KNOWLEDGE, CLINICAL COMPETENCIES AND MEDICO LEGAL RESPONSIBILITIES REQUIRED FOR THE ADMINISTRATION OF INTRAVENOUS CONTRAST MEDIA BY RADIOGRAPHERS

A dissertation submitted in fulfillment of the requirements for the Degree of Master of Health Sciences in Radiography at the Faculty of Health Sciences, Durban University of Technology.

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DECLARATION OF ORIGINALITY

Except for quotations specifically indicated in the text and such help as I have acknowledged, this dissertation is wholly my own work, and has not been submitted for any qualification at any other institution. Part of the work in this dissertation has been submitted for publication in the African Journal of Health Professions Education. The manuscript is currently in review.

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ABSTRACT

Background

The current scope of practice for diagnostic radiographers, does not allow them to administer intravenous contrast media (IVCM) since there are no formal training guidelines accredited by the Health Professions Council of South Africa (HPCSA) (Koch 2014: 26). In selected countries abroad, radiographers are allowed to administer IVCM and have thus received the necessary and accredited training to do so. In view of this, the South African radiographer's scope of practice is not on par with the selected countries. The radiologists in South Africa (SA) who are currently responsible for the administration of IVCM have issued a position statement which supports, in principle, the idea of radiographers administering IVCM should they receive the necessary and appropriate training to do so (RSSA 2011: 1-2). The aim of this research study was, therefore, to investigate the radiologists' perspectives regarding the theoretical knowledge, clinical competencies and medico legal responsibilities required by radiographers in order to effectively administer IVCM. This research study provides input for the development of national training guidelines for radiographers to administer IVCM.

Research methodology

A quantitative, descriptive study was conducted by targeting qualified radiologists residing and practicing within the province of KwaZulu Natal (KZN). Ethical approval was obtained from the Durban University of Technology's (DUT) Institutional Research and Ethics Committee (IREC). All the participants were contacted in their personal capacity. The research tool was an online survey administered through SurveyMonkey which included questions and statements relating to the administration of IVCM and was

structured so as to meet the study objectives. The research tool was evaluated and amended by an expert focus group to ensure reliability and validity. Confidentiality was maintained and all the data obtained during this research study was password protected.

Results and discussion

Fifty-nine radiologists (60.8 percent) participated in this study. Twelve respondents, however, were excluded due to incomplete surveys. The final response rate, therefore, was 48.5 percent (n=47) of which 72.3 percent of the respondents were from the private sector. Results illustrated the radiologists' agreement regarding the theoretical, clinical/practical and medico legal training components for inclusion in the further training of radiographers to administer IVCM. Most respondents supported the inclusion of three assessments: theoretical (87.2 percent), clinical (93.6 percent) and a record of clinical competencies (95.7 percent). The assessments were considered equally important in terms of percentage weighting. The overall results compared favorably to the current international trends and practice standards of radiographers administering IVCM.

Conclusion and recommendations

The study, in providing key data for the development of training guidelines for radiographers to administer IVCM, has demonstrated the importance of higher education (HE) and training in addressing transformation in health services with particular reference to professional scopes of practice. Furthermore, it reinforces the need for local research that will inform HE and training and hence a scope of practice that meets local needs. It was recommended that future studies should include those HE institutions offering training in Radiography as well as their stakeholders for the design and transformation of a national curriculum for radiographers to administer IVCM.

Keywords

Radiographers, scope of practice, role extension, intravenous contrast media

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ABBREVIATIONS

AJHPE : African Journal of Health Professions Education

AP : Advanced Practice

ARMRIT : American Registry of Magnetic Resonance Imaging Technologists

ARRT : American Registry of Radiologic Technologists

BLS : Basic Life Support

CM : Contrast media

CNS : Central nervous system

CPR : Cardiopulmonary resuscitation

CT : Computed Tomography

DoH : Department of Health

DUT : Durban University of Technology

HE : Higher Education

HPA : Health Professions Act

HPCSA : Health Professions Council of South Africa

IREC : Institutional Research and Ethics Committee

IV : Intravenous

IVCM : Intravenous contrast media

KZN : KwaZulu Natal

LA : Left atrium

LV : Left ventricle

MRI : Magnetic Resonance Imaging

NM : Nuclear Medicine

NQF : National Qualifications Framework

OMARS : Ontario Association of Medical Radiation Sciences

PBRCT : Professional Board for Radiography and Clinical Technology
PNS : Peripheral nervous system
QA : Quality Assurance
QC : Quality Control
RA : Right atrium
RCT : Radiography and Clinical Technology
RSSA : Radiological Society of South Africa
RT : Radiotherapy
RV : Right ventricle
SA : South Africa
SAQA : South African Qualifications Authority
SORSA : Society of Radiographers of South Africa
UK : United Kingdom
US : Ultrasound
USA : United States of America

GLOSSARY OF TERMS

Adequate knowledge

The necessary or minimum knowledge required for a specific purpose or goal (Dictionary.com 2017). This term should be used as a point of reference throughout this dissertation as the minimum knowledge required for the administration of intravenous contrast media (IVCM) by radiographers.

Angiography

The radiographic visualization of blood vessels after the administration of IVCM (Koch and Robbs 2016: 9).

Basic Life Support

The recognition of clinical signs indicating life threatening conditions such as cardiac arrests and airway obstructions and the application of the necessary treatment (Chandrasekaran *et al.* 2010: 121; Chaudhary, Parikh and Dave 2011: 80; Koch 2014: 26).

Cardiopulmonary resuscitation

A technique used to save the lives of those who require emergency medical treatment due to heart attacks and airway obstructions. Effective CPR will restore their heartbeat and breathing through the application of external chest compressions and rescue breathing (Chaudhary, Parikh and Dave 2011: 80; Mayo Clinic 2016a).

Computed Tomography

A radiographic imaging modality that produces sectional anatomical images of the human body, using complex computer and mechanical equipment (Bontrager and Lampignano 2005: 729).

