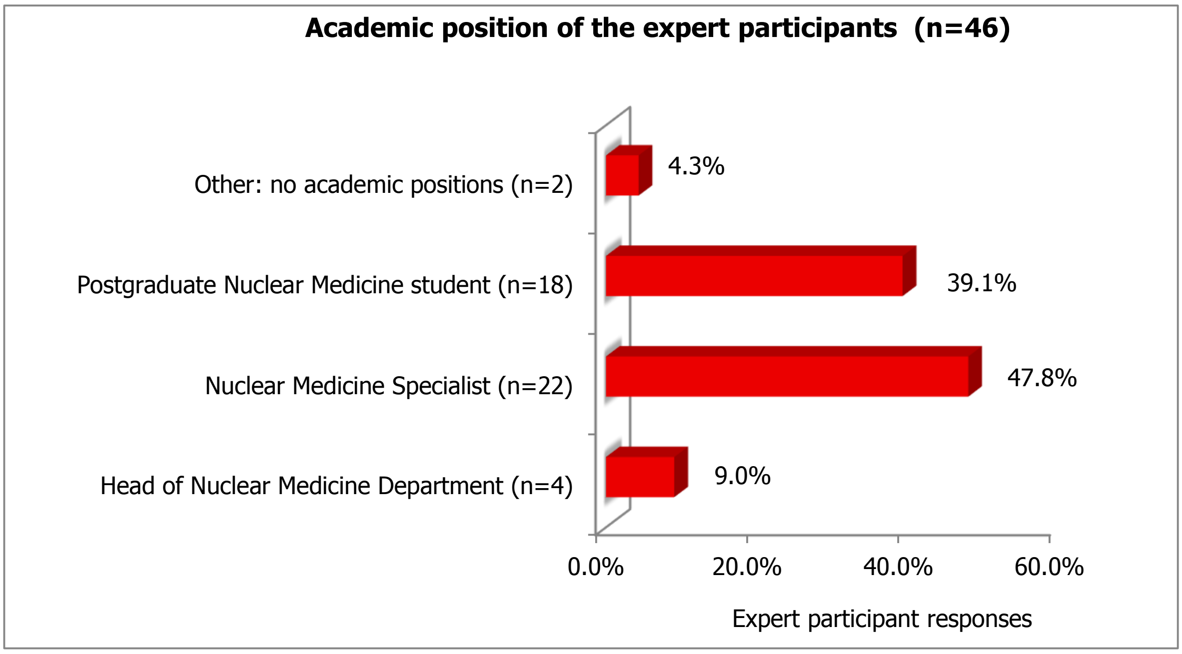


FIGURE 4.34: ACADEMIC POSITIONS OF THE NUCLEAR MEDICINE EXPERTS

Data analysis and description: According to the data collected in Figure 4.34, 56.8% (n=26) of the expert participants in academic positions, were nuclear medicine specialists/physicians and Heads of Nuclear Medicine Departments, while 4.3% (n=2) indicated that they did not hold academic positions. Postgraduate registrars and international IAEA fellows in nuclear medicine formed 39.1% (n=18) of the expert participants.

4.4.1.3 *Question 2.4: Undergraduate and postgraduate medical academic qualifications of the expert participants*

Expert participants were asked to indicate their undergraduate and postgraduate academic (medical) qualifications, with the aim of determining their knowledgeability of the research topic.

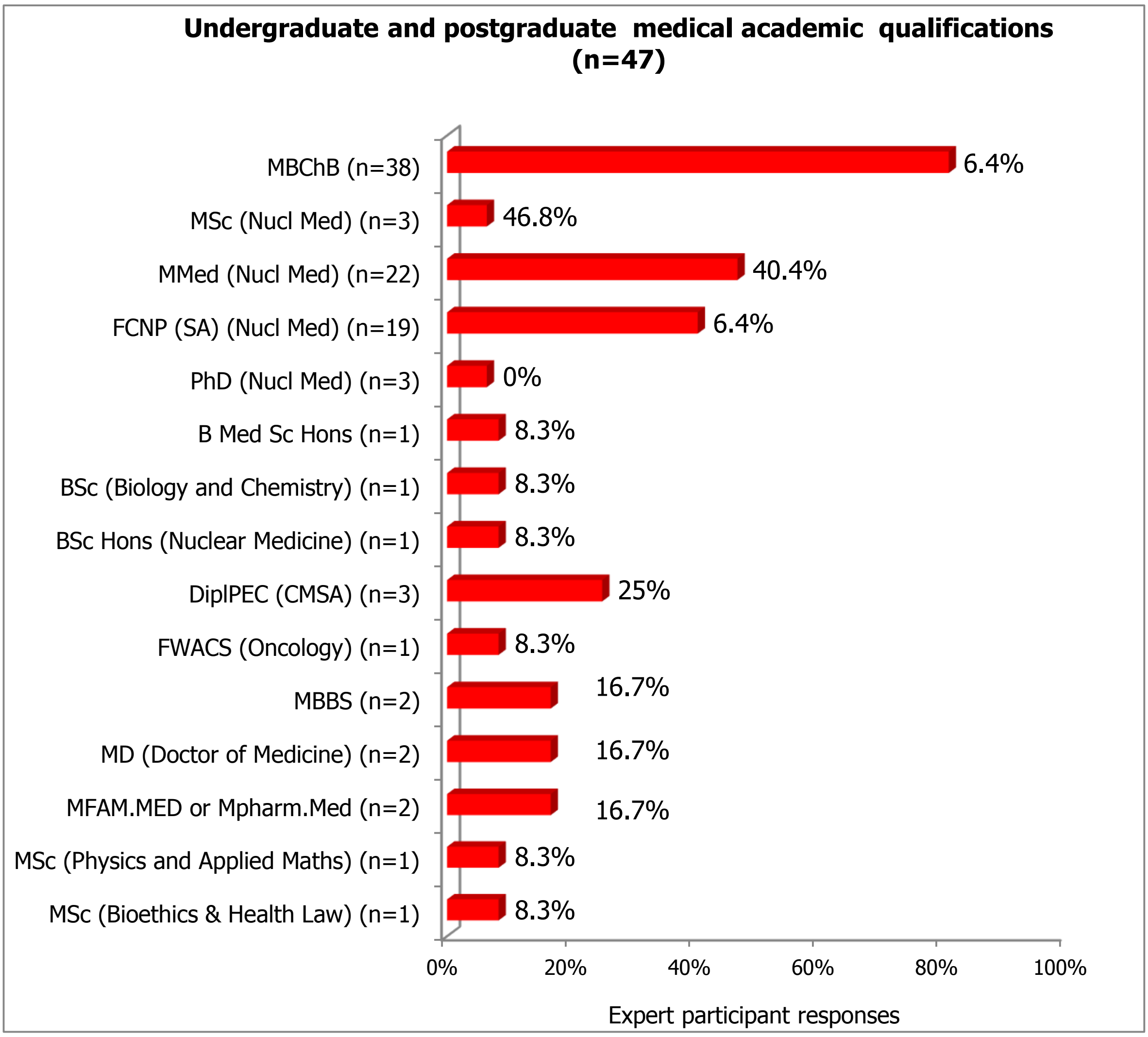


FIGURE 4.35: UNDERGRADUATE AND POSTGRADUATE MEDICAL ACADEMIC QUALIFICATIONS OF THE NUCLEAR MEDICINE EXPERTS

Data analysis and description: The medical academic qualifications of the expert nuclear medicine participants (n=47) are graphically displayed in Figure 4.35. All the participants had to be knowledgeable about the research topic to ensure the reliability of this study. The validity of this study also depended on the quality of the acquired data. The expert research population consisted of nuclear medicine experts in South Africa working in academe or private practice. Their academic qualifications indicated that they truly represented the research population.

Of the expert participants 80.9% (n=47) had completed their undergraduate medical studies with the MBChB exit qualification of the HPCSA in South Africa; 6.4% (n=3) had obtained the original MSc (Nuclear Medicine) degree, while 46.8% (n=22) had qualified as nuclear medicine specialists with the MMed (Nuclear Medicine) degree. The remaining 40.4% (n=19) had completed their postgraduate nuclear medicine speciality studies by passing the FCNP (SA) final examinations. Three experts (6.4%) had also obtained PhD (Nuclear Medicine) degrees. The other qualifications mentioned are either international medical qualifications or national, additional qualifications obtained by the experts; these qualifications are not applicable to the qualifications required for participation in this study.

4.4.1.4 *Question 2.6: Age distribution of the expert participants*

In this question expert participants were asked to indicate their ages.

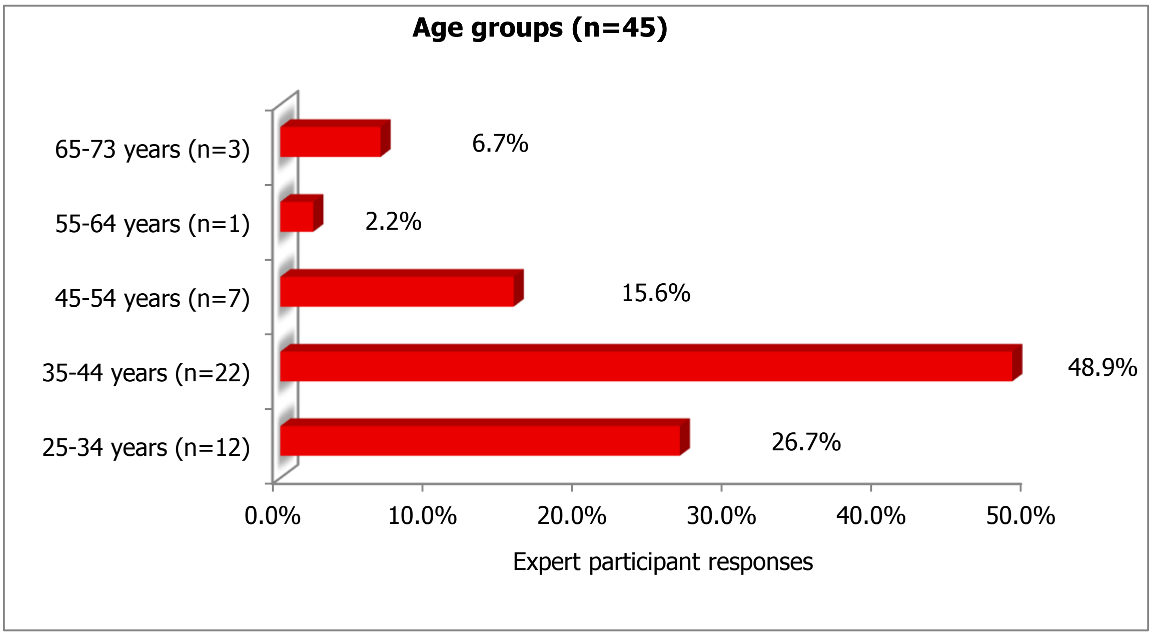


FIGURE 4.36: AGE DISTRIBUTION OF THE NUCLEAR MEDICINE EXPERTS

Data analysis and description: In general, the age distribution of the experts corresponds with that of the key persons (cf. Paragraph 4.3.1.3). According to the expert participant responses in Figure 4.36, most of their expert (48.9%) ages were between 35 and 44 years (n=22); they represent the new generation of nuclear medicine specialists in South Africa. They were followed in number by the postgraduate registrar group (26.7%)

in the age group of 25-34 years (n=12). Only 6.7% of the expert participants fell in the 65-73 year age group (n=3).

4.4.1.5 *Question 2.7: Gender distribution of the expert participants*

In this question the expert participants were asked to indicate their gender.

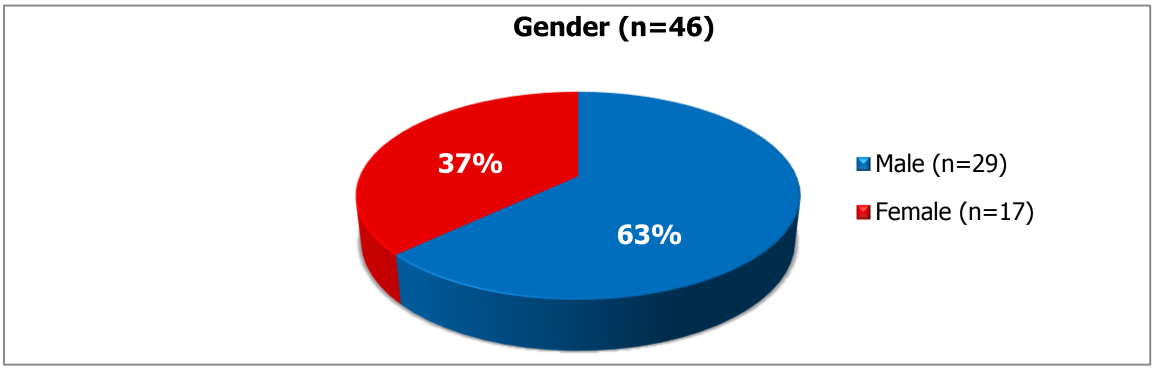


FIGURE 4.37: GENDER DISTRIBUTION OF NUCLEAR MEDICINE EXPERTS

Data analysis and description: Figure 3.37 shows that in contrast to the key persons' gender distribution (cf. Paragraph 4.3.1.4) where 80% (n=4) were women, here 63% (n=29) of the experts were men.

4.4.1.6 *Question 2.8: Any formal educational (formal teaching and learning education) qualifications of the expert participants*

Nuclear medicine expert participants were asked about any formal qualifications obtained in the teaching and learning domain.

THEME A: FORMAL (TEACHING AND LEARNING) EDUCATIONAL QUALIFICATIONS (n=23)

CATEGORIES IDENTIFIED:
A.1 No formal teaching and learning qualifications
A.2 Non-applicable qualifications mentioned
A.3 Inappropriate answers
A.4 Appropriate teaching qualifications

TABLE 4.3: CATEGORY A.1-NO FORMAL TEACHING QUALIFICATIONS (n=14)

No formal teaching and learning qualifications
"*none*"
"*N/A*"
"*No Degree/diploma in education*"

Discussion of the qualitative responses: The expert participants indicated in Table 4.3 that none of them had any formal teaching and learning educational qualifications.

TABLE 4.4: CATEGORY A.2-OTHER NON-APPLICABLE QUALIFICATIONS MENTIONED (n=6)

Qualifications mentioned that are not applicable to the asked question
MD (Zagreb), MMED (Nucl Med) WITS
BSc. Biology and chemistry MD
MD
MBBS (UPH) 2005
MBBS

Discussion of the qualitative responses: Not all participants understood the question about teaching qualifications and few of the answers and qualifications given were applicable to educational teaching qualifications. MBBS is an equivalent of the South African MBChB degree.

TABLE 4.5: CATEGORY A.3-OTHER INAPPROPRIATE ANSWERS (n=2)

Answers not appropriate to the question asked
"About to complete my fellowship of the West African Postgraduate Medical College in Diagnostic Radiology"
"YES"

Discussion of the qualitative responses: These answers were not applicable to the question asked.

TABLE 4.6: CATEGORY A.4-APPROPRIATE TEACHING QUALIFICATIONS

Appropriate qualification according to the question asked
"*workshops by the universities*"

Discussion of the qualitative responses: The response, "workshops by the universities" actually describes the extent of most medical educators' "formal" experiences of being taught how to teach medical students. Most experienced medical teachers are teaching students on the basis of their own clinical experience and they apply teaching methods they had experienced in their own years as students.

4.4.1.7 *Question 2.9: Educational (teaching and learning) experience of the expert participants. Specify the subjects and state for how long*

Nuclear medicine expert participants were asked to elaborate on their teaching experience and to state the subjects they have taught.

THEME B: EDUCATIONAL EXPERIENCE IN TEACHING MEDICAL STUDENTS AS WELL AS THE SUBJECTS/TOPICS PRESENTED/TAUGHT TO THE STUDENTS (n=47)

CATEGORIES IDENTIFIED:
B.1 No teaching experience (including no responses)
B.2 Inappropriate answers
B.3 Appropriate teaching experience

TABLE 4.7: CATEGORY B.1-NO TEACHING EXPERIENCE

No medical teaching experience (n=5)
"none"
"no"
"nil"
No responses (n=21)

Discussion of the qualitative responses: The majority of expert participants did not answer this question, indicating that clinical physicians do not necessarily engage in teaching. Referring back to the demographic information in Paragraph 4.4.1.2, 39.1% of the participants were postgraduate nuclear medicine registrars or fellows, explaining their current lack of teaching experience.

TABLE 4.8: CATEGORY B.2-INAPPROPRIATE ANSWERS

Answers not appropriate to the question asked (n=4)
"*M.Med part 1 exams. Took subjects in anatomy, physiology, chemical pathology, nuclear physics and radio chemistry over 18 month period. A further TNM research module*"
"*RADIATION ONCOLOGY FOR 3 YEARS*"
"*NM consultant 2007 -2009*"

Discussion of the qualitative responses: Several responses were not applicable to the question asked. Being a "NM consultant" does not necessarily indicate the persons' involvement in medical student teaching, although academic consultants are expected to teach students.

TABLE 4.9: CATEGORY B.3-APPROPRIATE TEACHING EXPERIENCE

Appropriate teaching experience
"40 years at academic hospital"
"In the 13 yrs that I have worked as a senior medical officer and registrar in an Academic Hospital before moving to private practice, I was involved in seminars and teaching for medical students as well as registrars in other fields of medicine. While in private practice I also gave lectures in the interpretation and reporting of Nuclear Medicine scans for young inexperienced registrars for about two years at an academic institute"
"Involved in teaching and learning for undergraduate (Fifth year) and postgraduate (nuclear medicine) since 1996. Renal physiology related to nuclear medicine for undergraduate and anatomy, physiology, medical physics, radiobiology; all being applied to nuclear medicine and the clinical practice of nuclear medicine itself"
"Nuclear Medicine - teaching Principales and Practice of Nuclear Medicine to postgraduate and under graduate students for the past 5 years"
"Only informal training teaching registrars. We teach one small session a month to 5th year medical students"
"Nuclear Medicine 15 yrs" *"Medical Physics 15 yrs"* *"Cross Sectional Anatomy 10 yrs"*
"Medical students for selected physiology lectures past 6 years"
"General Nuclear Medicine, radio-pharmacy and physics for Nuclear Medicine radiographers and registrars in Nuclear medicine - 2 to 3 years, mostly sessional"
"Informal & formal teaching sessions at the department to both registrars and radiographers in Nuclear Medicine (3yrs)"
"Nuclear medicine for 4 years"
"Comprehensive Nuclear Medicine teachings to registrars and radiographers from 1986 to 2002 full-time"
"Postgraduate Nuclear Medicine Students past 6 years"
"Registrar and undergraduate teaching, departmental and interdepartmental lectures"
"Sessional teaching to Nuclear Medicine radiographers in the subject of general nuclear medicine - 3 years."
"Teaching registrar in Nuclear Medicine June 2011-date"
"Teaching registrars in Nuclear Medicine 2 years"
"lecturing undergraduate MBChB and postgraduate small group teaching in Nuclear Medicine for about 15 years"

Discussion of the qualitative responses: As expected from expert nuclear medicine participants, a large number of them had many years of clinical teaching experience in their field of interest. Teaching experiences ranges from 2 to 40 years. Referring to the demographic information in Paragraph 4.4.1.2, as many as 76.8% of these experts were involved in an academic setting. The lower response from private nuclear medicine experts was the result of their belief that they were not currently involved in student training.

Referring back to the experts' age distribution (cf. Paragraph 4.4.1.4) the 10 expert participants in the age group 45-73 years contributed between 13 and 40 years to teaching nuclear medicine to undergraduate medical students and postgraduate registrars. A younger generation of nuclear medicine physicians between the ages of 35 and 44 years (49.8% of the expert participants) emerge with nuclear medicine related teaching experience of between 2 and 10 years.

Despite their years of clinical teaching experience none of these expert participants, all with advanced medical qualifications, had any formal educational teaching and learning qualifications (cf. Paragraphs 4.4.1.6, 4.4.1.7 and Tables 4.3 – 4.9). In this study, only the key person who took part in the pilot had a formal education qualification, in Health Professions Education, though he was not currently practicing as a nuclear medicine physician (cf. Paragraph 3.3.4).

4.4.2 Section B: Research sub-questions that need answering (why, when, which topics, to what extent, by whom, how presented and assessed and in what/which way)

The results and findings of these open-ended, qualitative questions will be presented and discussed in Chapter 5.

4.4.2.1 *Question 3.1: Do you think it is necessary to implement an undergraduate medical nuclear medicine educational module?*

Expert participants were asked to indicate if they think such an undergraduate medical nuclear medicine module is necessary.

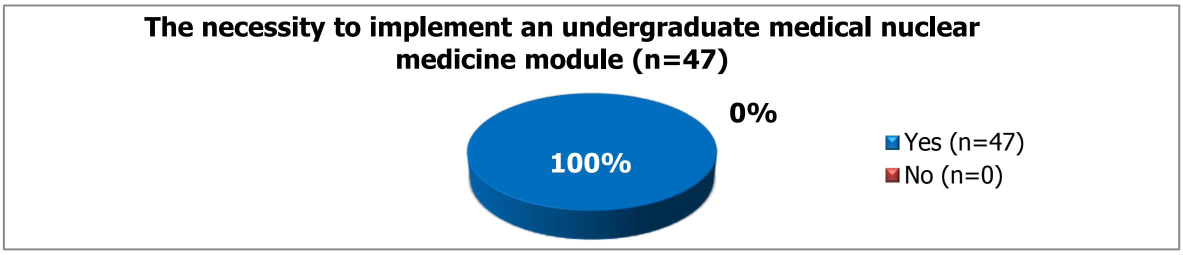


FIGURE 4.38: NECESSITY OF IMPLEMENTING AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE

Data analysis and description: All the expert participants (100%) regarded an undergraduate medical nuclear medicine educational module as necessary (cf. Paragraphs 4.4.3.4 and 4.4.3.5).

4.4.3 Section C: Medical nuclear medicine course content at undergraduate level indicated on a Likert-type frequency scale

4.4.3.1 *Questions 4.1 and 4.2: The basic-science topics that could fit into an undergraduate or primary-level nuclear medicine module*

Expert participants were asked to indicate whether basic-science topics should be taught or the teachers should just refer back to topics as part of the undergraduate medical nuclear medicine module.

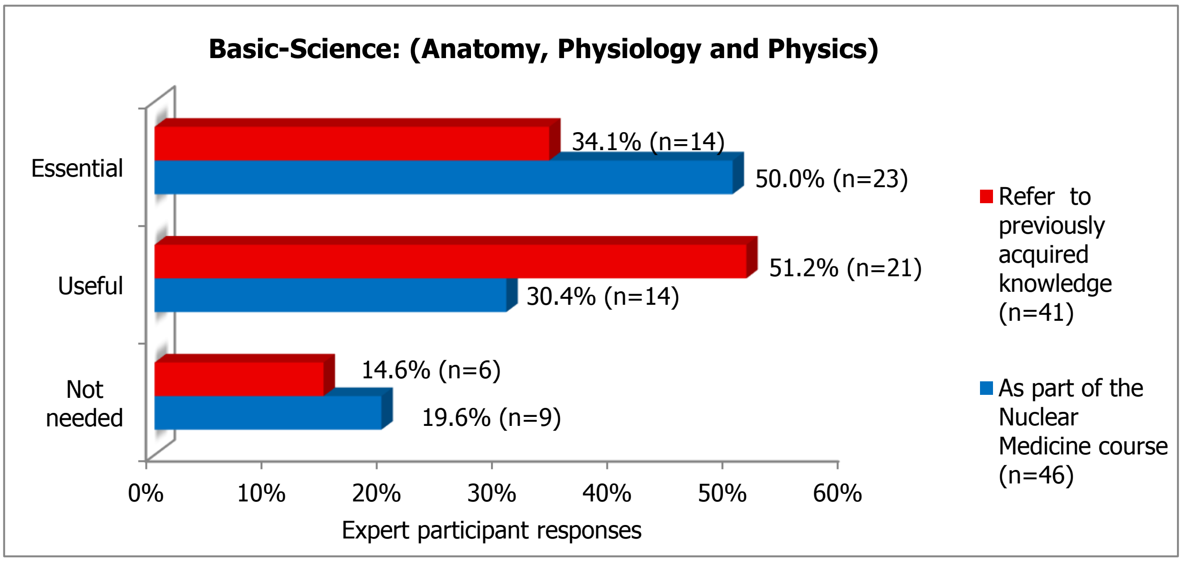


FIGURE 4.39: BASIC-SCIENCE TOPICS FITTING INTO AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

Data analysis and description: Half (50.0%) of the expert participants indicated that basic-science subjects need to be presented as part of the nuclear medicine module (n=23). Referring back to previously acquired basic-science subjects is indicated as useful by 51.5 % (n=21) of the experts. Basic-science subjects in the undergraduate nuclear medicine module is indicated as not needed by 14.6% (n=6) and 19.6% (n=9) of the expert participants (cf. Paragraph 4.3.5.1).

4.4.3.2 *Questions 4.3 to 4.6: Basic introductory nuclear medicine topics that could fit into an undergraduate or primary-level nuclear medicine module*

Expert participants were asked to indicate the basic, introductory nuclear medicine topics that should be taught as part of the undergraduate medical nuclear medicine module.

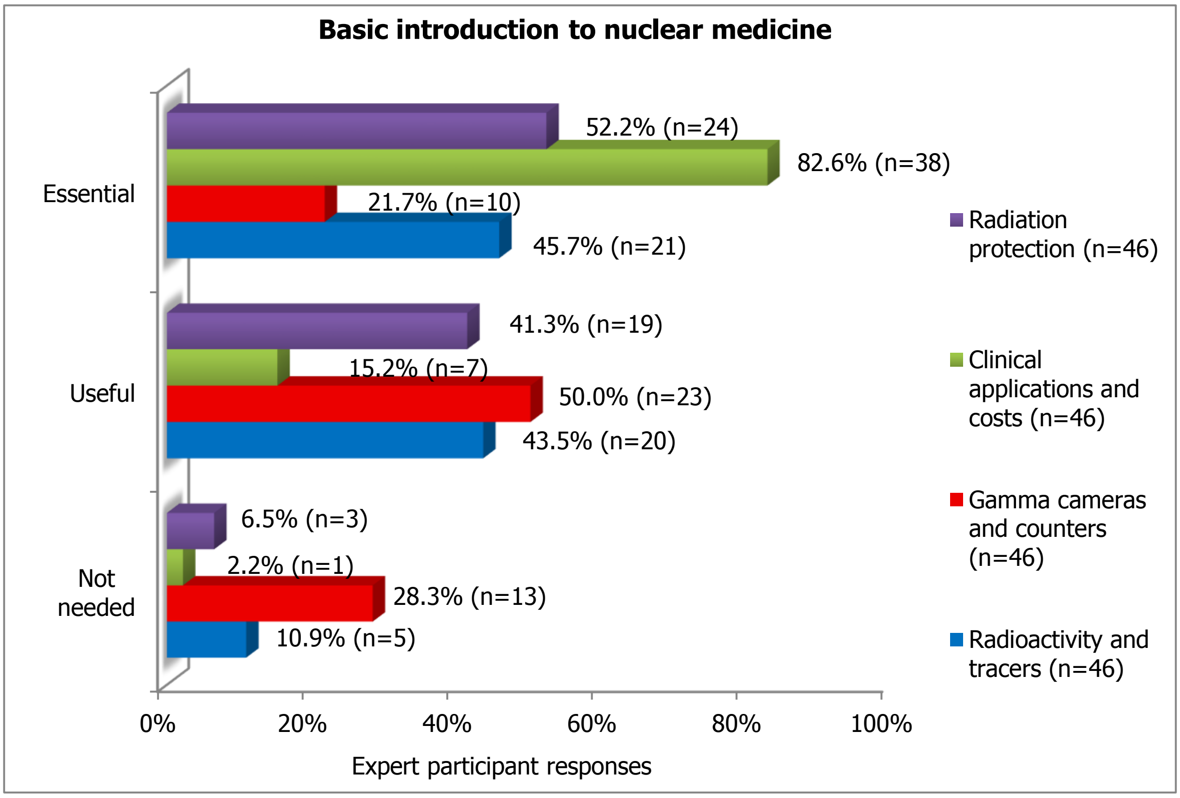
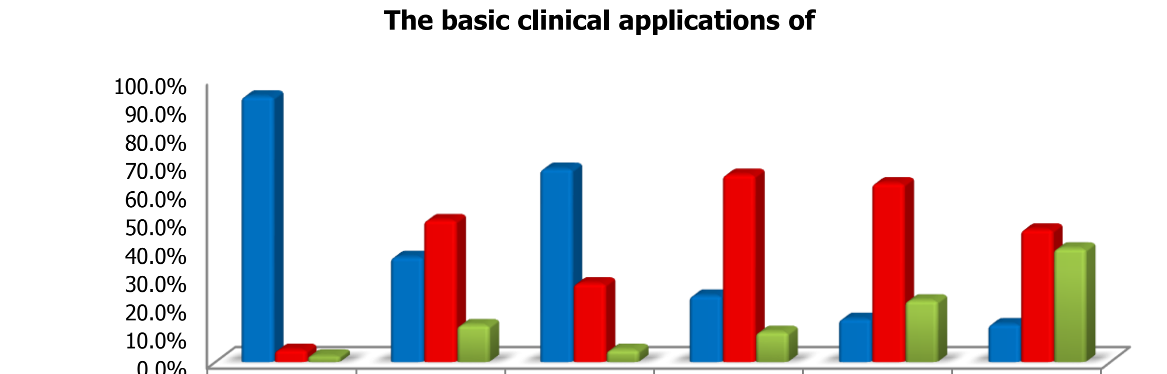


FIGURE 4.40: BASIC INTRODUCTORY NUCLEAR MEDICINE TOPICS SUITABLE FOR AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

Data analysis and description: According to 82.6% (n=38) of the nuclear medicine experts clinical applications and information about the cost of clinical studies are essential for inclusion in the module. Radiation protection is regarded as essential by 52.2% (n=24) and knowledge of radio-activity and tracers is regarded as essential by 45.7% (n=21) of the experts. Knowledge about gamma cameras is reported to be useful by 50.0% (n=23) of the experts, while 28.3% (n=13) regarded it as not needed (cf. Paragraphs 2.5.4.1 and 4.3.5.2).

4.4.3.3 *Questions 4.7 to 4.40: Basic clinical imaging procedures which could fit into an undergraduate or primary-level nuclear medicine module*

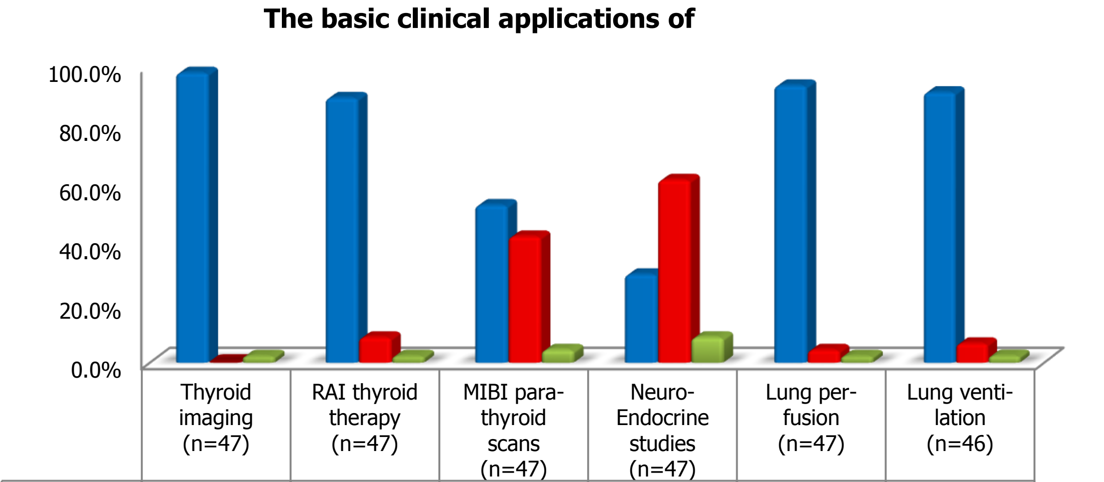
Nuclear medicine expert participants were asked to indicate on a Likert-type frequency scale the topics they considered suitable for inclusion in the undergraduate module. They were required to rate their decisions as essential, useful or not needed. Figures 4.41 – 4.46 illustrate the experts' views of the clinical nuclear medicine topics suitable for an undergraduate nuclear medicine module. As mentioned previously, the nuclear medicine topics were randomly chosen to prevent any bias (cf. Paragraph 4.3.5.3).



	Bone scan (n=47)	Liver/ spleen scan (n=46)	Hepatobiliary / hida scan (n=47)	Brain per-fusing imaging (n=47)	CSF leakage detection (n=46)	Salivary gland scans (n=45)
Essential	93.6%	37.0%	68.1%	23.4%	15.2%	13.3%
Useful	4.3%	50.0%	27.7%	66.0%	63.0%	46.7%
Not needed	2.1%	13.0%	4.3%	10.6%	21.7%	40.0%

FIGURE 4.41: BASIC CLINICAL IMAGING PROCEDURES SUITABLE FOR AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

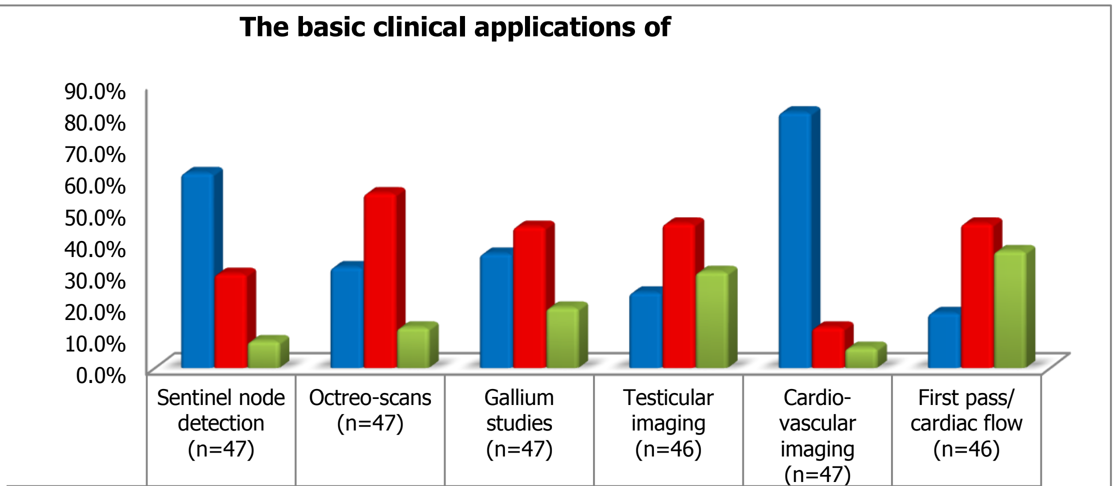
According to the collected data in Figure 4.41, bone scans were identified as being essential by 93.6% of the nuclear medicine experts, while only 13.3% stated that salivary-gland scans were essential. After bone scans, 68.1% of the experts indicated hepatobiliary scans as essential.



	Thyroid imaging (n=47)	RAI thyroid therapy (n=47)	MIBI para-thyroid scans (n=47)	Neuro-Endocrine studies (n=47)	Lung per-fusion (n=47)	Lung venti-lation (n=46)
Essential	97.9%	89.4%	53.2%	29.8%	93.6%	91.3%
Useful	0.0%	8.5%	42.6%	61.7%	4.3%	6.5%
Not needed	2.1%	2.1%	4.3%	8.5%	2.1%	2.2%

FIGURE 4.42: BASIC CLINICAL IMAGING PROCEDURES SUITABLE FOR AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

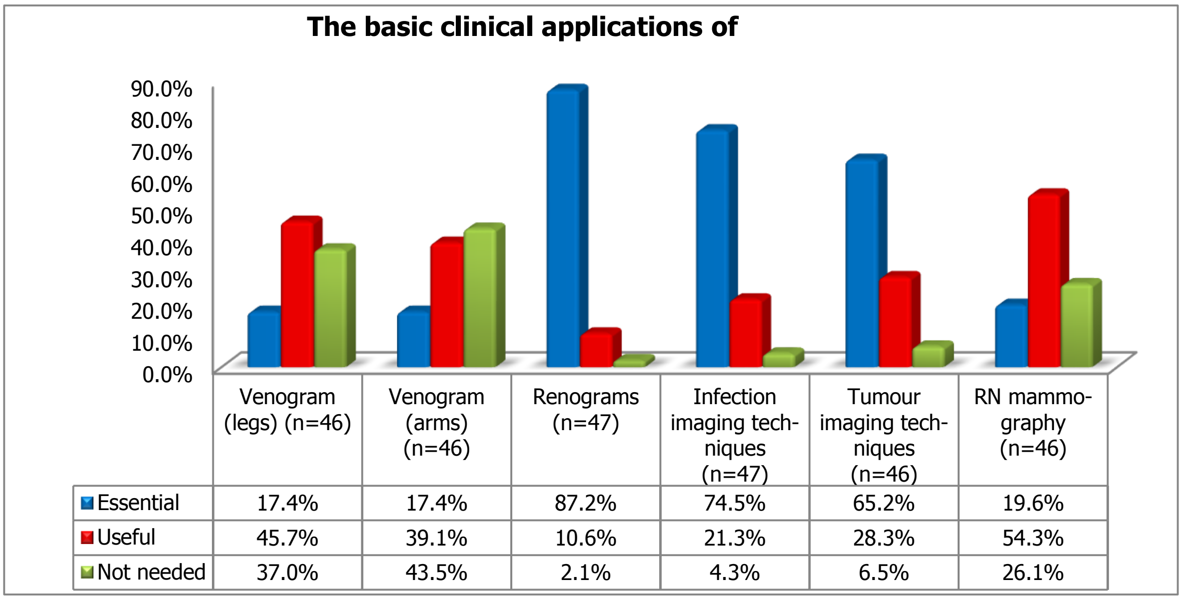
Figure 4.42 demonstrated that thyroid imaging (97.9%), radioactive iodine therapy (89.4%), lung perfusions (93.6%) and ventilation studies (91.3%) were regarded as being essential. Neuro-endocrine studies are reported on to be useful by 61.7% of the expert participants.



	Sentinel node detection (n=47)	Octreo-scans (n=47)	Gallium studies (n=47)	Testicular imaging (n=46)	Cardio-vascular imaging (n=47)	First pass/ cardiac flow (n=46)
Essential	61.7%	31.9%	36.2%	23.9%	80.9%	17.4%
Useful	29.8%	55.3%	44.7%	45.7%	12.8%	45.7%
Not needed	8.5%	12.8%	19.1%	30.4%	6.4%	37.0%

FIGURE 4.43: BASIC CLINICAL IMAGING PROCEDURES SUITABLE FOR AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE [

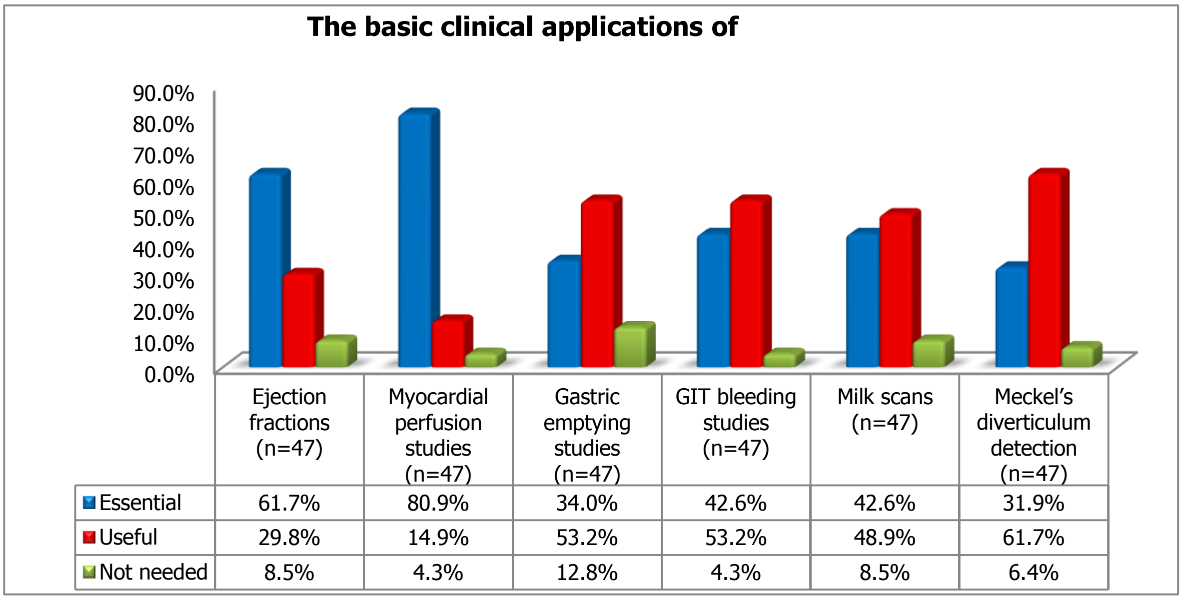
Figure 4.43 demonstrated that cardiovascular studies were indicated as essential by 80.9% of expert participants, while 61.7% indicated sentinel node detection as essential. Testicular imaging (30.4%) was regarded as not needed at undergraduate level.