Contrast media

Imaging agents used in various radiographic examinations to enhance the visibility of internal anatomical structures (Koch and Robbs 2016: 9-11). Contrast media in its plural form refers to more than one contrast medium, whereas ‘contrast medium’ provides reference to one specific contrast medium only. These two terms have been used extensively throughout this dissertation whereby ‘contrast media’ was abbreviated as ‘CM’ and ‘contrast medium’ was written in full.

Diagnostic Radiography

A category of Radiography that involves the production of medical images in order to visualize the internal structures of the human body (Bushong 2004: 3).

Interventional Radiography

A sub-specialty of Radiology providing minimally invasive image guided diagnosis and treatment of diseases in every organ system (Society of Interventional Radiology 2010: 1147).

Intravenous cannulation

The technique whereby a cannula (needle) is inserted into a vein for venous access – also referred to as ‘venipuncture’ (Bontrager and Lampignano 2005: 551). In the context of this study, it allows access for the administration of IVCM.

Magnetic Resonance Imaging

A radiographic imaging modality that makes use of magnetic fields and radio waves to create images of the anatomical structures of the human body (Bontrager and Lampignano 2005: 797).

Nuclear Medicine

A category of Radiography where small quantities of radioactive substances (radiopharmaceuticals) are administered intravenously in order to create images of the various physiological processes of the human body (Bontrager and Lampignano 2005: 786; Cain 2013).

Pharmacology

The study of drugs along with their distinct uses and effects (Dreyer *et al.* 2012: 1).

Quality Assurance

A process whereby activities are implemented to ensure and maintain quality standards (World Health Organization 2006: 9-10).

Radiograph

The visible image of the different anatomical structures of the human body (Bushong 2004: 3).

Radiographer

Allied health professional responsible for medical imaging, which is the taking of radiographs/medical images of the human body by using complex equipment (RSSA 2016).

Radiologist

A medical physician who has specialized in Radiology and is responsible for the diagnosis and management of diseases (RSSA 2016).

Radiotherapy

A category of Radiography that makes use of radiation to treat of various types of cancer (Bontrager and Lampignano 2005: 792).

Role extension

The adoption by an individual of specific duties that did not form part of his/her initial role and/or responsibilities (Gqweta 2012: 22).

Scope of practice

The legal and professional boundaries within which a professional must practice (Freeman 2013: 3).

Ultrasound

A category of Radiography that makes use of high frequency sound waves in order to produce images of the different anatomical structures within the human body (Bontrager and Lampignano 2005: 793-794).

CHAPTER 1
INTRODUCTION

1.1 Introduction

Chapter one includes the background, motivation for and significance of this research study. The research aim and objectives have been stated and the content of subsequent chapters briefly outlined.

1.2 Background

The profession of Radiography comprises of four sub categories which include Diagnostic (D), Nuclear Medicine (NM), Ultrasound (US) and Radiotherapy (RT). Training is offered at various universities and universities of technology across South Africa (SA). The majority of these training institutions are currently transforming their qualifications from three year national diplomas and degrees into four year professional degrees (Speelman 2015: 2). The new professional degrees are offered on the National Qualifications Framework (NQF) level eight which is a higher level than the previous, NQF level six, three year national diplomas and degrees (SAQA 2014). This indicates that the new qualifications could, possibly, include elements of professional role extension such as the administration of intravenous contrast media (IVCM) for radiographers practicing in SA.

The practice of Diagnostic Radiography includes the administration of IVCM by radiologists during specialized investigations (Bontrager and Lampignano 2005: 685-812) in order to enhance the visibility of the internal anatomical

structures of the human body i.e. blood vessels and organs (Andreucci, Solomon and Tasanarong 2014: 1; Merriam Webster 2014). The use of contrast media (CM) has also been introduced into the clinical practice of US (Thomson and Varma 2010: 19). Angiography, interventional radiographic procedures, Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are examples of specialized diagnostic imaging modalities that often require the administration of IVCM (Bontrager and Lampignano 2005: 685–812).

The radiographer's role and duties in the four categories of Radiography are unique in terms of their scopes of practice. Radiographers practicing US may apply their pattern recognition skills by reporting their findings in a written format, and NM radiographers are legally permitted to administer radiopharmaceuticals intravenously. These tasks are within the scope of practice of US and NM radiographers as they have received the necessary and accredited training. Diagnostic radiographers, however, are not permitted to administer IVCM due to its associated risk of complications and adverse reactions as well as the lack of available training (Koch 2014: 26).

The administration of IVCM and the interpretation of planar radiographs by South African radiographers have been well documented in literature as the two key areas that need to be included in the scope of radiographers in SA, hence extending their role (Kekana, Swindon and Mathobisa 2014; Kekana, Swindon and Mathobisa 2015: 1115). Radiographers in SA are legally prevented from administering IVCM as it is not within their professional scope of practice and they have not received the accredited training to do so (Kekana, Swindon and Mathobisa 2015: 1115; Koch 2014: 26; Munro *et al.* 2012: 27; PBRCT 2014). Whilst the administration of IVCM currently falls within the scope of practice of radiologists who are trained in this area (RSSA

2011: 2), the Professional Board for Radiography and Clinical Technology (PBRCT) is currently addressing the issue of role extension for radiographers in SA (PBRCT 2014).

The radiologists in SA have agreed, in principle, with the concept of radiographers administering IVCM, provided they receive the appropriate accredited training to do so (RSSA 2011: 2). It is, however, important to note that this is only the opinion of the Radiological Society of South Africa (RSSA) and does not automatically allow radiographers in SA to legally administer IVCM. According to Kekana, Swindon and Mathobisa (2015: 1115), the expansion for the South African radiographer's scope of practice is deemed necessary due to the national shortage of radiologists, service delivery constraints as well as the plea amongst radiographers to be recognized for the additional services they currently provide. In this context, the terms 'scope of practice' and 'scope of profession' are often misunderstood.

The 'scope of practice' of a health professional describes his/her specific role and responsibilities which are ultimately derived from the formal and accredited training that he/she has received and completed successfully (Freeman 2013: 3). The term 'scope of the profession' refers to the contribution of a specific health care profession within a chain of health care services (Freeman 2013: 3). For example, Diagnostic Radiography is focused on the management of patients undergoing diagnostic imaging investigations where the radiographer is responsible for producing medical images and assisting the radiologist during specialized procedures. This does not include image interpretation or the administration of IVCM.

In SA, and to date, there is no such document as a 'scope of practice' for radiographers. The only official document available is a set of guidelines

provided by the PBRCT to help define the scope of practice under which diagnostic radiographers in SA should practice. As a point of reference for this dissertation, however, the term 'scope of practice' has been used extensively.

According to Annexure 10 of the HPCSA's Ethical Rules of Conduct pertaining specifically to the profession of Radiography, radiographers may only work at the request of a registered practitioner approved by the PBRCT and may not exceed the limits of the category under which he/she is registered (HPCSA 2010: 42-43). This means that radiographers may only perform professional acts pertaining to the profession of Radiography and in particular the category in which they are registered for with the HPCSA. Currently, the administration of IVCM by radiographers is not allowed as it is not part of their training.

Due to the worldwide shortage of radiologists and the higher demand for specialized radiological investigations being requested, radiographers in some countries are now provided with opportunities to extend their professional scope of practice to include the administration of IVCM (Kelly, Piper and Nightingdale 2008: 71; Woodford 2005: 318). The radiologist-to-patient ratio in SA is approximately 1: 57 937 (Gqweta 2014: 1). Consequently, the delivery of specialized radiological services in SA that require the administration of IVCM is limited, as only radiologists may administer IVCM. Due to this national shortage of radiologists in SA, radiographers are, however, performing some tasks of radiologists, in particular, the administration of IVCM (Munro *et al*. 2012: 28). The Society of Radiographers of South Africa (SORSA) has received numerous reports of radiographers who administer IVCM in both the private and public healthcare sectors even though this is not within their legal scope of practice (Munro *et*

al. 2012: 28; PBRCT 2014). Radiographers are thus opening themselves up to possible litigation and disciplinary action for operating outside their scope of practice.

A recent role extension survey conducted amongst radiographers in SA by the PBRCT found that 44.2 percent indicated that they currently administer IVCM (Kekana, Swindon and Mathobisa 2014). In addition, the PBRCT survey results indicate that 32 percent of the participants were compelled to administer IVCM by their employers. It is perceived that these radiographers are afraid of refusing to carry out directives from their employers. This violation of the scope could have serious professional and medico legal consequences for the Radiography profession, as the radiographers in SA have not yet received the appropriate, accredited training to administer IVCM. Radiographers may, therefore, not be able to effectively manage and treat those patients who experience some form of adverse reaction or complication due to an intravenously administered contrast medium (RSSA 2011: 2).

The study by the PBRCT further revealed that 24.5 percent of radiographers in SA have attended workshops and received in-house training sessions to learn how to administer IVCM (Kekana, Swindon and Mathobisa 2014). It is, however, important to note that these workshops and in-house training sessions are not recognized or accredited by the PBRCT and therefore do not provide radiographers with the license to practice this extended role. Radiographers in SA who are currently administering IVCM are performing criminal acts and may be penalized accordingly as they do not possess the required knowledge, competencies or medico legal training to perform this task.

This research study was aimed at investigating the knowledge, clinical competencies and medico legal responsibilities required by South African radiographers in order to effectively administer IVCM. The study further attempted to determine and define the South African radiographer's future scope of training for the administration of IVCM by obtaining input from radiologists who already have this included in their scope of practice and accredited training. The radiologists were, therefore, best suited to provide the necessary data required for this research study.

1.3 Motivation and significance

To date, limited literature is available on national training guidelines for the extension of the South African radiographers' role pertaining to the administration of IVCM as this is an emerging area of practice. Studies conducted in KwaZulu Natal (KZN) have identified a need for further training of radiographers with regards to role extension (Gqweta 2012: 25; Gqweta 2014: 3; Munro *et al.* 2012: 33). The South African radiographer's role extension is further motivated by the fact that in selected countries abroad, radiographers are permitted to administer IVCM (with certain restrictions), following the completion of further training and certification. For example, the administration of IVCM by radiographers is already being practiced (with certain restrictions) in Canada, the United Kingdom (UK) and Australia (Munro *et al.* 2012: 32). It is evident from international literature that SA is not yet on par with the extended role and practice of the Radiography profession.

New Radiography qualifications that may include some elements of role extension are currently being implemented at universities and universities of technology across SA (Speelman 2015: 2). The need was, therefore, expressed for local research to be conducted in order to provide scientific

input, within a local context, for the development of national training guidelines for the administration of IVCM by radiographers. The previous chairperson of the PBRCT supported this statement during a HPCSA World Radiography Day seminar held in Durban, SA, on 07 November 2014. She indicated that the training provided abroad is unique to each country and may be due to the specific needs and legal boundaries of those countries, therefore it is important to obtain local South African data (Kekana 2014a). Furthermore, the current Editor-in-Chief of the African Journal of Health Professions Education (AJHPE) has also emphasized the need for local research to be conducted in order to meet the training needs of all healthcare professionals (Burch 2016: 146). The aim of this research study was, therefore, to identify the local training needs and to use the results to provide input to the HPCSA (PBRCT) for the development of national training guidelines for the administration of IVCM that will be relevant for South African radiographers.

It is envisaged that the proposed training guidelines (outcome of this research study) will inform the future scope of practice and scope of profession for IVCM administration by radiographers in SA as highlighted by the chairperson of the previous PBRCT (Kekana 2014a). Consequently, should the administration of IVCM be included within the South African radiographers' scope of practice, the delivery of specialized radiological procedures in SA could become more efficient and radiographers could be permitted to practice this extended role, legally. It is important to bear in mind that with this extended task there will be greater responsibilities and it should, therefore, be implemented primarily to benefit the patients undergoing the specialized radiological procedures.

1.4 Research aim

The aim of this study was to investigate the radiologists' perspective of the theoretical knowledge, clinical competencies and medico legal responsibilities required by South African radiographers for the administration of IVCM in order to provide input for the development of national training guidelines.