	Venogram (legs) (n=46)	Venogram (arms) (n=46)	Renograms (n=47)	Infection imaging tech-niques (n=47)	Tumour imaging tech-niques (n=46)	RN mammo-graphy (n=46)
Essential	17.4%	17.4%	87.2%	74.5%	65.2%	19.6%
Useful	45.7%	39.1%	10.6%	21.3%	28.3%	54.3%
Not needed	37.0%	43.5%	2.1%	4.3%	6.5%	26.1%

FIGURE 4.44: BASIC CLINICAL IMAGING PROCEDURES SUITABLE FOR AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

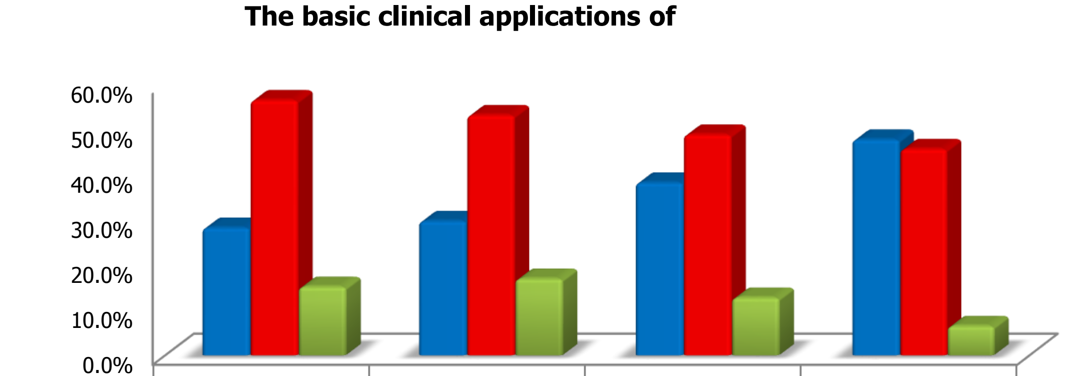
The collected data illustrated in Figure 4.44 show that renograms (87.2% of participants) and infection imaging (74.5%) were considered essential for inclusion into the undergraduate module. Figure 4.44 shows that venograms of the arms were regarded as not needed by 43.5% experts, while 45.7% regarded leg venograms as useful.



	Ejection fractions (n=47)	Myocardial perfusion studies (n=47)	Gastric emptying studies (n=47)	GIT bleeding studies (n=47)	Milk scans (n=47)	Meckel's diverticulum detection (n=47)
Essential	61.7%	80.9%	34.0%	42.6%	42.6%	31.9%
Useful	29.8%	14.9%	53.2%	53.2%	48.9%	61.7%
Not needed	8.5%	4.3%	12.8%	4.3%	8.5%	6.4%

FIGURE 4.45: BASIC CLINICAL IMAGING PROCEDURES SUITABLE FOR AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

Like the key person participants, of whom 80% were of the opinion that myocardial perfusion studies are essential (cf. Figure 4.29), here 80.9% of the experts held this view. Gastro-intestinal studies were mostly regarded as useful according to the data collected in Figure 4.45.



	Lympho-scintigrams (n=46)	Other RN therapies (e.g. MIBG) (n=47)	SPECT and SPECT/CT (n=47)	PET and PET/CT (n=46)
Essential	28.3%	29.8%	38.3%	47.8%
Useful	56.5%	53.2%	48.9%	45.7%
Not needed	15.2%	17.0%	12.8%	6.5%

FIGURE 4.46: BASIC CLINICAL IMAGING PROCEDURES SUITABLE FOR AN UNDERGRADUATE OR PRIMARY-LEVEL NUCLEAR MEDICINE MODULE

As graphically displayed in Figure 4.46, lympho-scintigrams (56.5% of expert participants), other radionuclide therapies (53.2%), SPECT/CT (48.9%) and PET/CT (45.7%) were regarded as useful but not essential.

Data analysis and description: Nuclear medicine experts' stances as indicated on a Likert-type frequency scale give an indication of the subjects they regard as suitable for inclusion in an undergraduate level medical nuclear medicine module. The complete list is as follows:

Regarded as essential subjects by 90-100% of nuclear medicine expert participants

- Bone scans (93.6%)
- Thyroid imaging (97.9%)
- Lung perfusion (93.6%)
- Lung ventilation studies (91.3%)

Regarded as essential subjects by 80-90% of nuclear medicine expert participants

- Radioactive thyroid therapy (89.4%)
- Renograms (87.2%)
- Cardiovascular studies (80.9%)
- Myocardial perfusion studies (80.9%)

Regarded as essential subjects by 70-80% of nuclear medicine expert participants

- Infection imaging (74.5%)

Regarded as useful subjects by 60-80% of nuclear medicine expert participants

- Brain perfusion (66%)
- Meckels' diverticulum (61.7%)
- Neuro-endocrine studies (61.7%)
- CSF leakage (63%)

PET/CT was regarded as both essential (47,8%) and useful (45,7%)

Regarded as not needed by 40-50% of nuclear medicine expert participants

- Venograms of the arms (43.5%)

4.4.3.4 *Question 4.41: Necessity of such an undergraduate module;*

AND

4.4.3.5 *Question 4.42: Necessity of standardised guidelines for such a module*

Expert participants were asked to indicate their viewpoints about the necessity of an undergraduate nuclear medicine module, and standardised guidelines for such a module.

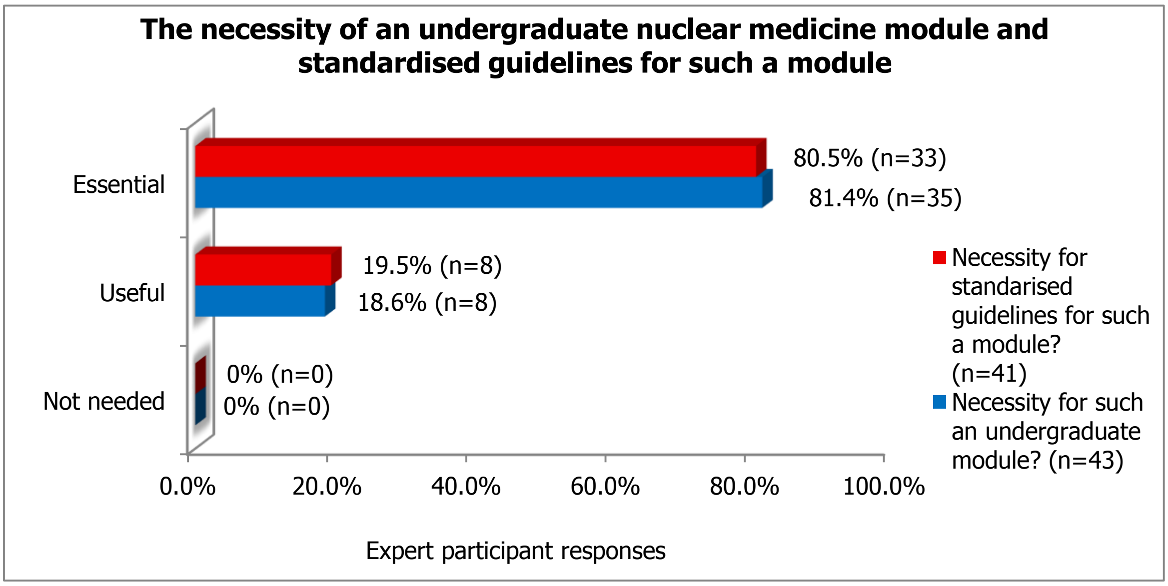


FIGURE 4.47: NECESSITY FOR AN UNDERGRADUATE MODULE AND STANDARDISED GUIDELINES FOR SUCH AN EDUCATIONAL MODULE

Data analysis and description: As demonstrated in Figure 4.47, expert participants indicated an undergraduate medical nuclear medicine module (81.4%) and the guidelines for such a module (80.5%) as essential (Paragraphs 4.3.5.4, 4.3.5.5 and 4.4.2.1).

4.5 CONCLUSION

This chapter discussed the quantitative results and findings of the email administered survey questionnaires, which were completed by key person and nuclear medicine expert participants in South Africa. A summary of the key persons' quantitative results on South African medical curricula (Study Objective 2) are included in the appendices section (cf. Appendix F3).

Appendix F5 summarises descriptive statistical results and information obtained from nuclear medicine expert participants on undergraduate nuclear medicine course content (Study Objective 3) as indicated on the Likert-type frequency scale (cf. Paragraph 4.4.3).

In the following chapter, Chapter 5, titled **Qualitative analysis of the semi-structured survey questionnaires results**, the qualitative findings and participants' opinions and responses regarding the applicability and contents of an undergraduate medical nuclear medicine module will be presented, analysed and discussed separately.

CHAPTER 5

QUALITATIVE ANALYSIS OF THE SEMI-STRUCTURED SURVEY QUESTIONNAIRE RESULTS

5.1 INTRODUCTION

In this study a semi-structured survey questionnaire, consisting of both closed and open-ended questions, was selected to collect reliable data from both academic and private nuclear medicine experts. Combining a quantitative study with qualitative components, provide participants with the opportunity to qualify and explain their answers (Joubert *et al*. 2010:109,110).

In the previous chapter, Chapter 4, the quantitative results of the key persons and nuclear medicine experts were presented and discussed separately according to the sections of the semi-structured survey questionnaires. In this chapter, Chapter 5, the participants' viewpoints regarding the applicability and contents of an undergraduate medical nuclear medicine module are analysed and these qualitative results and views are presented and discussed.

To standardise the trends and themes of viewpoints the participants presented in the open-ended questions, the questionnaires were provided in English only (cf. Appendices E2 and E4). The researcher coded and categorised the raw data into themes; categories were defined and the connection with the research questions was shown.

5.2 THE SEMI-STRUCTURED SURVEY QUESTIONNAIRES

The process of data-collection was described in Chapter 3 (cf. Paragraphs 3.3.5.1). As mentioned the *EvaSys* system provided the raw data for analysis as well as a final report on this study. This *Evasys* report is provided in the appendices section (cf. Appendix E10). The semi-structured survey questionnaires consisted of different sections for the key person and the nuclear medicine expert participants; these sections are discussed in Chapter 4 (cf. Paragraph 4.2) and illustrated in Figure 5.1.

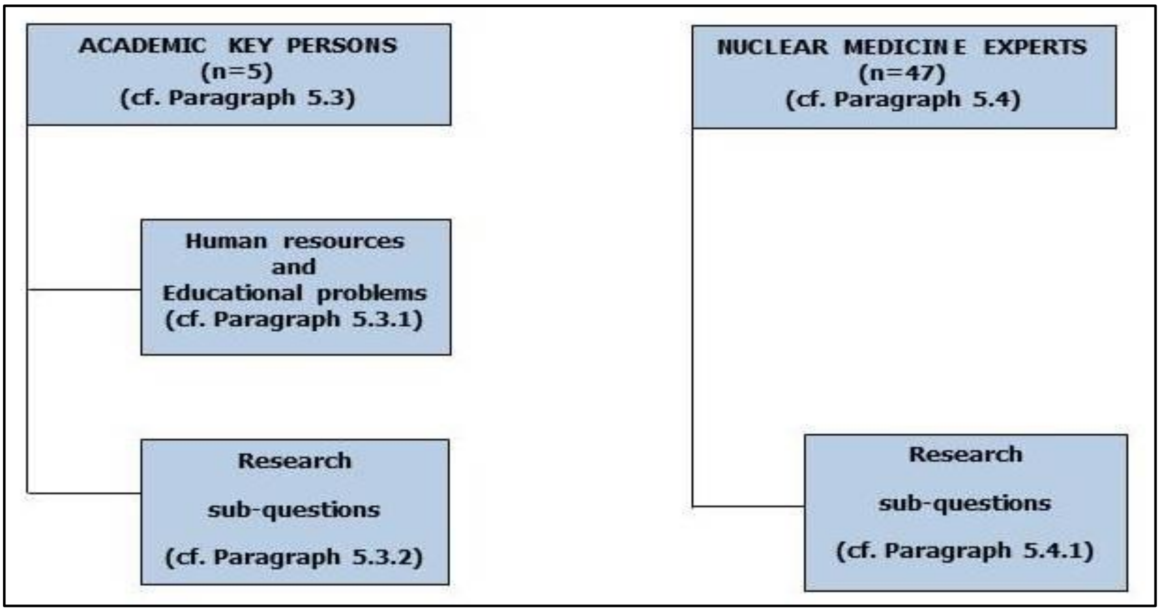


FIGURE 5.1: QUALITATIVE SECTIONS OF THE SEMI-STRUCTURED SURVEY QUESTIONNAIRES [Compiled by the researcher, Nel 2014]

In the next sections the qualitative results, findings and discussions will be organised separately according to the sections of the key person and nuclear medicine expert questionnaires.

5.3 QUALITATIVE RESULTS, FINDINGS AND DISCUSSION OF THE RESPONSES OF THE ACADEMIC KEY PERSON PARTICIPANTS TO THE OPEN-ENDED QUESTIONS

The key persons who answered the curriculum questions were appointed academic nuclear medicine physicians responsible for undergraduate medical nuclear medicine education. They were asked to explain and elaborate on their answers to the open-ended questions asked. The questions include editorial corrections and might slightly differ from those in the questionnaires (cf. Appendix E2).

Themes and categories identified from their answers will be presented and discussed below. Themes and categories of each question are summarised in Tables and the qualitative discussion of the findings follows. Direct quotes of participant responses will be given to elaborate on answers and to enhance the trustworthiness of the study. To simplify the analysis process, each question in this section will be analysed and discussed separately (cf. Figure 5.1). [Figures and Tables in the next sections were compiled by the researcher, Nel 2013 and 2014]

5.3.1 Section C: Human resources and educational problems

Human resources involved in undergraduate medical nuclear medicine education were discussed in Chapter 4 (cf. Paragraph 4.3.3). In the following paragraphs, the key person participants were asked to explain the effects and challenges caused by certain factors and conditions in their departments regarding their undergraduate medical nuclear medicine teaching. Themes and categories identified from Questions 4.7 – 4.11 of the semi-structured survey questionnaire administered to the key persons will be presented and discussed in Tables 5.1 – 5.5.

5.3.1.1 *Question 4.7: Explain how clinical service delivery loads affect undergraduate medical nuclear medicine education in your department*

THEME 1: EFFECTS AND CHALLENGES CAUSED BY CLINICAL SERVICE DELIVERY LOADS (n=5)

CATEGORIES IDENTIFIED:
1.1 Positive effects: No positive responses received.
1.2 Negative effects:
1.3 No effects:

TABLE 5.1: CATEGORY 1.1-3 EFFECTS OF CLINICAL SERVICE DELIVERY LOAD

Positive effects:
No positive responses received
Negative effects:
Unspecified negative effect reported as*: "negatively"*
"*Hospital admin is more focused on service delivery and is disinterested in teaching medical students"*
"*Busy work schedules sometimes affect lecture preparation. Hospital admin is more focused on service delivery and is disinterested in teaching medical students"*
"*Students attend practical sessions at end of week when amount of (radio-) activity available is less & patients are few, thus not enough patients for student practical sessions at end of week"*
"*Does infrequently affect the middle clinical rotations"*
No effects: No effects in departments with only an occasional presentation
"*No influence"*

Discussion of the qualitative responses: No positive effects were reported on and in Nuclear Medicine Departments, and with only an occasional presentation to undergraduate students, no effects were experienced. Most of the participants reported negative effects on their undergraduate teaching due to busy clinical service delivery responsibilities and hospital authorities' disinterest in teaching medical students (cf. Paragraph 2.4.4).

5.3.1.2 *Question 4.8: Explain how staff shortages affect undergraduate medical nuclear medicine education in your department*

THEME 2: EFFECTS AND CHALLENGES CAUSED BY STAFF SHORTAGES (n=5)

CATEGORIES IDENTIFIED:
2.1 Positive effect: No positive responses
2.2 Negative effects:
2.3 No effects:

TABLE 5.2: CATEGORY 2.1-3 EFFECTS OF STAFF SHORTAGES

Positive effect:
No positive responses received
Negative effects:
Unspecified negative effect reported as: "negatively"
"*The clinical work can be affected if there are staff shortages hence patients and patient reports could be delayed until the lectures are delivered"*
"*Not all staff want to be involved, the planning, management, practical sessions, formal lectures & assessment is too much work for only one person"*
No effect: Departments with few lecture presentations and with sufficient staff members numbers
"*No"*
"*No influence"*

Discussion of the qualitative responses: Again, no positive effects were mentioned and no effects occurred in the Nuclear Medicine Departments with sufficient staff for both service delivery and undergraduate educational functions. The negative effects reported include delays in issuing patient reports and increased teaching workload when colleagues are disinterested in teaching students. Unspecified negative effects were also reported (cf. Paragraph 2.4.4).

5.3.1.3 *Question 4.9: Explain the applicability of an undergraduate medical nuclear medicine module in undergraduate medical education in your department*

THEME 3: APPLICABILITY OF AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE (n=5)

CATEGORIES IDENTIFIED:
3.1 Positive responses: Student empowerment
3.2 Negative responses: Lack of resources
3.3 No responses:

TABLE 5.3: CATEGORY 3.1-3 APPLICABILITY OF AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE

Positive responses: Student empowerment
"*This is imperative. It could help the student to learn about being cost effective, knowing when to ask for specific exams, the limitations of the scan, patient preparation for the scan and ALARA principle and radiation safety*"
"*Student need exposure to Nuclear Medicine in order to apply knowledge of basic Nuclear Medicine for future patient treatment & care*"
Negative responses: Lack of resources
"*Makes this impossible with the staff we currently have*"
"*The amount of time allocated for nuclear medicine is too short*"
Unspecified negative response: "No"

Discussion of the qualitative responses: A question about the applicability of an undergraduate medical nuclear medicine module received negative responses in cases where staff shortages and inadequate time allocations are experienced. Positive effects of implementing such a module include benefits to patient care and radiation safety if students are empowered to know how and when to utilise nuclear medicine investigations.

5.3.1.4 *Question 4.10: Explain problems you may encounter with the MBChB phase(s) in which students are getting their undergraduate medical nuclear medicine education in your department*

THEME 4: PROBLEMS ENCOUNTERED WITH MBChB PHASE(S) IN WHICH STUDENTS ARE RECEIVING THEIR UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION (n=5)

CATEGORIES IDENTIFIED:
4.1 Negative effects: General remarks on problems
4.2 No effects: No problems mentioned

TABLE 5.4: CATEGORY 4.1-2 MBChB PHASES IN WHICH THE STUDENTS RECEIVE THEIR NUCLEAR MEDICINE TEACHING

Negative effect: General remarks on problems
"*Inconsistent and poor communication with medical school*"
"*Short time slots*"
"*Nuclear Medicine lectures must be given in each block (relevant to the block). Currently not all the blocks have Nuclear Medicine lectures*"
"*Pre-clinical students do not have clinical experience in order to fit Nuclear Medicine into the diagnostic workout of the patients*"
No effect: No problems mentioned
Unspecified negative response: "No"

Discussion of the qualitative responses: The phases in which medical students receive their nuclear medicine instruction can either have no effect or several negative effects on teaching (cf. Paragraph 2.5.3 and Table 2.4), including:

- Students in pre-clinical phases do not have the necessary clinical experience nor patient exposure to know where nuclear medicine fits into the bigger picture of patient care;
- Communication with members of the medical schools is reported to be inconsistent and poor regarding undergraduate nuclear medicine education for medical students and the time slots allocated for such teaching are too short; and
- Not all clinical disciplines have incorporated nuclear medicine lectures into their integrated blocks and the ideal situation will be for relevant nuclear medicine lectures to be presented in each block.

5.3.1.5 *Question 4.11: Explain the effects of a lack of specific guidelines for an undergraduate medical nuclear medicine module in undergraduate medical nuclear medicine education in your department*

THEME 5: EFFECTS OF A LACK OF SPECIFIC GUIDELINES FOR AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE (n=5)

CATEGORIES IDENTIFIED:
5.1 Negative effects: Student empowerment problems
5.2 Negative effects: Module content problems
5.3 No effects: Makes no difference

TABLE 5.5: CATEGORY 5.1-2 LACK OF SPECIFIC GUIDELINES FOR AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE

Negative effects: Student empowerment problems
"*Students don't understand what we teach. A structured NM module could emphasise the physics, how it works, radiation safety etc. hence the student will then be better prepared for the clinical applications"*
"*Lack of guideline causes different levels of exposure to Nuclear Medicine, no guidelines to ensure that students are getting an UNDERGRADUATE LEVEL of Nuclear Medicine teaching, they are NOT 'mini' specialists"*
Negative effect: Module content problems
"Difficult to know what should form part of the module"
No effect: Make no difference
Unspecified negative response: "No"
"*Not necessarily"*

Discussion of the qualitative responses: The absence of specific guidelines for undergraduate medical nuclear medicine education will not necessarily have any effect or a negative effect on the teaching of nuclear medicine to medical students, but it can have several positive effects, especially because most students do not understand what nuclear medicine is about. The lack of guidelines currently results in different levels of exposure or no exposure at all to nuclear medicine imaging procedures at undergraduate levels. The contents of such undergraduate modules can be problematic because students should not be taught to be "mini specialists"; they only need to be familiarised with the way it works in order to be prepared for future utilisation of nuclear medicine as a diagnostic imaging modality in patient care.

5.3.2 Section D: Research sub-questions that need answering by the key person participants

In the following section, the key person participants were asked for their views regarding the research sub-questions and to elaborate on their answers. Themes and categories identified from qualitative findings of Questions 5.2 to 5.10 of the semi-structured survey questionnaire will be summarised in Tables 5.6 – 5.28 and will be presented and discussed in this section.

5.3.2.1 *Question 5.2: WHY or why is it not necessary to implement an undergraduate medical nuclear medicine module in South African MBChB programmes?*

THEME 6: REASONS FOR IMPLEMENTING AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATIONAL MODULE IN THE MBChB PROGRAMME (n=5)

CATEGORIES IDENTIFIED:
6.1 Nuclear medicine as a diagnostic and therapeutic imaging modality
6.2 Improving undergraduate medical students' knowledge, skills and attitudes towards nuclear medicine as an imaging modality
6.3 Improved patient care

TABLE 5.6: CATEGORY 6.1-NUCLEAR MEDICINE AS A DIAGNOSTIC AND THERAPEUTIC IMAGING MODALITY

Nuclear medicine in the clinical, medical diagnostic imaging field
"*Exposure to different possible investigations presented by Nuclear Medicine in order to know the diagnostic value of Nuclear Medicine in patient care & diagnosis of pathology"*
"*So that qualified young doctors know how to use NM services efficiently in terms of appropriate referrals of patients."*
Nuclear medicine in the radioactive treatment and therapy field
"*Nuclear Medicine is rapidly evolving especially in therapy. Students need to know that there are alternative therapies for oncology patients."*
Indications for radionuclide studies/scans
"*They also need to know what NM scans are indicated and when should there be done. They also need to know the strengths and limitations, radiation safety, patient preparation etc."*
Need for appropriate referral of patients
"*So that qualified young doctors know how to use NM services efficiently in terms of appropriate referrals of patients. This will improve service delivery and reduce the number of unwarranted investigations."*

Discussion of the qualitative responses: The main reason given for introducing an undergraduate nuclear medicine module for medical students is to create awareness of nuclear medicine as a diagnostic and therapeutic speciality. Participants stated that students will know where and when nuclear medicine services can be used and such a module will create awareness of the strengths and limitations of nuclear medicine as an imaging modality. The need for appropriate patient referrals must also be brought to students' attention.

TABLE 5.7: CATEGORY 6.2-IMPROVING UNDERGRADUATE MEDICAL STUDENTS' KNOWLEDGE, SKILLS AND ATTITUDES TOWARDS NUCLEAR MEDICINE AS AN IMAGING MODALITY

Improving their knowledge, skills and attitude/perceptions regarding nuclear medicine
"Students qualify and do not know the place for certain investigations"
"So that qualified young doctors know how to use NM services efficiently in terms of appropriate referrals of patients"
"Educating medical students about the place and usefulness of Nuclear Medicine"

Discussion of the qualitative responses: The key person participants stated that medical students should be educated about the place and usefulness of nuclear medicine in patient care. Improving students' knowledge and skills.

TABLE 5.8: CATEGORY 6.3-IMPROVED PATIENT CARE

Improve patient care and management
"This will improve service delivery and reduce the number of unwarranted investigations."
"Cost effective patient management, students need to understand that although Nuclear Medicine scans are usually expensive, if used in the appropriate setting they can reduce morbidity, mortality and overall cost of patient care."
"They also need to know the strengths and limitations, radiation safety, patient preparation etc."

Discussion of the qualitative responses: Empowering students to improve their patient communication and preparation for nuclear medicine procedures will prevent unnecessary delays and ensure cost-effective patient care and patients' radiation safety.

(cf. Paragraphs 2.5.2, 5.4.1.1, Table 6.1 and Appendix F4 and F5)

THEME 7: REASONS WHY SUCH AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATIONAL MODULE SHOULD NOT BE IMPLEMENTED IN THE MBChB PROGRAMME (n=5)

CATEGORY IDENTIFIED:
7.1 Integration rather than implementation

TABLE 5.9: CATEGORY 7.1-INTEGRATION RATHER THAN IMPLEMENTATION

Rather integrate into clinical modules
"It is better to integrate it into the clinical modules, as it then is seen in the context of the clinical problems."
"An integrated approach will however, be better."

Discussion of the qualitative responses: Instead of implementing an additional nuclear medicine module, some key persons seem to prefer integration of nuclear medicine topics into other clinical modules.

5.3.2.2 *Question 5.3: WHEN will be the most effective time in the undergraduate MBChB curriculum to introduce a basic nuclear medicine module?*

THEME 8: THE MOST APPROPRIATE TIME TO INTRODUCE A BASIC NUCLEAR MEDICINE EDUCATIONAL MODULE IN THE MBChB PROGRAMME (n=5)

CATEGORIES IDENTIFIED:
8.1 Earlier years of medical studies
8.2 Later, near the end of the clinical blocks/years

TABLE 5.10: CATEGORY 8.1-EARLIER YEARS OF MEDICAL STUDIES

Module content will determine the phase
"Depending of what is meant with a 'basic' Nuclear Medicine module" *"Basic Physiology and Physics will be useful at the beginning of the clinical modules"*

Discussion of the qualitative responses: The content of a "basic" undergraduate medical nuclear medicine module is still a point of concern, and content will determine the time for instruction. In the earlier years of medical studies, basic-science subjects like physiology and physics provide background information for understanding how nuclear medicine imaging works.

TABLE 5.11: CATEGORY 8.2-LATER, NEAR TO THE END OF THE CLINICAL BLOCKS/YEARS

Later in the clinical years
"*Later in their Clinical years*"
"*Otherwise nearer the end of the clinical modules, when the students have better knowledge of diseases where NM may play a role.*"
"*Near the end of the clinical blocks.*"
Final two years
"*4th or 5th year." During these times the students' exposure to patients will also assist in them knowing how to investigate/treat their patients. The module must include basic physics, radiation safety, patient preparation and then clinical applications*
"*5th and/or 6th year*"

Discussion of the qualitative responses: In the views of the key person participants, the last two years of medical studies seem to be the most appropriate time to expose students to nuclear medicine imaging. Clinical experience and patient exposure will assist medical students in knowing how to investigate and treat patients. Subjects of importance at this stage are patient preparation, radiation safety and clinical applications. Basic physics will also be useful for understanding how different nuclear medicine technologies work.

(cf. Paragraphs 2.5.3, 4.3.2.4, 5.4.1.2, Tables 2.4, 6.3 and Appendix F4 and F5)

5.3.2.3 *Question 5.4: WHICH basic nuclear medicine topics will be the most appropriate to be taught at undergraduate level?*

THEME 9: THE MOST APPROPRIATE BASIC NUCLEAR MEDICINE TOPICS FOR TEACHING AT AN UNDERGRADUATE LEVEL (n=5)

CATEGORIES IDENTIFIED:
9.1 General undergraduate level nuclear medicine topics
9.2 Specific undergraduate level clinical nuclear medicine topics

TABLE 5.12: CATEGORY 9.1-GENERAL UNDERGRADUATE LEVEL NUCLEAR MEDICINE TOPICS

Introductory subjects
"*Introduction to Nuclear Medicine*"

Discussion of the qualitative responses: An introductory lecture will assist medical students in understanding the basic principles that underlie nuclear medicine imaging. An introduction to nuclear medicine can also be done when/while students visit the department to familiarise themselves with the workflow of the Nuclear Medicine Department and its staff.

TABLE 5.13: CATEGORY 9.2-SPECIFIC UNDERGRADUATE LEVEL CLINICAL NUCLEAR MEDICINE TOPICS

Clinical nuclear medicine scans (scintigrams)
(Alphabetical list compiled from responses)**
Bone scans and musculoskeletal imaging (n=4)
Brain and neurological imaging
Diagnostic thyroid imaging
Gastro-intestinal, liver-spleen and hepatobiliary scans
Genito-urinary and renal imaging
Infection and inflammation imaging
Lung perfusion and ventilation scans ± venogram legs
Nuclear cardiology
Nuclear medicine in Oncology and tumour imaging
Nuclear medicine in the emergency
Nuclear medicine in radionuclide therapy
Nuclear medicine in Paediatrics
Other endocrine and parathyroid imaging procedures
Therapeutic procedures for thyroid disease
(General remarks and opinions of key person participants)**
"Basic investigations such as VQ, Thyroid, Bone and HIDA scans."
"Cardiology, paediatrics, oncology, neurology, nuclear medicine in the emergency setting"
"Bone scintigraphy Renal scintigraphy Thyroid scintigraphy and some therapy Cardiac"
"Introduction to Nuclear Medicine, Liver/Spleen scintigraphy, Perfusion/Ventilation and venograms, Thyroid scans, RAI therapy, Endocrine/Parathyroids, Bone scans, Infection imaging, Cardio-vascular, Renograms, Tumor imaging"
"Role of Nuclear Medicine in cardiology, respiratory, endocrine, musculoskeletal, oncology, genitourinary, neurology and infection and inflammation."
"Gastrointestinal may be included, but is probably less important, as these conditions are more likely managed on a specialist level."

Discussion of the qualitative responses: Participants identified specific topics at undergraduate level that related to the clinical aspects of nuclear medicine scans that are available for diagnostic and therapeutic workout of patients. They suggested that the following studies are introduced to medical students:

- Bone scans and musculoskeletal imaging, diagnostic thyroid imaging and therapeutic procedures for thyroid disease were mentioned as the most important subjects;
- Lung perfusion and ventilation scans, genito-urinary and renal imaging as well as gastro-intestinal, liver-spleen and hepatobiliary scans;
- Other endocrine and parathyroid imaging procedures, brain and neurological imaging, infection and inflammation imaging; and
- Nuclear cardiology, role of nuclear medicine in oncology and tumour imaging, in emergency situations, in radionuclide therapy and in paediatrics.

(cf. Paragraphs 2.5.4, 4.3.5, 4.3.2.14, 5.4.1.3, Tables 2.4, 6.6 as well as Appendix F4 and F5).

5.3.2.4 *Question 5.5: WHAT should the extent of contents of each subject be at undergraduate level?*

THEME 10: THE EXTENT OF CONTENTS FOR EACH NUCLEAR MEDICINE TOPIC AT AN UNDERGRADUATE LEVEL (n=5)

CATEGORIES IDENTIFIED:
10.1 Extent of content for each general topic
10.2 Extent of content for each specific topic

TABLE 5.14: CATEGORY 10.1-EXTENT OF CONTENTS OF EACH GENERAL TOPIC

General topics: How nuclear medicine imaging works: Basic physics for students to understand how nuclear medicine imaging and radioactive therapy works
"How it works must be taught in a simplified way"
"Basic physics including how it works, radiation safety"
Basic principles of the relevant physiology and mechanisms of radioactivity uptake
"Mechanism of uptake and the relevant physiology"
Understand what radioactivity is, units used and aspects of radiation safety
"What radioactivity is? Units used. Mechanism of uptake and the relevant physiology."

Discussion of the qualitative responses: "Basic" content of topics/subjects at an undergraduate level remained a problematic issue in both the general and specific topics. Participants identified physics and physiology principles relating to how nuclear medicine works, what radiation is as well as radiation safety as important basic issues.

TABLE 5.15: CATEGORY 10.2-EXTENT OF CONTENTS FOR EACH SPECIFIC CLINICAL TOPIC

Specific clinical topics: The applications or clinical indications in the various clinical conditions
"The application of NM in the various conditions applicable to each system"
"At this level the students need to know the INDICATIONS for the investigations"
"Emphasis on the correct indications for the appropriate scan"
Emphasising the need for correct and sufficient clinical information when ordering a nuclear medicine study
"Student should be taught what info should be given to Nuclear Medicine in order to get an answer from the specific test acquired, 'garbage in, garbage out'"
Patient preparation for clinical diagnostic imaging procedures
"patient preparation, clinical indications, limitations"
What therapies are offered and how the patient is treated
"what therapies are offered and how is the patient treated"

Discussion of the qualitative responses: Applications and clinical indications for nuclear medicine procedures were identified as important topics. Emphasis was also placed on the importance of clinical information that is needed when patients are referred to nuclear medicine, as well as the correct patient preparation for both diagnostic and therapeutic procedures.

(cf. Paragraphs 2.5.5, 5.4.1.4, Table 6.7 as well as Appendix F4 and F5)

5.3.2.5 *Question 5.6*: *By WHOM should this course be presented (nuclear medicine physicians or other clinical physicians)?*

THEME 11: HUMAN RESOURCES RESPONSIBLE FOR THE PRESENTATION OF THE MODULE/COURSE (n=5). Which staff members should be responsible for undergraduate medical nuclear medicine education?

CATEGORIES IDENTIFIED:
11.1 Nuclear medicine physicians/specialists
11.2 Sharing teaching with other radiation workers

TABLE 5.16: CATEGORY 11.1-NUCLEAR MEDICINE PHYSICIANS OR SPECIALISTS

Nuclear medicine specialists
"*Nuclear Medicine Physicians, they work in Nuclear Medicine & experience the teaching info gathered from an investigation*"
"*Nuclear Physicians as there is still a lot of misconceptions regarding Nuclear Medicine.*"
"*NM physicians*"
"*Nuclear Medicine Physicians*"

Discussion of the qualitative responses: All the key person participants regarded the nuclear medicine physician or specialist as the most appropriate person to teach medical students about nuclear medicine imaging and radioactive therapy.

TABLE 5.17: CATEGORY 11.2-SHARING TEACHING WITH OTHER RADIATION WORKERS

Combinations
"*NM physicians and nuclear physicists*"

Discussion of the qualitative responses: The assistance of medical/nuclear physicists was recommended. This correlates with information obtained from the theoretical literature (cf. Paragraph 2.5.6.2), namely, that physicists can assist with lectures, especially on radiation safety.

(cf. Paragraphs 2.5.6, 4.3.3.1, 5.4.1.5, Table 6.5 as well as Appendix F4 and F5)

5.3.2.6 *Question 5.7*: *HOW should the undergraduate nuclear medicine course be presented (educational strategies and methods)?*

THEME 12: THE MOST APPROPRIATE EDUCATIONAL TEACHING METHODS AND STRATEGIES (n=5).

CATEGORIES IDENTIFIED:
12.1 Formal lectures
12.2 Practical demonstrations
12.3 Case studies
12.4 Combination/integration of methods and lectures

TABLE 5.18: CATEGORY 12.1-FORMAL LECTURES

Formal lectures
"*Lectures*"
"*Power Point presentations*"
"*examples, Power Point, interactive sessions, clinical examples*"
"*Integrated lectures e.g. a NM lecture when the thyroid is being discussed*"

Discussion of the qualitative responses: Interactive sessions, with integrated lectures making use of PowerPoint presentations and clinical examples, were identified as the most appropriate teaching methods for undergraduate nuclear medicine teaching to medical students.

TABLE 5.19: CATEGORY 12.2-PRACTICAL DEMONSTRATIONS

Practical sessions: Attending practical sessions in the Nuclear Medicine Department
"*visits to the department*"
"*Practical demonstrations*"

Discussion of the qualitative responses: Attending practical demonstration sessions during visits to the Nuclear Medicine Department were suggested to complement the theoretical lectures.

TABLE 5.20: CATEGORY 12.3-CASE STUDIES

Case studies: Interactive small-group sessions
"*This could be in simple case studies with assessment*"
"*examples, Power Point, interactive sessions, clinical examples*"
"*case scenarios*"

Discussion of the qualitative responses: Interactive, small-group sessions, consisting of simple case studies and clinical scenarios were also mentioned as a suitable teaching method.

TABLE 5.21: CATEGORY 12.4-COMBINATION or INTEGRATION

Combination/integration of methods
"*Combination of coursework and practical sessions*"
"*Integrated lectures e.g. a NM lecture when the thyroid is being discussed*"

Discussion of the qualitative responses: Key person participants seem to believe that combinations of integrated lectures during different clinical blocks, formal lectures and small-group practical sessions in the Nuclear Medicine Department are the most appropriate teaching methods for undergraduate nuclear medicine teaching to medical students.

(cf. Paragraphs 2.5.7, 2.5.7.1, 4.3.2.10, 5.4.1.6, Table 6.8 as well as Appendix F4 and F5)

5.3.2.7 *Question 5.8*: *HOW should the undergraduate nuclear medicine course be assessed (students' assessment strategies and methods)?*

THEME 13: STUDENTS' ASSESSMENT STRATEGIES AND METHODS (n=5).

CATEGORIES IDENTIFIED:
13.1 Formal written tests or examinations
13.2 Practical case studies
13.3 Integration with other clinical modules

TABLE 5.22: CATEGORY 13.1-FORMAL WRITTEN TESTS OR EXAMINATIONS

Tests or examinations: Summative assessment
"Written tests with MCQ's, single based answers and short questions"
"multiple questionnaires, written papers"
"Test assignments"

Discussion of the qualitative responses: Assessment of student learning is essential in any module/course. Key person participants pointed out that summative assessment at the end of the module/course needs to be done by using formal written tests or examinations. This can be integrated with other clinical modules and may consist of MCQs, single based answers and short questions. Test assignments were also mentioned as a method of summative assessment.

TABLE 5.23: CATEGORY 13.2-PRACTICAL CASE STUDIES

Practical case studies: Case discussions and assignments on the role of nuclear medicine imaging in specific clinical conditions
"This could be in simple case studies with assessment"
"Tests Assignments"
"For the rotations in NM case discussions and assignments on the role of NM in specific conditions could be considered"

Discussion of the qualitative responses: Case study discussions and assignments during small-group visits to the Nuclear Medicine Department can focus on the role of nuclear medicine in specific clinical conditions.

TABLE 5.24: CATEGORY 13.3-INTEGRATION WITH OTHER CLINICAL MODULES

Integrated assessment: Summative assessment as part of the clinical modules
"As part of the assessment in the clinical modules."

Discussion of the qualitative responses: Integrated assessment practices as part of other clinical modules is mentioned as a possible assessment method.

(cf. Paragraphs 2.5.7.4, 4.3.2.11, 4.3.2,12, 5.4.1.7, Table 6.9 as well as Appendix F4 and F5)

5.3.2.8 *Question 5.9: How should the undergraduate nuclear medicine course be presented (integrated with other clinical or imaging disciplines; as an independent module in an independent nuclear medicine discipline or a combination of both)?*

THEME 14: WAYS IN WHICH TO PRESENT THE NUCLEAR MEDICINE MODULE IN THE EXISTING UNDERGRADUATE MEDICAL CURRICULUM (n=5).

CATEGORIES IDENTIFIED:
14.1 An independent nuclear medicine module
14.2 Integrated with other clinical or imaging disciplines
14.3 Combination of both

TABLE 5.25: CATEGORY 14.1-AN INDEPENDENT NUCLEAR MEDICINE MODULE

Independent educational module
"Individually"

Discussion of the qualitative responses: Presenting nuclear medicine as an independent, individual module was suggested but not regarded as the main option.

TABLE 5.26: CATEGORY 14.2-INTEGRATED WITH OTHER CLINICAL OR IMAGING DISCIPLINES

Integrated educational module: with other clinical or diagnostic departments in clinical blocks of teaching
"The integration is an important component and allows for limited relevant case studies to be inserted at various stages during the clinical blocks"
"Integrated with other clinical disciplines"
"Consultation with clinical colleagues"

Discussion of the qualitative responses: Key person participants suggested integration with other clinical or imaging disciplines during clinical teaching blocks. Consultation with clinical colleagues is considered essential in this process.

TABLE 5.27: CATEGORY 14.3-A COMBINATION OF BOTH

A combination of both
"As combination of both"

Discussion of the qualitative responses: Another suggestion was to pursue a combination of both independent and integrated presentations.

(cf. Paragraphs 2.5.8, 4.3.2.5, 4.3.2.6, 4.3.2.13, 5.4.1.8, Table 6.4 as well as Appendix F4 and F5)

5.3.2.9 *Question 5.10: Any other opinions or important factors to be taken into consideration when implementing the specific guidelines for such a module?*

THEME 15: OTHER OPINIONS REGARDING GUIDELINES FOR AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATIONAL MODULE (n=3)

CATEGORIES IDENTIFIED:
15.1 General remarks

TABLE 5.28: CATEGORY 15.1-OTHER OPINIONS

General remarks
"*How it works must be taught in a simplified way"*
"C*ost effective patient management, students need to understand that although Nuclear Medicine scans are usually expensive, if used in the appropriate setting they can reduce morbidity, mortality and overall cost of patient care"*
"C*onsultation with clinical colleagues"*
"*Emphasis on the correct indications for the appropriate scan"*

Discussion of the qualitative responses: It was stated by some of the key person participants that students need to be taught in a simplified way "how nuclear medicine works", that emphasis needs to be placed on study indications and cost-effective patient management as well as consultation between nuclear medicine physicians and clinical colleagues.

5.4 QUALITATIVE RESULTS, FINDINGS AND DISCUSSION OF THE RESPONSES OF THE NUCLEAR MEDICINE EXPERTS TO THE OPEN-ENDED QUESTIONS

In the following paragraphs, the nuclear medicine expert participants (cf. Paragraph 3.3.3.1) were asked for their views regarding the research sub-questions and to elaborate on their answers.

5.4.1 Section B: Research sub-questions that need answering

Themes and categories identified from qualitative findings of Questions 3.2 – 3.10 of the semi-structured survey questionnaire administered to the nuclear medicine experts will be summarised in Tables 5.29 – 5.66 and presented and discussed in this section. Direct quotes of responses will be included in the Tables to elaborate on answers and to enhance the trustworthiness of the study. The findings and discussions will be organised according to the expert questionnaire's sections (cf. Figure 5.1) and to simplify the analysis process, each question in this section will be analysed and discussed separately

The questions below include editorial corrections and might slightly differ from those in the questionnaires (cf. Appendix E4).