1.5 Research objectives

1) To determine the theoretical knowledge required for radiographers to administer IVCM according to the radiologists' perspective.
2) To determine the clinical competencies required for radiographers to effectively administer IVCM according to the radiologists' perspective.
3) To determine the medico legal responsibilities related to the administration of IVCM by radiographers according to the radiologists' perspective.

1.6 Assumptions and delimitations

The researcher has assumed that the information provided by all the participants is their personal and honest opinions and perceptions based on their experience and expertise in the field of this research study. The study focused on obtaining input from qualified radiologists rather than the radiographers as the administration of IVCM currently falls within the radiologists' scope of practice and is not included in the radiographers' training.

1.7 Researcher's interest in the research study

The researcher has worked in various clinical settings whereby he has witnessed radiographers administering IVCM even though this is outside their legal scope of practice. In order for the South African Radiography profession to reach the same level of international practice, the need for further training exists. The training will need to be accredited with the HPCSA in order for the radiographers to legally administer the IVCM. The researcher's intention was, therefore, to identify the necessary training to overcome this gap in local practice. The researcher further hopes that the results of this study will inform the future scope of practice and training of radiographers in SA.

1.8 Summary of chapters

Chapter 1: Introduction

The Introduction chapter provided a brief background of the research study and the researcher's interest in the research study. The motivation and significance of the research study was explained and linked to the research aim and objectives. Additionally, this chapter outlined the content of subsequent chapters.

Chapter 2: Literature review

This chapter included a comprehensive literature review related to the context of the research study. The literature on this research topic has been critically analyzed and further linked to the study aim and objectives. The current scope of practice, responsibilities and practice of radiographers are explored both nationally and internationally with regards to the administration of IVCM. A summary from existing literature and research highlights the importance, needs and focus of this research study.

Chapter 3: Methodology

The type and design of the research study as well as the methodologies applied, including ethical considerations and limitations have been outlined in this chapter.

Chapter 4: Results

Chapter four included the results obtained from the research study by means of figures, tables and explanations thereof, according to the study objectives and/or themes.

Chapter 5: Discussion

A detailed discussion of the results and comparisons with appropriate documented literature was provided in this chapter.

Chapter 6: Conclusion and recommendations

The summarized findings and conclusion from this research study have been presented in this chapter. The chapter also highlights the significance of the study and indicated the strengths and limitations identified. Additionally, recommendations for future research have been made.

References

A list of all the academic sources used during this dissertation has been provided.

Appendices

All additional material relevant to the study has been included in this section, where appropriate.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

Current trends in Higher Education (HE), coupled with the changing needs of healthcare service and delivery have become areas of increasing interest in the Radiography profession. The alignment of HE and training with the professional needs of the healthcare service is thus of paramount importance in order to meet local needs and subsequently improve the delivery of local health care services in Radiography (Burch 2016: 146).

Specialized radiological services that require the administration of IVCM have escalated over the last few decades and are now placing more pressure on the radiographers in SA for the quality of the services they provide. In support of this, radiographers are being pressured to practice outside their professional and legal scope of practice by administering IVCM. This can be largely attributed to the national shortage of radiologists in SA (Gqweta 2012: 22).

Diagnostic radiographers produce the radiographs that are required by radiologists to make an accurate medical diagnosis and, therefore, work in close collaboration with each other (Etheredge 2011: 9). Although the administration of IVCM currently falls within the radiologist's scope of practice (RSSA 2011: 1-2), radiographers are responsible for assisting them during specialized procedures that require the administration of IVCM, in addition to imaging of the human body (HPCSA 1997: 1-2).

The Radiography profession is changing and expanding globally as radiographers in selected countries have extended their legal practice boundaries (Cowling 2008: 28). The South African radiographer's scope of practice has not been amended since 1997; however, it is currently under review to include the administration of IVCM. In a recent, local study, it was found that in order for this to happen, formal training is imperative (Kekana, Swindon and Mathobisa 2014). The researcher hopes to provide input for the development of national training guidelines for the administration of IVCM by South African radiographers from the data obtained from those who already have this in their scope of practice and training – i.e the radiologists.

2.2 Education, training and registration in South Africa

Radiographers in SA are required to register their qualifications with the HPCSA in order to practice in their profession legally. The HPCSA is a statuary body for health professionals, and is dedicated to protecting the general public by enforcing rules, regulations and policies as well as monitoring training (HPCSA 2013). The radiographer's scope of practice is defined by the qualification that has been approved by the PBRCT and the training they have received from the HE institutions. To date, no qualification has been approved that includes the administration of IVCM by South African radiographers.

According to the 'Ethical Rules of Conduct for Practitioners Registered under the Health Professions Act, 1974', Annexure 10, radiographers may not perform any task outside their level of training (HPCSA 2010: 42-43). Training can be defined as: the education required for entry, the work experience required and the practical training needed to acquire competency (Bureau of Labor Statistics, Office of Occupational Statistics and Employment

Projections 2013). This definition of training was used as a point of reference throughout this research study which aimed at identifying the training required by radiographers for gaining competence in an extended role, with regard to the administration of IVCM.

2.3 The international radiographer's scope of practice and training

The scope of practice for radiographers varies considerably in countries internationally. Radiographers in Australia and New Zealand are permitted to administer IVCM, but only under the supervision of a radiologist after having completed the necessary further training to do so (Munro *et al.* 2012: 32; The Royal Australian and New Zealand College of Radiologists 2016: 24). The administration of IVCM is therefore within their professional scope of practice and the further training is accredited.

Likewise, radiographers in the United States of America (USA) may also administer IVCM once they have received the necessary training; however, certification by either the American Registry of Radiologic Technologists (ARRT) or the American Registry of Magnetic Resonance Imaging Technologists (ARMRIT) is needed (American College of Radiology 2014: 3). Those radiographers in America who have successfully completed the further training to administer IVCM may then register as a 'radiologist assistant'. This is a radiographer who has advanced his/her role by successfully completing a radiologist assistant academic program and who has been assessed and found to be clinically competent. The radiologist assistant program includes the assessment of patients, patient management and other selected areas, i.e. the administration of IVCM (American College of Radiology 2014: 3).

Similarly, radiographers in the United Kingdom (UK) have been able to advance to consultant and advanced practice (AP) radiographers (Kelly, Piper and Nightingale 2008: e72; Price and Edwards 2008: e66). The advanced practitioner is a radiographer who has gained additional knowledge and experience in a specific field that forms part of the radiologists' responsibilities (Kelly, Piper and Nightingale 2008: e72).

The Michener Institute for Applied Health Sciences (2013) in Canada offers similar training for radiographers to administer IVCM. According to The Irish Institute of Radiography and Radiation Therapy (2007: 1), the administration of IVCM by radiographers has been implemented in Ireland since 1995. In addition, European radiographers at the University of Malta, Faculty of Health Sciences, are offered a postgraduate certificate of competence in administering intravenous injections (University of Malta, Department of Radiography 2010: 1–20).

It is important to evaluate the development and training of radiographers in terms of IVCM administration in other countries in order to benchmark the quality of the training guidelines for South African radiographers. The content of the research tool (Appendix C) used in this research study was based upon a collective review of literature from international training standards and practice. However, the intention of the research tool was to obtain data from a local perspective whilst still remaining internationally relevant.

2.4 The South African radiographer's scope of practice and training

A document issued by the HPCSA (1997: 1-2), 'Regulations defining the scope of the profession of Radiography' under The Health Professions Act no. 56 of 1974, states that in addition to acquiring high quality medical images

for accurate diagnosis, radiographers are responsible for medicine control by assisting medical doctors. It is important to note, however, that this does not allow the radiographers to administer IVCM (PBRCT 2014). The interpretation of the term 'assist' can be given a number of meanings pertaining to radiographers assisting radiologists. Traditionally, radiographers have always assisted the radiologists by preparing patients for the various imaging investigations and assisting them whilst they (the radiologists) administered the IVCM. Since the administration of IVCM is not in the current scope of practice for the South African radiographer, one can safely assume that 'assisting' the radiologist, does not mean physically administering the IVCM. This was further supported in a previous PBRCT newsletter which emphasized the need for the further training of radiographers to legally administer IVCM (Kekana 2014b: 1).

Radiographers in SA are legally and ethically bound to practice within the scope of their educational training and competence (PBRCT 2014). The RSSA has issued a position statement that supports, in principle, the idea of radiographers performing IV cannulation as well as the administration of IVCM under the supervision of a radiologist (RSSA 2011: 1-2). The RSSA position statement further recommends that radiographers should first be appropriately trained to place IV cannulas and to connect and control the flow of IVCM. Nonetheless, they feel that the radiologist should still remain responsible as radiographers are not formally trained to administer IVCM and manage the possible complications and adverse reactions thereof (RSSA 2011: 1-2). It is noted that this is a position statement and merely expresses the radiologists' opinions. It does not provide radiographers with permission to legally administer IVCM.

To date, there is limited literature available on training guidelines for the South African radiographer to administer IVCM as this is an emerging area of practice. A previous study conducted by Munro *et al.* (2012: 27-34) addressed the need for further training in this regard. The target population for their study included qualified, South African radiographers from both the public and private healthcare sectors. The study revealed that 62 percent of the respondents are willing to take on the role and responsibility of administering IVCM. In addition, 27 percent of the respondents indicated that they are currently administering IVCM, of whom 22 percent received in-house training. One of the recommendations made by the researchers was the establishment of national training guidelines that include input from all the relevant stakeholders (i.e. including the radiologists) (Munro *et al.* 2012: 33). The current research study sought to do exactly that by including the radiologists as participants.

A study conducted in 2014, by Kekana, Swindon and Mathobisa (2014), indicate that 81 percent of the radiologists in SA support the idea of radiographers administering IVCM provided they receive the necessary, accredited training to do so. Keenan, Muir and Cuthbertson (2001: 684) state that accreditation for advanced practice should be addressed by the appropriate professional body, (in this case the HPCSA), in order to ensure a high standard of clinical practice and competence. This is supported by Munro *et al.* (2012: 33) and Kekana, Swindon and Mathobisa (2015: 1123) who further suggested that national training guidelines should be developed through benchmarking. Benchmarking is important as it allows some form of control through the monitoring of the various theoretical (knowledge), clinical competency (skills) and medico legal components needed for the national training guidelines against international standards. The questions and

statements in the research tool for this research study were developed by consulting international training guidelines and standards of practice.

2.5 Theoretical knowledge for the administration of intravenous contrast media

The international training and practice standards pertaining to the knowledge of anatomy, physiology and pathology of the cardiovascular and urinary systems, upper and lower limbs, the nervous and respiratory systems are discussed below. In addition, a section pertaining to CM has been included.

2.5.1 Anatomy, physiology and pathology of the cardiovascular and urinary systems, upper and lower limbs, nervous and respiratory systems

The cardiovascular system consists of highly defined anatomical structures which include the blood vessels, blood and the heart (Moore, Dalley and Agur 2010: 3). The heart is located in the mediastinum which is situated in between the right and left lungs and is responsible for the circulation of blood via the blood vessels throughout the entire human body (Tortora and Derrickson 2007: 696). It is imperative to understand the physiology of the heart and the process of blood circulation as it is directly involved with the distribution of IVCM (Bae 2010: 34). Bae (2010: 33–34) further highlights the fact that any contrast medium administered intravenously, will travel to the right side of the heart during pulmonary circulation and thereafter to the left side of the heart before reaching the central arterial system. The blood within the circulatory process will dilute the contrast medium after it has been administered intravenously and it will therefore be less visible on the image in those areas more distal to the site of injection. This may also be a critical factor when

deciding on the site of CM administration. If radiographers are to be responsible for deciding on the site of administration, they should be trained on and have adequate knowledge of the cardiovascular system.