5.4.1.1 *Question 3.2: WHY or why is it not necessary to implement an undergraduate medical nuclear medicine module in South African MBChB programmes?*

THEME 16: REASONS FOR IMPLEMENTING AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE IN THE MBChB PROGRAMME (n=47)

CATEGORIES IDENTIFIED:
16.1 Undergraduate medical students
16.2 Nuclear medicine as a diagnostic imaging and therapeutic modality
16.3 Newly qualified interns and community-service physicians
16.4 Effective patient care

TABLE 5.29: CATEGORY 16.1-UNDERGRADUATE MEDICAL STUDENTS

Lack of knowledge/awareness/familiarity
"*They don't have a clue about Nuclear medicine and need broadening of their knowledge"*
"*Undergraduates have no clue about NM"*
"*Current lack of simple understanding of nuclear medicine examinations by junior doctors and even some senior doctors, especially in the academic environment is not acceptable"*
"*Our young medical doctors (a lot of them move to private practice as GP's after their community-service years) really need background information about nuclear medicine"*
"*General practitioners and even specialists have a very limited knowledge if any with regards to Nuclear Medicine"*
"*As a nuclear medicine physician working in private practice I regularly interact with referring doctors (GP's and specialists) who do not have a good basic understanding and sometimes no understanding of nuclear medicine."*
Early exposure to the subject
"*Nuclear medicine is an essential part of any medical practitioners' diagnostic range of tests. They should start acquiring the knowledge and skills early in their clinical careers"*
Educating the students (as future physicians) about the preparation of patients for nuclear medicine scans
"*There is a definite need to educate under graduates about the place and usefulness of Nuclear Medicine at an Under Graduate level - as future clinicians they are the ones who will ultimately use the resource"*

Discussion of the qualitative responses: Early exposure of medical students to a subject that forms an essential part of patient care will broaden their knowledge, understanding and perspectives regarding nuclear medicine as imaging modality and its role among the range of healthcare resources. Future referring medical doctors will be directed by previously acquired knowledge to utilise nuclear medicine imaging effectively in daily patient care.

TABLE 5.30: CATEGORY 16.2-NUCLEAR MEDICINE AS A DIAGNOSTIC IMAGING AND THERAPEUTIC MODALITY

Nuclear medicine in diagnostic and therapeutic medicine
"Nuclear medicine studies/examinations/therapies are increasingly becoming part and parcel of modern medicine"
"Because nuclear medicine is one of the important fields in diagnostic and therapeutic medicine that has been neglected over the past years"
"With the advances in medicine, nuclear medicine plays an important role in the way we diagnose many diseases, particularly those affecting the vast majority of our patients namely cancer, cardio-vascular and diseases and infection. Basic understanding on when and why a nuclear medicine examination is warranted in these conditions and also how to prepare patients for these examinations should be the basis of nuclear medicine education in undergraduate"
Create an awareness of the nuclear medicine speciality and services offered
"Nuclear Medicine is grossly under-utilised in South Africa in both the Public and Private sectors"
"To increase the impact of NM"
"For some basic exposure to Nuclear Medicine imaging"
"Currently nuclear medicine is a greatly misunderstood specialty. We have a lot to offer but if people do not know that we exist and what we can do for the patients we will never grow to our full potential to the eventual harm of patients"
"To increase awareness of doctors and to let them understand advantages and limitations of nuclear medicine"
Survival and growth of the speciality
"Lack of insight from referring clinicians can be addressed in such a way, it will promote the speciality as a proudly independent speciality, more awareness of services we offer will lead to increased use of such services and as such growth of the speciality, wider acceptance with clinicians as well as eventually medical aid"
Nuclear medicine services versus radiology services
"Functional imaging is as important as anatomical imaging. Undergraduates are exposed to radiological images during ward rounds, and with practically no exposure to nuclear medicine studies. Functional imaging parameters change quicker than anatomical imaging changes, and disease can be detected earlier"
Nuclear medicine as a career option
"It is not easy to grasp certain concepts about nuclear medicine in the beginning if you have not been exposed to it. It also creates an impression of nuclear medicine being an aloof specialty. Undergraduate exposure also could inspire students who would otherwise not have known about nuclear medicine to pursue it as a career"
Nuclear medicine physicians rely on appropriate referrals from general physicians and specialists
"Nuclear Physicians rely on appropriate referrals from generalists and specialists".
"As a nuclear medicine physician working in private practice I regularly interact with referring doctors (GP's and specialists) who do not have a good basic understanding and sometimes no understanding of nuclear medicine. This leads to inappropriate or a lack of referrals"
"Educate Colleagues - thus give patients a good chance of being referred to NM Optimize NM request Integrate NM as part of Healthcare"
"General practitioners and even specialists have a very limited knowledge if any with regards to Nuclear Medicine. Often referrals are not appropriate or patients that could benefit from Nuclear Medicine investigations are not referred because of lack of knowledge"

Discussion of the qualitative responses: The important roles that nuclear medicine plays in diagnostic and therapeutic patient management require that physicians and specialists are aware of the services a Nuclear Medicine Department provides. The complementary roles of nuclear medicine diagnostic services and other radiological procedures need to be emphasised to improve patient care. Physicians tend to make use of procedures they are familiar with, and with increasing availability of new, modern nuclear medicine technologies like SPECT/CT and PET/CT images it becomes increasingly difficult for clinical physicians to utilise available procedures for patient care effectively.

As mentioned by one of the expert participants, "it is not easy to grasp certain concepts about nuclear medicine in the beginning if you have not been exposed to it." A suggestion was made that lack of insight can be addressed and more awareness of services that are available can be offered to inspire students to pursue nuclear medicine as a career. The survival of nuclear medicine as an individual imaging modality should be ensured.

TABLE 5.31: CATEGORY 16.3-UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION

Exposure to BASIC nuclear medicine imaging procedures
"*To increase awareness of doctors and to let them understand advantages and limitations of Nuclear Medicine*"
"*Specialist training often does not allow sufficient time and/or exposure to other disciplines such as Nuclear Medicine*"
Ensuring good quality training of international standards
"*To provide good quality training of an international standard. To standardise the SA training*"
"*Standardising the South African undergraduate Nuclear Medicine education*"

Discussion of the qualitative responses: The time spent on postgraduate nuclear medicine education and service delivery may interfere with undergraduate nuclear medicine education. Undergraduate medical nuclear medicine education is as important as postgraduate nuclear medicine education and service delivery. Instruction of students needs to be of high quality if it is to meet international standards and if undergraduate medical nuclear medicine education in South African Schools of Medicine is to be standardised. Unfortunately, only six of the eight Schools of Medicine currently offer postgraduate and, to a lesser extent, undergraduate nuclear medicine education. Because two Schools of Medicine lack academic Nuclear Medicine Departments, there will be undergraduate medical students who were not exposed to formal nuclear medicine education during their undergraduate medical education.

TABLE 5.32: CATEGORY 16.4-NEWLY QUALIFIED INTERNS AND COMMUNITY-SERVICE PHYSICIANS

Clinicians responsible for effective patient care
"Newly qualified physicians treat patients with conditions that stand to benefit from nuclear medicine studies"
"They are the clinicians who will treat patients with conditions that can benefit from nuclear medicine studies (Scintigrams)"
"Because most doctors don't have a clue what we do. They either think of us as 'unclear' medicine or else like some magic 'silver bullet' that diagnoses everything"
"Most of the nuclear medicine scans are for tertiary environments BUT there are studies that play a role in the work out of primary and secondary hospital patient and in work out of general outpatient clinics/casualty patients. Under graduate students are the ones mostly working in these clinics and environments. As graduated doctors they should know the correct indication for these scans"
"General practitioners and even specialists have a very limited knowledge if any with regards to Nuclear Medicine"
As future clinicians they are the ones who will ultimately use the nuclear medicine diagnostic resource
"Our young medical doctors (a lot of them move to private practice as GP's after their community-service years) really need background information about nuclear medicine"

Discussion of the qualitative responses: The effects of inadequate undergraduate nuclear medicine exposure and training will soon be visible, when newly qualified doctors start their intern or community-service years, during which they are responsible for organising and ordering special investigations. For graduates without any undergraduate exposure they will feel as if they are working with "unclear" medicine, but hopefully those who had been exposed to some extent to undergraduate nuclear medicine education will not regard nuclear medicine as a foreign activity and they will be prepared to utilise it effectively in daily patient care. It was mentioned that medical graduates, as newly qualified medical doctors, should know and be aware of the correct indications for nuclear medicine studies to avoid unnecessary patient exposure to ionising radiation.

TABLE 5.33: CATEGORY 16.5-EFFECTIVE PATIENT CARE

Improved and appropriate cost-effective patient care
"All health care professionals should have a basic knowledge of how the discipline can enhance patient care, as well as what the studies and/or therapy would entail for their patients."
"Basic understanding on when and why a nuclear medicine examination is warranted in these conditions and also how to prepare patients for these examinations should be the basis of nuclear medicine education in undergraduate"
Improved patient/family/healthcare worker information and preparation
"Patients read information on internet and ask a lot of questions. They also need to be assured about the safety as well as the importance of this modality vs Radiology"

Discussion of the qualitative responses: Clinical imaging, including nuclear medicine, is integral to the management of all patients; therefore students, as future doctors, must make use of what they have learned to take care of their patients better. Medical doctors need to have basic knowledge of imaging procedures; they must know how to prepare patients and communicate effectively with them, their families and other healthcare workers.

Nuclear medicine specialists use the ALARA ("as low as reasonably achievable") principle to carefully select the amount of radiopharmaceutical that will provide an accurate test with the least amount of radiation exposure for the patient. The amount of radiation from diagnostic nuclear medicine procedures is therefore kept within safe limits according to the international ALARA principles.

THEME 17: REASONS WHY SUCH AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE SHOULD NOT BE IMPLEMENTED

CATEGORIES IDENTIFIED:
17.1 No responses

TABLE 5.34: CATEGORY 17.1-NO RESPONSES

Why undergraduate nuclear medicine module should not to be implemented
No responses received

Discussion of the qualitative responses: None of the expert participants gave any reasons why undergraduate medical nuclear medicine education does not need to be presented to medical students.

(cf. Paragraphs 2.5.2, 5.3.2.1, Table 6.1 as well as Appendix F4 and F5).

5.4.1.2 *Question 3.3: WHEN will be the most effective time in the undergraduate MBChB curriculum to introduce a basic nuclear medicine module?*

THEME 18: WHEN, IN THE UNDERGRADUATE MBChB CURRICULUM, WILL BE THE MOST APPROPRIATE TIME TO INTRODUCE A BASIC NUCLEAR MEDICINE MODULE? (n=47)

CATEGORIES IDENTIFIED:
18.1 The earlier undergraduate years
18.2 Later, nearer the end of the clinical blocks/years (last two years)

TABLE 5.35: CATEGORY 18.1-THE EARLIER UNDERGRADUATE YEARS

Pre-clinical years
"*First year*"
"*Second year*"
"*During the 2nd year or immediately after advanced physiology course*"
"*During Physiology and when student starts clinical years*"
"*During the physiology training. The appropriate NM examinations can be included with each disease process discussion*"
"*Third year*"
"*Last pre-clinical year*"
"*Just before they start their clinical training or very early in their clinical training*"
"*Last pre-clinical year and mid clinical year*"
"*Probably basics from year 3 and applications/patient/imaging contact from year*"
Early clinical years
"*Second year*"
"*Third year*"

Discussion of the qualitative responses: A variety of answers were provided by the expert participants. Depending on the structure of existing medical curricula, the pre-clinical years can differ in length. In some cases the pre-clinical years consisted of only one year, with year two already forming part of the clinical years (cf. Paragraph 4.3.2.3). Students should be familiarised and exposed to nuclear medicine early on in their medical studies – not to make them junior imaging specialists, but to familiarise them with the imaging modality.

TABLE 5.36: CATEGORY 18.2-LATER, NEARER TO THE END OF THE CLINICAL BLOCKS/YEARS (LAST TWO YEARS)

Clinical years
"*Perhaps it can be introduced during the first half of the course but the in-depth training should be done during the last 2 years*"
"*Curriculums differ between the different Universities. I would suggest that in the year when students start clinical training they should be introduced to basic Nuclear Medicine. This however should be repeated in their final year, because in young inexperienced medical students it is very difficult to see the importance of a scan without the necessary clinical background. Initially it doesn't make sense, but if repeated at a later stage they would understand the need for such an amazing physiological field with much better understanding*"
"*Fourth year*"
"*Fifth year*"
"*Six year*"
Final/last years
"*Final year or at least after sufficient clinical knowledge/ experience attained*"
"*From a practical perspective it is probably best combined with radiology in an integrated diagnostic imaging' module, preferably in the last year or two, when the students have some clinical experience and insight*"
"*In the 5th or 6th year, when there should already be a broad understanding of a wide spectrum of diseases*"

Discussion of the qualitative responses: It was suggested that the introductory instructions on nuclear medicine imaging takes place during the earlier years of medical study, followed by a more in-depth course nearer the end of medical training.

(cf. Paragraphs 2.5.3, 4.3.2.4, 5.3.2.2, Tables 2.4, 6.3 as well as Appendix F4 and F5).

5.4.1.3 *Question 3.4: WHICH basic nuclear medicine topics will be the most appropriate to be taught at undergraduate level?*

THEME 19: BASIC UNDERGRADUATE LEVEL NUCLEAR MEDICINE TOPICS (n=47)

CATEGORIES IDENTIFIED:
19.1 Basic-science subjects
19.2 General nuclear medicine subjects
19.3 Specific clinical nuclear medicine imaging subjects
19.4 Newer nuclear medicine technologies

TABLE 5.37: CATEGORY 19.1-BASIC-SCIENCE SUBJECTS

Basic medical physics
"Basic physics and instrumentation"
"Basic physics and ALARA principle"
"I don't think they need to know the physics, only the applications and when to refer"
Radiolabelling
"Basic physics of radiol-abelling"
"Introduction to radio labelling/radio labelled blood products"
Radiation protection
"Basic physics and ALARA principle"
"Radiation protection basics - this could also benefit radiology principles"
Radiopharmacy
"Basic knowledge of Radio-pharmacy"
"Basic knowledge on radiopharmaceuticals"
Imaging principles
"Gamma camera imaging"
"emission vs transmission imaging"

Discussion of the qualitative responses: Answers to Questions 3.4 and 3.5 overlapped and should be evaluated together. Course content (topics or subjects) and "extent of content" were treated as the same concepts. Answers to Question 3.4 frequently included the word "basic" but no elaboration was given on what "basic" really implies.

The question relating to what is meant by "basic" topics was also asked by one of the key persons (cf. Table 5.14). Enquiring about suggestions for "undergraduate level" topics or "critical core" content for each subject would have been more appropriate and would have provided more reliable answers to this question. Appropriate undergraduate level teaching needs to be correlated with the phase in which the teaching time is allocated.

Theoretical aspects of radiation physics are mentioned as important "basic knowledge" necessary to understand what nuclear medicine imaging is about and how it works. Radiation protection is mentioned by several of the participants and it is an important aspect of improved patient care.

A much more simplified attitude towards physics knowledge is reflected in one of the comments: "*I don't think they need to know the physics, only the applications and when to refer.*"

TABLE 5.38: CATEGORY 19.2-GENERAL NUCLEAR MEDICINE SUBJECTS

Basic introduction and principles of nuclear medicine studies
"*How the nuclear medicine procedures are done, what to expect from the examination and how to prepare the patients and fill the request form appropriately. In this regard I think 'A clinicians guide to nuclear medicine' by Andrew Taylor, is the most appropriate book*"
"*Basic understanding of how Nuclear Medicine work, what radio-isotopes are*"
"*Difference between functional and structural imaging*"
"*What is Nuclear Medicine - how does imaging work and how it differs from radiology*"
"*Types of nuclear scans done and radio pharmaceuticals involved*"
Indications for nuclear medicine studies
"*Applications rather than technical detail. Clinical integration as applicable in general practice*"

Discussion of the qualitative responses: "*How the nuclear medicine procedures are done, what to expect from the examination and how to prepare the patients and fill the request form appropriately.*" This explanation summarises the general attitude towards the need for undergraduate medical nuclear medicine knowledge.

TABLE 5.39: CATEGORY 19.3-SPECIFIC CLINICAL NUCLEAR MEDICINE IMAGING SUBJECTS (Table continues on the next page)

Clinical nuclear medicine
(General remarks)
"*Basic clinical indications (lung, bone, heart, brain, tumour -PET-, thyroid)*"
"*It is good to introduce them to all the systems - Indications for some basic examinations*"
"*Normal scans to help interpret abnormalities*"
"*Thyroid, lung and bone scans, as these are the scans most likely to be utilised for the conditions seen and treated by newly qualified doctors*"
(List of clinical imaging studies indicated as specific subjects)
Musculoskeletal and bone scans
"*Clinically practical topics aimed at GP's: bone scans, thyroid scans, VQ etc. 'bread and butter NM'*"
Respiratory perfusion and ventilation studies (V-Q scans)
"*Respiratory, specifically diagnosis of pulmonary embolism*"
"*Types of scans, indications, and very basic interpretation – i.e. that there are perfusion defects on a VQ scan*"

"General GIT studies"
"Liver/spleen and hepatobiliary studies"
Genito-urinary studies: Renograms, GFR's
Nuclear cardiology
"myocardial metabolism/pathology and scans"
"Introduction to Cardiovascular imaging"
"LVEF- Gated blood pool scintigraphy"
"Endocrine and neuro-endocrine subjects"
Thyroid diagnostic
Thyroid therapy
"Parathyroid"
"Brain and neurological studies"
"Radioactive therapies"
"Basis of nuclear therapy part 1 (general) and part 2 (targeted therapies)"
"Infection and inflammation imaging"
"Tumour imaging"
"Role of Nuclear Medicine in Oncology "
"Oncology (bone, PET/CT, therapy)"
"The role in endocrinology and oncology (especially PET in oncology)"
"Paediatric applications"
"Role of Nuclear Medicine in trauma"
"Trauma, including sports injuries"

Discussion of the qualitative responses: Most of the clinical subjects mentioned by the expert nuclear medicine participants are listed in Table 5.50. Investigations that were named most frequently (cf. Paragraphs 4.3.5.3 and 4.4.3.3, Figure 4.19) include

- Musculoskeletal and bone scans;
- Respiratory perfusion and ventilation studies (V-Q scans);
- Genito-urinary studies: Renograms, GFRs;
- Nuclear cardiology; and
- Thyroid diagnostic and thyroid therapy.

TABLE 5.40: CATEGORY 19.4-NEWER NUCLEAR MEDICINE TECHNOLOGIES AND WHAT TO EXPECT IN THE FUTURE

Newer technologies
"All topics are relevant unless still in the research phase"
"what to expect in the future (Hybrid machines & Correlative imaging, Telemedicine)"
"SPECT-CT"
"PET and PET-CT"
"Basic PET - FDG , F18, Choline"
"And also they need to be introduced to other things like PET/PET-CT, SPECT-CT in addition to basic gamma camera based imaging"
"Targeted therapies"
"Telemedicine"

Discussion of the qualitative responses: According to Buckenham (2005:1-3) it is becoming difficult for clinicians to order appropriate imaging studies due to rapid expansion of imaging modalities like SPECT, SPECT/CT, PET and PET/CT. These modern imaging techniques are involved in nearly all clinical scenarios and modern graduates need to have a working knowledge from the perspective of both the patient and the referring doctor. Participants suggested that hybrid studies (cf. Paragraph 2.2.2.2), including SPECT/CT (cf. Figures 4.30 and 4.45) and PET/CT (cf. Figures 4.30 and 4.45), are added to the module content. Targeted therapies (cf. Paragraph 2.2.2.3) as a new field of cancer-cell treatment may be regarded as a "core plus" subject for undergraduate medical students.

(cf. Paragraphs 2.5.4, 4.3.2.14, 4.3.5, 4.4.3, 5.3.2.3, Table 5.67, 6.6 as well as Appendix F4 and F5)

5.4.1.4 *Question 3.5: WHAT should the extent of the content of each subject be at undergraduate level?*

THEME 20: THE EXTENT OF THE CONTENT OF EACH SUBJECT/TOPIC (n=44)

CATEGORIES IDENTIFIED:
20.1 Nuclear medicine as an imaging modality
20.2 Role of nuclear medicine studies in patient handling
20.3 Specific basic core content regarding nuclear medicine
20.4 Cooperation between Nuclear Medicine Department and referring physicians
20.5 Newer nuclear medicine technologies

TABLE 5.41: CATEGORY 20.1-NUCLEAR MEDICINE AS AN IMAGING MODALITY

Understanding of nuclear medicine as an diagnostic imaging and therapeutic modality
"The extent should be basic not to confuse the student. It is important to underline the basic difference between radiology and Nuclear Medicine (physiology vs anatomy) and to make it clear that the two modalities are not competitive (complement each other)"
"Basic understanding of how Nuclear Medicine works, what radio-isotopes are, basic understanding of what diagnostic studies and treatments can be done/or is available, basic indications and expectations of studies"
"Indications, contraindications, preparations, understanding the report, radiation exposure and cost-effectiveness. Minimal emphasis on the technical aspects of the scans as these are not relevant to the referring physician"
Basic introduction and principles of nuclear medicine
"How it works and how it's done is not important, they should only understand that it's physiological imaging and not anatomic"
Clinical indications and contra-indications of procedures
"INDICATIONS - when and for who is the most important part that they as under graduates should know"
"Indications for requesting nuclear medicine scans so they can refer appropriately"
"How can it assist in the workup of a patient. Examples"
"Advantages and disadvantages of each study"
"Nuclear Medicine to complement radiology investigations"
"Basic knowledge of indications, how NM compliments Radiology, and what the studies/procedures mean for the patient"
"Complimentary/independent roles of nuclear medicine in clinical practice"

Discussion of the qualitative responses: As mentioned, the answers to Questions 3.4 and 3.5 overlapped and must be evaluated in conjunction with each other. The principle of understanding "how nuclear medicine works" and how it differs from diagnostic radiology procedures was mentioned again, while knowledge of indications, advantages and disadvantages of these nuclear medicine procedures were also regarded as important to patient care.

TABLE 5.42: CATEGORY 20.2-ROLE OF NUCLEAR MEDICINE STUDIES IN HANDLING OF PATIENTS

Effective patient preparation
"Even patient preparation is not important, if they know when and for what to call the Nuclear physician, he /she can inform them about patient preparation"
"The contents should be simple but practical to make them able to explain to the patients why we need them to go for such examinations and thus need to prepare them in such or such manner"

Discussion of the qualitative responses: Optimum patient care remains the most important aspect of the decision-making process regarding choice of most appropriate investigations. Effective communication between referring doctors and nuclear medicine physicians is important to improve communication and preparation of patients for nuclear medicine studies.

TABLE 5.43: CATEGORY 20.3-SPECIFIC, BASIC 'CORE' CONTENT REGARDING NUCLEAR MEDICINE

Specific, basic 'core' content of nuclear medicine as a diagnostic/therapeutic modality
"Basic and applicable content for GP's and future specialists for applicable referrals"
"The content must be limited to clinical integration of diseases and diagnosis at the time when the undergraduates are studying the theory and practice of these conditions as applicable in training to become house doctors, community-service doctors and general practitioners. Specialised medical practice aspects need not be included"
"Basic, otherwise overwhelming and not effective"
"Must be the minimum not to get them frightened of the subject but enough for them to know when to appropriately refer"
"Basic teaching to communicate relevance and applications"
"Introductory Basic without being technical"
"Role of Nuclear Medicine in various specialities"
"Very basic-types of scans, indications for scans and very basic interpretation"
"it should be clinically motivated with specific patient examples"
"Physiology to understand how Nuclear Medicine imaging and radioactive treatments works"
"Physiology and role of nuclear medicine in the aforementioned"
"Basic Physics to understand radiation exposure and protection principles"

Discussion of the qualitative responses: The importance of "critical core" content for undergraduate students is emphasised by the ESR White Paper on "a core curriculum of (undergraduate) radiology" (ESR 2011:363-374). This core content needs to be delivered to undergraduates according to OBE principles and must be integrated into the main medical curriculum.

Physiology and physics are again mentioned as necessary for an understanding of nuclear medicine imaging and radioactive treatments and for radiation exposure and protection. Interdisciplinary communication will enhance appropriate referrals.

TABLE 5.44: CATEGORY 20.4-COOPERATION BETWEEN NUCLEAR MEDICINE DEPARTMENTS AND REFERRING PHYSICIANS

Responsibilities of the referring physicians: Understanding a nuclear medicine report, and knowing how to react to the report
"Referral indications, patient preparation, basic understanding of which aspects of pathology the test is evaluating, what to do with the result"
"Effective referral letters when requesting studies"
"necessary clinical history, the use and limitations of the scan"
"Patterns of common pathologies"
"Show images. So that they know the place of nuclear medicine in a clinical setting"
"Recognise an abnormal scan"
"Everyone should be able to diagnose graves or a large embolism etc."

Discussion of the qualitative responses: Effective and appropriate patient management depends on communication between all stakeholders. All stakeholders will eventually benefit from cooperation between Nuclear Medicine Departments and referring physicians. The need to provide sufficient clinical information when requesting nuclear medicine procedures, effective patient preparation, appreciation of the nuclear medicine images and reports, and the referring doctor taking appropriate actions, are some of the means of cooperation mentioned that would lead to effective patient care.

TABLE 5.45: CATEGORY 20.5-NEWER NUCLEAR MEDICINE TECHNOLOGIES

Introduction to Hybrid and Molecular Imaging technologies
"They need also to be briefly introduced to higher imaging methods such as PET-PET/CT and SPECT/CT - their significance"
"PET and PET-CT"
"PET CT: Oncological indications SPECT CT: Dual imaging"
"Molecular imaging"
"Basic concepts/principles of molecular imaging. Introductory targets for radio labelling"

Discussion of the qualitative responses: As already mentioned hybrid imaging techniques are involved in nearly all clinical scenarios. Introduction of students to these "higher imaging methods" are important if they are to utilise nuclear medicine procedures when they become referring physicians.

(cf. Paragraphs 2.5.5, 4.3.5, 5.3.2.4, Table 6.7 as well as Appendix F4 and F5)

5.4.1.5 *Question 3.6: By WHOM should this course be presented (nuclear medicine physicians or other clinical physicians)?*

THEME 21: WHO SHOULD TEACH THE STUDENTS? (n=47)

CATEGORIES IDENTIFIED:
21.1 Nuclear medicine physicians/specialists
21.2 Other radiation workers
21.3 Other non-clinical lecturers or clinical physicians
21.4 Nuclear medicine physicians integrated with clinical physicians

TABLE 5.46: CATEGORY 21.1-NUCLEAR MEDICINE PHYSICIANS OR SPECIALISTS

Nuclear medicine specialists
"*Nuclear Physicians as other specialists generally have a poor understanding of nuclear medicine*"
"*Nuclear Medicine physicians are optimally trained, other clinical physicians most likely will be conveying the wrong information*"
"*Nuclear Medicine Physicians must bear the final responsibility on what gets taught: either they should present the material or they should vet the material before presentation by a clinician*"
"*Nuclear Medicine physicians - the current clinicians have a very limited knowledge with regards to Nuclear Medicine*"
"*Nuclear Medicine specialists should be responsible for what gets taught about our specialty if we wish doctors to practice best-evidence medicine*"
"*Nuclear medicine physicians, other physicians might be having some misconceptions about the role of nuclear medicine and might misrepresent us*"
"*Nuclear medicine physicians as the other clinicians have very limited knowledge of nuclear medicine procedures themselves having not been taught nuclear medicine formally in their career at all*"

Discussion of the qualitative responses: The nuclear medicine expert participants regarded nuclear medicine specialists as the most appropriate medical educators because they are the people best qualified to do so. They are the persons who are doing and reporting on nuclear medicine imaging studies on a daily basis.

TABLE 5.47: CATEGORY 21.2-OTHER RADIATION WORKERS

Nuclear medicine registrars and post graduate nuclear medicine students
"*Nuclear Medicine physicians and even senior registrars*"
Nuclear medicine radiographers, physicists and radio-pharmacists
"*the nuclear medicine physicians or chief radiographers where physicians are not available*"
"*Nuclear medicine physician and Nuclear medicine radiographer for practical sessions*"

Discussion of the qualitative responses: The nuclear medicine specialist can ask other staff members to assist in the teaching of undergraduate students. Medical physicists can teach radiation protection, the radiographers can assist in the practical sessions and postgraduate nuclear medicine registrars can give some of the lectures on clinical nuclear medicine imaging studies/procedures.

TABLE 5.48: CATEGORY 21.3-OTHER NON-CLINICAL LECTURERS OR CLINICAL PHYSICIANS

Physiologists
"The course however should include normal physiology for the students to better understand the clinical importance of this diagnostic field before overwhelming them with clinical applications and examples of different scans"
Clinical specialists
"Preferably by Nuclear Medicine Specialists, but due to manpower limitations other clinical physicians could also present"
"A lot of senior colleagues know when nuclear medicine examinations are required but do not bother or simply ignore the need for relevant clinical information and how to prepare patients. This all culture should be relooked/changed for a new generation of physicians with basic knowledge in practical clinical nuclear medicine"

Discussion of the qualitative responses: Presentation of nuclear medicine subjects by other clinical and non-nuclear medicine physicians does take place during ward rounds and in clinics. Medical or surgical physicians should not be the principal teachers of nuclear medicine. Collaborative and integrated presentations between nuclear medicine and clinical physicians as part of the existing medical curriculum are more acceptable.

TABLE 5.49: CATEGORY 21.4-NUCLEAR MEDICINE PHYSICIANS INTEGRATED WITH CLINICAL PHYSICIANS

A combination of nuclear medicine and clinical physicians
"Both, as both bring unique perspectives to the course. The clinician knows how to integrate the findings of the scan in the management of the patient while the nuclear specialist can best advice of the appropriate scan for a given patient or condition"
"By Nuclear physicians, but should be part of lectures by other clinical physicians which are specialist in that field, for example: after the endocrine team explained Graves pathology, presentation, special investigations and treatment, the Nuclear team should teach on the thyroid scan with pictures and patient cases"
"Nuclear medicine physicians and specialist physicians/surgeons as it is important to illustrate how/where nuclear medicine plays a role in the clinical work up of a patient"

Discussion of the qualitative responses: As previously mentioned integrated collaboration between nuclear medicine physicians and clinical or other radiological physicians is acceptable in multidisciplinary or inter-professional teaching opportunities.

(cf. Paragraphs 2.5.6, 4.3.3.1, 5.3.2.5, Table 6.5 as well as Appendix F4 and F5)

5.4.1.6 *Question 3.7: HOW should the undergraduate nuclear medicine course be presented (educational strategies and methods)?*

THEME 22: THE MOST APPROPRIATE EDUCATIONAL TEACHING METHODS AND STRATEGIES (n=44)

CATEGORIES IDENTIFIED:
22.1 Formal lectures
22.2 Small-group discussions
22.3 Practical group sessions
22.4 Combination of methods
22.5 Other options
22.6 Unsure participants

TABLE 5.50: CATEGORY 22.1-FORMAL LECTURES

Didactic lectures
"Power Point presentations of lectures"
"Didactic lectures with clinical scenarios. Lots of illustration and audio visuals. An interactive session with one exit exam"
"Formal lecture + notes + images"
"Lectures, written information"

Discussion of the qualitative responses: The traditional formal didactic lecture in either written or PowerPoint format seems to be the most popular choice of teaching method among the expert nuclear medicine participants. Adding clinical scenarios with or without illustrations, and using nuclear medicine pictures/images, will result in an interesting way of introducing nuclear medicine fundamentals to undergraduate medical students.

TABLE 5.51: CATEGORY 22.2-SMALL-GROUP DISCUSSIONS

Small-group tutorials
"The strategy could involve tutorials, exposure to clinical scenarios with images etc."
"Interactive case studies with students. Show a few images and discuss the clinical situation and diagnosis"

Discussion of the qualitative responses: Utilisation of interactive case studies and nuclear medicine images will expose students to clinical scenarios, through which the role of nuclear medicine as one of the healthcare resources can be demonstrated.

TABLE 5.52: CATEGORY 22.3-PRACTICAL SESSIONS IN THE NUCLEAR MEDICINE DEPARTMENT

Practical group sessions
"Orientation in the department"
"Selected cases demonstration at a nuclear medicine reporting workstation"
"As rotation e.g. 2 weeks"
"Practical group sessions, i.e. witnessing a scan being performed, analyse the scan, preparing a report"
"observation (e.g. lecture on MIBI's and then the students can follow a MIBI from stressing to reporting)"*

Discussion of the qualitative responses: Another teaching method that can be used is practical sessions within the Nuclear Medicine Department. In this way students can be orientated to the department, familiarised with imaging procedures, they can witness how a nuclear medicine study is done and reported and they can gain experience regarding what patients go through when booked for a nuclear medicine study. Case demonstrations at digital reporting stations can be impractical taken into consideration the clinical workload.

[*MIBI (Methoxy-Isobutyl-Isonitrile): Myocardial perfusion study]

TABLE 5.53: CATEGORY 22.4-COMBINATION OF STRATEGIES OR METHODS

Combination of methods
"First basic information in the form of lectures. Visit to the Department: show them the hot lab, preparation of radiopharmaceuticals, gamma cameras: even the reporting room and interpretation of scans"
"Limited lectures integrated with clinical teaching"
"A few formal lectures, participating in a few reporting sessions"
"Basic lectures as background prior to rotation in the Nuclear Medicine department"
"Classroom lectures, tutorials and visits to the department in small groups"
"Lectures and clinical demonstrations"
"Lectures .Short rotations because learning things just from theory makes grasping of the subject matter more difficult. Assessments through written tests"
"Practical problem cases, with power point projection of the imaging findings. Rotation sessions in the Nuclear Medicine department will also be of great value"

Discussion of the qualitative responses: Course content is associated with the phase in which medical students encounter their nuclear medicine teaching. Course content also determines the teaching methods that should be used for instructing students. According to the expert participants, an introductory background lecture is recommended prior to the students' visit to the Nuclear Medicine Department for an observational visit. Students can be familiarised with the department by showing them the hot lab, gamma cameras, and reporting room and involving them in a reporting session.

A combination of the mentioned teaching methods can be implemented to provide learning experience opportunities for students. Short rotations by small groups of students combined with practical case studies will be of great value to the students.

TABLE 5.54: CATEGORY 22.5-OTHER OPTIONS TO BE CONSIDERED

Other methods
"At the clinical bedside teaching and outpatient level
To be integrated with physiology
"As imaging of physiological principles. Physiology can also be revised. Simple working group rotations to teach them diagnosis of simple scans"
"Ideally I would see nuclear medicine forming a part of several courses. It should be a prominent component of physiology (perhaps to illustrate clinical relevance of renin-angiotensin-aldosterone system), in internal medicine, GI surgery, urology, oncology and radiology"
"Lectures combined with the pathology and clinical lectures in the systems/specific diseases where the nuclear scans play a role in patient management. Nuclear medicine part of the lectures should contain very little detail on the "nuclear" part, but the clinical indications should be explained in detail, with example of a scan in each setting"
"in one block if possible but selective participation e.g. in practical presentations highly recommended"

Discussion of the qualitative responses: Conventional didactic teaching of students combined with intra-departmental practical sessions and small-group discussions can be integrated with other clinical or diagnostic disciplines. Alternative teaching methods and places include clinical bedside and outpatient teaching. Clinical imaging cannot be taught as a totally discrete entity and organised integration with several other courses, such as physiology, pathology and other clinical courses, including internal medicine, surgery, urology, oncology and radiology, need to be considered, especially in the students' final year. Such multidisciplinary courses empower students to work effectively in a healthcare team, keeping in mind the main goals of better patient care and delivery of quality healthcare for all.

TABLE 5.55: CATEGORY 22.6-UNSURE PARTICIPANTS CATEGORY

Participants not familiar with newer teaching methods and strategies
"I am not sure which strategies/methods are available and which should be used."
"Like all others courses (maybe I do not understand the question)"

Discussion of the qualitative responses: The majority of academic medical doctors/physicians were involved in some form of teaching; however, only a few had received formal training in teaching skills. Earlier generations of doctors did not receive any specific training in teaching skills, but it is expected of them as clinical teachers to teach students on the basis of their scholarship in certain subjects.

In more recent curricula, subject expertise is important, but it is not sufficient for effective student-centred teaching. Dedicated medical lecturers/educators should have the opportunity to attend staff-development courses to empower them with knowledge and skills regarding new educational trends applicable to higher education, including medical education.

(cf. Paragraphs 2.5.7.1, 4.3.2.10, 5.3.2.6, Table 6.8 as well as Appendix F4 and F5).

5.4.1.7 *Question 3.8: HOW should the undergraduate nuclear medicine course be assessed (students' assessment strategies and methods)?*

THEME 23: STUDENT ASSESSMENT STRATEGIES AND METHODS (n=46)

CATEGORIES IDENTIFIED:
23.1 Formal written test or exams
23.2 Practical case studies
23.3 Combination of methods
23.4 Unsure participants

TABLE 5.56: CATEGORY 23.1-WRITTEN TESTS AND EXAMINATIONS

Formal written tests and examinations
"short questions and multiple choice questions (MCQ's)"
"Fill in the blank spaces"
"Short test on basic concepts and tests available"
"written paper focusing on indications"
"on its own as a modular test"

Discussion of the qualitative responses: Assessment of student learning achievement is an essential part of students' learning experience, as they adapt their learning to the assessment required. Expert participants suggested using written tests, with a variety of question types, as a method of choice to test students' learning achievement (cf. Paragraph 4.3.2.11). MCQs are currently used extensively in many forms of testing worldwide (cf. Paragraph 4.3.2.12).

TABLE 5.57: CATEGORY 23.2-PRACTICAL CASE STUDIES

Practical clinical problem case studies
"small assignments during small group visits to Nuclear Medicine"
"very limited practical knowledge interpretation"
"Practical problem cases"
"Evaluation by means of an integrated, diagnostic imaging OSCE"

Discussion of the qualitative responses: Small-group case studies are part of Problem-based learning (PBL) orientated, student-centred educational strategies, where practical problem cases are provided and discussed in small groups to find solutions.

Objective structured clinical examination (OSCE) is suggested as another way of assessment through practical studies. OSCEs are suited for testing integrated clinical imaging and clinical practice knowledge by utilising imaging pictures.

TABLE 5.58: CATEGORY 23.3-INTEGRATED COMBINATION OF METHODS

Other combinations
"Written test as well as impression during rotation at nuclear medicine dept"
"By means of continuous assessment"
"OSCE and maybe oral"
"As part of internal medicine" or "Like Radiology"
"A certain percentage of the papers that they write should include questions with regard to Nuclear Medicine"
"MCQ questions in medical/surgical papers"
"Online questionnaire"

Discussion of the qualitative responses: A mixture of assessment approaches can be used; among which written examinations, oral exams, OSCEs and online-based assessments. Assessments include both formative or continuous assessment as well as summative assessment at the end of the learning experience.

An important suggestion is that *a "certain percentage of the papers that they write should include questions with regard to Nuclear Medicine".* It implicates the presence of a separate nuclear medicine imaging paper or questions as part of integrated student assessments. Questions that focus specifically on nuclear medicine imaging must ensure that students have mastered nuclear medicine-related knowledge and skills.

TABLE 5.59: CATEGORY 23.4-UNSURE PARTICIPANTS CATEGORY

Unsure participants
"I am not sure which strategies/methods are available and which should be used"
"Like all others modules"

Discussion of the qualitative response: As mentioned in the discussion of Table 5.55, not all medical clinicians are familiar with newer teaching and assessment methods.

(cf. Paragraphs 2.5.7.4, 4.3.2.11, 4.3.2.12, 5.3.2.7, Table 6.9 as well as Appendix F4 and F5).

5.4.1.8 *Question 3.9: HOW should the undergraduate nuclear medicine course be presented (integrated with other clinical or imaging disciplines; as an independent nuclear medicine module in an independent nuclear medicine discipline or a combination of both)?*

THEME 24: WAYS TO PRESENT (STRUCTURE) THE NUCLEAR MEDICINE MODULE INTO EXISTING UNDERGRADUATE MEDICAL CURRICULA (n=47)

CATEGORIES IDENTIFIED:
24.1 An independent nuclear medicine module
24.2 Integrated with other clinical or imaging disciplines
24.3 Combination of both

TABLE 5.60: CATEGORY 24.1-AN INDEPENDENT NUCLEAR MEDICINE MODULE

Individually
"*As an independent department"*
"*Basic module should be independent thereafter to be integrated with other clinical modules"*

Discussion of the qualitative responses: There was recognition of the value of a specific, independent structure for the early stages of medical education. Total independence was not considered as a principal option.

TABLE 5.61: CATEGORY 24.2-INTEGRATED WITH OTHER CLINICAL OR IMAGING DISCIPLINES

Integrated with clinical specialities
"*At undergraduate level it should be mainly integrated with other clinical departments"*
"*Integrated with other departments to emphasize relevance and application"*
"*Integrated with relevant referring specialities such as orthopaedics, internal medicine and paediatrics"*
Integrated with diagnostic imaging modalities
"*As part of special postings, as applied to radiology, radiation oncology"*
"*Other Diagnostic imaging modalities: Radiology modalitie"*
"*Integrated with Radiology"*

Discussion of the qualitative responses: Integration with other clinical and/or diagnostic disciplines is advocated to emphasise the place and role of nuclear medicine imaging and therapy in patient healthcare management. Integration with clinical and other radiation science disciplines was suggested. In the literature Ell (1997:1081-1082) argues that integrated teaching is not really delivering what is required, especially when the inadequacy of referral letters to imaging departments is monitored (cf. Paragraph 2.5.8.2).

TABLE 5.62: CATEGORY 24.3-A COMBINATION OF BOTH

Combined
"Integrated with relevant referring specialities such as orthopaedics, internal medicine and paediatrics as well as independent"
"Basics module should be independent thereafter to be integrated with other clinical modules"

Discussion of the qualitative responses: Some nuclear medicine experts indicated that a combination of independence and integration was the most acceptable way to structure the nuclear medicine course into the existing medical curriculum. This is also confirmed in the literature that, according to the opinion of Jensen (1977:482-483), the most effective method for teaching radiological imaging is a multidisciplinary presentation where physicians, pathologists, imaging specialists and other clinical doctors are involved in clinical decision-making and choosing treatment options (cf. Paragraph 2.5.8.2).

(cf. Paragraphs 2.5.8, 4.3.2.5, 4.3.2.6, 5.3.2.8, Table 6.4 as well as Appendix F4 and F5).

5.4.1.9 *Question 3.10: Any other opinions or important factors to be taken into consideration when implementing the specific guidelines for such a module?*

THEME 25: OTHER OPINIONS REGARDING AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE (n=27)

CATEGORIES IDENTIFIED:
25.1 Patient care and management
25.2 Compulsory attendance
25.3 Inter-departmental communication
25.4 Committed team involved

TABLE 5.63: CATEGORY 25.1-PATIENT CARE AND MANAGEMENT

Patient care and management
"Module should be aimed at giving basic information to make it easier for clinicians to know when and why to refer, what to expect, as well what basic information to give patient when a referral is made - this will hopefully increase the appropriateness, timeousness and cost effectiveness of referrals as well as better use of available resources and be ultimately beneficial for the patient."
"What is most required of the students at this level is just an appreciation of what nuclear medicine can do to help patients, how to refer and prepare patients appropriately for the nuclear medicine procedure and what to expect from the nuclear physician"
"To emphasise the importance of medical diagnostic imaging to students for them to help their patients to have a better understanding about an imaging modality"
"This module is very important for education of the future doctors to be able to know what Nuclear Medicine can offer and refer appropriately"
"try to keep it clinically relevant"
"Short concise and to the point, most common clinical conditions which can help in management of the patient"
(*"The temptation to overload the students with details must be resisted"*)

Discussion of the qualitative responses: Emphasis was placed on improved patient care as the main goal for improved service delivery through implementation of an undergraduate medical nuclear medicine module. Medical students must not be overloaded with unnecessary detail and course content needs to be clinically relevant.

TABLE 5.64: CATEGORY 25.2-COMPULSORY ATTENDANCE

Compulsory attendance
"Attendance should be compulsory"
"The students should be aware that they will be examined on this topic - otherwise this is just another lecture we can skip"
"It should not be a block which prevents a student from progressing to the next level"

Discussion of the qualitative responses: Compulsory attendance and the importance of summative assessment were highlighted. It was also suggested that the planned nuclear medicine module should not be something that will prevent students from progressing to next levels.

TABLE 5.65: CATEGORY 25.3-INTER-DEPARTMENTAL COMMUNICATION

Inter-departmental communication
"I am concerned at the current lack of communication between specialties with regards to the material that is presented to students. Frequently material is outdated or contradictory which is extremely confusing to students. They have a huge amount of knowledge to master in a relatively short time without the additional challenge of 'unlearning' wrong information. Key clinical lessons should be discussed and agreed upon by all the relevant specialties"
"Continued interaction with all clinical depts"
"NM physicians need to be invited by clinicians responsible for a system e.g. cardiology, to give a lecture integrating the contribution of NM with the other clinical teaching they receive"
"The present teachers of clinical medicine should attend courses to educate them on the clinical application because the integration of Nuclear Medicine and molecular imaging procedures into clinical medicine is critically important rather than as a separate component"

Discussion of the qualitative responses: Expert participants pointed out that communication between all the stakeholders is important for deciding on a core curriculum for such a course. Nuclear medicine specialists, clinical specialists and curriculum developers should work together to establish an appropriate undergraduate module to the benefit of all stakeholders. Successful integration can only take place when nuclear medicine physicians, along with their clinical colleagues, can decide on the core curriculum. Nuclear medicine physicians should be invited to present nuclear medicine-related lectures otherwise out-dated and contradictory nuclear medicine imaging information will be presented to students, confusing them. With the emergence of new and sophisticated molecular imaging procedures, clinical medicine educators should attend nuclear medicine information courses to be educated on the clinical applications of integration.

TABLE 5.66: CATEGORY 25.4-COMMITTED TEAMWORK

Committed teamwork
"There should be committed Nucl Med team and good learning environment"
"So imaging should be addressed as imaging when teaching and not just segregated into nuclear medicine and radiology"
"Perhaps a joint programme with Radiology under the banner of 'Medical Imaging' may allow under grads to appreciate which modality to utilise in specific clinical scenarios"
"Comparison with similar radiology examinations taking in account the advantages and disadvantages"
"The difference between physiological anatomical imaging"

Discussion of the qualitative responses: The role of committed nuclear medicine educators, the complementary role of nuclear medicine and diagnostic radiology studies and a joint programme between nuclear medicine and radiology under the banner of "medical imaging" was suggested.

5.5 CONCLUSION

Chapter 5 provided an overview of the findings of the qualitative data analysis of responses to the open-ended questions by the nuclear medicine key person and expert participant semi-structured questionnaires. These findings and viewpoints were used to obtain information and suggestions regarding the current state of undergraduate medical nuclear medicine teaching in South Africa.

Summaries of both the key persons' and nuclear medicine experts' quantitative results, qualitative findings and their viewpoints on guidelines for an undergraduate medical nuclear medicine module (Study Objective 2 and 3) are included in the appendices section (cf. Appendix F4 and F5). This information together with international trends discussed in Paragraph 2.5 (Study objective 2) will eventually contribute to providing guidelines for an undergraduate medical nuclear medicine module (cf. Section 6.3).

In the next chapter, Chapter 6, **Guidelines for undergraduate nuclear medicine education in the MBChB programmes in South Africa**, a summary of achieved study objectives will be presented, followed by the provision, contextualising and discussion of guidelines, as the final outcome of the study.

CHAPTER 6

GUIDELINES FOR UNDERGRADUATE NUCLEAR MEDICINE EDUCATION IN THE MBChB PROGRAMMES IN SOUTH AFRICA

6.1 INTRODUCTION

This study was done in the inter-disciplinary fields of Health Professions Education and clinical Nuclear Medicine Imaging in undergraduate MBChB programmes in South Africa (cf. Paragraph 1.5). It lies in the domain of academic programme design and delivery and the aim and goals were to provide guidelines for standardisation and uniformity of undergraduate medical nuclear medicine education in MBChB programmes in South Africa.

Chapter 2 provided the non-empirical theoretical perspective applicable to this research study. Chapters 4 and 5 devoted attention to the empirical results and findings of the quantitative and qualitative data acquired from the semi-structured survey questionnaires administered to the key persons and nuclear medicine experts. By combining the non-empirical and empirical results and findings acquired from the research sub-questions (cf. Paragraph 1.3.2), the researcher identified aspects that could be used to answer the research question and solve the research problem (cf. Paragraph 1.3.1).

Specific research objectives were pursued to address the aim of the study and in the next sections a summary of these objectives (cf. Paragraph 1.4.3) will be presented prior to providing the necessary guidelines for answering the research question.

6.2 RESEARCH OBJECTIVES

Figure 6.1 illustrates the research objectives achieved to address the aim of the study (cf. Paragraph 1.4.1).

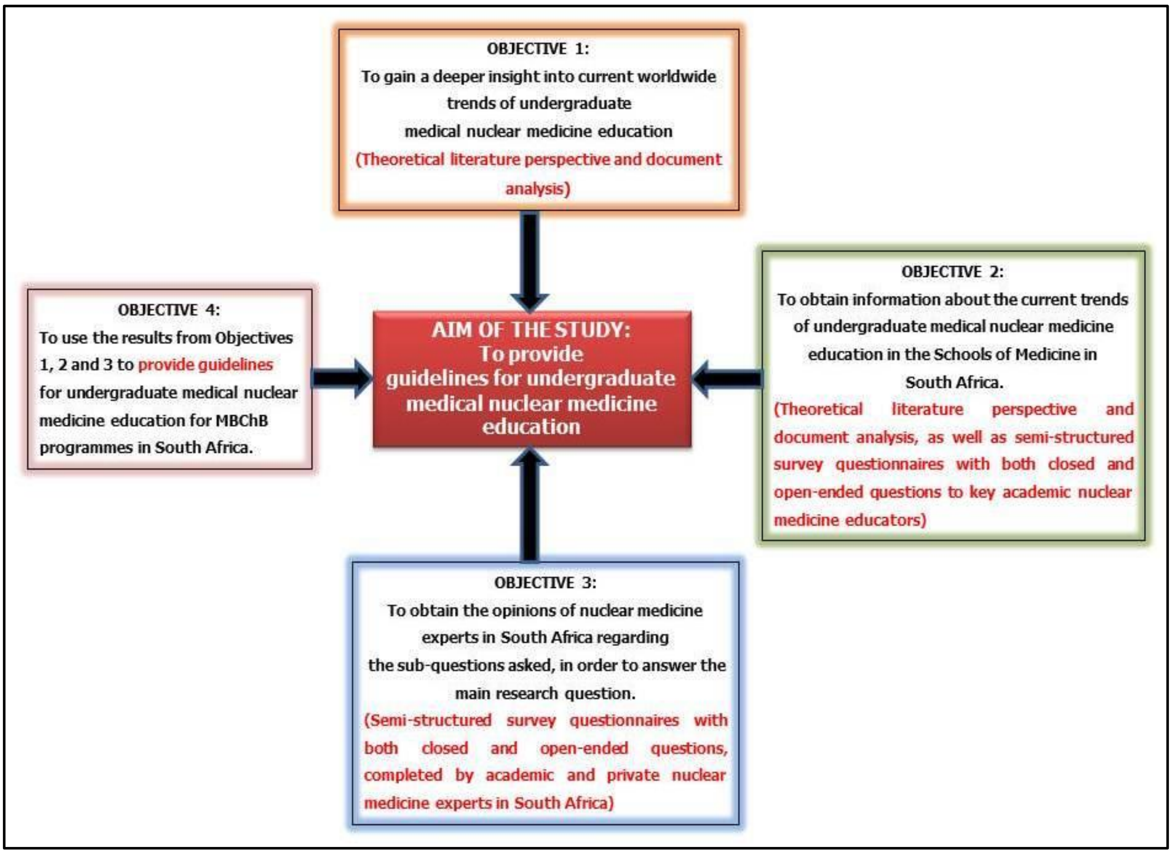


FIGURE 6.1: RESEARCH OBJECTIVES ACHIEVED [Compiled by the researcher, Nel 2014]

In order to address the aim of the study, namely, to provide guidelines for an undergraduate nuclear medicine module in MBChB programmes in South Africa, the following objectives were met:

6.2.1 Objective 1: Gaining deeper insight into current international trends in undergraduate medical nuclear medicine education *(Theoretical literature perspective and document analysis)*

Section 2.5 paid attention to international theoretical perspectives on each research sub-question's relevance to the research question and problem. Information obtained from various sources contributed to suggested guidelines according to international standards (cf. Paragraphs 2.5.2.6, 2.5.3.5, 2.5.4.4, 2.5.6.4, 2.5.7.1, 2.5.7.4 and 2.5.8). Table F1, as part of Appendix F1, summarises these information.

6.2.2 Objective 2: Obtaining information about the current trends of undergraduate medical nuclear medicine education in the Schools of Medicine in South Africa *(Theoretical literature perspective and document analysis, as well as semi-structured survey questionnaires with both closed and open-ended questions to key academic nuclear medicine educators)*

Section 2.4 paid attention to theoretical perspectives on current undergraduate medical curricula and trends in undergraduate medical nuclear medicine education in Schools of Medicine in South Africa (cf. Table F2 as part of Appendix F2) while Section 4.3 presented the key person participants' descriptive statistical results (cf. Table F3 as part of Appendix F3) and Section 5.3 the opinions of nuclear medicine key persons regarding the research sub-questions asked, in order to answer the main research question (cf. Table F4 as part of Appendix F4).

6.2.3 Objective 3: Obtaining the opinions of nuclear medicine experts in South Africa regarding the research sub-questions asked *(Semi-structured survey questionnaires with both closed and open-ended questions, completed by academic and private nuclear medicine experts in South Africa)*

As mentioned, Chapter 4 presented the quantitative descriptive statistical results on undergraduate nuclear medicine course content as indicated on the Likert-type frequency scale and Chapter 5 the opinions and views of South African nuclear medicine experts regarding the research sub-questions asked in order to answer the main research question. Table F5, as part of Appendix F5, summarises information obtained from the nuclear medicine experts in order to answer the main research question.

6.2.4 Objective 4: *Using results from Objectives 1, 2 and 3* to provide guidelines for undergraduate medical nuclear medicine education in MBChB programmes in South Africa

Obtaining consistent information regarding undergraduate medical nuclear medicine education nationally and internationally helped the researcher compile the following guidelines, which will be provided as benchmark to Schools of Medicine in South Africa.

6.3 GUIDELINES FOR UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION: PLANNING AN ACADEMIC UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE ACCORDING TO OBJECTIVE 4 GUIDELINES

In the following paragraphs the responses to the research sub-questions will be used to develop and provide academic Nuclear Medicine Departments with guidelines to address the research problem to improve patient care and nuclear medicine service delivery. Guidelines will be compiled according to steps in the curriculum development process as demonstrated by Figure 6.2 (cf. Section 2.3 and Figure 2.2). These steps will be utilised to plan, develop and apply an undergraduate nuclear medicine module for medical students as a final outcome (Objective 4) for this study:

- ***Guidelines for undergraduate medical nuclear medicine education in the MBChB programmes in South Africa.***

Referring back to the theoretical perspective of curriculum planning and development in Section 2.3 will assist the reader and future undergraduate medical nuclear medicine module developers to orientate themselves to the steps in this problem-solving process. Figure 6.2 illustrates the steps followed in the next section and Tables 6.1 to 6.9 summarise the guidelines compiled from research results.

[Figures and Tables in the next sections were compiled by the researcher, Nel 2014]

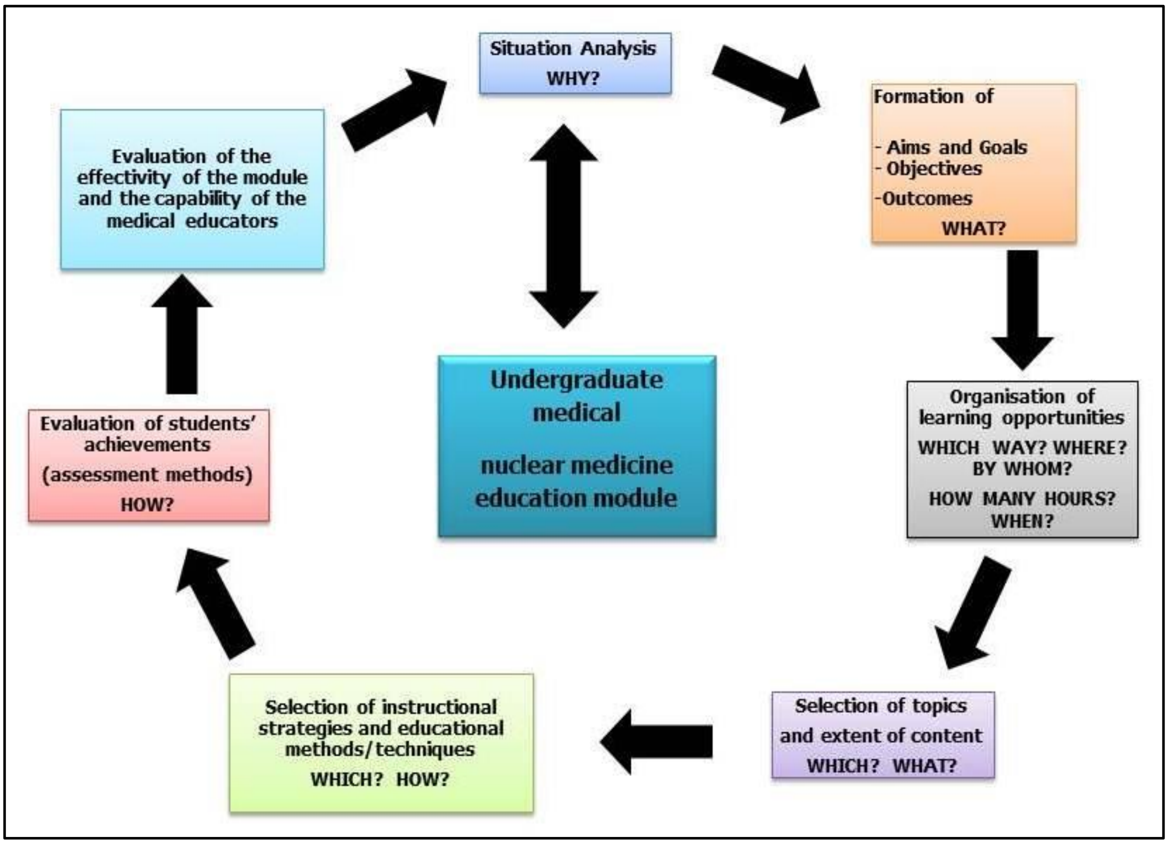


FIGURE 6.2: CYCLICAL CURRICULUM DEVELOPMENT PROCESS [Compiled by the researcher, Nel 2014]

Note: The colour coding in Figure 6.2 represents the different elements referred to in the following section, as follows:

Situation Analysis WHY?	Reasons WHY it is necessary to implement an undergraduate medical nuclear medicine educational module in the MBCHB programmes (What is the problem? How can it be solved?)
Formation of: • Aims and Goals • Objectives • Outcomes WHY? WHAT?	The AIM of the problem-solving process GOALS for the problem-solving process OBJECTIVES in this problem-solving process Formation of OUTCOMES regarding undergraduate nuclear medicine education taking into consideration what is expected from South African medical students and newly qualified medical doctors?
Organisation of learning opportunities WHICH WAY? WHERE? BY WHOM? HOW MANY HOURS? WHEN?	HOW to structure and incorporate the undergraduate medical nuclear medicine module into existing medical programmes The most effective time WHEN to introduce a basic nuclear medicine module Staff members by WHOM this module must be taught and who qualify to be medical imaging educators WHERE the students must be taught and on which level HOW MANY HOURS should be spent on undergraduate teaching and learning
Selection of topics and extent of content WHICH? WHAT?	WHICH nuclear medicine topics or subjects will be the most appropriate at undergraduate level The extent of the contents for each subject or topic at undergraduate level
Selection of instructional strategies and educational methods/ techniques WHICH? HOW?	HOW to present undergraduate nuclear medicine to the medical students (teaching and learning strategies and methods)
Evaluation of students' achievements (assessment methods) HOW?	HOW to present undergraduate nuclear medicine to the medical students (formative and summative assessment methods)
Evaluation of the effectivity of the module and the capability of the medical educators	Evaluation of the medical educators' capabilities Evaluation of the newly developed undergraduate medical nuclear medicine module as well as future re-evaluations thereof

6.3.1 Situation analysis

Newly qualified medical interns and some community service doctors that do not know how to use nuclear medicine imaging in the diagnostic workout of their patients, were identified as a nuclear medicine service delivery problem, while their lack of knowledge and skills regarding nuclear medicine and the negative impact on service delivery and patient care (cf. Paragraph 1.3.1) represented a "mismatch" between what is expected of newly qualified doctors (cf. Paragraph 2.3.2 and 2.4.5) and the competencies they gained from their undergraduate training programmes.

Table 6.1 summarises the reasons ***WHY*** it is necessary to implement an undergraduate medical nuclear medicine module as identified in Objective 1 (cf. Table F1, as part of Appendix F1), Objective 2 (cf. Table F4 as part of Appendix F4) and Objective 3 (cf. Table F5, as part of Appendix F5).

TABLE 6.1: REASONS WHY IT IS NECESSARY TO IMPLEMENT AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATIONAL MODULE IN THE MBCHB PROGRAMMES

Empowering and equipping medical students and newly qualified doctors with:
Necessary knowledge, skills and the right perspective and attitude regarding nuclear medicine as an imaging modality
Necessary knowledge, skills and the right perspective/attitude regarding nuclear medicine as part of the healthcare team
Ability to utilise nuclear medicine procedures more effectively and efficiently
Ability of improved inter-departmental and inter-disciplinary communication and teamwork
Improving effective patient care and management by:
Optimising patient preparation
Improving appropriate, cost-effective patient care
Improving communication with patients, families and other healthcare professionals
Paying attention to legal responsibilities (informed consent)
Emphasising nuclear medicines' role as a diagnostic and therapeutic imaging modality, regarding:
Patient care settings (need for appropriate referrals)
Clinical, medical, diagnostic imaging (indications for nuclear medicine studies)
Radioactive treatment and therapy
Playing a complementary role with other radiological modalities
Ionising radiation protection and safety according to the ALARA principles
Exposure to basic nuclear medicine imaging procedures, awareness of services offered
Standardisation of undergraduate medical nuclear medicine education according to international standards:
Ensuring good quality training according to international standards
Integration of nuclear medicine teaching into clinical modules, to see it in the context of clinical problems
Early exposure to imaging procedures increases students interest in imaging as a career option
Ensuring survival and growth of nuclear medicine as an imaging speciality

To address the identified "mismatch" and solve the service delivery problem, certain educational decisions are therefore needed to improve medical students' knowledge, skills and attitudes or perceptions regarding nuclear medicines role in patient care.

6.3.2 Formulation of aims, goals and objectives

Decisions to be taken to solve the current problem, include:

- The ***aim of the problem-solving process*** will be to empower and equip the medical students with the necessary knowledge and skills to utilise nuclear medicine services effectively, and provide information to transfer right perspectives/attitudes regarding nuclear medicine imaging to them.
- ***Goals for the problem-solving process*** involve methods on how to empower and equip the students. Lack of adequate undergraduate education in nuclear medicine services can be identified as a reason for newly qualified doctors' lack of knowledge and skills. Improving and standardising the undergraduate medical nuclear medicine education is necessary. In this decision making process, all stakeholders (students, nuclear medicine medical educators and programme developers at the higher education institutions) should be involved.
- ***Objectives in this problem-solving process*** include to:

— Commence with specific problem-solving processes to implement an effective undergraduate nuclear medicine module according to stakeholders' needs;

— Investigate the modules and their content currently available in undergraduate nuclear medicine modules; and

— Ensure that the improved formal, structured undergraduate teaching of nuclear medicine will improve students' knowledge and skills and change their attitudes towards nuclear medicine.

Figure 2.3 summarises the decisions to be made in the problem-solving process regarding the aim, goals, objectives and expected learning outcomes for a South African undergraduate medical nuclear medicine module (cf. Paragraph 2.3.4.2).

6.3.3 Formation of outcomes

Higher-education institutions' attitudes towards the radiological imaging disciplines, including nuclear medicine, will impact on what is expected of their medical students, while different regulatory and professional bodies also assist in providing certain predefined outcomes for medical students (cf. Paragraph 2.4.4). Students should know what is expected of them and what they should be able to do at the end of the module. The outcomes must be clearly specified at undergraduate level, in all three of the main categories of Bloom's (Overbaugh & Schultz *s.a.:*online) educational activities, namely ***knowledge, skills and attitudes*** (cf. Paragraph 2.3.4.2).

It should be emphasised clearly that the intention is not to make medical students "mini imaging specialists" but to empower them to utilise nuclear medicine imaging in their patient care management effectively. Therefore, the knowledge, understanding and basic application categories of Blooms' taxonomy will be applicable to undergraduate nuclear medicine outcomes according to what is expected from SA medical students and newly qualified doctors (cf. Paragraphs 2.4.5 and Table 2.6) taking into consideration international exit-level outcomes applicable for newly qualified doctors (cf. Paragraph 2.3.2 and Table 2.1).

But, as mentioned previously (cf. Paragraph 2.3.4.2) outcomes are only valid if the required action can be observed, assessed and measured; therefore the "know" and "understand" levels of Bloom's taxonomy are not useful as outcomes. The other higher-order thinking skills of Blooms' taxonomy are more useful for testing outcomes on specific education levels and in this case specifically at undergraduate level.

Table 6.2 provides specific undergraduate level learning outcomes expected of South African medical students regarding undergraduate nuclear medicine imaging taking into consideration national and international expectations of a "good" medical doctor.

TABLE 6.2: UNDERGRADUATE LEVEL NUCLEAR MEDICINE IMAGING LEARNING OUTCOMES EXPECTED OF SOUTH AFRICAN MEDICAL STUDENTS
(Table continuous on the next pages)

LEARNING OUTCOMES FOR UNDERGRADUATE LEVEL MEDICAL NUCLEAR MEDICINE EDUCATION ON BLOOMS' HIGHER ORDER LEARNING CAPABILITIES: *Medical knowledge, clinical skills and professional attitudes in the provision of patient care* (Dent & Harden 2009:18,19; Dent & Harden 2013:18)
COGNITIVE DOMAIN (KNOWLEDGE)

MEDICAL EXPERT OR SCHOLAR SCIENTIST
HOW THE DOCTOR APPROACH HIS/HER WORK
WHAT IS GENERALY EXPECTED FROM A MEDICAL DOCTOR AS A MEDICAL EXPERT OR SCHOLAR SCIENTIST? (Frank 2005:online; GMC 2009:online)
• Need scientific knowledge to be a medical expert: Application of basic and clinical sciences as a basis for medical practice.
• Apply this expert medical knowledge as well as basic clinical scientific principles.
• Use critical thinking, problem solving, decision making, clinical reasoning and judgement.
• Apply appropriate information retrieval and handling skills.
UNDERGRADUATE NUCLEAR MEDICINE OUTCOMES EXPECTED FROM MEDICAL STUDENTS AND NEWLY QUALIFIED DOCTORS
1. Obtaining basic and clinical sciences knowledge as a basis for medical practice according to HPCSA (Knowledge of the development of disease and pathology)
The ***'core' undergraduate medical curriculum*** required by the HPCSA consist of: ***Basic-science subjects***; Pathology; Main clinical subjects; and Ancillary subjects. The ***ancillary subjects*** include: Medical imaging; Nuclear medicine; Radiation oncology; and Radiation protection.

2. Use critical thinking, decision making, clinical reasoning and judgement to solve problems
Identify and solve clinical and diagnostic problems. Use science and technology effectively. Use medical-scientific terminology with confidence.
3. Obtaining undergraduate medical nuclear medicine education according to standardised national and international standards
Obtain the basic hard 'core' content of nuclear medicine as a diagnostic imaging and radio-active therapeutic modality.
Integrate undergraduate medical nuclear medicine teaching into clinical modules to see it in the context of clinical problems.
4. Increase students interest in imaging disciplines as a career option
5. Ensure survival and growth of nuclear medicine as an imaging speciality

Testing on the "know" domain: **Recall and remember information (define, describe, name, outline, select, state, list, identify, label, match)**
• Obtain medical knowledge and apply the knowledge to patient care. • Select and describe the appropriate imaging examinations for different clinical situations. • Outline the basic workflow of the Nuclear Medicine Department so that they can communicate with patients, families and other healthcare workers. • Identify strengths and weaknesses of the nuclear medicine investigations/procedures. • Outline the effects of ionising radiation and radiation protection.

Testing on the "understand" domain: **Compare and draw conclusions (explain, predict, estimate, paraphrase, defend, distinguish, generalise, summarise)**
• Explain imaging investigations from the patient's perspective and from the referring doctors' perspectives. • Conceptualise (have an idea of) the nuclear medicine vocabulary in order to interpret reports and prevent misunderstandings. • Conceptualise and explain the basic principles of radiation physics and on how nuclear medicine works.

Testing on the "apply" domain: **Use information to report on or make something (demonstrate, organise, solve, transfer, change, develop, prepare, change, operate)**
• Apply doctors' legal responsibilities with regard to patient care.
• Adhere to legal requirements relevant to referrals to imaging departments and acquiring informed consent.
• Adhere to legal requirements involving radiation exposure.

PSYCOMOTOR DOMAIN (SKILLS)

MEDICAL PRACTITIONER
WHAT THE DOCTOR SHOULD BE ABLE TO DO
WHAT IS GENERALY EXPECTED FROM A MEDICAL DOCTOR AS A MEDICAL PRACTITIONER? (Frank 2005:online; GMC 2009:online)
• Need specific skills to practice as a medical doctor to manage patients: Apply clinical skills to provide patient care
• Clinical skills of history taking and physical examination
• Diagnose and manage clinical presentations and conditions
• Undertake practical procedures to investigate patients
• Interpret results of special investigations/diagnostic procedures
• Communicate with patients and colleagues in a medical context
• Apply appropriate information retrieval and handling skills
UNDERGRADUATE NUCLEAR MEDICINE OUTCOMES EXPECTED FROM MEDICAL STUDENTS AND NEWLY QUALIFIED DOCTORS
1. Manage patient care
Ensure highest possible patient care.
Diagnose, treat and manage disease/injury.
Perform clinical skills of history taking and physical examination.
Perform clinical skills to interpret findings and make a diagnosis.
Exhibit effective interpersonal and communication skills for effective exchange of information and collaboration with the department, patients, families and other healthcare professionals.
Prepare patients effectively.

2. Undertake practical procedures
Use diagnostic aids, and clinical skills to interpret the findings, including appropriate and cost-effective utilisation of special investigations and new technologies.
Interpret the results of investigations: X-rays and the results of diagnostic procedures.
Conceptualise imaging procedures from the perspective of patients' and referring doctors' perspectives.
Use other resources in the healthcare system to provide optimal care to their patients.
3. Making use of nuclear medicine services
Use the Nuclear Medicine Department's services.
Apply the necessary knowledge, skills and the right perspective and attitude regarding nuclear medicine as an imaging modality: Understand how nuclear medicine imaging works.
Emphasise *nuclear medicines' role as a diagnostic and therapeutic imaging modality,* regarding: • *Indications* for clinical, medical, diagnostic imaging procedures and radioactive therapy in various clinical conditions; • *Contra-indications* of nuclear medicine imaging procedures; • *Limitations* of each study; and • *Costs and benefits* of nuclear medicine procedures.
Improve appropriate, cost-effective patient care through: • Utilisation of nuclear medicine procedures; • Exposure to basic nuclear medicine imaging procedures; and • Awareness of services offered.
Interpret the imaging report and know how to react to it in order to narrow down a differential diagnosis.
Distinguish normal from abnormal findings, and possessing basic skills in imaging interpretation (interpretational skills).
4. Improve and optimise appropriate patient preparation
Apply diagnostic and therapeutic procedures for decision making and problem solving.
Understand the complementary role of nuclear medicine imaging with other clinical radiological modalities.
Apply knowledge and understanding of radioactivity and ionising radiation: Including patient protection and safety according to the ALARA principles.
Image interpretation must take the back seat to appropriate utilisation of nuclear medicine services and staff.
5. Executing effective referral skills
Communicate and cooperate with other physicians in the diagnosis and treatment of a patients
Provide correct and sufficient clinical information and a clear statement of the indications when ordering a nuclear medicine study.
6. Communication skills
Communicate effectively with patients, their relatives and other members of the healthcare team and colleagues in a medical context.
Facilitate effective doctor-patient relationships: Improve cooperation between Nuclear Medicine Department and referring physicians.
Levels on which students' skills can be tested:
• Imitation (Know what to do): Repeat, follow, grasp, align, • Manipulation (Know how to do it): Repeat, follow, grasp, align, • Precision (Show how to do it): Performing independent actions without any visual, written or verbal instructions • Articulation (Do it correctly): Perform the acts accurately in the appropriate sequence. Perform acts smoothly with confidence and integration • Naturalisation (Do it automatic and naturally): Perform acts routinely with ease and perfections

EMOTIONAL/AFFECTIVE DOMAIN (Attitudes/Feelings/Behaviour)

MEDICAL PROFESSIONAL
THE DOCTOR AS A PROFESSIONAL PERSON
WHAT IS GENERALY EXPECTED FROM A MEDICAL DOCTOR AS A MEDICAL PROFESSIONAL? (Frank 2005:online; GMC 2009:online)
• This indicates responsible doctors who are honest, trustworthy and has integrity and who demonstrate appropriate attitude and behaviour patterns to ensure quality healthcare.
• Professional: behave according to ethical practices, professional regulations and with high personal standards and behaviour.
• Collaborator: Work effectively within a multi-professional healthcare delivery team to achieve optimal patient care.
• Manager: Full fill the role of the doctor within the healthcare delivery system by participating in healthcare organisations and contributing to the effectiveness of the healthcare system.
• Health advocate: Promote healthcare and disease prevention by influencing health and well-being of individual patients, communities and the population.
• Communicator: Facilitating effective doctor-patient relationships by communicating with patients, their relatives and other members of the healthcare team.
• Scholar: Demonstrate a lifelong commitment to personal development and development of transferable medical knowledge.
UNDERGRADUATE NUCLEAR MEDICINE OUTCOMES EXPECTED FROM MEDICAL STUDENTS AND NEWLY QUALIFIED DOCTORS
1. Health promotion and disease prevention
Participating in healthcare organisations and contributing to the effectiveness of the healthcare delivery system.
Influencing advancement of health and well-being of individual patients, communities and populations.
Obtain a better view on imaging as a career.
2. Work effectively within a multi-professional team
Achieve optimal patient care by effective work within a healthcare team (collaborator).
Use improved inter-departmental and inter-disciplinary communication and teamwork.
Understand the role of the imaging specialist in the healthcare team and the relationship with other clinical disciplines.
Apply the necessary knowledge, skills and the right perspective/attitude regarding nuclear medicine as part of the healthcare team.
Call on other resources in the healthcare system to provide optimal care to their patients.
Avoid considering nuclear medicine as an exotic activity restricted to a few medical centres
3. Behave according to ethical and legal principles
Apply an understanding of ethical and legal issues relevant to the practice of medicine, profession-led regulations and high personal standards of behaviour.
Incorporate appropriate attitudes, ethical stance, and an understanding of *medico-legal and ethical practices* and the legal responsibilities of referring physicians, like obtaining informed consent from patients.
Maintain the highest standards of personal conduct and moral integrity.

4. Act in the best interest of patients
Provide adequate information about patient diagnosis, treatment, costs and any other pertinent information to enable patients to exercise choice and informed decision-making pertaining to their health and that of others.
Take into consideration the cost aspects of diagnostic and therapeutic procedures
Provide effective referrals that lead to good working relationships and improved patient care.
Carry out professional responsibilities, adhere to ethical principles and be sensitive to peoples' diverse backgrounds.
5. Communication skills
Communicate effectively with patients, their relatives and other members of the healthcare team and colleagues in a medical context.
Levels on which students' attitude, feelings and Behaviour can be evaluated:
• Receiving: Hear, notice, be aware of, acknowledge, pay attention, listen, attend and be attentive • Responding: Care for, communicate, comply, cooperate, obey, follow, consent, contribute, respond, participate willingly, volunteer • Valuing: Demonstrate a preference, display an attitude to comply with a certain conviction, choose, prefer, seek, desire, show concern, commit, assume responsibility, use resources • Organising: Decide, make appropriate choices, organise likes and preferences, resolve conflict Adapt, adjust, arrange, classify, formulate, organise, conceptualise • Internalising/Characterising: Develop a behaviour consistent with your values, integrates a value system that controls behaviour Act upon, defend, influence, support, serve, maintain, advocate

6.3.4 Organising learning opportunities

If students are to demonstrate what they have achieved as was expected from them, it is essential to provide them with the educational experiences needed. Students need access to appropriate learning environments, resources and facilities to develop and improve their knowledge, clinical and practical skills and develop behaviour consistent with required expectations (module outcomes) as presented in Table 6.2. The existing medical curriculum in which the module needs to be incorporated into will determine the physical, human and financial resources needed (cf. Paragraphs 2.3.4.3, 2.4.3 and 4.3.3).

For undergraduate nuclear medicine education to medical students, both service delivery (cf. Paragraph 5.3.1.1) and educational functions are needed and depend on the availability of:

- ***Physical resources*** such as gamma cameras, availability of radionuclides, nuclear medicine images for teaching purposes and the necessary lecture rooms and viewing apparatus;
- ***Human resources*** to serve as medical imaging educators as well as people responsible for imaging service (cf. Paragraph 4.3.3.1, 5.3.1.2, Figure 4.21 and Table 5.2);

- ***Financial resources***, financial restrictions on the academic platform influence both physical and human resources negatively (cf. Paragraph 2.4.4); and
- ***Time available*** (in the existing medical curricula) for academic teaching (cf. Paragraph 5.3.1.4 and Table 5.4).

Availability of teaching staff and time available for academic teaching as well as clinical service delivery loads are some of the greatest resource constraints (Dent & Harden 2013:21).

In the next paragraphs, guidelines applicable to the provision of adequate learning opportunities will be provided according to information and data acquired from the literature perspectives (cf. Paragraphs 2.3 – 2.5), study participants' responses in Chapter 4 and 5 as well as the summaries of the study objectives [Objective 1 (cf. Table F1, as part of Appendix F1), Objective 2 (cf. Tables F2, F3 and F4 as part of Appendix F2, F3 and F4) and Objective 3 (cf. Table F5, as part of Appendix F5)].

Table 6.3 summarises the most effective time ***WHEN*** to introduce the undergraduate nuclear medicine module in the existing medical curricula and the goals to achieve in each phase.

TABLE 6.3: THE MOST EFFECTIVE TIME WHEN TO INTRODUCE A BASIC NUCLEAR MEDICINE MODULE (cf. Paragraphs 2.5.3, 4.3.2.4, 5.3.2.2 and 5.4.1.2)

Pre-clinical phase of the medical curriculum
Deepening students' understanding of basic principles central to nuclear medicine imaging procedures
Equipping students to enter clinical phase with familiarity to order imaging studies
Transition from pre-clinical to clinical experience
Familiarise students with radiographical appearance of disease pathology
Early clinical phase of the medical curriculum
Exposure to clinical applications, indications, advantages and disadvantages of imaging procedures
Late clinical phase, near the end of the clinical blocks/years
Last/final two years when students were exposed to patients It is then easier for students to understand how nuclear medicine fits into the clinical workout of patients
Teaching imaging as a consistent part of the existing medical curriculum in every training year is regarded as best practise teaching and learning

As mentioned in Paragraph 4.3.2.4 as many as 80% of undergraduate medical students receive nuclear medicine teaching only in the clinical phase while only 20% are teaching students in both phases (n=5).

Table 6.4 summarises the ***WAYS IN WHICH*** an undergraduate nuclear medicine module can be ***INCORPORATED INTO THE EXISTING MEDICAL CURRICULA***.

TABLE 6.4: HOW TO STRUCTURE AND INCORPORATE THE UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE INTO EXISTING MEDICAL PROGRAMMES (cf. Paragraphs 2.5.8, 4.3.2.6, 5.3.2.8 and 5.4.1.8)

Different options exist for the way that nuclear medicine modules can be structured or presented
Options depend on the attitude of the parent institution towards radiological imaging disciplines including nuclear medicine imaging
An independent nuclear medicine module ("classical" model)
Radiological Imaging (including nuclear medicine) is taught as an independent discipline with its own examination/test
Integrated educational module ("modular" model)
Integrated with other clinical or diagnostic disciplines in clinical blocks of teaching
Incorporating/integrating nuclear medicine into the teaching framework of already existing medical/imaging departments
Clinical specialities: Internal medicine, oncology/radiotherapy, orthopaedics, paediatrics
Diagnostic imaging modalities: Radiology modalities
Combination of both: "Hybrid" approach
The combination of classic and modular type of teaching
Combination of independent and integration structures

(cf. Paragraph 2.5.8.3)
Kourdioukova *et al.* (2011:309-318): "Conventional medical curricula based on the 'classic building block' are predominantly used in 62% of European institutions. This finding is contrary to the findings of other research, which shows that an integrated approach to radiological education leads to more effective radiology education".

As mentioned in Paragraph 4.3.2.6 the key person participants indicated that 80% of undergraduate medical nuclear medicine module presentations are integrated with another clinical or diagnostic discipline, while only 20% of teaching takes place as a combination of both an independent nuclear medicine module as well as integrated with another clinical discipline.

Table 6.5 summarises the answers to the question on ***WHO*** is teaching undergraduate medical students about nuclear medicine imaging.

TABLE 6.5: STAFF MEMBERS BY WHOM THIS MODULE SHOULD BE TAUGHT AND WHO QUALIFY TO BE MEDICAL IMAGING EDUCATORS (cf. Paragraphs 2.5.6, 4.3.3.1, 5.3.2.5 and 5.4.1.5)

Imaging specialists/nuclear medicine physicians
Are the best qualified people to teach imaging to undergraduate medical students
Other radiation workers who are qualified to assist
Medical physicists
Radiographers
Postgraduate registrars
Radiopharmacists
Other clinical physicians
Expectations for students to learn imaging from their attachment to other clinical departments
This was strongly condemned (in literature) as sub-standard practise
Other non-clinical lecturers/specialists mentioned
Physiologists in the pre-clinical phase

Nuclear medicine specialists most often are the people actually concerned with clinical and academic activities and are regarded as the best qualified people to act as medical imaging educators.

Other human resource aspects of teaching nuclear medicine imaging to medical students include:

- How many educators should be involved (cf. Paragraph 4.3.3.2): Participants reported that in most cases three dedicated nuclear medicine lecturers are involved in teaching undergraduate medical students while staff shortages (cf. Paragraph 5.3.1.2) and high clinical service delivery loads (cf. Paragraph 5.3.1.1) impacted negatively on their undergraduate teaching.
- Where should the students be taught and at which level (cf. Paragraph 2.5.7.2): Undergraduate students should be taught at their knowledge level according to identified outcomes (cf. Table 6.2).
- How many hours should be spent on undergraduate teaching and learning (cf. Paragraph 2.5.7.3, 4.3.2.7 and 4.3.2.8): Great variation exists in hours allocated for teaching undergraduate nuclear medicine modules.