The urinary system comprises of left and right kidneys and ureters, a urinary bladder and a urethra, responsible for the excretion of foreign and/or waste substances (Tortora and Derrickson 2007: 993-994). The kidneys are responsible for filtering blood plasma whereby they return water and nutrients to the bloodstream. The water that remains in the kidneys creates urine which then passes through the ureters to be stored in the urinary bladder. The urethra is responsible for excreting the urine from the urinary bladder (Tortora and Derrickson 2007: 993). The kidneys produce approximately one liter of urine per day and the absorption of CM by the kidneys is almost entirely due to glomerular filtration (Robbins and Pozniak 2010: 16). According to Nimmons *et al.* (2013: 479) in order for the iodine (found in CM) to be excreted by the urinary system, it may take approximately two months or more. In the context of this study, the contrast medium can be seen as a foreign substance administered to the human body and will therefore be excreted by the urinary system. It is therefore important for the radiographers to understand the basic anatomy, physiology and pathology of the urinary system should the administration of IVCM be included in their future scope of practice.

The upper and lower limbs are generally considered for possible sites of cannulation and IVCM administration. It is, therefore, also important for the individual administering IVCM to have adequate knowledge of the related anatomy, physiology and pathology of the upper and lower limbs to successfully perform the cannulation procedure and administer the IVCM (University of Malta, Department of Radiography 2010: 5). Adequate

knowledge of the anatomical and cardiovascular structures of the upper and lower limbs will allow the individual to comprehend what he/she should be cognisant of whilst administering the contrast medium (i.e. identifying possible sites for cannulation). Similarly, adequate knowledge pertaining to the physiology and pathology of the upper and lower limbs will allow the person injecting, to understand the circulation process of CM within the bloodstream and the possible complications and adverse reactions that could occur.

The nervous system is known to be the most complex of all the body systems and is divided into the central nervous system (CNS) and peripheral nervous system (PNS) (Tortora and Derrickson 2007: 404-405). The nervous system allows the body to respond to those changes experienced by its external and internal environments (Moore, Dalley and Agur 2010: 46) which can be categorized as sensory, integrative and motor functions (Tortora and Derrickson 2007: 405). It is important that any person administering IVCM should know the anatomy and understand the physiology and pathology of the nervous system in order to accurately identify and treat the signs and symptoms of possible complications and adverse reactions due to IVCM such as, if a patient becomes unresponsive. Patient unresponsiveness may be identified as a possible adverse reaction of the nervous system after the administration of IVCM and may be seen as an attempt to safeguard the human body (Huffman and Stern 2013: 228). It is for this reason that the individual administering the contrast medium should have adequate knowledge on physiology and pathology of the nervous system. This study sought to identify whether radiographers should be responsible for treating the adverse reactions and complications, therefore questions were included in the research tool to address this.

The respiratory system consists of two components including the upper and lower respiratory systems. The upper respiratory system includes the nose and pharynx whereas the lower respiratory system includes the larynx, trachea, bronchi and lungs (Healthline Medical Team 2016). In addition to the cardiovascular system, the respiratory system contributes to homeostasis by exchanging gases (oxygen and carbon dioxide) between the blood, tissue cells and atmospheric air (Tortora and Derrickson 2007: 846–847). It is important for the person administering IVCM to have adequate knowledge of the anatomy, physiology and pathology of the respiratory system in order to be able to identify the clinical signs associated with the possible complications and adverse reactions to IVCM, such as bronchospasms and acute airway obstructions. It will also provide insight on how to manage or treat similar adverse reactions and complications (The Royal College of Radiologists 2010: 13).

The anatomy and physiology of the cardiovascular system, as well as the upper and lower limbs are included in the postgraduate certificate of competence in administering intravenous injections offered by the University of Malta in Europe (University of Malta, Department of Radiography 2010: 5). Furthermore, the training of radiographers in Canada includes the study of venous anatomy and physiology (OMARS 2010). Similarly, the further training in the UK includes the study of the anatomy of the upper and lower limbs as well as the physiology relating to homeostasis, the blood brain barrier and fluid compartments (The College of Radiographers 2011: 7). The study of the respiratory system, however, was not identified in any available international literature pertaining to the training guidelines on IVCM administration and was therefore not included in the research tool for this study.

2.5.2 Contrast media

CM was discovered in 1953 by Vernon Wallingford, a pharmacist from the USA (Geenen, Kingma and van der Molen 2013: 812). The composition of CM subsequently improved over time and various types became readily available and were used extensively (Pasternak and Williamson 2012: 390). It was, however, noted that intravenously administered CM encouraged severe adverse effects and life threatening complications due to its high ionic characteristic (ionicity) and osmolarity. Ionicity refers to the extent to which a molecule is able to break down into a negatively charged anion and a positively charged cation, whereas osmolarity refers to the molecular value per kilogram of water (Singh and Daftary 2008: 69). Low osmolar, non-ionic CM was developed and proved to be a safer alternative for use in patients contraindicated for high ionic and osmolar CM (Geenen, Kingma and van der Molen 2013: 812).

The significance of IVCM during medical imaging is indisputable (Robbins and Pozniak 2010: 1; Singh and Daftary 2008: 69). CM can be administered intravenously, orally and rectally (Rawson and Pelletier 2013: 312). It is important to bear in mind that the increased use and demand for contrast enhanced investigations leads to a higher degree of accountability for the individual administering the contrast medium (Morrison and Odle 2007; Trindade *et al.* 2007: 324). For the purpose of this research study, the focus was on the IV method of CM administration.

2.5.2.1 Pharmacology

In the context of this research study, the pharmacology of CM relates to the study of the different types of IVCM along with their clinical and biomedical

indications and contraindications. CM may be considered as harmful drugs and it is for this reason that only those who have been adequately trained on the use of CM may prescribe it. CM can be categorized as iodinated and non-iodinated. Iodinated CM contains iodine whereas non-iodinated does not (Queensland Department of Health 2013: 5). Iodinated CM is more frequently used during specialized radiographic procedures and non-iodinated during US and MRI investigations (Thomson and Varma 2010: 19). CM is generally denser than bodily fluid (i.e. blood). Therefore, it will absorb more radiation compared to blood. It is for this reason that it can be easily visualized on medical imaging (Singh and Daftary 2008: 69). This research study focused on iodinated CM.