6.3.5 Selection of topics and content

The learning outcomes that have been identified will determine what is being taught, and all modules must contribute in some way to existing curriculum outcomes. By linking the outcomes of each discipline to overall outcomes of the existing curriculum, the content and outcomes of every discipline are integrated into the main curriculum. ***Specific 'hard core' knowledge*** must be identified that students need to master in order to understand and utilise imaging procedures during clinical problem management (Dent & Harden 2009:19) (cf. Paragraphs 2.3.4.5 and 2.5.4.3).

Table 6.6 summarises the nuclear medicine topics or subjects identified by the majority of participants, to be the most appropriate at an undergraduate level.

TABLE 6.6: NUCLEAR MEDICINE TOPICS OR SUBJECTS WHICH WILL BE THE MOST APPROPRIATE AT UNDERGRADUATE LEVEL (cf. Paragraphs 2.5.4, 4.3.2.14, 4.3.5.1, 4.3.5.2, 4.3.5.3, 4.4.3.1, 4.4.3.2, 4.4.3.3, 5.3.2.3, 5.4.1.3 and Figure 4.20)
(Table continuous on the next page)

Basic-science topics/subjects
Basic medical physics
Radiolabelling and radiopharmacy
Imaging principles
Radiation protection
Basic (general) introductory nuclear medicine topics/subjects
Basic introduction and principles of nuclear medicine studies
Introduction and general overview of medical radiation science
Indications for nuclear medicine studies
Specific basic clinical nuclear medicine imaging subjects/scans
100% essential topics (according to Likert-type scales results) include
Bone scans and musculoskeletal imaging
Thyroid diagnostic imaging
Thyroid therapy
Respiratory perfusion and ventilation studies (V-Q scans)
Genito-urinary renal imaging: Renogram, GFRs
Nuclear cardiology: Cardiovascular ejection fractions, myocardiac perfusion studies

Other nuclear medicine imaging subjects/scans
Infection and inflammation imaging
Brain and neurological imaging
Gastro-intestinal, liver-spleen and hepatobiliary scans
Other endocrine and parathyroid imaging procedures
Role of nuclear medicine in oncology and tumour imaging
Nuclear medicine in the emergency situations
The role of nuclear medicine in radionuclide therapy
The role of nuclear medicine in paediatrics

Newer nuclear medicine technologies and what to expect in the future (awareness of new developments)
SPECT-CT and PET-CT
Targeted therapies: what therapies are offered and how the patient is treated?

Figure 4.20 demonstrates the topics/subjects currently incorporated in undergraduate medical nuclear medicine teaching and learning.

TABLE 6.7: THE EXTENT OF THE CONTENTS FOR EACH SUBJECT OR TOPIC AT UNDERGRADUATE LEVEL (cf. Paragraphs 5.3.2.4 and 5.4.1.4)

Instruction/teaching must be done on the students' undergraduate knowledge level and cognitive complexity
Specific clinical topics: Nuclear medicine as an imaging modality
Basic 'hard core' content of nuclear medicine as a diagnostic/therapeutic modality
Clinical indications (and contra-indications) of nuclear medicine imaging procedures in the various clinical conditions
Limitations of each study
The role of nuclear medicine as an diagnostic imaging and therapeutic modality
How nuclear medicine imaging works
What radioactivity is
Critical aspects of radiation safety
Important legal responsibilities of referring physicians (informed consent)
Basic costs and benefits of nuclear medicine procedures

General topics: Role of nuclear medicine studies in handling of patients
Introduction to Nuclear Medicine Department and how to utilise nuclear medicine services
Imaging procedures from the perspective of patients and referring doctors
Effective referral of patients by providing adequate clinical history and a clear statement of the indications for the examinations being requested. Emphasising the need for correct and sufficient clinical information when ordering a nuclear medicine study
Patient preparation
Cooperation between Nuclear Medicine Department and referring physicians
Image interpretation (BUT it must take the back seat to appropriate utilisation of nuclear medicine services and staff
The role of the imaging specialist in the healthcare team and the relationship with other clinical disciplines

6.3.6 Selection of instructional strategies and educational methods/techniques

The introduction of the OBE approach (cf. Paragraphs 2.3.4.2, 2.3.4.4 and 2.4.3.1) to education in South Africa brought about major changes in the traditional way in which teachers approached the process of teaching and learning (Beets & Van Louw 2005:online).

Table 6.8 summarises the educational strategies and teaching methods to be used to present an interesting nuclear medicine module to students.

TABLE 6.8: HOW TO PRESENT UNDERGRADUATE NUCLEAR MEDICINE TO THE MEDICAL STUDENTS (TEACHING AND LEARNING STRATEGIES AND METHODS)
(cf. Paragraphs 2.5.7.1, 4.3.2.10, 5.3.2.6 and 5.4.1.6)

Hard "core" content presented through:
Formal instruction and didactic lectures
Teacher-centred formal lectures
Integrated small group seminars, Integrated teaching with physiology
Integrated tutorials with other clinical and imaging departments
Interactive small-group case studies
Audio-visual aids for teaching
E-learning teaching facilities
Practical sessions in the Nuclear Medicine Department
Observational practical sessions and practical demonstrations
Active participation practical sessions
Elective possibilities available in Nuclear Medicine Department
Utilisation of radiological pictures or images
Enabling students to see disease pathology processes and internal anatomy and physiology in patients' organs
Student-centred "core plus" clinical lectures can be available for interested students
Combination of strategies or methods
Other options
Integrated bedside teaching (This was strongly condemned as sub-standard practise if done by other clinical disciplines alone)

6.3.7 Evaluation of student achievements, assessment strategies and methods

Table 6.9 provide student achievement assessment methods (cf. Paragraph 2.3.4.8) that were identified to be applicable to this module.

TABLE 6.9: STUDENTS' ACHIEVEMENTS ASSESSMENT STRATEGIES AND METHODS
(cf. Paragraphs 2.5.7.4, 4.3.2.11, 4.3.2.12, 5.3.2.7 and 5.4.1.7)
(Table continuous on the next page)

FORMATIVE assessment (assessment during the learning experience period)
Provide insight into aspects of professional competence, including the ability to work in a team, attitudes, and commitment
Stimulates learning according to students' learning styles
Feedback is essential after each assessment: Provides feedback on improvement of learning
Formative assessment methods may include:
*Small group case study presentations;
*Portfolios;
*Written assignments;
*Oral presentations; and/or
*No assessments.

SUMMATIVE assessment (assessment at the end of the learning experience period)
Summative assessment methods may include:
*Formal written tests and examinations;
*Oral examinations;
*Imaging examination in form of Objective Structured Clinical Examination (OSCE);
*Practical clinical problem case studies;
*Integrated combination of methods;
*Computer-based evaluation; and/or
*No assessments
Various types of questions that may be encountered are OSCE questions, multiple choice questions (MCQs), single best answer questions, short answer questions, extended matching items, and viva topics
FEEDBACK is essential after each assessment
GENERAL remarks
Radiological imaging examinations **mostly take place as an integrated part of larger modular clinical examinations** together with other clinical and imaging disciplines
There should also be a separate assessment in radiological imaging and nuclear medicine alone, providing assessment within the imaging department

6.3.8 Evaluation of the undergraduate medical nuclear medicine module and the capability of the medical educators

Nowadays the ultimate goal of modern education is not for educators to teach well, but for learners to learn well. Changing modes of healthcare delivery need new educational curricula and educational strategies to improve patient care practices of future doctors to meet the changing demands of medical practice in the 21st century (cf. Paragraphs 2.3.1 and 2.4.4).

Curriculum planning and development (cf. Paragraph 2.3.4) are important in order to match what is expected of young doctors, and the competencies they gain from medical training programmes (Dent & Harden 2009:10). Empowering and informing lecturers and educators about the curriculum and its educational implications is a prerequisite for successful delivery of the curriculum.

Clinical radiological imaging educators are responsible for coordinating course/module and learning objectives to ensure that other radiological imaging educators will teach students imaging on an appropriate undergraduate level. Imaging educators should be encouraged to use student feedback to evaluate their own teaching and learning abilities as well as for the evaluation and re-evaluation of the imaging course/module itself (cf.

Paragraph 2.5.7.4). Without student feedback, core teaching programs and teaching abilities of lecturers cannot be tailored in a form that medical students appreciate.

Effective clinical lecturers and educators in healthcare science require additional educational teaching and learning knowledge and skills to fulfil their roles as curriculum planners, assessors and learning facilitators (Van Heerden 2013:21-22). Divisions of Health Science Education provide training and qualifications in health professions education, providing training in curriculum development and in new educational approaches (cf. Paragraph 2.3.3).

6.4 CONCLUSION

Guidelines for undergraduate medical nuclear medicine education in the MBChB programmes in SA, as the final outcome of this research study, were compiled from information and data obtained from the literature perspectives and semi-structured survey questionnaires applied as research methods in this study. The compiled guidelines were then presented according to the problem-solving steps in the curriculum development process as answer to the research question and to solve the service delivery problem that was identified by the local UFS Nuclear Medicine Department.

In light of the great variety that exists in medical education in general and undergraduate nuclear medicine education in particular (cf. Table 2.5) in South African Schools of Medicine not all problem-solving procedures, as mentioned in the previous paragraphs, apply to each one of them. Each academic nuclear medicine facility can apply their own problem-solving procedures, according to their unique needs and resources. However, guidelines can be provided as a benchmark for improved undergraduate medical nuclear medicine education, keeping in mind what patients need.

In the next chapter, Chapter 7, titled **Conclusions, recommendations and limitations,** final conclusions on the study will be drawn. Limitations of the study will be discussed and recommendations will be made.

CHAPTER 7

CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS OF THE STUDY

7.1 INTRODUCTION

In the previous chapter, Chapter 6, guidelines were provided for an undergraduate medical nuclear medicine module as final achievement of this research study's objectives and to answer the main research question, which was:

- ***What will the guidelines be for undergraduate nuclear medicine education in the MBChB programmes in South Africa?***

The aim of this chapter, Chapter 7, is to conclude the study by providing an overview and concluding thoughts on the findings of this study. The chapter commences with an overview of the study, which is followed by presentation of results and findings of the semi-structured survey questionnaires, contributions and significance of the research, and recommendations based on the study. A short discussion on the limitations of this study, conclusive remarks and a final conclusion will be given.

7.2 OVERVIEW OF THE STUDY

As mentioned previously the problem that initiated the research study was that the local Nuclear Medicine Department at the UFS experienced problems when patients were referred for diagnostic imaging studies and radioactive therapy by newly qualified doctors (cf. Sections 1.2 and 1.3). The problematic patient referrals impacted negatively on nuclear medicine service delivery and patient care (cf. Paragraphs 1.3.1 and 6.3.1). Lack of knowledge and skills and wrong perceptions on the part of the newly qualified doctors could be the cause of these referral-related problems, which can be traced back to the absence of standardised guidelines for undergraduate medical nuclear medicine education in existing MBChB programmes in South Africa (cf. Section 1.2 and Paragraph 1.3.1).

Undergraduate level nuclear medicine education in South African Schools of Medicine is not yet standardised, and no directives exist to ensure uniformity and higher educational standards, as is expected of professional medical programmes, including MBChB/MBBChB (cf. Section 1.2). The implementation of nationally accepted guidelines for undergraduate medical nuclear medicine education in South Africa could contribute to the effective utilisation of nuclear medicine as an imaging modality and eventually improve patient care.

An in-depth study was carried out by the researcher with a view to providing guidelines for an undergraduate medical nuclear medicine module. The study involved an investigation into theoretical literature and documentary perspectives (cf. Paragraph 3.3.1), and an empirical study (cf. Paragraph 3.3.2), which obtained the perspectives of both key persons and nuclear medicine experts on such an undergraduate medical nuclear medicine module as part of an existing medical curriculum.

The research was based on the research problem that had been identified and research questions that were asked to solve the identified problem (cf. Paragraph 1.3.1). Answers to several sub-questions were needed to answer the main research question (cf. Paragraph 1.3.2), and the research results and findings formed the basis of the provided guidelines (cf. Section 6.3) and recommendations (cf. Section 7.5) that will be discussed in this chapter.

7.2.1 Research problem

The problem that initiated this research (cf. Paragraph 1.3.1) is that newly qualified doctors do not know how to utilise nuclear medicine imaging and radioactive therapeutic procedures in the diagnostic workout and treatment of their patients. The lack of knowledge and skills, as well as wrong perceptions regarding nuclear medicine procedures can only be solved if undergraduate medical nuclear medicine education is improved according to national and international standards.

7.2.2 Main research question

As mentioned previously the research question that emanated from the research problem is:

- ***What will the guidelines be for an undergraduate nuclear medicine educational module in the MBChB programmes in South Africa?***

7.2.3 Aim of the study

The aim of this study was to provide guidelines for an undergraduate nuclear medicine educational module in MBChB programmes in South Africa (cf. Paragraph 1.4.1).

7.2.4 Goal of the study

This study had a dual goal. First, the goal was to investigate national educational trends in nuclear medicine for undergraduate medical students in the various Schools of Medicine in South Africa and, second, to investigate international educational trends in nuclear medicine for undergraduate medical students (cf. Paragraph 1.4.2).

7.2.5 Research sub-questions

To answer the research question and to provide guidelines to solve the research problem, the answers to several sub-questions relating to such an educational module were required. Paragraph 1.3.2 provides an outline of the research question and sub-questions that guided the research study and shaped the final outcome, which is presented in this final chapter.

7.2.6 Objectives of the study

To achieve the aim of the study and to answer the research questions and sub-questions four objectives (cf. Paragraph 1.4.3) were pursued:

***Objective 1*:** Gaining deeper insight into current international trends of undergraduate medical nuclear medicine education, in order to provide the necessary context for the study.

The theoretical perspective (the first research method), (cf. Paragraph 3.3.1) provided access to the existing body of knowledge and to existing secondary information drawn from the work of other researchers and their research into the research problem and the sub-questions asked. Research findings were placed in the context of what is already known about the research subject. The first research objective was therefore accomplished and reported on in Section 2.5 (cf. Paragraph 2.5.9 and Appendix F1).

Objective 2: Obtaining information about current national trends of undergraduate medical nuclear medicine education in the Schools of Medicine in South Africa.

The theoretical perspective and document analysis, as reported on in Section 2.4 accomplished this objective partially (cf. Tables 2.4, 2.5 and 2.6 as well as Appendix F2). Results and findings from the semi-structured survey questionnaire (the second research method), (cf. Paragraph 3.3.2) which had been distributed to academic nuclear medicine key persons, provided additional data about medical education in South Africa, on available undergraduate nuclear medicine educational modules and the key person participants' viewpoints on the research sub-questions that needed answering. The second objective was therefore accomplished and reported in Section 4.3 and Section 5.3 (cf. Paragraph 4.5 as well as Appendix F3 and F4).

Objective 3: Obtaining the opinions of nuclear medicine experts in South Africa regarding the sub-questions asked in order to answer the main research question.

Results and findings from the semi-structured survey questionnaire (the second research method) that had been distributed to private and academic nuclear medicine experts in South Africa provided data and opinions regarding the sub-questions. The third objective was therefore accomplished and was reported on in Section 4.4 and Section 5.4 (cf. Paragraph 5.5 and Appendix F5).

Objective 4: Using the results obtained from achieving Objectives 1, 2 and 3 to provide guidelines for undergraduate medical nuclear medicine education in MBChB programmes in South Africa. The fourth objective was accomplished and reported on in Chapter 6 (cf. Section 6.3 and Tables 6.1 – 6.9) according to steps in the curriculum development process.

Achieving Objectives 1, 2, 3 and 4 provided the necessary guidelines (cf. Figure 6.1 and Section 6.3) and in thereby the aim of the study was achieved.

7.2.7 Methods of investigation

To answer the research question and to achieve the study objectives, a non-empirical theoretical literature perspective, which made use of existing secondary data, gave an indication of current national and international trends in undergraduate medical nuclear medicine education (cf. Paragraph 3.3.1). Primary data were acquired by means of an empirical study that made use of semi-structured survey questionnaires (cf. Sections 4.2) with both quantitative and qualitative components (cf. Paragraph 3.3.2). The standardised, fixed data that were required were collected from relevant practitioners involved in nuclear medicine in South Africa (cf. Paragraph 3.3.3).

7.2.8 Results and findings of the semi-structured survey questionnaires

The theoretical perspective, discussed in Section 2.4 gave insight into national trends in undergraduate medical nuclear medicine education while international trends and viewpoints on the research sub-questions were discussed in Section 2.5. Appendix F1 summarises the answers to the research sub-questions.

Chapter 3 provided background information about data gathering, collection, analysis and interpretation (cf. Paragraphs 3.3.5 and 3.3.6), while Chapters 4 and 5 displayed the actual quantitative results and qualitative findings.

In Chapter 4 quantitative results of the emailed, self-administered survey questionnaires were presented and discussed. The responses of the key persons and nuclear medicine experts were reported separately, according to the questionnaire sections (cf. Figure 4.1). The key persons' quantitative (cf. Section 4.3) and qualitative results (cf. Section 5.3) provided information about the current status of undergraduate medical nuclear medicine education in South Africa.

In Chapter 5 qualitative results of the emailed, self-administered survey questionnaires were presented and discussed. As mentioned, the responses of the key persons and nuclear medicine experts were reported separately according to the questionnaire sections (cf. Figure 5.1). Quantitative results and qualitative responses of key persons and nuclear medicine experts to the research sub-questions were summarised and tabulated in Appendix F3, F4 and F5.

Both empirical and non-empirical aspects and findings of this research study provided final answers to the research question and sub-questions, it eventually contributed to developing guidelines for an undergraduate medical nuclear medicine educational module (cf. Section 6.3 and Tables 6.1 – 6.9).

7.3 CONTRIBUTION AND SIGNIFICANCE OF THIS RESEARCH

The overall value of this study lies in the provision of guidelines for a more structured and standardised undergraduate medical nuclear medicine module in MBChB programmes in South Africa. Providing guidelines to answer the research question and resolve the research problem will enable academic Departments of Nuclear Medicine in South Africa to standardise their undergraduate medical nuclear medicine educational module, and will empower medical students with knowledge, skills and the suitable perspective regarding nuclear medicine imaging as part of the healthcare team. The researcher holds the view that these research results presented contribute to the research subject in a variety of ways.

7.3.1 Undergraduate medical students

The main value if the study lies in its potential to empower and equip undergraduate medical students, as future referring doctors, with the necessary knowledge, skills and attitude towards nuclear medicine as a medical, clinical, diagnostic imaging and therapeutic modality. The study's intention is not to train students as "mini" nuclear medicine specialists, but to teach them how to utilise nuclear medicine in an effective way during diagnostic workouts of patients with the aim of improving patient care.

The ideal situation would be to expose all medical students and future medical interns at all Schools of Medicine to the same level of undergraduate medical nuclear medicine education. They will then know where, when and how to utilise nuclear medicine imaging services for the benefit of their patients. The issuing of high-quality and adequate referral letters will solve the research problem and contribute to excellent service delivery and patient care. This uniformity will also increase medical students' interest in nuclear medicine as a specialisation field and attract students for postgraduate studies.

7.3.2 Improved patient care and management

The ultimate goal of medical education is to prepare and equip medical students with knowledge, skills and the right attitude to become medical practitioners of the future. Good doctors make the care of their patients their first concern by ensuring that they (the doctors) are competent; that their knowledge and skills are up to date; that they establish and maintain good relationships with patients and colleagues; are honest and trustworthy; and act with integrity. All these characteristics will be addressed when imaging educators empower students with the necessary knowledge and skills to utilise nuclear medicine procedure to the benefit of patients.

7.3.3 Nuclear Medicine Departments and Private Nuclear Medicine Practices

Improved communication between Nuclear Medicine Departments and referring doctors will improve referrals and preparation of patients prior to nuclear medicine imaging procedures, thereby contributing to improved patient care and satisfaction. Improved knowledge about nuclear medicine scans and understanding where they fit into the diagnostic pathways will make referring doctors more willing to utilise the services offered by the private practice – these doctors will not regard nuclear medicine scans as a specialised modality only. The increasing utilisation of nuclear medicine imaging procedures, can, in turn, secure the future of nuclear medicine as an independent clinical imaging modality. To instil this level of knowledge and understanding of nuclear medicine procedures, undergraduate level medical nuclear medicine education should be raised to a uniform, nationally acceptable level that corresponds with international standards.

7.3.4 National value

At national level, the value of this research will be to provide guidelines for all the Schools of Medicine in South Africa, to implement a formal, standardised, undergraduate medical nuclear medicine educational module. Great variation exists in South African medical curricula and only six of the current eight Schools of Medicine present undergraduate and postgraduate nuclear medicine education – a fact that could complicate implementation of these guidelines (cf. Table 2.4).

The findings of the research will be brought to the attention of Faculties of Health Sciences and Schools of Medicine in South Africa. It could serve as a benchmark for current (or, in certain cases, non-existent) undergraduate nuclear medicine modules in MBChB programmes (cf. Paragraph 1.8). The research findings will be presented at appropriate conferences and articles that arise from it will be submitted to academic journals with a view to publication, as the researcher hopes to make a contribution to undergraduate medical nuclear medicine education in South Africa.

7.4 LIMITATIONS OF THE STUDY

The researcher recognises the following limitations of the study:

- Although an extensive literature search was performed, few research studies were identified that concentrated exclusively on undergraduate medical nuclear medicine education. Literature on undergraduate radiology education was included because nuclear medicine may be integrated within undergraduate level radiology education at several international radiation science institutions;
- Although some of the references were very old, dating from 1958 (cf. Paragraph 2.5.8), 1966 (cf. Paragraph 2.2.1), 1973 (cf. Paragraph 2.5) and 1977 (cf. Paragraph 2.5) the content reflected problems still applicable nowadays;
- To date, there are no results of previous research studies based in South Africa, to which the findings of this study could be compared;
- Only six of the eight Schools of Medicine present postgraduate nuclear medicine education, and, at undergraduate level, to a minor extent. Newly qualified students at the two Schools of Medicine that do not present nuclear medicine education will still qualify as medical doctors without having received any formal nuclear medicine exposure and education. Depending on where their internship years and community service years are served, the problem of lack of knowledge and skills and a possibly incorrect perception regarding nuclear medicine will be problematic;
- Only five of the six key persons appointed by the Deans of the Faculties of Health Sciences completed the key person questionnaire. Appointing the medical educator who is actually involved in undergraduate nuclear medicine education was crucial for the reliability and validity of the study;
- In explaining their low response rate, private nuclear medicine experts explained they are not involved in medical education and therefore could not contribute to the study;
- No personal visits to Nuclear Medicine Departments or private practices could be done due to time constraints and other obligations on the side of the researcher.

This was also the reason why focus groups were ruled out as research method in this study;

- Focus groups could have increased the reliability of the study, but time and working constraints made it impossible to include this method of data collection in this study;
- Inputs from medical students, curriculum developers or other clinical disciplines were not included in the scope of this study;
- Lack of hard-copy questionnaires was a problem for a few participants, who claimed that they did not have the computer literacy necessary to complete the online questionnaire; and
- Incorrect interpretation of the phrase “educational qualifications (teaching and learning)” in both questionnaires (cf. Questions 2.8 and 2.9) resulted in several non-applicable answers.

7.5 RECOMMENDATIONS

This research study makes a significant contribution to the body of knowledge in the field of undergraduate medical nuclear medicine education in South African. The recommendations may contribute to the development and implementation of a standardised medical undergraduate nuclear medicine educational module within existing medical curricula, taking individual needs and abilities of each academic Nuclear Medicine Department into account.

The following recommendations are made from the study:

- The guidelines can be customised for undergraduate medical nuclear medicine modules/courses at other South African universities;
- The most important recommendation is that the guidelines should be implemented and re-evaluated for reliability and validity after implementation;
- Focus groups can be used to investigate matters relating to undergraduate nuclear medicine implementation;
- It is recommended that the findings of this study be submitted to the Phase III committee of the School of Medicine at UFS for consideration, implementation and further recommendations, as a way forward in the education and training of medical students at this institution;
- The research results should be presented at national and international congresses;
- The results should be disseminated by means of submission of articles to accredited higher-education journals;

- Further research is recommended on more specific, newer, current teaching and learning strategies and methods, as well as on assessment methods and criteria;
- Further research on customising the guidelines for implementation of the module in the existing medical programmes in South Africa is recommended;
- A similar research study can be undertaken to obtain the perspectives of medical students, curriculum developers and other clinical disciplines on the same topic; and
- More consultations are needed with all stakeholders, and even with national (and international) regulatory and professional bodies.

7.6 CONCLUSIONS

This study was based on the recognition and acknowledgement that there is a need for investigation in the field of undergraduate medical nuclear medicine education in South Africa; this finding was found to exist on an international level too. A combination of research methods was used to generate information and data. Results and findings, comprising existing secondary data and the opinions of key persons and expert nuclear medicine practitioners, were applied to bridge the gap identified, and guidelines were provided to develop the required educational modules.

Provided guidelines can be used to plan and structure an undergraduate medical nuclear medicine module according to international as well as national trends suggested by South African nuclear medicine experts. The content of the guidelines reflects what the nuclear medicine community expects from referring physicians but also directs what is expected from the nuclear medicine educators to empower these physicians to effectively utilise nuclear medicine services in their patient care and management.

The researcher acknowledges that circumstances at South African Universities and Schools of Medicine differ significantly and that it is not possible to prescribe a standardised approach to undergraduate clinical imaging, including nuclear medicine, education. The great variety between medical curricula and the availability of nuclear medicine education in the Schools of Medicine in South Africa complicates implementation of standardised guidelines in every Nuclear Medicine Department. It is therefore recommended that each Medical School should adhere as closely as possible to a standard 'core' curriculum for imaging while keeping in mind what patients need.

7.7 CONCLUDING REMARK

The study investigated and reported on the current status of undergraduate medical nuclear medicine education in South Africa. The implementation of the guidelines for undergraduate medical nuclear medicine education could enrich existing undergraduate medical programmes; could produce better equipped medical practitioners and consequently, render a better and more informed service to patients.

SOLI DEO GLORIA!
TO GOD ALONE THE GLORY!

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APPENDICES A to G

APPENDIX A1: ETHICS COMMITTEE UFS 2013 APPROVAL LETTER
APPENDIX A2: ETHICS COMMITTEE UFS 2014 APPROVAL LETTER
APPENDIX A3: UNIVERSITY OF THE FREE STATE AUTHORITY APPROVAL

APPENDIX B1: ETHICS COMMITTEE UCT 2013 APPROVAL LETTER

APPENDIX C1: APPROVAL REQUEST TO UNIVERSITY OF THE FREE STATE
APPENDIX C2: APPROVAL FROM UNIVERSITY OF THE FREE STATE
APPENDIX C3: APPROVAL FROM UNIVERSITY OF PREORIA
APPENDIX C4: APPROVAL FROM UNIVERSITY OF THE WITWATERSRAND
APPENDIX C5: APPROVAL FROM UNIVERSITY OF LIMPOPO (MEDUNSA)
APPENDIX C6: APPROVAL FROM UNIVERSITY OF STELLENBOSCH
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APPENDIX C9: APPROVAL INKOSI ALBERT LUTHULI CENTRAL HOSPITAL

APPENDIX D1: GENERAL REQUEST TO PARTICIPATE
APPENDIX D2: REQUEST TO KEY PERSONS
APPENDIX D3: REQUEST TO NUCLEAR MEDICINE-EXPERTS

APPENDIX E1: REQUEST TO PARTICIPATE WITH LINK TO QUESTIONARE
APPENDIX E2: KEY PERSONS' QUESTIONARE
APPENDIX E3: KEY PERSONS' DATA DICTIONARY
APPENDIX E4: NUCLEAR MEDICINE EXPERTS' QUESTIONARE
APPENDIX E5: NUCLEAR MEDICINE EXPERTS' DATA DICTIONARY
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APPENDIX E7: KEY PERSONS' EXCEL RESULTS
APPENDIX E8: *EVASYS* REMINDER LETTER
APPENDIX E9: *EVASYS* FINAL REPORT LETTER
APPENDIX E10: *EVASYS* FINAL REPORT ON STUDY

APPENDIX F1: SUMMARY OF INFORMATION OBTAINED FROM THE THEORETICAL PERSPECTIVE ON UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION INTERNATIONALLY IN ORDER TO ANSWER THE MAIN RESEARCH QUESTION (STUDY OBJECTIVE 1)

APPENDIX F2: SUMMARY OF INFORMATION OBTAINED FROM THE THEORETICAL PERSPECTIVE ON UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION NATIONALLY IN ORDER TO ANSWER THE MAIN RESEARCH QUESTION (STUDY OBJECTIVE 2)

APPENDIX F3: SUMMARY OF THE KEY PERSONS' DESCRIPTIVE STATISTICAL QUANTITAIVE RESULTS ON SOUTH AFRICAN MEDICAL CURRICULA (STUDY OBJECTIVE 2)

APPENDIX F4: SUMMARY OF THE KEY PERSONS' QUANTITATIVE RESULTS, QUALITATIVE FINDINGS AND THEIR VIEWPOINTS ON GUIDELINES FOR AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE (STUDY OBJECTIVE 2)

APPENDIX F5: SUMMARY OF THE NUCLEAR MEDICINE EXPERTS' QUANTITATIVE RESULTS, QUALITATIVE FINDINGS AND THEIR VIEWPOINTS ON GUIDELINES FOR AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE (STUDY OBJECTIVE 3)

APPENDIX G: PROOF OF LANGUAGE EDITING

APPENDIX A

(INCLUDING APPENDICES A1-A3)

APPENDIX A1: ETHICS COMMITTEE UFS 2013 APPROVAL LETTER

APPENDIX A2: ETHICS COMMITTEE UFS 2014 APPROVAL LETTER

APPENDIX A3: UNIVERSITY OF THE FREE STATE AUTHORITY APPROVAL

APPENDIX A1

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS UV

Research Division
Internal Post Box G40
☎(051) 4052812
Fax (051) 4444359

E-mail address: StraussHS@ufs.ac.za

Ms H Strauss/hv

2012-11-28

REC Reference nr 230408-011
IRB nr 00006240

DR MG NEL
DEPT OF NUCLEAR MEDICINE
FACULTY OF HEALTH SCIENCES
UFS

Dear Dr Nel

ECUFS NR 198/2012
DR MG NEL **DEPT OF NUCLEAR MEDICINE**
PROJECT TITLE: GUIDELINES FOR UNDER GRADUATE NUCLEAR MEDICINE EDUCATION IN THE M.B. CH.B. PROGRAMMES IN SOUTH AFRICA.

- You are hereby kindly informed that the Ethics Committee approved the above project at the meeting held on 27 November 2012.
- Committee guidance documents: Declaration of Helsinki, ICH, GCP and MRC Guidelines on Bio Medical Research. Clinical Trial Guidelines 2000 Department of Health RSA; Ethics in Health Research: Principles Structure and Processes Department of Health RSA 2004; Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa, Second Edition (2006); the Constitution of the Ethics Committee of the Faculty of Health Sciences and the Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines.
- Any amendment, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.
- The Committee must be informed of any serious adverse event and/or termination of the study.
- A progress report should be submitted within one year of approval of long term studies and a final report at completion of both short term and long term studies.
- Kindly refer to the ETOVS/ECUFS reference number in correspondence to the Ethics Committee secretariat.

Yours faithfully

....
DR SM LE GRANGE
ACTING CHAIR: ETHICS COMMITTEE

Cc **Dr Johan Bezuidenhout**

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS UV

Research Division
Internal Post Box G40
☎(051) 4052812
Fax (051) 4444359

E-mail address: StraussHS@ufs.ac.za

Ms H Strauss/jdpls

2014-03-06

REC Reference nr 230408-011
IRB nr 00006240

DR MG NEL
DEPT OF NUCLEAR MEDICINE
FACULTY OF HEALTH SCIENCE
UFS

Dear Dr Nel

ECUFS NR 198/2012
PROJECT TITLE: GUIDELINES FOR UNDER GRADUATE NUCLEAR MEDICINE EDUCATION IN THE M.B. CH.B. PROGRAMMES IN SOUTH AFRICA.

1. You are hereby kindly informed that the Ethics Committee approved the following at the meeting held on 4 March 2014:

   - ***Amendments to the protocol***
   - ***Progress report***

2. Committee guidance documents: Declaration of Helsinki, ICH, GCP and MRC Guidelines on Bio Medical Research. Clinical Trial Guidelines 2000 Department of Health RSA; Ethics in Health Research: Principles Structure and Processes Department of Health RSA 2004; Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa, Second Edition (2006); the Constitution of the Ethics Committee of the Faculty of Health Sciences and the Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines.

3. Any amendment, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

4. The Committee must be informed of any serious adverse event and/or termination of the study.

5. All relevant documents e.g. signed permission letters from the authorities, institutions, changes to the protocol, questionnaires etc. have to be submitted to the Ethics Committee before the study may be conducted (if applicable).

6. Kindly refer to the ETOVS/ECUFS reference number in correspondence to the Ethics Committee secretariat.

Yours faithfully

....
PROF WH KRUGER
CHAIR: ETHICS COMMITTEE

Cc Dr J Bezuidenhout

APPENDIX A3

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

Dekaan: Fakulteit Gesondheidswetenskappe
Universiteit van die Vrystaat
ECA2
2012 -11- 02
Dean: Faculty of Health Sciences
University of the Free State

APPROVAL FORM: UFS AUTHORITIES / GOEDKEURINGSVORM: UV OWERHEDE

FOR PARTICIPATION OF STUDENTS/STAFF OF THIS FACULTY IN RESEARCH PROJECTS

VIR DEELNAME VAN STUDENTE/PERSONEEL VAN HIERDIE FAKULTEIT AAN NAVORSINGSPROJEKTE

Name & student/ staff number
Naam & studente-/personeelnr
DR M G Nel (Riana) staff number:0857953
student number: 1977308020

Department
Departement
DEPARTMENT OF NUCLEAR MEDICINE, SCHOOL of MEDICINE, UNIVERSITAS ACADEMIC COMPLEX, BLOEMFONTEIN, SOUTH AFRICA

Tel nr & e-mail
Tel nr & e-pos
(W) 051-4053487/8 (Cell) 082 801 8203 (email) nelmg@ufs.ac.za

Study leader(s)
Studieleier(s)
Dr Johan Bezuidenhout Tel:051 4053095
Dr Saretha Brüssow Tel:051 4013525

Title of project / *Titel van projek*
Guidelines for under graduate Nuclear Medicine education in the M.B.,Ch.B. programmes in South Africa.

Who will be involved in the study? Please tick (✓) in appropriate box. /
Wie sal by die studie betrek word? Merk (✓) asseblief in die gepaste blokkie.

	YES / *JA*	NO / *NEE*
Personnel *Personeel*	Yes	
Students *Studente*	Yes	

Please attach the protocol for the study and the Ethics Committee application form.

Kindly note that it is the responsibility of the researcher(s) to ensure that all relevant signatures are obtained before this signed form is returned to the Ethics Committee Administration Division (D115) Francois Retief Building, Faculty of Health Sciences, UFS. The protocol may, however, be submitted for Ethics Committee approval while signatures are being obtained. /

Heg asseblief die protokol vir die studie hierby aan, asook die Etiekkomitee aansoekvorm.

Neem asb kennis dat dit die verantwoordelikheid van die navorser(s) is om te verseker dat alle toepaslike handtekeninge verkry word voor hierdie getekende vorm terugbesorg word aan die Etiekkomitee Administratiewe kantoor (D115) Francois Retief-gebou, Fakulteit Gesondheidswetenskappe, UV. Die protokol mag intussen ingehandig word vir Etiekkomitee goedkeuring terwyl handtekeninge bekom word.

A.

Approved / Goedgekeur	Rejected / Afgekeur
X	

HEAD OF SCHOOL / HOOF VAN DIE SKOOL

SIGNATURE / HANDTEKENING — DATE / DATUM: 02-11-12

COMMENTS / KOMMENTAAR:

B.

Approved / Goedgekeur	Rejected / Afgekeur
X	

DEAN OF THE FACULTY / DEKAAN VAN DIE FAKULTEIT

SIGNATURE / HANDTEKENING — DATE / DATUM: 5/11/12

COMMENTS / KOMMENTAAR:

C.

Approved / Goedgekeur	Rejected / Afgekeur
X	

VICE-RECTOR: ACADEMIC VISE-REKTOR: AKADEMIES /

SIGNATURE / HANDTEKENING — DATE / DATUM/: 9/11/12

COMMENTS / KOMMENTAAR:

D. Not applicable

If research will include students on campus and if questionnaires will be distributed in hostels on campus the Dean: Student Affairs has to be notified. /
Wanneer studente op kampus by navorsing ingesluit gaan word en wanneer vraelyste versprei gaan word by koshuise moet die Dekaan: Studente Aangeleenthede in kennis gestel word.

APPENDIX B

(INCLUDING APPENDIX B1)

APPENDIX B1: ETHICS COMMITTEE UCT 2013 APPROVAL LETTER

APPENDIX B1

UNIVERSITY OF CAPE TOWN

Faculty of Health Sciences
Human Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • **Facsimile** [021] 406 6411
e-mail: shuretta.thomas@uct.ac.za
Website: www.health.uct.ac.za/research/humanethics/forms

18 February 2013

HREC REF: 070/2013

Dr M G Nel
c/o Dr J Bezuidenhout
P O Box 38819
Langenhovenpark
Bloemfontein
9330

Dear Dr Nel

PROJECT TITLE: GUIDELINES FOR UNDER GRADUATE NUCLEAR MEDICINE EDUCATION IN THE MBChB PROGRAMMES IN SOUTH AFRICA

Thank you for submitting your request to the Faculty of Health Sciences Human Research Ethics Committee for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year till the 15th February 2014

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/research/humanethics/forms)

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC. REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN ETHICS
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938
This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.
The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

s.thomas

APPENDIX C

(INCLUDING APPENDICES C1-C9)

APPENDIX C1: APPROVAL REQUEST TO UNIVERSITY OF THE FREE STATE

APPENDIX C2: APPROVAL FROM UNIVERSITY OF THE FREE STATE

APPENDIX C3: APPROVAL FROM UNIVERSITY OF PREORIA

APPENDIX C4: APPROVAL FROM UNIVERSITY OF THE WITWATERSRAND

APPENDIX C5: APPROVAL FROM UNIVERSITY OF LIMPOPO (MEDUNSA)

APPENDIX C6: APPROVAL FROM UNIVERSITY OF STELLENBOSCH

APPENDIX C7: REQUEST TO WALTER SISULU UNIVERSITY

APPENDIX C8: APPROVAL FROM EASTERN CAPE PROVINSIAL HOSPITAL

APPENDIX C9: APPROVAL FROM INKOSI ALBERT LUTHULI CENTRAL HOSPITAL

APPENDIX C1

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

2 NOVEMBER 2012

Dekaan: Fakulteit Gesondheidswetenskappe Universiteit van die Vrystaat
2012 -11- 07
Dean: Faculty of Health Sciences University of the Free State

Prof G. J. van Zyl
Dean of the Faculty of Health Sciences
University of the Free State
Bloemfontein

Application: For permission to continue with the research study and collecting data from two academic Nuclear Medicine physicians, three post graduate students in Nuclear Medicine as well as two post graduate Radiology registrars, who are qualified Nuclear Medicine physicians.

Request: For your identification of a key person in your Institution's Department of Nuclear Medicine, who are primarily responsible and involved with the under graduate medical Nuclear Medicine educational module, to answer questions regarding the structure and contents of the module.

TITLE: GUIDELINES FOR UNDER GRADUATE NUCLEAR MEDICINE EDUCATION IN THE M.B.,Ch.B. PROGRAMMES IN SOUTH AFRICA.

Dear Prof van Zyl,

I would like to ask for permission to continue with the above-mentioned research study and to collect data from the following academic Nuclear Medicine physicians and post graduate students, as part of the Magister Degree in Health Professions Education. M. (HPE)

[redacted]

[redacted]

My study leaders are:

1. Dr Johan Bezuidenhout, Division Health Sciences Education, Office of the Dean, Faculty of Health Sciences, University of the Free State.
2. Dr Saretha Brüssow, Directorate for Institutional Research and Academic Planning, (DIRAP), University of the Free State.

Due to the poor quality and inadequacy of referral letters to the local Nuclear Medicine Department, the need was identified to ensure empowerment of newly qualified doctors to utilise Nuclear Medicine imaging procedures more effectively. Not all of the newly qualified doctors completed their medical studies at the School of Medicine (SoM), Faculty of Health Sciences (FHS) at the University of the Free State (UFS). These problems urged the researcher to investigate the current Nuclear Medicine educational trends for under graduate medical students in the respective Schools of Medicine in South Africa (SA).

Only six, of the eight, Schools of Medicine in SA, are currently involved in medical Nuclear Medicine educational programmes. Nuclear Medicine is traditionally taught on post graduate level and no nationally accepted under graduate medical Nuclear Medicine educational guidelines currently exist.

The researcher intends to investigate the existing under graduate medical Nuclear Medicine modules (or the absence of such under graduate modules), to identify mutual educational problems. The aim of this study is to develop guidelines for an effective, nationally accepted, under graduate medical Nuclear Medicine educational module, to ensure that all medical students and future medical interns will be exposed to the same level of under graduate Nuclear Medicine education.

The research questions that need to be answered are the following:

WHY is it necessary to implement an under graduate medical Nuclear Medicine educational module in the South African M.B.,Ch.B. programme?
WHEN will be the most effective time, to introduce such a basic Nuclear Medicine module, in the already overloaded under graduate M.B.,Ch.B. programme? (pre-clinical or clinical phase)
WHICH Nuclear Medicine topics will be the most appropriate to be taught on an under graduate level?
WHAT must the contents of each subject be on the under graduate level?
BY WHOM must this course be taught? (Nuclear Medicine physicians or other clinical physicians during ward rounds)
HOW must the under graduate Nuclear Medicine module be presented? (educational and assessment strategies and methods)
WHICH WAY? Integrated with other clinical departments, as an independent department or a combination of both?

The Deans of the respective Faculties of Health Sciences in South Africa, will be asked to identify a key person, who is primarily responsible for the under graduate medical Nuclear Medicine education, to complete the main questionnaire on their Department's under graduate educational module.

[redacted]

The same questionnaire will be shortened to only three sections, excluding the sections on the departmental educational module, and electronically distributed to all the other academic and private Nuclear Medicine experts in SA.

I would then like to request your permission to continue with this research study and to have access to the academic Nuclear Medicine physicians and the post graduate Nuclear Medicine and Radiology registrars.

I would also appreciate your identification of the key person, who is responsible and involved with the under graduate medical Nuclear Medicine module in the SoM, FHS at UFS, to answer questions regarding the module.

I would like to thank you and trust that my request will receive your favourable consideration.

Yours faithfully

MG Nel

Dr M G Nel (Riana)
Staff number: 0857953
Student number: 1977308020
Cell phone number: 0828018203
Work number: 051-4053487/8
Email: nelmg@ufs.ac.za

ATTACHMENTS:

a) The application form for ethical approval to conduct this research, from the Ethics Committee of the FHS, at UFS.

b) The protocol for the above-mentioned research study.

APPENDIX C2

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

Dekaan:
Fakulteit Gesondheidswetenskappe
Universiteit van die Vrystaat
2013 -01- 17
Dean: Faculty of Health Sciences
University of the Free State

16/01/2013

Dear Prof GJ van Zyl

Application: For permission to continue with research study and collecting data & request: for your identification of a key person

A letter received from Dr Riana Nel regarding the above request refers:

I had a discussion with Dr Riana Nel last week and she explained her research study to me. I hereby approved the request to nominate Dr U Snyman as the contact person in our Faculty to assist Dr Riana Nel with her research study on condition that the mentioned responsibilities do not interfere with her current responsibilities and workload.

I hope your find the above mentioned in order

Kind regards

Prof WH Kruger
(Acting Head) School of Medicine

Approved
17/1/13

205 Nelson Mandela Drive/Rylaan | Park West/Parkwes | Bloemfontein 9301 | South Africa/Suid-Afrika
P.O. Box/Posbus 339 | Bloemfontein 9300 | South Africa/Suid-Afrika | T: +27(0)51 401 9111 | www.ufs.ac.za

APPENDIX C3

On Thu, Dec 6, 2012 at 7:51 AM, Eric Buch <Eric.Buch@up.ac.za> wrote:
Dear Riana

Your request and the accompanying documentation refers. As Dean I am happy to give you permission to conduct the study subject to individual informed consent of the HOD of Nuclear Medicine, [redacted] and the individual respondents. [redacted], copied in on this e mail will be your contact person at UP in the first instance and he can decide if he wants to delegate this responsibility to anyone else.

Kind regards

Eric Buch

Professor Eric Buch
Dean, Faculty of Health Sciences
Professor, Health Policy and Management
University of Pretoria

Tel (w) +27-12-354-2386
Tel (m) +27-83-391-6962
Fax +27-12-329-1351
Private Bag X323, Arcadia, 0007,
South Africa

>>> Riana Nel <gnknmgn@gmail.com> 2012/12/06 10:49 AM >>>
Dear Prof Buch,

I am currently working on an extended mini-dissertation in the partial fulfillment of a structured Master's Degree in Health Professions Education
at the Faculty of Health Sciences, University of the Free State (Student
number: 1977308020). The protocol has been approved by the Ethics Committee, Faculty of Health Sciences at University of the Free State on
the 27 November 2012 and the ECUFS number is 198/2012. (*see the attached
documents, please*)

TITLE: GUIDELINES FOR UNDER GRADUATE NUCLEAR MEDICINE EDUCATION IN THE

M.B.,Ch.B. PROGRAMMES IN SOUTH AFRICA

I would like to ask for permission to collect data and opinions from the
academic Nuclear Medicine physicians, medical officers, radio-pharmacists
and the post graduate Nuclear Medicine registrars from your Institution.

I would also appreciate your *identification of the key person*, who is
responsible and involved with the under graduate medical Nuclear

Medicine
educational module to answer questions regarding the module. It is very
important to emphasise that the Head of the Nuclear Medicine Department, is
not necessarily the key person, and he/she can be asked to assist the Dean
in appointing the specific person.

I would like to thank you for your attention and consideration of
my request.

Yours faithfully

Dr M G Nel (Riana)

Principle Medical Officer/Lecturer

Department of Nuclear Medicine

Faculty of Health Sciences, School of Medicinne

University of the Free State

Staff number: 0857953

Student number: 1977308020

Cell phone number: 0828018203

Work number: 051-4053487/8

Email: nelmg@ufs.ac.za

APPENDIX C4

Ahmed A. Wadee
Dean: Faculty of Health Sciences
University of the Witwatersrand, Johannesburg
Private Bag 3, Wits, 2050, South Africa •Tel: +27(0)11 717 2555 •Email: ahmed.wadee@wits.ac.za • www.wits.ac.za

18th January 2013

Dr M G Nel
University of the Free State
Faculty of the Health Sciences

By email

Dear Dr Nel

As per your request dated 5th December, permission is hereby granted to have access to information and collect data and opinions from the academic Nuclear medicine physicians and post graduate Nuclear medicine students.

[redacted] is the contact person for Nuclear Medicine and her contact details are:
Telephone: [redacted]
Email: [redacted]

[redacted] should communicate with the post graduate students concerned, and facilitate your access to them in order to ensure that confidentiality of student information is maintained.

Yours sincerely

AA Wadee
Dean : Faculty of the Health Sciences

[redacted]

Professor of Immunology
• Cell: +27(0)82 807 2628 • Email: reubs@hixnet.co.za
• P.O.Box 3485,Cresta, 2118

FACULTY OF HEALTH SCIENCES

APPENDIX C5

University of Limpopo
OFFICE OF THE EXECUTIVE DEAN
FACULTY OF HEALTH SCIENCES
PO Box 201, MEDUNSA, 0204,SOUTH AFRICA
Tel: +27 12 521 4961, Fax: +27 12 560 0018, E-Mail: marie@ul.ac.za

15 April 2013

Dr R Nel
Department of Nuclear Medicine

Tel: 051 405 3488
Cell: 082 801 8203

Dear Dr Nel

RE : RESEARCH PROJECT

Following consultation with [redacted] of the Department of Nuclear Medicine at the Dr George Mukhari Hospital, University of Limpopo – Medunsa Campus, and having received the relevant information you requested from his office, as Executive Dean, I hereby grant permission that UL – Medunsa's Department of Nuclear Medicine participate in the Research project that you intend to undertake.

Regards

PROF EA HOLLAND
EXECUTIVE DEAN: FACULTY OF HEALTH SCIENCES
/mdp

From: To:*90514445250 15/04/2013 15:18 #390 P.001/001

Department of Nuclear Medicine

University of Limpopo – Medunsa Campus / Dr George Mukhari Complex
2nd Floor, ClinPath Building, Medunsa Tel: (012) 521 5753/5865 Fax: (012) 521 4604

15 April 2013

Dr Nel
Department of Nuclear Medicine
Free State University
Fax: (051) 444 5250
Tel: (051) 405 3488

Dear Dr Nel

Re: Research Project

The Department of Nuclear Medicine at University of Limpopo/Dr George Mukhari Hospital expresses willingness to participate in your research project.

Regards

[redacted]

[redacted]

APPENDIX C6

Gmail by Google

Riana Nel <gnknmgn@gmail.com>

Requesting permission to conduct research (for M.HPE) at your Institution

Volmink, Jimmy, Prof <jvolmink@sun.ac.za> <jvolmink@sun.ac.za> Mon, Mar 25, 2013 at 8:33 AM
To: "gnknmgn@gmail.com" <gnknmgn@gmail.com>
Cc: "[redacted]

Dear Dr Nel

I am pleased to provide my approval for your study to be conducted at the FMHS, Stellenbosch University.

You may liaise further with [redacted], Head: Division of Nuclear Medicine in this regard.

Allow me at the same time to wish you every success with the completion of your project and its subsequent publication.

Kind regards, Jimmy

****

Prof Jimmy Volmink
Dean/Dekaan
Faculty of Medicine and Health Sciences/Fakulteit Geneeskunde en Gesondheidswetenskappe
Stellenbosch University/Universiteit Stellenbosch
Tel: 021 938-9200 Faks/Fax: 021 931-8100
****
"Man's capacity for justice makes democracy possible, but man's inclination to injustice makes democracy necessary." **Reinhold Niebuhr**

From: [redacted]
Sent: 20 March 2013 04:47 PM
To: Volmink, Jimmy, Prof <jvolmink@sun.ac.za>
Subject: Requesting permission to conduct research (for M.HPE) at your Institution

From: Riana Nel [mailto:gnknmgn@gmail.com]
To: Volmink, JA, Prof <deanfhs@sun.ac.za>
Subject: Re: Requesting permission to conduct research (for M.HPE) at your Institution

Beste [redacted], Baie dankie vir die terugvoer. Sal dit net groot asb moontlik wees dat Prof Volmink vir my (sommer email) in sy naam as Dekaan net die toestemming gee sodat ek dit aan ons etiese komitee kan voorle? Jammer vir ongerief maar dis wat hulle versoek het.

Waardeer julle hulp in die verband
Groete

Riana Nel
Kerngeneeskunde Dept
Universitas Hospitaal
Bloemfontein

Beste dr Nel

[Quoted text hidden]

Subject: Requesting permission to conduct research (for M.HPE) at your Institution

Dear Prof Volminck,

I am currently working on an extended mini-dissertation in the partial fulfillment of a structured Master's Degree in Health Professions Education at the Faculty of Health Sciences, University of the Free State (Student number: 1977308020). The protocol has been approved by the Ethics Committee, Faculty of Health Sciences at University of the Free State on the 27 November 2012 and the ECUFS number is 198/2012. (**see the attached documents, please**)

TITLE: GUIDELINES FOR UNDER GRADUATE NUCLEAR MEDICINE EDUCATION IN THE M.B.,Ch.B. PROGRAMMES IN SOUTH AFRICA

I would like to ask for permission to collect data and opinions from the academic Nuclear Medicine physicians, medical officers, radio-pharmacists and the post graduate Nuclear Medicine registrars from your Institution.

I would also appreciate your **identification of the key person**, who is responsible and involved with the under graduate medical Nuclear Medicine educational module to answer questions regarding the module. It is very important to emphasise that the Head of the Nuclear Medicine Department, is not necessarily the key person, and he/she can be asked to assist the Dean in appointing the specific person.

I would like to thank you for your attention and consideration of my request.

Yours faithfully

Dr M G Nel (Riana)

Principle Medical Officer/Lecturer

Department of Nuclear Medicine

Faculty of Health Sciences, School of Medicinne

University of the Free State

Staff number: 0857953

Student number: 1977308020

Cell phone number: 0828018203

Work number: 051-4053487/8

Email: nelmg@ufs.ac.za

APPENDIX C7

---------- Forwarded message ----------
From: **Riana Nel** <gnknmgn@gmail.com>
Date: Thu, Dec 6, 2012 at 6:52 AM
Subject: Requesting permission to do research (for M.HPE) at your Institution
To: kmfenyana@wsu.ac.za

Dear Prof Mfenyana,

I am currently working on an extended mini-dissertation in the partial fulfillment of a structured Master's Degree in Health Professions Education at the Faculty of Health Sciences, University of the Free State (Student number: 1977308020). The protocol has been approved by the Ethics Committee, Faculty of Health Sciences at University of the Free State on the 27 November 2012 and the ECUFS number is 198/2012. (**see the attached documents, please**)

TITLE: GUIDELINES FOR UNDER GRADUATE NUCLEAR MEDICINE EDUCATION IN THE

M.B.,Ch.B. PROGRAMMES IN SOUTH AFRICA

I would like to ask for permission to collect data and opinions from the academic Nuclear Medicine physicians, medical officers, radio-pharmacists and the post graduate Nuclear Medicine registrars from your Institution.

I would also appreciate your **identification of the key person**, who is responsible and involved with the under graduate medical Nuclear Medicine educational module to answer questions regarding the module. It is very important to emphasise that the Head of the Nuclear Medicine Department, is not necessarily the key person, and he/she can be asked to assist the Dean in appointing the specific person.

I would like to thank you for your attention and consideration of my request.

Yours faithfully

Dr M G Nel (Riana)

Principle Medical Officer/Lecturer

Department of Nuclear Medicine

Faculty of Health Sciences, School of Medicinne

University of the Free State

Staff number: 0857953

Student number: 1977308020

Cell phone number: 0828018203

Work number: 051-4053487/8

Email: nelmg@ufs.ac.za

Gmail by Google

Riana Nel <gnknmgn@gmail.com>

Requesting permission to do research (for M.HPE) at your Institution

Riana Nel <gnknmgn@gmail.com>
To: Faith Sonkqayi <fsonkqayi@wsu.ac.za>

Wed, Jan 23, 2013 at 7:42 AM

If you need any other information, please feel free to contact me. Riana

On Wed, Jan 23, 2013 at 6:17 AM, Faith Sonkqayi <fsonkqayi@wsu.ac.za> wrote:

Yes Doc

I got the stuff with about 11 attachments

Faith

>>> Riana Nel <gnknmgn@gmail.com> 2013/01/23 10:12 AM >>>

Morning Faith! I'm trying again!

Kind Regards
Dr Nel

---------- Forwarded message ----------
From: **Riana Nel** <gnknmgn@gmail.com>
Date: Tue, Jan 22, 2013 at 11:08 AM
Subject: Fwd: Requesting permission to do research (for M.HPE) at your Institution
To: FSonkqaya@wsu.ac.za

Dear Faith,

Here are the original e-mail with ALL the attachment regarding the research project as part of a M.(HPE) degree.

I am aware that WSU School of Medicine don't offer a medical Nuclear Medicine course, but I'm not sure if there is Nuclear Medicine Department in one of your Academic Hospitals?

The UFS ethics committee requested approval of all the Deans of the FoHS before the research can start.(see all the attachments)

If there is Nuclear Medicine Specialists working in your hospitals I would like to have their names and e-mail addresses, and the appointment of a Key person to answer the "Keypersons" questionnaire. All the other Nucl Med doctors will be asked to answer the "experts" questionnaire.

If no Nucl Med doctors are employed in the Academic Hospitals, and no medical Nucl Med course is offered, then I need only a letter from the Dean of the FoHS at WSU, to state it in writing. This letter will then go back to our Ethics committee before I can start with my research.

I would like to thank you for your assisstance
Kind Regards

Dr M G Nel (Riana)
Dept Nuclear Medicine
Universitas Hospital
Bloemfontein

APPENDIX C8

Gmail by Google

Riana Nel <gnknmgn@gmail.com>

Fwd: Application

Riana Nel <gnknmgn@gmail.com> Thu, Mar 14, 2013 at 12:00 PM
To: Robyn May <Robyn.May@impilo.ecprov.gov.za>

Dear Dr May,

I appreciate your approval and I will wait to hear from [redacted] I did speak to him and he know what it is about. I did not want to send his request to participate before I contacted you. If it's right with you I will email his request letter in which the whole study is explained.

He will only answer the shorter questionnaire that does not contain any academic curriculum questions. His contribution will be highly appreciated because there are so few Nuclear medicine physicians in the EC.

Kind regards
Dr M G Nel (Riana)
Dept of Nuclear medicine
Universitas hospital
Bloemfontein

On Thu, Mar 14, 2013 at 11:49 AM, Riana Nel <NelMG@ufs.ac.za> wrote:

---------- Forwarded message ----------
From: "Robyn May" <Robyn.May@impilo.ecprov.gov.za>
To: <nelmg@ufs.ac.za>
Cc:
Date: Thu, 14 Mar 2013 15:33:51 +0200
Subject: Application

Dear Dr Nel

Your application today to get data/opinions from the Nuclear Medicine physicians at PE Provincial hospital refers.
There is only one Nuclear Medicine physician at Provincial - [redacted] - we are not an academic/training institution as far as Nuclear medicine is concerned, and have no Nuclear medicine registrars.
I have sent your request to [redacted] for his consideration - there is no objection to his participation, but obviously he is not obliged to do so. Please liaise further with [redacted] in this regard.
Yours sincerely

Dr R May
Senior Medical Superintendent

Disclaimer:

APPENDIX C9

health

Department:
Health
PROVINCE OF KWAZULU-NATAL

Inkosi Albert Luthuli Central Hospital
Ethekwini Health District
Office of the Medical Manager
Private Bag X 03, Mayville, 4058
800 Bellair Road, Mayville, 4058
Tel.: 031 240 1059,
Fax.: 031 240 1050
Email.:ursulanun@ialch.co.za
www.kznhealth.gov.za

Reference: ECUFS 198/2012
Enquiries: Dr M E L Joshua

20 February 2013

Dr M G Nel
Principle Medical Office/Lecturer
Department of Nuclear Medicine
University of the Free State

Dear Dr Nel

RE: PERMISSION TO CONDUCT RESEARCH AT IALCH

I have pleasure in informing you that permission has been granted to you by the Medical Manager to conduct research on: GUIDELINES FOR UNDER GRADUATE NUCLEAR MEDICINE EDUCATION IN THE M.B.,Ch.B. PROGRAMMES IN SOUTH AFRICA.

Kindly take note of the following information before you continue:

1. Please ensure that you adhere to all the policies, procedures, protocols and guidelines of the Department of Health with regards to this research.
2. This research will only commence once this office has received confirmation from the Provincial Health Research Committee in the KZN Department of Health.
3. Kindly ensure that this office is informed before you commence your research.
4. The hospital will not provide any resources for this research.
5. You will be expected to provide feedback once your research is complete to the Medical Manager.

Yours faithfully

....
Dr M E L Joshua
Medical Manager

uMnyango Wezempilo . Department van Gesondheid

Fighting Disease, Fighting Poverty, Giving Hope

APPENDIX D

(INCLUDING APPENDICES D1-D3)

APPENDIX D1: GENERAL REQUEST TO PARTICIPATE

APPENDIX D2: REQUEST TO KEY PERSONS

APPENDIX D3: REQUEST TO NUCLEAR MEDICINE EXPERTS

APPENDIX D1

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

REQUEST TO PARTICIPATE IN A MAGISTER STUDY

TITLE: GUIDELINES FOR UNDER GRADUATE NUCLEAR MEDICINE EDUCATION IN THE M.B.,Ch.B. PROGRAMMES IN SOUTH AFRICA

Dear Colleague,

I am currently working on an extended mini-dissertation in the partial fulfillment of a structured Master's Degree in Health Professions Education at the Faculty of Health Sciences, University of the Free State (Student number: 1977308020). The protocol has been approved by the Ethics Committee, Faculty of Health Sciences at University of the Free State on 27 November 2012 and the ECUFS number is 198/2012.

The need was identified to ensure empowerment of newly qualified doctors to utilise Nuclear Medicine imaging procedures more effectively. At the beginning of each year, the newly qualified medical interns and community service doctors, experience difficulty in booking and preparing their patients for Nuclear Medicine imaging studies. These problems urged me to investigate the current Nuclear Medicine educational trends for under graduate medical students in the different Schools of Medicine (SoM) in South Africa (SA).

The aim is to develop guidelines for an effective, nationally accepted, under graduate medical Nuclear Medicine educational module, to ensure that all medical students and future medical interns will be exposed to the same level of under graduate Nuclear Medicine education. The value for the under graduate medical students will mainly be empowerment to effectively utilise Nuclear Medicine imaging studies, and not to make them "mini" Nuclear Medicine physicians.

I WOULD LIKE TO REQUEST YOUR PARTICIPATION IN THIS RESEARCH STUDY.

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YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

The questionnaire will be available in English only (for standardisation of the specific themes of opinions and trends used by the participants to give their opinions in the open ended questions) and distributed to participants by email with a hyperlink for online completion and submitting of completed questionnaires. It will take you approximately 45 - 60 min to complete the questionnaire. Detailed instructions will be provided by the EvaSys internet based survey management system. The questionnaire will be distributed early in February 2013 and participants are requested to complete the questionnaires within four (4) weeks after receiving the email.

By completing the provided questionnaire, you will be consenting to participate voluntarily in this research study and to any future publication of the results. Unfortunately participants will not be remunerated for participating in this study. You are also welcome to contact the Secretariat of the Ethics Committee of the Faculty of Health Sciences, UFS at telephone number 051-4052812 if you have questions.

Confidentiality will be kept throughout the study, keeping personal information and participant responses confidential to anybody except myself and my study leaders. You are requested not to discuss the contents of the questionnaire or your responses and opinions with other participants. Your compliance in this regard will be greatly appreciated.

I would like to thank you in advance for your assistance. For any inquiries please feel free to contact me and I will gladly assist you.

Yours sincerely

MG Nel

Dr MG Nel(Rabie) MBChB
Medical Officer gr 3 Nuclear Medicine
MP: 0271772 Tel nr: 082 801 8203

Dr Riana Nel (M.B.,Ch.B. UOVS)
Cell phone number: 0828018203
Work number: 051-4053487/8
Email: nelmg@ufs.ac.za

APPENDIX D2

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

COVER LETTER FOR THE STRUCTURED SURVEY QUESTIONNAIRE DIRECTED AT THE SIX KEY PERSONS

COVER LETTER AND INSTRUCTIONS for the QUESTIONNAIRE ON UNDER GRADUATE NUCLEAR MEDICINE EDUCATION IN THE M.B.,Ch.B. PROGRAMMES IN SOUTH AFRICA.
(KEY ACADEMIC PERSONS)

Dear Colleague,

You were identified, by the Dean of your Institution, as the key person in your Nuclear Medicine Department responsible for the under graduate medical Nuclear Medicine educational module. I would like to thank you for your voluntary participation in this research study.

As previously mentioned your personal information as well as responses to the questions will be kept confidential and anonymous to anybody except the researcher and her supervisors. You are requested not to discuss the contents of the questionnaire or your responses and opinions with other participants. Your co-operation in this regard will be appreciated.

This questionnaire consists of **five (5) sections**:
Section A: Demographic information of the participants
Section B: Your Institution's M.B.,Ch.B. programme and your current under graduate medical Nuclear Medicine module
Section C: Human resources and current educational problems
Section D: Answers to the why, what, how, which and by whom questions
Section E: Nuclear Medicine subjects on an under graduate level.

Department Nuclear Medicine/Departement Kerngeneeskunde
C/S: +27(0)83 704 0719, T: +27(0)51 405 3962, F: +27(0)51 444 5250, E: gnknaco@ufs.ac.za
205 Nelson Mandela Drive/Rylaan, Park West/Parkwes, Bloemfontein 9301, South Africa/Suid-Afrika
P.O. Box/Posbus 339 (G50), Bloemfontein 9300, South Africa/Suid-Afrika, www.ufs.ac.za

Please complete ALL the SECTIONS and follow the instructions for submitting the completed questionnaire. It will take you approximately 60 min (1 hour) to complete the questionnaire. You have four weeks to complete the questionnaire, and your co-operation is **greatly appreciated**.

Yours sincerely

Dr MG Nel

Dr Riana Nel (M.B.,Ch.B., UOVS)
Cell phone number: 0828018203
Work number: 051-4053487/8
Email: nelmg@ufs.ac.za

APPENDIX D3

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

COVER LETTER FOR THE STRUCTURED SURVEY QUESTIONNAIRE DIRECTED TO THE OTHER NUCLEAR MEDICINE EXPERTS IN SA

COVER LETTER AND INSTRUCTIONS FOR THE QUESTIONNAIRE ON UNDER GRADUATE NUCLEAR MEDICINE EDUCATION IN THE M.B.,Ch.B. PROGRAMMES IN SOUTH AFRICA.
(NUCLEAR MEDICINE EXPERTS IN SOUTH AFRICA)

Dear Colleague,

I would like to thank you for your voluntary participation in this research project. As previously mentioned your personal information as well as responses to the questions will be kept confidential and anonymous to anybody except the researcher and her supervisors. You are requested not to discuss the contents of the questionnaire or your responses and opinions with other participants. Your co-operation in this regard will be appreciated.

This questionnaire consists of **three (3)** sections:
Section A: Demographic information of the participant
Section B: Answers to the why, what, how, which and by whom questions
Section C: Nuclear Medicine subjects on an under graduate level.

Please complete ALL the SECTIONS and follow the instructions for submitting the completed questionnaire. It will take you approximately 45 min to complete the questionnaire. You have four weeks to complete the questionnaire, and your co-operation is **greatly appreciated**.

Yours sincerely
Dr Riana Nel (M.B.,Ch.B. UOVS)
Cell phone number: 0828018203 Work number: 051-4053487/8
Email: nelmg@ufs.ac.za

Dr MG Nel
Medical Officer
MP: 0271772 Tel nr

APPENDIX E

(INCLUDING APPENDICES E1-E10)

APPENDIX E1: REQUEST TO PARTICIPATE WITH LINK TO QUESTIONARE

APPENDIX E2: KEY PERSONS' QUESTIONARE

APPENDIX E3: KEY PERSONS' DATA DICTIONARY

APPENDIX E4: NUCLEAR MEDICINE EXPERTS' QUESTIONARE

APPENDIX E5: NUCLEAR MEDICINE EXPERTS' DATA DICTIONARY

APPENDIX E6: NUCLEAR MEDICINE EXPERTS' EXCEL RESULTS

APPENDIX E7: KEY PERSONS' EXCEL RESULTS

APPENDIX E8: *EVASYS* REMINDER LETTER

APPENDIX E9: *EVASYS* FINAL REPORT LETTER

APPENDIX E10: *EVASYS* FINAL REPORT ON STUDY

APPENDIX E1

Gmail by Google

Undergraduate Nuclear Medicine education in the M.B., Ch.B programmes in South Africa

UFS EvaSys Admin <no-reply@ufs.ac.za> Tue, Feb 26, 2013 at 2:03 PM
To: gnknmgn@gmail.com

Dear Colleague,

You were identified, by the Dean of your Institution, as the key person in your Nuclear Medicine Department responsible for the under graduate medical Nuclear Medicine educational module. I would like to thank you for your voluntary participation in this research study.

As previously mentioned your personal information as well as responses to the questions will be kept confidential and anonymous to anybody except the researcher and her supervisors. You are requested not to discuss the contents of the questionnaire or your responses and opinions with other participants. Your co-operation in this regard will be appreciated.

This questionnaire consists of five (5) sections:
Section A: Demographic information of the participants
Section B: Your Institution's M.B.,Ch.B. programme and your current under graduate medical Nuclear Medicine module
Section C: Human resources and current educational problems
Section D: Answers to the why, what, how, which and by whom questions
Section E: Nuclear Medicine subjects on an under graduate level.

Please complete ALL the SECTIONS and follow the instructions for submitting the completed questionnaire. It will take you approximately 60 min (1 hour) to complete the questionnaire. You have four weeks to complete the questionnaire, and your co-operation is greatly appreciated.

Pleasae click on the link below to complete the survey

http://surveys.ufs.ac.za/evasys/indexstud.php?typ=html&user_tan=H3KPZ

Yours sincerely,

Dr Riana Nel (M.B.,Ch.B., UOVS)
Cell phone number: 0828018203
Work number: 051-4053487/8
Email: nelmg@ufs.ac.za

Note: This email has been created automatically. The password indicated in this E-MAIL cannot be traced to you. Your vote is anonymous.

Gmail by Google

Undergraduate Nuclear Medicine Education in M.B.,Ch.B programmes in SA (Nuclear Medicine Experts)

UFS EvaSys Admin <no-reply@ufs.ac.za> Thu, Mar 14, 2013 at 3:29 PM
To: gnknmgn@gmail.com

Beste Kollega,

Die vraelys wat uitgestuur sal word aan die "key academic persons" is voltooi en die loodstudie sal gedoen word sodra ek bevestiging ontvang het dat hierdie vraelys ook reg is. Hierdie vraelys is vir "Nuclear Medicine Experts".

Voltooi asseblief die vraelys deur op die onderstaande link te kliek en stuur asseblief enige kommentaar of versoeke vir veranderinge direk na meintjesa@ufs.ac.za of skakel x9082

http://surveys.ufs.ac.za/evasys/online.php?pswd=PC1DV

Groete,
Anneri

Note: This email has been created automatically. The password indicated in this E-MAIL cannot be traced to you. Your vote is anonymous.

EvaSys	Under Graduate Medical Nuclear Medicine Education (Key Academic Persons)	Electric Paper

University of the Free State Dr. M.G. Nel

Mark as shown: ☐ ☒ ☐ ☐ ☐ Please use a ball-point pen or a thin felt tip. This form will be processed automatically.
Correction: ☐ ■ ☐ ☒ ☐ Please follow the examples shown on the left hand side to help optimize the reading results.

1. Instructions

Please complete ALL THE SECTIONS by selecting the appropriate option, and write your answers and opinions in the provided space.

2. SECTION A: DEMOGRAPHIC INFORMATION

2.1 Name your School of Medicine

2.2 Academic position of the respondent
☐ Head of Nuclear Medicine department ☐ Nuclear Medicine specialist ☐ Post graduate Nuclear Medicine student
☐ Radiographer ☐ Radio-pharmacist ☐ Other

2.3 If "other"was selected in question 2.2, please specify

2.4 Graduate and post graduate academic qualification of the respondent (you can choose more than one)
☐ MB CHB ☐ M.Sc (Nuclear Medicine) ☐ M Med (Nuclear Medicine)
☐ FCNP (SA) (Nuclear Medicine) ☐ PhD (Nuclear Medicine) ☐ Other

2.5 If "other" was selected in question 2.4, please specify

2.6 Age of the respondent
☐ 25-34 years ☐ 35-44 years ☐ 45-54 years
☐ 55-64 years ☐ 65-74 years

2.7 Gender of the respondent ☐ Male ☐ Female

2.8 Any formal <u>EDUCATIONAL</u> (formal teaching and training education) qualifications of the respondent. Please specify

2.9 <u>EDUCATIONAL</u> (teaching and learning) experience of the respondent. Specify the subjects and state for how long.

3. SECTION B: THE M.B., Ch.B. PROGRAMME & CURRENT UNDER GRADUATE NUCLEAR MEDICINE MODULE

Please note that you may choose more than one option in this section

3.1 What is the total duration of the M.B.Ch.B. programme in your institution (years) ☐ 5 years ☐ 6 years ☐ other

3.2 If you selected other in question 3.1 please specify

What is the duration of the two phases of the M.B.,Ch.B programme in your institution? (in years)

3.3 Pre-clinical years: ☐ 2 years ☐ 3 years ☐ other

3. SECTION B: THE M.B., Ch.B. PROGRAMME & CURRENT UNDER GRADUATE NUCLEAR MEDICINE MODULE [Continue]

3.4 If you selected "other" in question 3.3 please specify

[ ]

3.5 Clinical years: ☐ 2 years ☐ 3 years ☐ other

3.6 If you selected other in question 3.5 please specify

[ ]

3.7 In which year(s) do medical students encounter the Nuclear Medicine education? (choose more than one if applicable)

☐ Pre-clinical years ☐ Clinical years ☐ Both phases
☐ Other

3.8 If "other"was selected in question 3.7 please specify

[ ]

3.9 How is the Nuclear Medicine module presented? (more than one option may be selected if a combination of the options are applicable)

☐ As part of a formal curriculum ☐ Only an occasional presentation ☐ As part of an integrated teaching and learning
☐ Another combination

3.10 If the 'another combination' option was selected in question 3.9, please specify

[ ]

3.11 If the Nuclear Medicine module was presented in any other way than mentioned in question 3.9 please specify

[ ]

3.12 How is the under graduate Nuclear Medicine teaching structured?

☐ As an independent discipline with own lecturing time AND formal assessment
☐ As an independent discipline with own lecturing time WITHOUT formal assessment
☐ As part of another clinical or diagnostic discipline (Internal Medicine, Surgery, Oncology or Radiology)
☐ Hybrid type (any combination of abovementioned)
☐ Other method

3.13 If "other" was selected in 3.12 please specify

[ ]

For questions **3.14 - 3.18** please specify how many hours per year are being spent on under graduate Medical Nuclear Medicine education in the <u>pre-clinical years</u>

3. SECTION B: THE M.B., Ch.B. PROGRAMME & CURRENT UNDER GRADUATE NUCLEAR MEDICINE MODULE [Continue]

3.14 Formal Nuclear Medicine lectures

3.15 Practical sessions in the Department

3.16 Formal Assessment

3.17 Feedback from and to the students

3.18 Any E-Learning methods

3.19 Please specify which E-Learning method (if question 3.18 was applicable)

3.20 Specify the hours spent in the **FIRST** year

3.21 Specify the hours spent in the **SECOND** year

3.22 Specify the hours spent in the **THIRD** year

3.23 Others (please specify)

For questions **3.24 - 3.28** please specify how many hours per year are being spent on under graduate Medical Nuclear Medicine education in the clinical years?

3.24 Formal Nuclear Medicine lectures

3.25 Practical Sessions in the Department

3.26 Formal Assessment

3.27 Feedback from and to students

3.28 Any E-learning methods

3.29 Please specify which E-learning method (if question 3.28 was applicable)

3.30 Specify the hours spent in the **THIRD** year

3. SECTION B: THE M.B., Ch.B. PROGRAMME & CURRENT UNDER GRADUATE NUCLEAR MEDICINE MODULE [Continue]

3.31 Specify the hours spent in the **FOURTH** year

3.32 Specify the hours spent in the **FIFTH** year

3.33 Specify the hours spent in the **SIXTH** year

3.34 Other (please specify)

3.35 Which Nuclear Medicine Resources are available for the students? (Choose more than one if applicable)

- ☐ Departmental specific workbooks
- ☐ Formal lectures in other printed format
- ☐ Practical session hand outs
- ☐ E-learning facilities
- ☐ Nuclear Medicine textbooks in the Library
- ☐ Self-directed learning opportunities e.g. individual or group assignments
- ☐ Others

3.36 Which teaching methods and strategies are being used? (Choose more than one if applicable)

- ☐ Formal structured (teacher centred) lectures without active student interaction or participation
- ☐ More student-orientated lectures with active student participation (e.g. PBL or case studies)
- ☐ Practical sessions in the Department for observation alone
- ☐ Practical sessions in the Department with active participation and case study presentation
- ☐ E-Learning as part of practical sessions
- ☐ Elective possibilities in Nuclear Medicine
- ☐ Others

3.37 Which FORMATIVE assessment methods are being used? (choose more than one if applicable)

- ☐ Written assignments
- ☐ Oral presentations
- ☐ Case studies
- ☐ None
- ☐ Others

3.38 If "others" was selected in 3.37 please specify

3.39 Which SUMMATIVE assessment methods are being used? (choose more than one if applicable)

- ☐ Oral presentations
- ☐ Portfolio with case studies
- ☐ Written test/exam
- ☐ MCQ's
- ☐ OSCE
- ☐ None
- ☐ Others

3.40 If "others" was selected in 3.39 please specify

3.41 Does this module contribute any credits towards another module in the M.B.,Ch.B. programme? ☐ Yes ☐ No

3.42 Please specify

3. SECTION B: THE M.B., Ch.B. PROGRAMME & CURRENT UNDER GRADUATE NUCLEAR MEDICINE MODULE [Continue]

3.43 Which Nuclear Medicine topics are currently included in your under graduate course? (lectures and practical sessions)

4. SECTION C: HUMAN RESOURCES AND EDUCATIONAL PROBLEMS

4.1 Who is teaching the medical students clinical Nuclear Medicine imaging? (choose more than one if applicable)

- ☐ Head of the Nuclear Medicine Department
- ☐ Nuclear Medicine Specialist
- ☐ Nuclear Medicine Registrar
- ☐ Nuclear Medicine medical officer
- ☐ Radiographer
- ☐ Medical Physicist
- ☐ Radiologists
- ☐ Radio-Pharmacist
- ☐ Other medical personnel in Nuclear Medicine

4.2 If *"other medical personnel in Nuclear Medicine"* was selected in question 4.1 please specify

4.3 Medical personnel in other Clinical Departments (please specify)

4.4 Any others (please specify)

4.5 How many teachers/lecturers are involved?

- ☐ One dedicated teacher/lecturer
- ☐ Two dedicated teachers/ lecturers
- ☐ Other

4.6 Please specify

For question 4.7 - 4.11 explain how the following factors affect the medical under graduate eduaction in your Department? (Please explain and specify in your own words)

4.7 Clinical service delivery load

4.8 Staff shortages

4.9 The applicablility of an undergraduate medical Nuclear Medicine module

4. SECTION C: HUMAN RESOURCES AND EDUCATIONAL PROBLEMS [Continue]

4.10 Problems you may encounter with the M.B.,Ch.B. PHASE (s) in which students are getting their Nuclear Medicine education

4.11 The lack of specific guidelines for an UNDER GRADUATE medical Nuclear Medicine module

5. SECTION D: IMPORTANT RESEARCH QUESTIONS WHICH NEED ANSWERING (WHY, WHEN, WHICH TOPICS, WHAT, BY WHOM, HOW AND IN WHICH WAY?)

Please answer, explain, motivate and specify in your own words

5.1 Do you think it is necessary to implement an UNDER GRADUATE Medical Nuclear Medicine educational module? ☐ Yes ☐ No

5.2 Why/ why not?

5.3 WHEN will be the most effective time in the UNDER GRADUATE M.B.,CH.B curriculum to introduce a basic Nuclear Medicine module?

5.4 WHICH basic Nuclear Medicine topics will be the most appropriate to be taught on an UNDER GRADUATE level?

5.5 WHAT must the extent of contents of each subject be? (on the UNDER GRADUATE level) Please motivate

5. SECTION D: IMPORTANT RESEARCH QUESTIONS WHICH NEED ANSWERING (WHY, WHEN, WHICH TOPICS, WHAT, BY WHOM, HOW AND IN WHICH WAY?) [Continue]

5.6 BY WHOM must this course be presented? (Nuclear Medicine physicians or other clinical physicians) Please motivate

5.7 HOW must the UNDER GRADUATE Nuclear Medicine course be presented? (the educational strategies and methods)

5.8 HOW must the UNDER GRADUATE Nuclear Medicine course be assessed? (assessment strategies and methods)

5.9 IN WHICH WAY must the UNDER GRADUATE Nuclear Medicine course be presented? (Integrated with other clinical departments; as an independent department or a combination of both?)

5.10 Any other opinions or important factors to be taken into consideration when implementing the specific guidelines for such a module?