The pharmacology of CM is included in the further training of radiographers in the UK (The College of Radiographers 2011: 7), Canada (OMARS 2010) and Ireland (The Irish Institute of Radiography and Radiation Therapy 2007: 2). It can thus be assumed that the pharmacology of IVCM should be a critical component in the further training of radiographers. It is for this reason that the theoretical study thereof has been included in the research tool for this study.

2.5.2.2 Type and dose

According to Hesley and Hartman (2008: 20), the type of iodinated IVCM to be administered often depends on the age of the patient, risk for allergies, the type of examination and medical history (i.e. renal function). Robbins and Pozniak (2010: 1) highlight just how important it is to know that there is a distinct difference between the types and dosages of IVCM to be administered for pediatric and adult patients. The study of the different types and doses administered for adult and pediatric patients have, thus, been included in the research tool. No international literature was found pertaining

to the training of radiographers in terms of the different types and dosages of IVCM administered for the adult and pediatric patient.

2.5.2.3 Clinical and biomedical indications and contraindications

Clinical indications for the use of CM may include neoplastic, infective or inflammatory conditions, amongst others (Thomson and Varma 2010: 19). The administration of IVCM is only indicated if it contributes to the diagnostic value of the examination (The Royal College of Radiologists 2010: 5; Thomson & Varma 2010: 19). It is advised, however, that alternative imaging investigations be considered, that will provide similar diagnostic information (American College of Radiology 2013: 4). Hesley and Hartman (2008: 20) and The Royal College of Radiologists (2010: 5) further state that if an effective screening program is performed prior to the administration of IVCM, the risk of possible complications and adverse reactions may decrease. Robbins and Pozniak (2010: 1) suggest that those individuals who administer IVCM must be well acquainted with the indications for use, characteristics and adverse reactions of the different types of CM. This validates the need for knowledge of the clinical and biomedical indications and contraindications to be included in the further training of radiographers to administer IVCM.

Radiographers in Canada are expected to be able to identify possible contraindications for the use of IVCM in a patient; however, they must first be assessed for competence in order to obtain the enhanced practice certificate in intravenous injection of CM (OMARS 2010). The training offered in the UK includes the study of patient selection and risk groups, but does not list or state the inclusion of the study of clinical and biomedical indications and contraindications (The College of Radiographers 2011: 7). This research study, however, included questions on the study of clinical and biomedical

indications and contraindications for the use of IVCM. It is important for the individual administering the IVCM to be competent in this in order to prevent the risk for complications and adverse reactions.

2.5.2.4 Complications and adverse reactions

In the context of this research study, adverse reactions are defined as the unwanted pharmacological effects resulting after the administration of a drug or medicine to a patient, such as IVCM (Alomar 2014: 84). According to Singh and Daftary (2008: 70) there are two types of adverse reactions, anaphalactoid and non-anaphalactoid. Anaphalactoid reactions occur more frequently and may lead to serious medical complications. These types of reactions are common in patients with previous allergic reactions to CM, patients with asthma as well as patients with renal and cardiovascular diseases whereas non-anaphalactoid reactions disrupt the homeostasis of the human body, particularly blood circulation, and are dependent on the physical properties of the CM. Hesley and Hartman (2008: 20) are in agreement with Singh and Daftary and further add that those patients with a history of previous anaphalactoid reactions due to IVCM, should be pre-medicated.

Adverse reactions to IVCM may vary from mild to moderate and severe (Lightfoot *et al.* 2009: 692; Rawson and Pelletier 2013: 314; Robbins and Pozniak 2010: 4). It is important that those individuals administering IVCM should have the appropriate knowledge and training to prevent the possibility of patient death and litigation. Mild reactions include nausea and vomiting, a warm sensation and headaches and the suggested treatment requires observation and reassurance. Moderate reactions may include tachycardia, bradycardia, hypertension, hypotension and dyspnea. Prompt treatment with close observation is recommended for moderate reactions. Severe reactions

may be life threatening with symptoms such as convulsions and cardiopulmonary arrest. Immediate treatment with hospitalization is recommended for severe reactions (Robbins and Pozniak 2010: 4). This research study sought to identify the necessary training associated with the possible adverse reactions by including various questions and statements in the research tool, derived from the reviewing of literature.

The further training offered in the UK, includes the study of emergency situations which covers the management of reactions as well as the study of emergency equipment and drugs (The College of Radiographers 2011: 7). Radiographers in Canada are taught to recognize and respond to the patient in the event of an emergency situation. Furthermore, those radiographers in Canada who have successfully completed the further training are expected to inform the patient of the possible complications of CM (OMARS 2010). In view of this, knowledge of the possible complications and adverse reactions can be considered important when administering IVCM.

2.6 Clinical competencies for the administration of intravenous contrast media

Factors associated with techniques applied, infection control practices and emergency medical treatment are fundamental determinants of clinical competency. Clinical competencies (skills), in the context of such factors are, therefore of important consideration.

2.6.1 Technique/s

The American College of Radiology (2013: 17) states that the technique for administering IVCM depends on the type of examination being performed, the

vascular access and the possibility of clinically related challenges. The application of local anesthetic agents and creams may be beneficial for children and neonates to minimize the pain and discomfort caused by placing the needle (Larsan *et al.* 2014). Once IV access has been secured, the CM can be administered by hand or power-injector (Plumb and Murphy 2011: 197). It is important to bear in mind that different examinations may require different types and quantities of CM to be administered (Rawson and Pelletier 2013: 312) and in order to prevent possible complications such as soft tissue extravasation, proper technique must be performed (American College of Radiology 2013: 17–18).

It is recommended that a tourniquet be placed around the non-dominant arm of the patient on which the injection will be performed. The veins on the dorsal aspect of the hand should be the first choice for cannulation (Cheung *et al.* 2009: 494; Larsan *et al.* 2014; Shlamovitz 2015). In the case of neonates, Larsan *et al.* (2014) recommend that the dorsal veins of the feet be used for cannulation, but should be avoided in older children and adults as this method causes extreme pain. Depending on the depth of the vein being punctured, the angle of the needle entry will vary. A smaller angle of approximately 10º-25º should be used for the cannulation of superficial veins and a larger angle of 30º-45º for the deeper veins. If the placement of the needle is successful, a backflow of blood will appear (Larsan *et al.* 2014).