6. SECTION E: MEDICAL NUCLEAR MEDICINE COURSE CONTENT ON AN UNDER GRADUATE LEVEL

Please give a clear indication of the topics which could fit into an UNDER GRADUATE or PRIMARY LEVEL Nuclear Medicine module)

		Essential	Useful	Not needed
	BASIC SCIENCE (Anatomy, Physiology and Physics)			
6.1	To be presented as part of the Nuclear Medicine course	☐	☐	☐
6.2	JUST refer back to the previously acquired knowledge	☐	☐	☐
	BASIC INTRODUCTION TO NUCLEAR MEDICINE			
6.3	Radio-activities and tracers	☐	☐	☐
6.4	Gamma cameras and counters	☐	☐	☐

6. SECTION E: MEDICAL NUCLEAR MEDICINE COURSE CONTENT ON AN UNDER GRADUATE LEVEL [Continue]

6.5 Clinical applications and costs	☐	☐	☐
6.6 Radiation protection	☐	☐	☐
THE BASIC CLINICAL APPLICATIONS OF:			
6.7 Bonescan	☐	☐	☐
6.8 Liver/Spleen scan	☐	☐	☐
6.9 Hepatico-Biliary/ Hida scan	☐	☐	☐
6.10 Brain perfusion imaging	☐	☐	☐
6.11 CSF Leakage detection	☐	☐	☐
6.12 Salivary gland scans	☐	☐	☐
6.13 Thyroid imaging	☐	☐	☐
6.14 RAI Thyroid therapy	☐	☐	☐
6.15 MIBI Parathyroid scans	☐	☐	☐
6.16 Neuro-endocrine studies	☐	☐	☐
6.17 Lung perfusion	☐	☐	☐
6.18 Lung ventilation	☐	☐	☐
6.19 Venogram (legs)	☐	☐	☐
6.20 Venogram (arms)	☐	☐	☐
6.21 Renograms	☐	☐	☐
6.22 Infection imaging techniques	☐	☐	☐
6.23 Tumour imaging techniques	☐	☐	☐
6.24 RN Mammography	☐	☐	☐
6.25 Sentinel node detection	☐	☐	☐
6.26 Octreoscans	☐	☐	☐
6.27 Gallium studies	☐	☐	☐
6.28 Testicular imaging	☐	☐	☐
6.29 Cardio-vascular imaging	☐	☐	☐
6.30 First pass/cardiac flow	☐	☐	☐
6.31 Ejection fractions	☐	☐	☐
6.32 Myo-Cardiac perfusion studies	☐	☐	☐
6.33 Gastric emptying studies	☐	☐	☐
6.34 GIT Bleeding studies	☐	☐	☐
6.35 Milk scans	☐	☐	☐
6.36 Meckel's Diverticulum detection	☐	☐	☐
6.37 Lympho-Scintigrams	☐	☐	☐
6.38 Other RN Therapies (e.g. MIBG)	☐	☐	☐
6.39 SPECT and SPECT/CT	☐	☐	☐
6.40 PET and PET/CT	☐	☐	☐
6.41 Necessity for such an under graduate module?	☐	☐	☐
6.42 Necessity for standardised guidelines for such a module?	☐	☐	☐

THANK YOU FOR SUBMITTING THE COMPLETED QUESTIONNAIRE

APPENDIX E3

Nuclear Medicine Study (Key Persons)

Data Dictionary

Variable Name	Variable Value	Valid Values
Sheet	Participant Number	Number
Timestamp	Time questionnaire was completed	Time
SECTION A: DEMOGRAPHIC INFORMATION		
2.1	Name your School of Medicine	Text
2.2	Academic position of the respondent	1 = Head of Nuclear Medicine Department
		2 = Nuclear Medicine Specialist
		3 = Postgraduate Nuclear Medicine Student
		4 = Radiographer
		5 = Radio-pharmacist
		6 = Other
2.3	If "other" was selected in previous question, please specify	Text
Graduate and postgraduate academic qualification of the respondent (you can choose more than one)		
2.4.1	MB CHB	0 = No
		1 = Yes
2.4.2	M.Sc (Nuclear Medicine)	0 = No
		1 = Yes
2.4.3	M.Med (Nuclear Medicine)	0 = No
		1 = Yes
2.4.4	FCNP (SA)(Nuclear Medicine)	0 = No
		1 = Yes
2.4.5	PhD (Nuclear Medicine)	0 = No
		1 = Yes
2.4.6	Other	0 = No
		1 = Yes
2.5	If "other" was selected in previous question, please specify	Text
		1 = 25 - 34 years

			5 = 65 - 74 years
2.7		Gender of respondent	1 = Male 2 = Female
2.8		Any formal educational (formal teaching and training education) qualifications of the respondent. Please specify	Text
2.9		Educational (teaching and learning) experience of the respondent. Specify the subjects and state for how long	Text
SECTION B: THE MB.CH.B. PROGRAMME & CURRENT UNDERGRADUATE NUCLEAR MEDICINE MODULE			
3.1		What is the total duration of the M.B.Ch.B programme in your institution (years)	1 = 5 years 2 = 6 years 3 = other
3.2		If you selected other in the previous question, please specify	Text
What is the duration of the two phases of the M.B.Ch.B programme in your institution? (in years)			
3.3		Pre-clinical years	1 = 2 years 2 = 3 years 3 = other
3.4		If you selected other in the previous question, please specify	Text
3.5		Clinical years	1 = 2 years 2 = 3 years 3 = other
3.6		If you selected other in the previous question, please specify	Text
3.7 In which year(s) do medical students encounter the Nuclear Medicine education? (choose more than one if applicable)			
3.7.1		Pre-clinical years	0 = No 1 = Yes
3.7.2		Clinical years	0 = No 1 = Yes
3.7.3		Both phases	0 = No 1 = Yes
3.7.4		Other	0 = No 1 = Yes

3.8		If you selected other in the previous question, please specify		Text
3.9 How is the Nuclear Medicine module presented?				
3.9.1		As part of a formal curriculum		0 = No
				1 = Yes
3.9.2		Only an occasional presentation		0 = No
				1 = Yes
3.9.3		As part of an integrated teaching and learning		0 = No
				1 = Yes
3.9.4		Another combination		0 = No
				1 = Yes
3.10		If "another combination" option was selected, please specify		Text
3.11		If the Nuclear Medicine module was presented in any other way than mentioned in question 3.9, please specify		Text
3.12		How is the undergraduate Nuclear Medicine teaching structured		1 = As an independent discipline with own lecturing time **and** formal assessment
				2 = As an independent discipline with own lecturing time **without** formal assessment
				3 = As part of another clinical or diagnostic discipline (internal medicine, surgery, oncology or radiology)
				4 = Hybrid type (any combination of abovementioned)
				5 = Other method
3.13		If you selected other in the previous question, please specify		Text
For questions 3.14 - 3.18 please specify how many hours per year are being spent on undergraduate Medical Nuclear Medicine education in the PRE-CLINICAL years				
3.14		Formal Nuclear Medicine lectures		Text
3.15		Practical sessions in the department		Text
3.16		Formal Assessment		Text
3.17		Feedback from and to the students		Text
3.18		Any E-learning methods		Text
3.19		Please specify which E-learning method (if 3.18 was applicable)		Text

3.20		Specify the hours spent in the FIRST year	Text
3.21		Specify the hours spent in the SECOND year	Text
3.22		Specify the hours spent in the THIRD year	Text
3.23		Others (please specify)	Text
For questions 3.14 - 3.18 please specify how many hours per year are being spent on undergraduate Medical Nuclear Medicine education in the CLINICAL years			
3.24		Formal Nuclear Medicine lectures	Text
3.25		Practical sessions in the department	Text
3.26		Formal Assessment	Text
3.27		Feedback from and to the students	Text
3.28		Any E-learning methods	Text
3.29		Please specify which E-learning method (if 3.28 was applicable)	Text
3.30		Specify the hours spent in the THIRD year	Text
3.31		Specify the hours spent in the FOURTH year	Text
3.32		Specify the hours spent in the FIFTH year	Text
3.33		Specify the hours spent in the SIXTH year	Text
3.34		Others (please specify)	Text
3.35 Which Nuclear Medicine Resources are available for the students (more than one option may be selected)			
3.35.1		Departmental specific workbooks	0 = No 1 = Yes
3.35.2		Formal lectures in other printed format	0 = No 1 = Yes
3.35.3		Practical session hand outs	0 = No 1 = Yes
3.35.4		E-Learning facilities	0 = No 1 = Yes
3.35.5		Nuclear Medicine textbooks in the Library	0 = No 1 = Yes
3.35.6		Self-directed learning opportunities e.g. individual/ group assignments	0 = No 1 = Yes
3.35.7		Others	0 = No 1 = Yes
3.36 Which teaching methods and strategies are being used (more than one option may be selected)			
3.36.1		Formal structured (teacher centred) lectures without active student interaction/ participation	0 = No 1 = Yes
3.36.2		More student-orientated lectures with active student	0 = No

3.36.2		participation (e.g. PBL or case studies)	1 = Yes
3.36.3		Practical sessions in the Department for obervation alone	0 = No 1 = Yes
3.36.4		Practical sessions in the Department with active participation and case study presentation	0 = No 1 = Yes
3.36.5		E-Learning as part of practical sessions	0 = No 1 = Yes
3.36.6		Elective possibilities in Nuclear Medicine	0 = No 1 = Yes
3.36.7		Others	0 = No 1 = Yes
3.37 Wich FORMATIVE assessment methods are being used? (more than one option may be selected)			
3.37.1		Written assignments	0 = No 1 = Yes
3.37.2		Oral presentations	0 = No 1 = Yes
3.37.3		Case studies	0 = No 1 = Yes
3.37.4		None	0 = No 1 = Yes
3.37.5		Others	0 = No 1 = Yes
3.38		If you selected other in the previous question, please specify	Text
3.39 Wich SUMMATIVE assessment methods are being used? (more than one option may be selected)			
3.39.1		Oral presentations	0 = No 1 = Yes
3.39.2		Portfolio with case studies	0 = No 1 = Yes
3.39.3		Written test/exam	0 = No 1 = Yes
3.39.4		MCQ's	0 = No 1 = Yes
3.39.5		OSCE	0 = No 1 = Yes
3.39.6		None	0 = No 1 = Yes

3.39.7		Others		0 = No
				1 = Yes
3.40		If you selected other in the previous question, please specify		Text
3.41		Does this module contribute any credits towards another module in the M.B.Ch.B programme		1 = Yes
				2 = No
3.42		Please specify (If "yes" was selected in previous question)		Text
3.43		Which Nuclear Medicine topics are currently included in your undergraduate course (lectures and practical sessions)		Text
SECTION C: HUMAN RESOURCES AND EDUCATIONAL PROBLEMS				
4.1 Who is teaching the medical students clinical Nuclear Medicine imaging? (more than one option may be selected)				
4.1.1		Head of the Nuclear Medicine Department		0 = No
				1 = Yes
4.1.2		Nuclear Medicine Specialist		0 = No
				1 = Yes
4.1.3		Nuclear Medicine Registrar		0 = No
				1 = Yes
4.1.4		Nuclear Medicine medical officer		0 = No
				1 = Yes
4.1.5		Radiographer		0 = No
				1 = Yes
4.1.6		Medical Physicist		0 = No
				1 = Yes
4.1.7		Radiologists		0 = No
				1 = Yes
4.1.8		Radio-pharmacist		0 = No
				1 = Yes
4.1.9		Other medical personnel in Nuclear Medicine		0 = No
				1 = Yes
4.2		If you selected other in the previous question, please specify		Text
4.3		Medical personnel in other Clinical Departments		Text
4.4		Any others (specify)		Text
				1 = one dedicated teacher/ lecturer

4.5		How many teachers/lecturers are involvled		2 = two dedicated tearchers/lecturers
				3 = other
4.6		If you selected other in the previous question, please specify		Text
For questions 4.7 - 4.11 explain how the following factors affect the medical undergraduate education in your Department				
4.7		Clinical service delivery load		Text
4.8		Staff shortages		Text
4.9		The applicability of an undergraduate medical Nuclear Medicine module		Text
4.10		Problems you may encounter with the M.B.Ch.B. phase(s) in which students are getting their Nuclear Medicine education		Text
4.11		The lack of specific guidelines for an UNDERGRADUATE medical Nuclear Medicine module		Text
SECTION D: IMPORTANT RESEARCH QUESTIONS WHICH NEED ANSWERING (WHY, WHEN, WHICH TOPICS, WHAT, BY WHOM, HOW AND IN WHICH WAY?)				
5.1		Do you think it is necessary to implement an undergraduate medical Nuclear Medicine educational module?		1 = Yes
				2 = No
5.2		Why/ why not?		Text
5.3		WHEN will be the most effective time in the undergraduate M.B.Ch.B. curriculum to introduce a basic Nuclear Medicine module?		Text
5.4		WHICH basic Nuc Med topics will be the most appropriate to be taught on an undergraduate level?		Text
5.5		WHAT must the extent of contents of each subject be (on the undergraduate level) Please motivate		Text
5.6		BY WHOM must this course be presented (Nuc Med physicians or other clinical physicians) please motivate		Text
5.7		HOW must the undergraduate Nuc Med course be presented (educational strategies and methods)		Text
5.8		HOW must the undergraduate Nuc Med course be assessed (assessment strategies and methods)		Text

5.9		IN WHICH WAY must the undergraduate Nuc Med course be presented (integrated with other clinical departments; as an independent department or a combination of both)		Text
5.10		Any other opinions or important factors to be taken into consideration when implementing the specific guidelines for such a module?		Text
SECTION E: MEDICAL NUCLEAR MEDICINE COURSE CONTENT ON AN UNDERGRADUATE LEVEL				
Basic Science (Anatomy, Physiology and Physics)				
6.1		To be presented as part of the Nuclear Medicine course		1 = Essential
				2 = Useful
				3 = Not Needed
6.2		JUST refer back to the previously acquired knowledge		1 = Essential
				2 = Useful
				3 = Not Needed
Basic introduction to Nuclear Medicine				
6.3		Radio-activities and tracers		1 = Essential
				2 = Useful
				3 = Not Needed
6.4		Gamma cameras and counters		1 = Essential
				2 = Useful
				3 = Not Needed
6.5		Clinical applications and costs		1 = Essential
				2 = Useful
				3 = Not Needed
6.6		Radiation protection		1 = Essential
				2 = Useful
				3 = Not Needed
The basic clinical application of:				
6.7		Bonescan		1 = Essential
				2 = Useful
				3 = Not Needed
6.8		Liver/ Spleen scan		1 = Essential
				2 = Useful
				3 = Not Needed
				1 = Essential

6.9		Hepatico-Biliary/ Hida Scan		2 = Useful
				3 = Not Needed
6.10		Brain perfusion imaging		1 = Essential
				2 = Useful
				3 = Not Needed
6.11		CSF Leakage detection		1 = Essential
				2 = Useful
				3 = Not Needed
6.12		Salivary gland scans		1 = Essential
				2 = Useful
				3 = Not Needed
6.13		Thyroid imaging		1 = Essential
				2 = Useful
				3 = Not Needed
6.14		RAI Thyroid therapy		1 = Essential
				2 = Useful
				3 = Not Needed
6.15		MIBI Parathyroid scans		1 = Essential
				2 = Useful
				3 = Not Needed
6.16		Neuro-endocrine studies		1 = Essential
				2 = Useful
				3 = Not Needed
6.17		Lung perfusion		1 = Essential
				2 = Useful
				3 = Not Needed
6.18		Lung ventilation		1 = Essential
				2 = Useful
				3 = Not Needed
6.19		Venogram (legs)		1 = Essential
				2 = Useful
				3 = Not Needed
6.20		Venogram (arms)		1 = Essential
				2 = Useful
				3 = Not Needed
6.21		Renograms		1 = Essential
				2 = Useful

				3 = Not Needed
6.22		Infection imaging techniques		1 = Essential
				2 = Useful
				3 = Not Needed
6.23		Tumour imaging techniques		1 = Essential
				2 = Useful
				3 = Not Needed
6.24		RN Mammography		1 = Essential
				2 = Useful
				3 = Not Needed
6.25		Sentinal node detection		1 = Essential
				2 = Useful
				3 = Not Needed
6.26		Octreoscans		1 = Essential
				2 = Useful
				3 = Not Needed
6.27		Gallium studis		1 = Essential
				2 = Useful
				3 = Not Needed
6.28		Testicular imaging		1 = Essential
				2 = Useful
				3 = Not Needed
6.29		Cardio-vascular imaging		1 = Essential
				2 = Useful
				3 = Not Needed
6.30		First pass/ cardiac flow		1 = Essential
				2 = Useful
				3 = Not Needed
6.31		Ejections fractions		1 = Essential
				2 = Useful
				3 = Not Needed
6.32		Myo-Cardiac perfusion studies		1 = Essential
				2 = Useful
				3 = Not Needed
6.33		Gastric emptying studies		1 = Essential
				2 = Useful
				3 = Not Needed

6.34		GIT Bleeding studies		1 = Essential
				2 = Useful
				3 = Not Needed
6.35		Milk Scans		1 = Essential
				2 = Useful
				3 = Not Needed
6.36		Meckel's Diverticulum detection		1 = Essential
				2 = Useful
				3 = Not Needed
6.37		Lympho-Scintigrams		1 = Essential
				2 = Useful
				3 = Not Needed
6.38		Other RN Therapies (e.g. MIBG)		1 = Essential
				2 = Useful
				3 = Not Needed
6.39		SPECT and SPECT/CT		1 = Essential
				2 = Useful
				3 = Not Needed
6.40		PET and PET/CT		1 = Essential
				2 = Useful
				3 = Not Needed
6.41		Necessity for such an undergraduate module?		1 = Essential
				2 = Useful
				3 = Not Needed
6.42		Necessity for standardised guidelines for such a module?		1 = Essential
				2 = Useful
				3 = Not Needed

EvaSys	Under Graduate Medical Nuclear Medicine Education (Nuclear Medicine Experts)	Electric Paper
University of the Free State	Dr. M.G Nel	

Mark as shown: ☐ ☒ ☐ ☐ ☐ Please use a ball-point pen or a thin felt tip. This form will be processed automatically.

Correction: ☐ ■ ☐ ☒ ☐ Please follow the examples shown on the left hand side to help optimize the reading results.

1. Instructions

Please complete ALL THE SECTIONS by selecting the appropriate option, and write your answers and opinions in the provided space.

2. SECTION A: DEMOGRAPHIC INFORMATION

2.1 Please select the option relevant regarding your place of work:
- ☐ School of Medicine
- ☐ Private Practice
- ☐ Academic Hospital
- ☐ Others

2.2 Academic position of the respondent
- ☐ Head of Nuclear Medicine department
- ☐ Nuclear Medicine specialist
- ☐ Post graduate Nuclear Medicine student
- ☐ Radiographer
- ☐ Radio-pharmacist
- ☐ Other

2.3 If "other"was selected in question 2.2, please specify

2.4 Graduate and post graduate academic qualification of the respondent (you can choose more than one)
- ☐ MB CHB
- ☐ M.Sc (Nuclear Medicine)
- ☐ M Med (Nuclear Medicine)
- ☐ FCNP (SA) (Nuclear Medicine)
- ☐ PhD (Nuclear Medicine)
- ☐ Other

2.5 If "other" was selected in question 2.4, please specify

2.6 Age of the respondent
- ☐ 25-34 years
- ☐ 35-44 years
- ☐ 45-54 years
- ☐ 55-64 years
- ☐ 65-74 years

2.7 Gender of the respondent
- ☐ Male
- ☐ Female

2.8 Any formal EDUCATIONAL (formal teaching and training education) qualifications of the respondent. Please specify

2.9 EDUCATIONAL (teaching and learning) experience of the respondent. Specify the subjects and state for how long.

3. SECTION B: IMPORTANT RESEARCH QUESTIONS WHICH NEED ANSWERING (WHY, WHEN, WHICH TOPICS, WHAT, BY WHOM, HOW AND IN WHICH WAY?)

Please answer, explain, motivate and specify in your own words

3.1 Do you think it is necessary to implement an UNDER GRADUATE Medical Nuclear Medicine educational module?
- ☐ Yes
- ☐ No

3. SECTION B: IMPORTANT RESEARCH QUESTIONS WHICH NEED ANSWERING (WHY, WHEN, WHICH TOPICS, WHAT, BY WHOM, HOW AND IN WHICH WAY?) [Continue]

3.2 Why/ why not?

3.3 WHEN will be the most effective time in the UNDER GRADUATE M.B.,CH.B curriculum to introduce a basic Nuclear Medicine module?

3.4 WHICH basic Nuclear Medicine topics will be the most appropriate to be taught on an UNDER GRADUATE level?

3.5 WHAT must the extent of contents of each subject be? (on the UNDER GRADUATE level) Please motivate

3.6 BY WHOM must this course be presented? (Nuclear Medicine physicians or other clinical physicians) Please motivate

3.7 HOW must the UNDER GRADUATE Medical Nuclear Medicine course be presented? (the educational strategies and methods)

3.8 HOW must the UNDER GRADUATE Medical Nuclear Medicine course be assessed? (assessment strategies and methods)

3. SECTION B: IMPORTANT RESEARCH QUESTIONS WHICH NEED ANSWERING (WHY, WHEN, WHICH TOPICS, WHAT, BY WHOM, HOW AND IN WHICH WAY?) [Continue]

3.9 IN WHICH WAY must the UNDER GRADUATE Medical Nuclear Medicine course be presented? (Integrated with other clinical departments; as an independent department or a combination of both?)

3.10 Any other opinions or important factors to be taken into consideration when implementing the specific guidelines for such a module?

4. SECTION C: MEDICAL NUCLEAR MEDICINE COURSE CONTENT ON AN UNDER GRADUATE LEVEL

Please give a clear indication of the topics which could fit into an UNDER GRADUATE or PRIMARY LEVEL Nuclear Medicine module)

		Essential	Useful	Not needed
	BASIC SCIENCE (Anatomy, Physiology and Physics)			
4.1	To be presented as part of the Nuclear Medicine course	☐	☐	☐
4.2	JUST refer back to the previously acquired knowledge	☐	☐	☐
	BASIC INTRODUCTION TO NUCLEAR MEDICINE			
4.3	Radio-activities and tracers	☐	☐	☐
4.4	Gamma cameras and counters	☐	☐	☐
4.5	Clinical applications and costs	☐	☐	☐
4.6	Radiation protection	☐	☐	☐
	THE BASIC CLINICAL APPLICATIONS OF:			
4.7	Bonescan	☐	☐	☐
4.8	Liver/Spleen scan	☐	☐	☐
4.9	Hepatico-Biliary/ Hida scan	☐	☐	☐
4.10	Brain perfusion imaging	☐	☐	☐
4.11	CSF Leakage detection	☐	☐	☐
4.12	Salivary gland scans	☐	☐	☐
4.13	Thyroid imaging	☐	☐	☐
4.14	RAI Thyroid therapy	☐	☐	☐
4.15	MIBI Parathyroid scans	☐	☐	☐
4.16	Neuro-endocrine studies	☐	☐	☐
4.17	Lung perfusion	☐	☐	☐
4.18	Lung ventilation	☐	☐	☐
4.19	Venogram (legs)	☐	☐	☐
4.20	Venogram (arms)	☐	☐	☐
4.21	Renograms	☐	☐	☐
4.22	Infection imaging techniques	☐	☐	☐
4.23	Tumour imaging techniques	☐	☐	☐
4.24	RN Mammography	☐	☐	☐
4.25	Sentinel node detection	☐	☐	☐
4.26	Octreoscans	☐	☐	☐

4. SECTION C: MEDICAL NUCLEAR MEDICINE COURSE CONTENT ON AN UNDER GRADUATE LEVEL [Continue]

4.27 Gallium studies	☐	☐	☐
4.28 Testicular imaging	☐	☐	☐
4.29 Cardio-vascular imaging	☐	☐	☐
4.30 First pass/cardiac flow	☐	☐	☐
4.31 Ejection fractions	☐	☐	☐
4.32 Myo-Cardiac perfusion studies	☐	☐	☐
4.33 Gastric emptying studies	☐	☐	☐
4.34 GIT Bleeding studies	☐	☐	☐
4.35 Milk scans	☐	☐	☐
4.36 Meckel's Diverticulum detection	☐	☐	☐
4.37 Lympho-Scintigrams	☐	☐	☐
4.38 Other RN Therapies (e.g. MIBG)	☐	☐	☐
4.39 SPECT and SPECT/CT	☐	☐	☐
4.40 PET and PET/CT	☐	☐	☐
4.41 Necessity for such an under graduate module?	☐	☐	☐
4.42 Necessity for standardised guidelines for such a module?	☐	☐	☐

THANK YOU FOR SUBMITTING THE COMPLETED QUESTIONNAIRE

APPENDIX E5

Nuclear Medicine Study (Experts)

Data Dictionary

Variable Name	Variable Value	Valid Values
Sheet	Participant Number	Number
Timestamp	Time questionnaire was completed	Time
SECTION A: DEMOGRAPHIC INFORMATION		
2.1	Name your School of Medicine	Text
2.2	Academic position of the respondent	1 = Head of Nuclear Medicine Department
		2 = Nuclear Medicine Specialist
		3 = Postgraduate Nuclear Medicine Student
		4 = Radiographer
		5 = Radio-pharmacist
		6 = Other
2.3	If "other" was selected in previous question, please specify	Text
Graduate and postgraduate academic qualification of the respondent (you can choose more than one)		
2.4.1	MB CHB	0 = No
		1 = Yes
2.4.2	M.Sc (Nuclear Medicine)	0 = No
		1 = Yes
2.4.3	M.Med (Nuclear Medicine)	0 = No
		1 = Yes
2.4.4	FCNP (SA)(Nuclear Medicine)	0 = No
		1 = Yes
2.4.5	PhD (Nuclear Medicine)	0 = No
		1 = Yes
2.4.6	Other	0 = No
		1 = Yes
2.5	If "other" was selected in previous question, please specify	Text
		1 = 25 - 34 years

2.6		Age of respondent		2 = 35 - 44 years
				3 = 45 - 54 years
				4 = 55 - 64 years
				5 = 65 - 74 years
2.7		Gender of respondent		1 = Male
				2 = Female
2.8		Any formal educational (formal teaching and training education) qualifications of the respondent. Please specify		Text
2.9		Educational (teaching and learning) experience of the respondent. Specify the subjects and state for how long		Text
SECTION B: IMPORTANT RESEARCH QUESTIONS WHICH NEED ANSWERING (WHY, WHEN, WHICH TOPICS, WHAT, BY WHOM, HOW AND IN WHICH WAY?)				
3.1		Do you think it is necessary to implement an undergraduate medical Nuclear Medicine educational module?		1 = Yes
				2 = No
3.2		Why/ why not?		Text
3.3		WHEN will be the most effective time in the undergraduate M.B.Ch.B. curriculum to introduce a basic Nuclear Medicine module?		Text
3.4		WHICH basic Nuc Med topics will be the most appropriate to be taught on an undergraduate level?		Text
3.5		WHAT must the extent of contents of each subject be (on the undergraduate level) Please motivate		Text
3.6		BY WHOM must this course be presented (Nuc Med physicians or other clinical physicians) please motivate		Text
3.7		HOW must the undergraduate Nuc Med course be presented (educational strategies and methods)		Text
3.8		HOW must the undergraduate Nuc Med course be assessed (assessment strategies and methods)		Text

3.9		IN WHICH WAY must the undergraduate Nuc Med course be presented (integrated with other clinical departments; as an independent department or a combination of both)		Text
3.10		Any other opinions or important factors to be taken into consideration when implementing the specific guidelines for such a module?		Text
SECTION C: MEDICAL NUCLEAR MEDICINE COURSE CONTENT ON AN UNDERGRADUATE LEVEL				
Basic Science (Anatomy, Physiology and Physics)				
4.1		To be presented as part of the Nuclear Medicine course		1 = Essential 2 = Useful 3 = Not Needed
4.2		JUST refer back to the previously acquired knowledge		1 = Essential 2 = Useful 3 = Not Needed
Basic introduction to Nuclear Medicine				
4.3		Radio-activities and tracers		1 = Essential 2 = Useful 3 = Not Needed
4.4		Gamma cameras and counters		1 = Essential 2 = Useful 3 = Not Needed
4.5		Clinical applications and costs		1 = Essential 2 = Useful 3 = Not Needed
5.6		Radiation protection		1 = Essential 2 = Useful 3 = Not Needed
The basic clinical application of:				
4.7		Bonescan		1 = Essential 2 = Useful 3 = Not Needed

4.8		Liver/ Spleen scan		1 = Essential 2 = Useful 3 = Not Needed
4.9		Hepatico-Biliary/ Hida Scan		1 = Essential 2 = Useful 3 = Not Needed
4.10		Brain perfusion imaging		1 = Essential 2 = Useful 3 = Not Needed
4.11		CSF Leakage detection		1 = Essential 2 = Useful 3 = Not Needed
4.12		Salivary gland scans		1 = Essential 2 = Useful 3 = Not Needed
4.13		Thyroid imaging		1 = Essential 2 = Useful 3 = Not Needed
4.14		RAI Thyroid therapy		1 = Essential 2 = Useful 3 = Not Needed
4.15		MIBI Parathyroid scans		1 = Essential 2 = Useful 3 = Not Needed
4.16		Neuro-endocrine studies		1 = Essential 2 = Useful 3 = Not Needed
4.17		Lung perfusion		1 = Essential 2 = Useful 3 = Not Needed
4.18		Lung ventilation		1 = Essential 2 = Useful 3 = Not Needed

4.19		Venogram (legs)		1 = Essential
				2 = Useful
				3 = Not Needed
4.20		Venogram (arms)		1 = Essential
				2 = Useful
				3 = Not Needed
4.21		Renograms		1 = Essential
				2 = Useful
				3 = Not Needed
4.22		Infection imaging techniques		1 = Essential
				2 = Useful
				3 = Not Needed
4.23		Tumour imaging techniques		1 = Essential
				2 = Useful
				3 = Not Needed
4.24		RN Mammography		1 = Essential
				2 = Useful
				3 = Not Needed
4.25		Sentinal node detection		1 = Essential
				2 = Useful
				3 = Not Needed
4.26		Octreoscans		1 = Essential
				2 = Useful
				3 = Not Needed
4.27		Gallium studis		1 = Essential
				2 = Useful
				3 = Not Needed
4.28		Testicular imaging		1 = Essential
				2 = Useful
				3 = Not Needed
4.29		Cardio-vascular imaging		1 = Essential
				2 = Useful
				3 = Not Needed

4.30		First pass/ cardiac flow		1 = Essential
				2 = Useful
				3 = Not Needed
4.31		Ejections fractions		1 = Essential
				2 = Useful
				3 = Not Needed
4.32		Myo-Cardiac perfusion studies		1 = Essential
				2 = Useful
				3 = Not Needed
4.33		Gastric emptying studies		1 = Essential
				2 = Useful
				3 = Not Needed
4.34		GIT Bleeding studies		1 = Essential
				2 = Useful
				3 = Not Needed
4.35		Milk Scans		1 = Essential
				2 = Useful
				3 = Not Needed
4.36		Meckel's Diverticulum detection		1 = Essential
				2 = Useful
				3 = Not Needed
4.37		Lympho-Scintigrams		1 = Essential
				2 = Useful
				3 = Not Needed
4.38		Other RN Therapies (e.g. MIBG)		1 = Essential
				2 = Useful
				3 = Not Needed
4.39		SPECT and SPECT/CT		1 = Essential
				2 = Useful
				3 = Not Needed
4.40		PET and PET/CT		1 = Essential
				2 = Useful
				3 = Not Needed

4.41		Necessity for such an undergraduate module?		1 = Essential
				2 = Useful
				3 = Not Needed
4.42		Necessity for standardised guidelines for such a module?		1 = Essential
				2 = Useful
				3 = Not Needed

APPENDIX E6

Sheet	2.1	2.2	2.3	2.4.1	2.4.2	2.4.3	2.4.4	2.4.5	2.4.6	2.5	2.6	2.7	2.8	2.9	3.1	3.2	3.3	3.4	3.5	3.6	3.7
1	2	2		1	1	1	0	0	0		4	1			1	Undergard	Final yr	Thyroid, ca	Basic princ	NM special	Formal lec
2	2	2		1	0	0	1	0	0		3	1			1	For some b	5th year	Clinical Nu	Clinical ind	Nuclear Me	A few form
3	2	2		1	0	1	1	0	0	B Med Sc H	2	1			1	Newly qua	From a pra	Thyroid, lu	Indications	Both, as bc	Short, intro
4	3	2		1	0	1	1	0	1	MPharmM	2	2		Informal &	1	Nuclear Ph	In the 5th (	Thyroid-, sl	Referral in	Nuclear Physicians as	
5	3	2		1	0	1	1	0	0		2	1	none	Nuclear M	1	Nuclear Me	in the 5th y	1. Endocrir	The future	Definitely I	Lectures, t
6	3	3		1	0	0	0	0	0		1	2			1	Most doctc	An imaging	Basic physics of radiol:		Nuclear me	Orientatio
7	3	1		1	0	1	1	0	0		2	2	None	Only inforr	1	Currently r	The final ye	Cardiac stu	Cardiac Stu	Nuclear ph	In formal t
8	2	2		0	0	1	0	0	0		3	2	MD (Zagrel	None	1	To broader	Together w	General Nu	Basic intro	By Nuclear	In form of
9	3	3		0	0	0	0	0	1	DOCTOR O	2	2	MD		1	To create a	3rd year	Endocrine,	Basic princ	Nuclear me	As rotation
10	3	2		1	0	1	1	1	1	BSc (Physic	3	1	no	lecturing u	1	All health c	Last 2 year	Cardiology	Basic know	NM physici	lectures, sr
11	3	1		0	0	1	0	0	0		5	1		Teaching a	1	To increase	Diagn: Alor	Basic clinic	45 min/sub	NM physici	Theory + c
12	3	3		1	0	0	1	0	0		1	1	None	None	1	Nuclear Me	Final year c	Thyroid sci	Thyroid sci	Nuclear Me	Ideally I wo
13	3	3		1	0	0	0	0	0		2	1	None	None	1	Nuclear me	400-500 lev	Red cell ma	Physiology	Nuclear Me	As a subsp
14	2	6	No academ	1	0	1	1	0	1	Dip PEC (Cl	2	1		Sesional te	1	Post gradu	Most prob:	What is Nu	Basic and a	Nuclear Me	Lectures ar
15	2	2		1	0	1	1	0	0		2	2			1	To provide	Perhaps it	clinically pr	as mentior	the nm par	see 3.4-3.6
16	3	3		1	0	0	0	0	0		1	1		M.Med pa	1	For early e	Last pre-cli	Nuclear im	Basic conce	Nuclear ph	Didactic le
17	3	2		0	0	0	1	0	0		3	2	BSc. Biolog	Nuclear m	1	Just like all	During the	Basic Physi	The above	If you mea	Like all oth
18	3	1		0	1	0	0	0	0		5	1		4 0 years a	1	general pra	at least wh	thyroid,lun	knowledge	nuc medcii	in one bloc
19	2	2		0	0	1	0	0	0		2	2	MBChB MMED		1	To educate	Final years	Diagnostic	To educate	Nuclear Me	Basic lectu
20	2	2		1	1	1	0	0	1	B. Sc Hons	3	2	None	In the 13 y	1	Because Nu	Cirruculum	Basic physi	the extent	Preferably	See 3.4 as
21	3	3		1	0	0	0	0	0		1	1			1	To get stuc	5th year	Types of nuclear scans		Nuclear medicine phy	
22	1	2		1	0	1	0	0	1	MFAM.ME	3	1			1	Nuclear me	Just before	Bone,thyrc	Just practi	Nuclear me	I am not su
23	1	1		1	0	1	0	1	0		2	1	No Degree	Nuclear M	1	Educate Cc	MB ChB 3,	Endocrine	Introducto	NM Physici	Presentatic
24	3	2		1	0	1	1	0	0		2	2			1	Medical stu	Towards th	Thyroid im	Thyroid im	A trained N	Lectures ar
25	3	3		1	0	0	0	0	0		1	1	MBBS(UPH	nil	1	To allow th	3yr or 4th y	Bone scans	Principle o	Both	Power poir
26	3	3		1	0	0	0	0	0		1	1			1	It will deve	5th year or	BASIC KNO	BASIC	NUCLEAR N	Simple wit
27	3	2		1	0	1	1	0	0		2	1		NM consul	1	Functional	During the	Basic physi	#NAME?	Preferably	Practical p
28	3	3		1	0	0	0	0	0		1	2			1	It is import	later in the	cardiac inv	indications	nuclear me	lectures an
29	3	3		1	0	0	0	0	1	DipPEC	1	1	No	No	1	Because m	With an im	Principles c	Simple bas	Nuclear me	As imaging
30	3	2		1	0	0	1	0	0		2	2		Teaching r	1	Lack of insi	Clinical yea	Difference	What is the	NM physici	Lectures cc
31	2	2		1	0	0	1	0	0		2	1	No		1	As a nuclea	5th and fin	Cardiac stu	Emphasis s	Nuclear me	It should b
32	2	6	No academ	1	0	1	1	0	1	Dip PEC (Cl	2	1	No	General Nu	1	To educate	Probably b	Basic unde	Basic, othe	Nuclear Ph	Lectures ar
33	1	2		1	0	1	0	0	0		5	1	N/A	Professor E	1	The qualific	The last tw	Applicatior	The conter	Preferably	1. At the cl
34	3	3		1	0	0	0	0	0		1	2			1	Most of the	When they	Thyroid sca	1. INDICAT	By Nuclear	Lectures cc
35	3			0	0	1	0	1	1	MD, MSc N	3	1	workshops	Involved in	1	Current lac	The modul	The indicat	The conter	Nuclear ph	Theoretica
36	2	2		1	0	1	0	0	0		2	2			1	Medical pr	As part of a	I don't thin	How is the	NM physicians	
37	3	3		1	0	0	0	0	0		1	2			1	It is not ea:	5th and 6th	The place c	Basic princ	Nuclear Me	It could be
38	3	2		1	0	1	1	0	0		2	1	No	Teaching r	1	To increase	During Phy	Principles c	Must be th	Nuclear Me	formal lect
39	3	2		1	0	1	1	0	1	BSc	2	2	No	Registrar a	1	To increase	from year I	All topics a	Basic teach	Nuclear Me	Lectures SI
40	3	3		1	0	0	0	0	0		2	1	MBBS		1	to expose t	2nd year	physics, rac	basic introc	Nuclear me	lectures an
41	3	3		0	0	0	0	0	0			1			1	To let the f	4-5 year	How the nuclear medi		Nuclear me	1. Lectures
42	3	3		1	0	0	0	0	1		2	1			1	There is a r	In my opin	General ov	As above	Nuclear me	Classroom
43	3	2		1	0	0	1	0	0		2	1	None	Post gradu	1	General pr	In the time	Types of sc	Very basic	Nuclear Me	Stuctured
44	3	2		1	0	0	1	0	0						1	Interns are	During the	The place c	Indications	Nuclear me	Lectures, w
45	3	3		1	0	0	0	0	0		1	1			1	As is part c	Once they	General nu	Physiololog	Nuclear me	To be integ
46	3	3		1	0	0	0	0	0		1	1	About to c	I have beer	1	It is very ne	400 LEVEL	It is good t	As indicate	Nuclear Me	Can be pre
47	3	3		0	0	0	0	0	1	FWACS(ON	2	2	YES	RADIATION	1	MEDICINE	AT THE BEC	BASIC KNO	SHOULD BI	NUCLEAR N	LECTURES

APPENDIX E7

Sheet	2.1	2.2	2.3	2.4.1	2.4.2	2.4.3.	2.4.4	2.4.5
1	[redacted]	1		1	0	0	1	0
2	Faculty of I	1		1	1	1	0	0
3	[redacted]	2		0	0	1	0	0
4	University ı	2		1	0	0	1	0
5	[redacted]	2		1	0	0	1	0

2.4.6	2.5	2.6	2.7	2.8	2.9	3.1	3.2	3.3
0		2	2	No	Nuclear Me	2		1
0		4	2		Teaching c	2		3
0		2	2		Cardiology	1		3
0		2	1	no	none	2		2
0		2	2	Bsc Bsc Hoı		2		1

3.4	3.5	3.6	3.7.1	3.7.2	3.7.3	3.7.4	3.8	3.9.1
	2		0	1	0	0		0
1 year	3	5 years	0	1	0	0		1
2years & 6	3	2years & 6	0	1	0	0		0
	2		0	0	1	0		1
	3	4	0	1	0	0		0

3.9.2	3.9.3	3.9.4	3.10	3.11	3.12	3.13	3.14	3.15
1	0	0			3		0	0
0	0	0			3		0	0
1	1	0			4		none	none
0	1	0			3		5 hours	none
0	0	1	As part of r	As part of r	3		0	0

3.16	3.17	3.18	3.19	3.20	3.21	3.22	3.23	3.24
0	0	0		0	0			1
0	0	0		0	This is alre	This is alre		8
none	none	none	none	none	none	none		25 hours
1 hour	none	lecture ma	lecture ma	0	0	5		2 hours
0	0	0		0	0	0	0	About 9 ho

3.25	3.26	3.27	3.28	3.29	3.30	3.31	3.32	3.33
0	0	0	Lecture is a		0	0	1	0
8	Part of asse	0			Lectures in	Middle clin	Middle clin	0
128 hours	1 hour	as part of t	yes	blackbord f	145 hours	none	9 hours	none
none	1 hour	none	lecture ma		5	0	2	0
0	0	0	0	0	0	0	9	0

3.34	3.35.1	3.35.2	3.35.3	3.35.4	3.35.5	3.35.6	3.35.7	3.36.1
	0	0	0	1	0	0	0	1
	0	1	0	0	1	1	0	1
	1	0	1	1	1	0	0	1
	0	0	0	1	1	0	0	1
	0	0	0	0	0	0	0	1

3.36.2	3.36.3	3.36.4.	3.36.5	3.36.6	3.36.7	3.37.1	3.37.2	3.37.3
0	0	0	0	0	0	0	1	0
0	1	1	0	1	0	1	0	1
0	1	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

3.37.4	3.37.5	3.38	3.39.1	3.39.2	3.39.3	3.39.4	3.39.5	3.39.6
0	0		0	0	0	0	0	1
0	0		0	0	1	1	0	0
0	0		0	0	1	0	0	0
1	0		0	0	1	1	0	0
1	0		0	0	0	0	0	1

3.39.7	3.40	3.41	3.42	3.43	4.1.1	4.1.2	4.1.3	4.1.4
0		2		General ov	1	1	0	0
0		2		Cardiovasc	1	1	1	0
0		1	40 marks o	Introductio	1	1	1	1
0		1		Bone scinti	1	1	0	0
0		2		Only renal	0	1	1	0

4.1.5	4.1.6	4.1.7	4.1.8	4.1.9	4.2	4.3	4.4	4.5
0	0	0	0	0				2
0	0	0	0	0				3
0	0	0	0	0	General Su			3
0	0	0	0	0				3
0	0	0	0	0	No			3

4.6	4.7	4.8	4.9	4.10	4.11	5.1	5.2	5.3
	Negatively	Negatively	Makes this	Inconsister	Difficult to	1	Students q	Near the e
3 dedicate	Does infrec	No	No	No	No	2	It is better	Depending
one dedica	Student att	Not all staf	Student ne	Pre clinical	Lack of gui	1	Exposure t	Later in the
4	Busy work	The clinical	This is impe	Nuclear Me	Students d	1	Nuclear Me	4th or 5th y
All the spec	No influenc	No influenc	The amoun	Short time	Not necess	1	So that qua	5th and/ or

5.4	5.5	5.6	5.7	5.8	5.9	5.10	6.1	6.2
Basic inves	At this leve	Nuclear Ph	This could I	See above.	The integra		3	1
Role of Nuc	The applica	NM physici	Combinatic	As part of t	integrated	Consultatic	2	1
Most impo	Student sh	Nuclear Me	examples,	multiple qu	As combina		3	1
Cardiology,	Basic physi	NM physici	Integrated	Written tes	Integrated	'How it wo	1	3
Bone scinti	What radio	Nuclear Me	Lectures Pr	Tests Assig	Individually	Emphasis c	2	2

6.3	6.4	6.5	6.6	6.7	6.8	6.9	6.10	6.11
1	3	3	2	1	2	1	3	3
2	3	1	2	1	2	2	1	2
1	1	1	1	1	1	1	3	3
1	1	1	1	1	1	1	1	2
1	2	2	2	1	3	3	2	2

6.12	6.13	6.14	6.15	6.16	6.17	6.18	6.19	6.20
3	1	1	1	2	1	1	1	1
3	1	1	2	2	1	1	3	3
3	1	1	2	2	1	1	1	3
2	1	1	1	1	1	1	2	2
3	1	1	2	2	1	1	3	3

6.21	6.22	6.23	6.24	6.25	6.26	6.27	6.28	6.29
1	2	1	1	1	2	2	1	2
1	1	2	2	1	2	2	2	1
1	2	2	3	1	3	3	3	1
1	1	1	1	1	1	2	2	1
1	2	1	3	2	2	2	3	1

6.30	6.31	6.32	6.33	6.34	6.35	6.36	6.37	6.38
1	1	2	1	3	1	2	1	2
2	1	1	2	2	2	2	2	2
1	1	1	1	1	1	1	3	2
1	1	1	1	1	1	1	1	1
3	1	1	3	2	2	3	2	2

6.39	6.40	6.41	6.42	timestamp	Source of dataset
1	1	1	1	01.05.2013 at 14:33:22	O
2	2	1	2	15.05.2013 at 17:17:50	O
1	2	3	3	24.05.2013 at 15:35:15	O
1	1	1	1	31.05.2013 at 15:58:36	O
2	2	1	1	06.06.2013 at 16:27:07	O

APPENDIX E8

Gmail by Google

Riana Nel <gnknmgn@gmail.com>

Undergraduate Nuclear Medicine research project: Dr M G Nel (Riana)

Riana Nel <gnknmgn@gmail.com> Thu, May 23, 2013 at 6:37 AM
To: NelMG@ufs.ac.za

Dear colleagues,

We nearly reached the last week in which you can complete this research questionnaire that is been distributed by the **UFS EvaSys (online research) system**.

I would like to thank everyone who already completed and submitted the completed questionnaires; I really appreciate your contribution. I would also like to ensure and confirm the confidentiality of the provided opinions and information.

I would like to encourage those whose questionnaires are still outstanding to please take a few minutes and complete this very important questionnaire on **Undergraduate MEDICAL Nuclear Medicine education in South Africa.** I need the input of all the Nuclear Medicine experts (private as well as academic personnel) in South Africa.

The questionnaires will be available on the Evasys link up to the 31 May 2013. You can just open the link on the **UFS EvaSys e-mail**, then complete and submit it directly online. The "expert" questionnaire will take approximately 20min to complete while the "key persons" questionnaire will take a bit longer. I will appreciate all your opinions whether positive or negative.

Feel free to contact me with questions regarding the questionnaires.

Kind regards

Dr Riana Nel
Dept Nuclear Medicine
Universitas Hospital, SoM UFS
Bloemfontein

051-4053488/7 or 0828028203

APPENDIX E9

Gmail by Google

Riana Nel <gnknmgn@gmail.com>

Navorsingsprojek: Riana Nel (RESULTATE)

Anneri Meintjes <Meintjesa@ufs.ac.za> Wed, Jun 26, 2013 at 9:09 AM
To: "Nel, Riana" <gnknmgn@gmail.com>
Cc: "Bezuidenhout, Johan" <BezuidJ@ufs.ac.za>, "Brussow, Saretha" <SBrussow@ufs.ac.za>, "Joubert, Gina" <gnbsgj@ufs.ac.za>

Hi Riana,

Hiermee die finale resultate van die studie (ek CC jou studieleiers en prof Joubert in op hierdie e-pos):

1. Die finale resultate van die Key Person studie in Excel-formaat
2. Die finale resultate van die Key Person studie in SPSS-formaat
3. Die finale resultate van die Key Person studie in PDF-formaat
4. Die finale resultate van die Expert studie in Excel-formaat
5. Die finale resultate van die Expert studie in PDF-Formaat
6. Die finale resultate van die Expert vraelys wat vir die oorspronklike 85 proefpersone gestuur is in SPSS-formaat*
7. Die finale resultate van die Expert vraelys wat vir die 3 ekstra proefpersone gestuur is in SPSS-formaat*
8. Die finale resultate net weer van die Expert studie se loods (SPSS, Excel en PDF)
9. Key Person vraelys
10. Expert vraelys
11. Expert vraelys wat gebruik is in die loodsstudie.

* Ek kon die resultate van die Expert studie kombineer vir die 2 geleenthede wat die vraelys gestuur is in Excel en PDF-formaat, maar nie in SPSS nie, daarom is daar 2 SPSS dokumente vir die Expert studie, maar net 1 Excel en 1 PDF verslag.

Ek sal so gou as moontlik vir jou 'n opsomming van wanneer vraelyste oopgemaak is, wanneer "reminders" gestuur is, wat die responskoerse was en daardie beskrywing van wat EvaSys is vir jou metodologie gedeelte stuur (voor die einde van die week ten minste). Ek sal daarmee saam vir jou die log sheet stuur.

Groete,
Anneri

UFS UV

Anneri Meintjes
Directorate for Institutional Research and Academic Planning (DIRAP)
Direktoraat vir Institusionele Navorsing en Akademiese Beplanning (DINAB)
PO Box / Posbus 339, Bloemfontein 9300, Republic of South Africa / Republiek van Suid-Afrika
051 401 9082
MeintjesA@ufs.ac.za
www.ufs.ac.za

UNIVERSITY OF THE FREE STATE UNIVERSITEIT VAN DIE VRYSTAAT YUNIVESITHI YA FREISTATA

>>> Riana Nel <gnknmgn@gmail.com> 2013/06/25 04:43 PM >>>
Hallo Anneri,

Ek is more terug by die werk. As jy 'n tydjie het kan jy dalk net die finale lys met voltooi en onvoltooide vraelyste vir my stuur nadat jy gister die studie toegemaak het.

Die resultate dan in excel formaat na Dr's Johan Bezuidenhout, Saretha Brussow en Prof Gena Joubert, asb. (en myself).

Baie dankie vir alles. Jy kan sommer ook die rekening vir die uitstaande bedrag wat ek julle skuld ook stuur. Indien jy dalk ook nou verlof het, wag ons tot jy terug is.

Groete
Riana

APPENDIX E10

UNDERGRADUATE NUCLEAR MEDICINE EDUCATION IN THE M.B.CH.B PROGRAMMES IN SOUTH AFRICA STUDY

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS UV
DIRECTORATE FOR INSTITUTIONAL RESEARCH AND ACADEMIC PLANNING (DIRAP)

Prepared by DIRAP

July 2013

1. Introduction

The Directorate for Institutional Research and Academic Planning was approached at the end of 2012 by Dr M.G. Nel for assistance with the data gathering phase of her Master's Degree in Health Professions Education (HPE). The purpose of this report is to describe the methodology used to conduct the surveys. The response rates will be discussed and the software used to create and distribute the surveys will be described briefly.

2. Methodology

Two surveys were conducted by means of online questionnaires. The first was targeted at key persons in Nuclear Medicine and the questionnaire was sent to 8 participants. The second was targeted at Nuclear Medicine experts and was sent to 89 participants (including one pilot questionnaire sent to a Nuclear Medicine Expert two weeks prior to the e-mails sent to the remaining 88 participants). Both questionnaires were e-mailed to the participants and each e-mail contained a link which allowed a participant to access the questionnaire. Both surveys were open for the duration of 10 weeks during which 6 reminder e-mails were sent to participants who had not completed the survey in an attempt to increase response rates.

2.1 EvaSys

EvaSys, an automated, web-based survey system, was used to create and distribute the surveys in this study. The system was developed specifically for educational institutions and is an effective tool for comprehensively implementing and processing surveys. EvaSys is suitable for both paper and online surveys. The system is especially useful for research because of the flexibility in survey methods and its strong functions for reporting and analysis.[1]

3. Response rates

Nuclear Medicine key persons

A total number of 6 questionnaires, of the 8 that were sent to participants, were completed and submitted; hence a response rate of 75% was obtained.

Nuclear Medicine experts

Of the 89 questionnaires that were sent to participants of the study, 48 were submitted. A response rate of 54% was thus obtained for this survey.

4. List of documents accompanying this report

- Results of both surveys in PDF-format
- Raw data of both surveys in Excel-format

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[1] Electric Paper. (n.d.). Effective Evaluation Software for Education. Retrieved June 3, 2013, from EvaSys Education Survey Automation Software: http://www.evasys.co.uk/products/education.html

- Raw data of both surveys **in** sav-format (SPSS statistics data document)
- Both questionnaires
- Data dictionary for both surveys, to assist with the analysis of raw data, **in** Excel-format

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APPENDIX F

(INCLUDING APPENDIX F1-F5)

APPENDIX F1: SUMMARY OF INFORMATION OBTAINED FROM THE THEORETICAL PERSPECTIVE ON UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION INTERNATIONALLY IN ORDER TO ANSWER THE MAIN RESEARCH QUESTION (STUDY OBJECTIVE 1)

APPENDIX F2: SUMMARY OF INFORMATION OBTAINED FROM THE THEORETICAL PERSPECTIVE ON UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION NATIONALLY IN ORDER TO ANSWER THE MAIN RESEARCH QUESTION (STUDY OBJECTIVE 2)

APPENDIX F3: SUMMARY OF THE KEY PERSONS' DESCRIPTIVE STATISTICAL QUANTITAIVE RESULTS ON SOUTH AFRICAN MEDICAL CURRICULA (STUDY OBJECTIVE 2)

APPENDIX F4: SUMMARY OF THE KEY PERSONS' QUANTITATIVE RESULTS, QUALITATIVE FINDINGS AND THEIR VIEWPOINTS ON GUIDELINES FOR AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE (STUDY OBJECTIVE 2)

APPENDIX F5: SUMMARY OF THE NUCLEAR MEDICINE EXPERTS' QUANTITATIVE RESULTS, QUALITATIVE FINDINGS AND THEIR VIEWPOINTS ON GUIDELINES FOR AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE (STUDY OBJECTIVE 3)

APPENDIX F1

SUMMARY OF INFORMATION OBTAINED FROM THE THEORETICAL PERSPECTIVE ON UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION INTERNATIONALLY IN ORDER TO ANSWER THE MAIN RESEARCH QUESTION (STUDY OBJECTIVE 1)

Objective 1: Gaining deeper insight into current international trends in undergraduate medical nuclear medicine education, providing the necessary context of the study. ***(Theoretical literature perspective and document analysis)***

Information obtained from the available body of knowledge regarding undergraduate medical nuclear medicine education internationally was captured to meet Objective 1 (cf. Paragraph 1.4.3) in order to address the aim of the study; namely, to provide guidelines for an undergraduate nuclear medicine module in MBChB programmes in South Africa.

Table F1 summarises information obtained from the theoretical perspective set out in Paragraph 2.5 to answer the research sub-questions (cf. Paragraph 1.3.2).

TABLE F1: INTERNATIONAL TRENDS IN UNDERGRADUATE NUCLEAR MEDICINE EDUCATION [Compiled by the researcher, Nel 2014]
(Table continues on the next pages)

Objective 1a: WHY is it necessary to implement an undergraduate medical nuclear medicine educational module in the MBChB programme? (cf. Paragraphs 2.5.2 and 2.5.2.6)
Empowering and equipping medical students and newly qualified doctors with the necessary knowledge and skills and correct perspective/attitude regarding nuclear medicine physicians' contribution as part of the healthcare team
Improving patient care by empowering and equipping medical students and newly qualified doctors so that they can utilise nuclear medicine procedures more effectively and efficiently
Improving understanding of the place of nuclear medicine imaging procedures in patient care settings; **emphasising complementary roles with other radiological procedures**
Standardisation of undergraduate medical nuclear medicine education according to international standards
Early exposure to imaging procedures **increases** medical students' **interest in imaging as a career option**

Objective 1b: WHEN will be the most effective time to introduce such a basic nuclear medicine module? (cf. Paragraphs 2.5.3 and 2.5.3.5)
Pre-clinical phase of the medical curriculum
Deepening students' understanding of basic principles central to nuclear medicine imaging procedures
Equipping students to enter the clinical phase familiar with the way to order imaging studies
Transition from pre-clinical to clinical experience
Familiarise students with appearance of disease pathology as it appears radio-graphically
Clinical phase of the medical curriculum
Exposure to clinical applications, indications, advantages and disadvantages of imaging procedures
Both phases of the medical curriculum
Teaching imaging as a consistent part of the existing medical curriculum in every training year

Objective 1c: WHICH nuclear medicine topics or subjects will be most appropriate at undergraduate level? (cf. Paragraphs 2.5.4 and 2.5.4.4)
Critical 'core' knowledge, skills and perceptions regarding nuclear medicine imaging
Basic principles of radiation physics including radiation protection
Introduction to Nuclear Medicine Department and how to utilise nuclear medicine services
Working knowledge base of imaging procedures from perspective of patients and referring doctors
Improving communication between Nuclear Medicine Department and referring doctors
Understanding the role of the imaging specialist in the healthcare team and the relationship with other clinical disciplines
Need for effective referral of patients by providing adequate clinical history and a clear statement of the indications for the examinations being requested
Legal responsibilities of referring physicians (informed consent)
Costs and benefits of nuclear medicine procedures
Image interpretation must take the back seat to appropriate utilisation of nuclear medicine services
Awareness of new developments

Objective 1d: WHAT should the extent of the contents be of each subject or topic at undergraduate level? (cf. Paragraph 2.5.5)
Clearly define specific knowledge, skills, behaviours and attitudes required of students
Provide the educational experiences needed so that the students can demonstrate that they have achieved what was expected of them
Teaching should not be done at a too high level and in as much detail which then fall outside the learning goals or outcomes of undergraduate students
Feedback is essential after each assessment

Objective 1e: By WHOM should this module be taught – by nuclear medicine physicians or by other clinical physicians during ward rounds? (cf. Paragraphs 2.5.6 and 2.5.6.4)
Imaging specialist/nuclear medicine physician is the best qualified person to teach imaging to undergraduate medical students
Assistance of medical physicists, radiographers and postgraduate registrars may be acquired
Expectations that students learn imaging only from their **attachment to other clinical departments** was ***strongly condemned*** as sub-standard practise.

Objective 1f: HOW should the undergraduate nuclear medicine module be presented to students? (Teaching and learning strategies and methods) (cf. Paragraphs 2.5.7 and 2.5.7.1)
High levels of variation exist in the approach to teaching, number of hours devoted to nuclear medicine teaching, length of the course and variation in the form of teaching/presenting nuclear medicine
Utilisation of radiological pictures or images enabling students to see disease pathology processes and internal anatomy and physiology in patients' organs
Hard 'core' content presented through formal instruction and didactic lectures
'Core plus' clinical lectures can be available for interested students
Practical sessions in the Nuclear Medicine Department
Integrated small-group seminars/tutorials with other clinical and imaging departments
Audio-visual aids for teaching
Electives available in Nuclear Medicine Department

Objective 1g: HOW should the undergraduate nuclear medicine module be presented to the students? (Student achievements' assessment strategies and methods) (cf. Paragraph 2.5.7.4)
FORMATIVE assessment tools; assessment during the learning experience period
Provide insight into aspects of professional competence, including the ability to work in a team, attitudes, and commitment
Stimulates learning according to students' learning styles'
Methods include small-group case study presentations, portfolios
Provides feedback on improvement of learning
Feedback is essential after each assessment

SUMMATIVE assessment tools; assessment at the end of the learning experience period
Radiological imaging examinations, mostly as **an integrated part of larger**, modular **clinical examinations**, together with other clinical and imaging disciplines/departments
There should also be a **separate assessment in radiological imaging and nuclear medicine alone**, providing assessment within the imaging department
Most commonly used methods for student evaluation, include: - Written tests and/or oral examinations; - Computer-based evaluation: and/or - Objective, structured clinical examination (OSCE) evaluation
Various types of questions that may be encountered are OSCE questions, multiple choice questions (MCQs), single best answer questions, short answer questions, extended matching items, and viva topics
Feedback is essential after each assessment

Objective 1h: HOW should the module be incorporated into existing medical educational programmes? (cf. Paragraph 2.5.8)
Different options exist regarding the way that nuclear medicine modules can be structured or presented
Options depend on the attitude of the parent institution towards the discipline
The options include:
Creation of a **separate/independent nuclear medicine module in an independent Nuclear Medicine Department** - in more than half the radiology is taught as an independent discipline with its own examination (the "classical" model);
Incorporating/integrating nuclear medicine into the framework of already existing medical departments (most effective teaching method for a imaging course would be a multi-disciplinary course, in which internists, diagnostic radiologists, pathologists and other clinicians discuss all the possibilities and then decide on the treatment; this type of teaching dominates in 20% of teaching centres in Europe; and
Combination of independent and integrated structures-a hybrid approach (the combination of classic and modular type of teaching is practiced in 32% of European centres.
Kourdioukova *et al.* (2011:309-318): ***Conventional medical curricula based on the "classic building block" are used predominantly in 62% of European institutions.*** This finding neglects the findings of other research, which shows that an integrated approach to radiological education leads to more effective radiological education.

APPENDIX F2

SUMMARY OF INFORMATION OBTAINED FROM THE THEORETICAL PERSPECTIVE ON UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION NATIONALLY IN ORDER TO ANSWER THE MAIN RESEARCH QUESTION (STUDY OBJECTIVE 2)

Objective 2: To obtain information about the current trends of undergraduate medical nuclear medicine education in the Schools of Medicine in South Africa. ***(Theoretical literature perspective and document analysis, as well as semi-structured survey questionnaires with both closed and open-ended questions to key academic nuclear medicine educators)***

Section 2.4 captured the theoretical perspectives on current undergraduate medical curricula and trends in undergraduate medical nuclear medicine education in Schools of Medicine in South Africa (cf. Table 2.4). Table F2 summarises characteristics in undergraduate medical curricula and undergraduate medical nuclear medicine education in South Africa. According to the data collected for Table 2.4 great variation exists between what is currently available and presented to medical students at South African Schools of Medicine.

TABLE F2: NATIONAL CHARACTERISTICS IN UNDERGRADUATE MEDICAL CURRICULA AND UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION IN SOUTH AFRICA (Table continues on the next pages)

THEORETICAL PERSPECTIVES ON CURRENT MEDICAL CURRICULA IN EIGHT SCHOOLS OF MEDICINE IN SOUTH AFRICA (n=8)	
Duration of the MBChB programmes in South Africa (cf. Table 2.4)	
Total duration	**6-year programme: 7 of the 8 SoM**
	5-year programme: only 1 of the 8 SoM
Duration of pre-clinical phases	**3 years: 3 of the 8 SoM**
	2,5 years: 1 of the 8 SoM
	2 years: 3 of the 8 SoM
	1 year: 1 of the 8 SoM
Duration of the clinical phases	**5 years: 1 of the 8 SoM**
	4 years: 3 of the 8 SoM
	3 years: 3 of the 8 SoM
	2,5 years: 1 of the 8 SoM

THEORETICAL PERSPECTIVES ON UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION IN SIX SCHOOLS OF MEDICINE IN SOUTH AFRICA	
Phases in which undergraduate nuclear medicine education currently takes place (cf. Section 2.4 and Table 2.4)	
Pre-clinical phase	*"lecture and assessment 3rd years*
	"practical induction 1st years"
	"POME I 1st year part of family medicine scope of medicine"
Clinical phase	*"Lecture to 5th years"*
	"Renal lecture as part of urology rotation"
	"First semester year 6: Imaging Forming"
	"Clinical integrated from 2nd year. Integrated practical in middle rotation"
	"Semester 6: 3rd years, lectures, test and practical sessions in nuclear medicine department"
	"Semester 10: 5th years imaging sessions and integrated thyroid sessions"
	"Year IV, once a year thyroid lecture; Year V integrated Surgery, Radiology, Orthopaedics sessions"
	"Optional 2 week electives"

APPENDIX F3

SUMMARY OF THE KEY PERSONS' DESCRIPTIVE STATISTICAL QUANTITAIVE RESULTS ON SOUTH AFRICAN MEDICAL CURRICULA (STUDY OBJECTIVE 2)

Chapter 4 (cf. Section 4.3 and Figure 4.1) presented the nuclear medicine key persons' quantitative descriptive statistical results on South African medical curricula and undergraduate medical nuclear medicine education in order to answer the main research question. Information was obtained from responses to Section B and C of the key person's semi-structured survey questionnaire:

- ***Section B***: Closed and open-ended questions on the trends and contents of existing MBChB programmes and their current specific undergraduate medical nuclear medicine module (Paragraph 4.3.2); and
- ***Section C***: Human resources and educational problems (cf. Paragraph 4.3.3).

Table F3 present a summary of the key person's responses to some of the closed questions in Section B (cf. Paragraph 4.3.2) and information from Section C regarding human resources (cf. Paragraph 4.3.3) involved in teaching of undergraduate medical nuclear medicine.

TABLE F3: KEY PERSONS' QUANTITATIVE RESULTS ON SOUTH AFRICAN MEDICAL CURRICULA AND UNDERGRADUATE MEDICAL NUCLEAR MEDICINE EDUCATION
(Table continues on the next page)

Total duration of MBChB programmes (cf. Figure 4.7 and Paragraph 4.3.2.1)
6 years: 4 Schools of Medicine (80%)
5 years: 1 School of Medicine (20%)
Duration of pre-clinical phases/years (cf. Figure 4.8 and 4.9) [Great variation exists (cf. Paragraph 4.3.2.2)]
3 years: 2 Schools of Medicine (40%)
2.5 years: 1 School of Medicine (20%)
2 years: 1 School of Medicine (20%)
1 year: 1 School of Medicine (20%)
Duration of clinical phases/years (cf. Figure 4.8 and 4.9) [Great variation exists (cf. Paragraph 4.3.2.3)]
5 years: 1 School of Medicine (20%)
4 years: 1 School of Medicine (20%)
3 years: 2 Schools of Medicine (40%)
2.5 years: 1 School of Medicine (20%)
Phases in which students attend nuclear medicine lectures/practical sessions [Great variation exists (cf. Paragraph 4.3.2.4) (cf. Figure 4.10)]
Pre-clinical alone: none
Clinical alone: 80%
Combination: 20%

Nuclear medicine course/module structuring [Great variation exists (cf. Paragraph 4.3.2.6 and Figure 4.12)]
Total independent discipline: none
Integrated with other disciplines: 80%
Combination of both: 20%
Teaching methods and strategies employed (cf. Paragraph 4.3.2.10 and Figure 4.16)
Teacher centred formal lectures: 100%
Observational practical sessions: 40%
Active E-learning: zero %
Formative assessment methods employed (cf. Paragraph 4.3.2.11 and Figure 4.17)
Written assignments: 40%
Case studies: 20%
Oral presentations: 20%
None: 40%
Summative assessment methods employed (cf. Paragraph 4.3.2.12 and Figure 4.18)
Written tests/examination: 60% (MCQ's are used in 40%)
None: 40%
Contribution of credits towards other existing MBChB modules (cf. Paragraph 4.3.2.13 and Figure 4.19)
None: 60%
Nuclear medicine module test marks carried over to the fourth year's credits: 40%
People teaching nuclear medicine imaging to the undergraduate medical students (cf. Paragraph 4.3.3.1 and Figure 4.21)
Nuclear medicine specialists: 100%
Heads of Nuclear Medicine Departments: 80%
Nuclear medicine registrars: 60%
Nuclear medicine medical officer: 20%
Other clinical physicians involved: 20%
How many lecturers involved (cf. Paragraph 4.3.3.2 and Figure 4.22)
Two: 20%
Three: 40%
Four: 20%
Eleven rotating physicians: 20%
Nuclear medicine topics presented as part of the undergraduate modules in SA (cf. Paragraph4.3.2.14 and Figure 4.20)
In 60% of cases:
Introduction and general overview topics
Bone scans and musculoskeletal studies
Genito-urinary studies including renograms
Endocrine studies, including thyroid imaging, RAI Rx, parathyroid and neuro-endocrine studies
Infection imaging
In 40% of cases:
Cardiovascular studies
Abdomen and liver imaging
Respiratory lung perfusion and ventilation studies
In 20 % of cases:
Tumour imaging
Venograms
Neurology
Overview of PET/CT

- ***Section E***: Medical nuclear medicine course content on an undergraduate level, requiring responses on a Likert-type frequency scale (cf. Paragraph 4.3.5).

Chapter 4 (cf. Paragraph 4.3 5) also presented the nuclear medicine key persons' indications whether basic-science topics (cf. Figures 4.24) and basic introductory nuclear medicine topics (cf. Figure 4.25), should be taught or, alternatively, referred back to as part of the undergraduate medical nuclear medicine module.

Paragraph 4.3.5.3 and Figures 4.26 – 4.31 present and discuss the key persons 'responses on the questions asked in the Likert-type frequency scale regarding undergraduate medical nuclear medicine course content (see page 121).

APPENDIX F4

SUMMARY OF THE KEY PERSONS' QUANTITATIVE RESULTS, QUALITATIVE FINDINGS AND THEIR VIEWPOINTS ON GUIDELINES FOR AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE (STUDY OBJECTIVE 2)

Objective 2: To obtain information about the current trends of undergraduate medical nuclear medicine education in the Schools of Medicine in South Africa. ***(Theoretical literature perspective and document analysis, as well as semi-structured survey questionnaires with both closed and open-ended questions to key academic nuclear medicine educators)***

Chapter 4 presented the descriptive statistical results and Chapter 5 the viewpoints of key person participants regarding current undergraduate medical curricula and trends in undergraduate medical nuclear medicine education in Schools of Medicine in South Africa. This information provides the necessary context of the study to meet objective 2 (Paragraph 1.4.3) in order to address the aim of the study, namely, to provide guidelines for an undergraduate nuclear medicine module in MBChB programmes in South Africa.

Table F4, as part of Appendix F4, summarises information obtained from the ***nuclear medicine key persons (n=5)*** responses regarding:

- Qualitative findings and opinions reported on the research sub-questions that needed answering (why, when, which topics, to what extent, by whom, how presented and assessed and in which way presented in the existing undergraduate curricula) in Section D of Chapter 4 (cf. Paragraph 4.3.4) and Section B of Chapter 5 (cf. Paragraph 5.3.2); and
- Key person participants' viewpoints on guidelines for an undergraduate medical nuclear medicine module (cf. Paragraphs 4.3.4.1, 4.3.5.4 and 4.3.5.5).

TABLE F4: KEY PERSONS' QUANTITATIVE RESULTS AND QUALITATIVE FINDINGS OBTAINED FROM SEMI-STRUCTURED SURVEY QUESTIONNAIRES
(Table continues on the next pages)

Objective 2a: WHY is it necessary to implement an undergraduate medical nuclear medicine module in the MBChB programme? (cf. Paragraph 5.3.3.1), (cf. Tables 5.6 – 5.8)
Nuclear medicine as a diagnostic and therapeutic imaging modality
"Understanding the role of nuclear medicine in the clinical, medical diagnostic imaging field"
"Understanding the role of nuclear medicine in the radioactive treatment and therapy field"
"Know the indications for radionuclide studies/scans"
"Understand the need for appropriate referral of patients"
Improve patient care and management
Improving undergraduate medical students' knowledge, skills and attitudes towards nuclear medicine as an imaging modality

Objective 2a: Reasons WHY such an undergraduate medical nuclear medicine educational module should NOT be implemented in the MBCHB programme
Integrate nuclear medicine into clinical modules rather than implementing a specific module

Objective 2b: WHEN will be the most effective time to introduce such a basic nuclear medicine module? (cf. Paragraph 5.3.2.2 and Tables 5.10 – 5.11)
CHAPTER 4: Descriptive statistical quantitative results. Figure 4.10 summarises the phases in which undergraduate nuclear medicine modules are presented to students (cf. Paragraph 4.3.2.4)
80% (n= 4): in clinical phase only
20% (n=1): in both pre-clinical and clinical phases
CHAPTER 5: Qualitative views and findings. Most appropriate time to introduce a basic nuclear medicine module in the MBChB programmes(cf. Paragraph 5.3.2.2)
Earlier years of medical studies (cf. Table 5.10)
"Depending on the topics or subjects to be taught"
Later, near the end of the clinical blocks/years (cf. Table 5.11)
"Final 2 years"

Objective 2c: WHICH nuclear medicine topics or subjects will be most appropriate at an undergraduate level? (cf. Paragraph 4.3.2.14), (cf. Paragraph 4.3.5.1 – 4.3.5.3 and Figures 4.24 – 4.31) (cf. Paragraph 5.3.2.3 and Tables 5.12 – 5.13)
CHAPTER 4: Descriptive statistical quantitative results. Figure 4.19 summarises the topics currently included in undergraduate nuclear medicine courses (cf. Paragraph 4.3.2.14)
Introduction and general overview
Musculoskeletal/bone scans
Genito-urinary/renograms
Infection imaging
Endocrine topics, including thyroid
Parathyroid studies
Cardiovascular imaging
Abdomen, liver imaging
Lungs, ventilation and perfusion studies

CHAPTER 4: Descriptive statistical quantitative results. Figures 4.25 to 4.30 summarise clinical subjects chosen on the Likert-type scale (cf. Paragraph 4.3.5.1 – 3)
100% essential topics include: • Bone scans; • Thyroid imaging; and • Thyroid therapy.
Lung perfusion and ventilation studies
Renograms
Cardiovascular ejection fractions
CHAPTER 5: Qualitative views and findings. Most appropriate basic nuclear medicine topics for teaching at an undergraduate level (cf. Paragraph 5.3.2.3)
GENERAL topic (cf. Table 5.12)
Introductory subjects
SPECIFIC clinical nuclear medicine scans (cf. Table 5.13)
Bone scans and musculoskeletal imaging
Diagnostic thyroid imaging
Therapeutic procedures for thyroid disease
Lung perfusion and ventilation scans
Genito-urinary and renal imaging
Gastro-intestinal, liver-spleen and hepatobiliary scans
Other endocrine and parathyroid imaging procedures
Brain and neurological imaging
Infection and inflammation imaging
Nuclear cardiology
Role of nuclear medicine in oncology and tumour imaging
Nuclear medicine in the emergency
The role of nuclear medicine in radionuclide therapy
The role of nuclear medicine in paediatrics

Objective 2d: WHAT should the extent of the contents be for each subject or topic at an undergraduate level? (cf. Paragraph 5.3.2.4)
General topics: (cf. Table 5.14)
Understand how nuclear medicine imaging works
Understand what radioactivity is and units used
Understand aspects of radiation safety
Specific clinical topics: (cf. Table 5.15)
Clinical indications (and contra-indications) of nuclear medicine imaging procedures in the various clinical conditions
Limitations of each study
Need for correct and sufficient clinical information when ordering a nuclear medicine study
Patient preparation
What therapies are offered and how the patient is treated

Objective 2e: By WHOM should this module be taught – by nuclear medicine physicians or by other clinical physicians during ward rounds? (cf. Paragraphs 4.3.3.1 and 5.3.2.5)
CHAPTER 4: Descriptive statistical quantitative results (cf. Figure 4.21)
100%:Nuclear medicine specialists
80%: Heads of Nuclear Medicine Department
60%: Nuclear medicine registrars
20%: Nuclear medicine medical officer
20%: Other clinical physicians

CHAPTER 5: Qualitative views and findings (cf. Tables 5.16 and 5.17)
Nuclear medicine physicians/specialists
Combinations of nuclear medicine physicians and nuclear physicists

Objective 2f: HOW should the undergraduate nuclear medicine module be presented to the students (teaching and learning strategies and methods)? (cf. Paragraphs 4.3.2.10 and 5.3.2.6)
CHAPTER 4: Descriptive statistical quantitative results (cf. Figure 4.16)
100%:Teacher-centred formal lectures
40%: Observational practical sessions
20%: Active participation practical sessions
20%: Elective possibilities
No student-centred lectures or E-learning teaching facilities
CHAPTER 5: Qualitative views and findings (cf. Tables 5.18 – 21)
Formal lectures
Practical demonstrations
Interactive small-group case studies
Integrated combination of methods

Objective 2g: HOW should the undergraduate nuclear medicine module be presented to the students (students' achievements, assessment strategies and methods)? (cf. Paragraph 4.3.2.11 and 4.3.2.12), (cf. Paragraph 5.3.2.7)
CHAPTER 4: Descriptive statistical quantitative results
Formative assessment methods (cf. Figure 4.17)
40%: Written assignments
40%: No assessment done
20%: Case studies
20%: Oral presentations
Summative assessment methods (cf. Figure 4.18)
60%: Written tests/examinations
40%: MCQs
40%: No assessment done
CHAPTER 5: Qualitative views and findings
Formal written tests or examinations (cf. Table 5.22)
Including short questions, MCQs or single based answers
Summative assessment as part of or integrated with the clinical modules
Practical case study assignment(cf. Table 5.23)
Simple case studies with assessment
Assignments as part of small-group visits to the Nuclear Medicine Department
Integrated assessment with other clinical modules (cf. Table 5.24)

Objective 2h: HOW should the module be incorporated into the existing medical programmes? (cf. Paragraph 4.3.2.5, 4.3.2.6, 4.3.2.13and 5.3.2.8), (cf. Table 4.10 and 5.25 - 5.27)
CHAPTER 4: Descriptive statistical quantitative results
40% form part of the existing medical curricula
40% are integrated with other departments
40% are occasional presentations
80% integrated lectures
20% combination approach
No total independent nuclear medicine lectures

CHAPTER 5: Qualitative opinions and findings
An independent nuclear medicine module
Integrated module
Integrated with other clinical or diagnostic departments in clinical blocks of teaching
A combination of both

KEY PERSON PARTICIPANTS' VIEWPOINTS ON GUIDELINESS FOR UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE

NECESSITY for undergraduate nuclear medicine educational *module* (cf. Paragraph 4.3.4.1, 4.3.5.4 and 5.3.1.3), (cf. Figure 4.23 and 4.32)
CHAPTER 4: Descriptive statistical quantitative results
80%: Yes (module 80%: Essential)
20%: No (module 20%: Not needed)
CHAPTER 5: Qualitative opinions and findings
Positive responses on the effect of such a module includes (cf. Table 5.3)
Student can learn about requesting the right investigations, cost effectiveness, patient preparations and radiation safety according to the ALARA principles

NECESSITY for *guidelines* for undergraduate nuclear medicine educational module (cf. Paragraph 4.3.5.5 and 5.3.1.5)
CHAPTER 4: Descriptive statistical quantitative results (cf. Figure 4.32)
Guidelines 60%: Essential
Guidelines 20%: Useful
Guidelines 20%: Not needed
CHAPTER 5: Qualitative opinions and findings
Negative response on the effect of such a module (cf. Table 5.5)
"Makes this impossible with the staff we currently have"
"The amount of time allocated for nuclear medicine is too short"

APPENDIX F5

SUMMARY OF NUCLEAR MEDICINE EXPERTS' QUANTITATIVE RESULTS AND QUALITATIVE RESPONSES TO THE RESEARCH SUB-QUESTIONS AND THEIR VIEWPOINTS ON GUIDELINES FOR AN UNDERGRADUATE MEDICAL NUCLEAR MEDICINE MODULE (STUDY OBJECTIVE 3)

Objective 3: To obtain the opinions of nuclear medicine experts in South Africa regarding the sub-questions asked, in order to answer the main research question. **(Semi-structured survey questionnaires with both closed and open-ended questions, completed by academic and private nuclear medicine experts in South Africa).**

As mentioned, Chapter 4 (cf. Figure 4.1) presented the descriptive statistical results and Chapter 5 (cf. Figure 5.1) the opinions of South African nuclear medicine regarding undergraduate medical nuclear medicine education nationally. This information contributes to and provides the necessary context of the study to meet Objective 3 (Paragraph 1.4.3) in order to address the aim of the study, namely, to provide guidelines for an undergraduate nuclear medicine module in MBChB programmes in South Africa.

Table F5, as part of Appendix F5, summarises information obtained from ***nuclear medicine expert participants' (n=47)*** responses regarding:

- Quantitative descriptive statistical results on undergraduate nuclear medicine course content as indicated on the Likert-type frequency scale as described in Section C of Chapter 4 (cf. Paragraph 4.4.3);
- Qualitative findings and opinions/views reported on the research sub-questions that needed answering (why, when, which topics, to what extent, by whom, how presented and assessed and in which way presented in the existing undergraduate curricula) in Section B of Chapter 5 (cf. Paragraph 5.4.1); and
- Nuclear medicine expert participants' viewpoints on guidelines for an undergraduate medical nuclear medicine module (cf. Paragraphs 4.4.2.1, 4.4.3.4 and 4.4.3.5).

TABLE F5 NUCLEAR MEDICINE EXPERTS' QUANTITATIVE RESULTS AND QUALITATIVE FINDINGS OBTAINED FROM SEMI-STRUCTURED SURVEY QUESTIONNAIRES
(Table continues on the next pages)

***Objective 3a*: WHY is it necessary to implement an undergraduate medical nuclear medicine educational module in the MBChB programme?** (cf. Paragraph 5.4.1.1 and Tables 5.29 – 5.33)
Undergraduate medical students
Lack of knowledge/awareness/familiarity
Early exposure to the subject
Educating the students (as future physicians) about the preparation of patients
Educating medical students about the place and usefulness of nuclear medicine
Nuclear medicine as a diagnostic imaging and therapeutic modality
Role of nuclear medicine in diagnostic and therapeutic medicine
Create an awareness of the nuclear medicine speciality and services offered
Survival and growth of the speciality
Nuclear medicine services versus radiology services
Nuclear medicine as a career option
Nuclear medicine physicians rely on appropriate referrals from general physicians and specialists
Undergraduate nuclear medicine education
Integration of nuclear medicine teaching into clinical modules: to see it in the context of the clinical problems
Ensuring good quality training of international standards
Exposure to BASIC nuclear medicine imaging procedures
Newly qualified interns and community-service physicians
As future clinicians they are the ones who will ultimately use the nuclear medicine diagnostic resource
Clinicians are responsible for effective patient care
Effective patient care

***Objective 3b:* WHEN will be the most effective time to introduce such a basic nuclear medicine module?** (cf. Paragraph 5.4.1.2 and Tables 5.35 – 5.36)
The earlier undergraduate years
Pre-clinical years/Early clinical years
"Just before they start their clinical training or very early in their clinical training"
Later, nearer the end of the clinical blocks/years
Clinical years
Last two years

***Objective 3c:* WHICH nuclear medicine topics or subjects will be most appropriate at undergraduate level?** (cf. Paragraph 4.4.3.1 – 4.4.3.3 and Figures 4.39 – 4.46), (cf. Paragraph 5.4.1.3 and Tables 5.37 – 5.40)
CHAPTER 4: Descriptive statistical quantitative results. Figures 4.41 to 4.46 summarise clinical subjects chosen on the Likert-type scale (cf. Paragraph 4.4.3.3)
>90% essential topics
97.9%: Thyroid imaging
93.6%: Bone scans
93.6%: Lung perfusions
91.3%: Lung ventilation
>80% essential topics
89.4%: RAI thyroid therapy
87.2%: Renograms
80.9%: Cardiovascular imaging

CHAPTER 5: Qualitative opinions and findings
Basic-science subjects (cf. Table 5.37)
Basic medical physics
Radiation protection
Radiolabelling and Radiopharmacy
Imaging principles
General nuclear medicine subjects (cf. Table 5.38)
Basic introduction and principles of nuclear medicine studies
Indications for nuclear medicine studies
Specific clinical nuclear medicine imaging subjects(cf. Table 5.39)
Musculoskeletal and bone scans
Respiratory perfusion and ventilation studies (V-Q scans)
Genito-urinary studies: Renograms, GFRs
Nuclear cardiology
Thyroid diagnostic
Thyroid therapy
Newer nuclear medicine technologies and what to expect in the future(cf. Table 5.40)
"All topics are relevant unless still in the research phase"
"*SPECT-CT, PET and PET-CT*"
"*Targeted therapies*"

Objective 3d: **WHAT should the extent of the contents be for each subject or topic at an undergraduate level?** (cf. Paragraph 5.4.1.4 and Tables5.41 – 5.45)
Nuclear medicine as an imaging modality
Understanding nuclear medicine as an diagnostic imaging and therapeutic modality
Basic introduction and principles of nuclear medicine
Clinical indications and contraindications of procedures
Role of nuclear medicine studies in handling of patients
Effective patient preparation
Specific, basic core content regarding nuclear medicine
Basic core content of nuclear medicine as a diagnostic/therapeutic modality
Cooperation between Nuclear Medicine Department and referring physicians
Newer nuclear medicine technologies

Objective 3e: **By WHOM should this module be taught - by nuclear medicine physicians or by other clinical physicians during ward rounds?** (cf. Paragraph 5.4.1.5 and Table 5.46 – 5.49)
Nuclear medicine physicians/specialists
Other radiation workers
Nuclear medicine registrars and postgraduate nuclear medicine students
Nuclear medicine radiographers, physicists and radio-pharmacists
Other non-clinical lecturers or clinical physicians
Clinical specialists
Physiologists
Nuclear medicine physicians integrated with clinical physicians
A combination of nuclear medicine and clinical physicians

Objective 3f: **HOW should the undergraduate nuclear medicine module be presented to the students (teaching and learning strategies and methods)?** (cf. Paragraph 5.4.1.6 and Tables 5.50 – 5.55)
Formal didactic lectures
Small-group discussions and tutorials
Practical sessions in the Nuclear Medicine Department
Combination of strategies or methods
Other options to be considered: bedside teaching
Integrated teaching with physiology
Participants not familiar with newer teaching methods and strategies

Objective 3g: **HOW should the undergraduate nuclear medicine module be presented to the students (students' achievements, assessment strategies and methods)?** (cf. Paragraph 5.4.1.7 and tables 5.56 – 5.59)
Formal written tests and examinations
Practical clinical problem case studies
Integrated combination of methods
Unsure participants

Objective 3h: **HOW should the module be incorporated into the existing medical programmes?** (cf. Paragraph 5.4.1.8 and Tables 5.60 – 5.62)
An independent department
Integrated with other departments
Clinical specialities: Internal medicine, oncology/radiotherapy
Clinical specialities: Orthopaedics, paediatrics
Other diagnostic imaging modalities: Radiology modalities
Combination of both

NECESSITY of undergraduate nuclear medicine educational *module*. (cf. Paragraphs 4.4.2.1, 4.4.3.4 and Figures 4.38, 4.47)
CHAPTER 4: Descriptive statistical quantitative results
100%: Yes
Module 81.4%: Essential
Module 18.6%: Useful

NECESSITY of *guidelines* for undergraduate nuclear medicine educational module. (cf. Paragraph 4.4.3.5 and Figure 4.47)
CHAPTER 4: Descriptive statistical quantitative results
Guidelines 80.5%: Essential
Guidelines 19.5%: Useful

APPENDIX G

(INCLUDING APPENDIX G)

APPENDIX G: PROOF OF LANGUAGE EDITING

APPENDIX G1

18 December 2014

Luna Bergh

55 Jim Fouché Avenue

Universitas, Bloemfontein

To whom it may concern

This is to certify that I language-edited the M. HPE dissertation of Riana Nel manually (excluding references). She effected the changes herself. In this way both linguistic excellence and the candidate's ownership of her text were ensured.

Sincerely

Luna Bergh

Language and writing specialist