Removing the needle requires that the infusion of the solution (i.e. the contrast medium) be stopped. The tubing must be disconnected from the skin by loosening the tape and only after removing the tape, may the needle be removed. It is recommended that direct pressure with gauze be applied to the site of injection for approximately five minutes in order to prevent the formation of a hematoma (Shlamovitz 2015). This relates directly to the

clinical competence and skill of the individual placing the needle and administering IVCM and was, thus, included in the research tool questions.

The training of radiographers in the UK and Canada include techniques associated with patient preparation, cannulation and IVCM administration (OMARS 2010; The College of Radiographers 2011: 7). From the international training guidelines, it is clear that the radiographers must first observe the cannulation procedure before attempting to perform it independently. The same applies for the administration of IVCM. IV cannulation is the technique whereby a cannula (needle) is inserted within a vein for venous access. In Radiography, it allows access for the administration of IVCM. IV cannulation is also referred to as venipuncture (Bontrager and Lampignano 2005: 551). It is important to note that the placing of a needle and the administration of IVCM are two different skills and techniques. Questions on the study of patient preparation, management and aftercare as well as the minimum number of observations and independent needle placements to be recorded were identified from literature and were included in the research tool. In addition, the research tool also included questions on the minimum number of observations and independent IVCM administrations needed before being considered clinically competent.

2.6.2 Infection control

Infectious diseases are caused by organisms (i.e. bacteria) within or around the human body. These organisms are harmless, but may be a source of disease (Mayo Clinic 2016b). According to Larsan *et al.* (2014), infection is more commonly experienced with long term vascular access as opposed to short term access. The prevalence of infection during the administration of IVCM, however, is dependent on the administration site, the type of needle

used, the age of the patient and the technique of the individual administering the contrast medium (Larsan *et al.* 2014).

Health care workers, in general, have been found to be non-compliant with regards to infection control measures (Morrison and Odle 2007: 9). As a result, this may pose serious health risks to the patient, the individual administering IVCM as well as other healthcare professionals. It is therefore important that the individual administering IVCM be clinically competent and adheres to the necessary infection control measures. Adequate training, strict hand washing protocols and aseptic techniques decrease the risk of infection and are all supported in the training offered in the UK (The College of Radiographers 2011: 7) and in Canada (OMARS 2010). The disposal of sharp instruments and contaminated materials also form part of the training for radiographers to administer IVCM in Canada (OMARS 2010). The study of infection control was found to be important in international training, therefore it was included in the research tool for this study for both the theoretical and practical components for further training.

2.6.3 Emergency medical treatment

Emergency medical treatment can be defined as the actions taken and treatment given to individuals before the arrival of the appropriate medical personnel (Koch 2014: 26). Chaudhary, Parikh and Dave (2011: 80) as well as Chandrasekaran *et al*. (2010: 121) state that basic life support (BLS) training includes the recognition of clinical signs for various life threatening conditions including cardiac arrests, airway obstructions, the need for defibrillation as well as cardiopulmonary resuscitation (CPR). Radiographers must be able to assist medical doctors during medical emergencies and

should, therefore, be competent in performing BLS when the need arises (Keenan, Lamacraft and Joubert 2009: 3; Koch 2014: 26).

The training offered in the UK and Canada for IVCM administration includes the study of emergency situations and treatment, such as CPR and BLS (OMARS 2010; The College of Radiographers 2011: 7). The training in the UK further includes the study of the management of possible complications and adverse reactions as well as the study of emergency equipment and drugs (The College of Radiographers 2011: 7). Although this is included in the further training for the international radiographers, it is noted that the radiologists in the UK remain responsible for treating the possible complications and adverse reactions due to the administration of IVCM (Munro *et al.* 2012: 32). The same has been noted for Australia (Queensland Department of Health 2013: 2).

A research study conducted locally by Koch (2014: 28) in Port Elizabeth, SA, found that radiographers are not competent in performing BLS and CPR as they do not experience medical emergencies on a daily basis. Medical emergencies may occur at any time or place and without any warning signs or symptoms, especially in those patients undergoing specialized radiological investigations that require the administration of IVCM (Koch 2014: 28). It is therefore important that all radiographers be competent in recognizing the signs associated with medical emergencies and be able to assist when required. The RSSA (2012) states that CPR trained health care workers must be present whilst IVCM is being administered. It was therefore necessary to include all of these aspects in the study.

2.7 Medico legal factors

The following section includes a review of literature related to the medico legal responsibilities and training needed for the administration of IVCM. The legal boundaries of practice must be identified should the administration of IVCM be included in the South African radiographer's future scope of practice.

2.7.1 Medico legal responsibilities

The medico legal responsibilities discussed below include obtaining informed consent, deciding on the type and dose of CM to be used as well as the site of administration. Lastly, the responsibility for managing the possible complications and adverse reactions to IVCM has been discussed.

2.7.1.1 Obtaining informed consent

Informed consent is when the patient makes a decision after being fully informed and provided with adequate knowledge regarding the benefits and risks of a medical procedure that he/she is indicated for (Friedrich-Nel and Munro 2015: 30). In the context of this study, this would be consent for the administration of IVCM during specialized radiological investigations. The HPCSA (2008a: 2) and The Royal College of Radiologists (2010: 7) both state that the patient has the right to be informed of the possible risks involved for the medical procedure. Informed consent will thus allow patients to make their own decisions regarding their own management and treatment (Friedrich-Nel and Munro 2015: 30). The patient may refuse, at any given time, to be injected by a certain health care worker (HPCSA 2008a: 2; The Irish Institute of Radiography and Radiation Therapy 2007: 5). For this

reason, it is important to once again highlight the fact that currently the administration of IVCM is outside the South African radiographer's legal scope of practice and should any adverse event occur as a result of the radiographer administering IVCM, he/she may be challenged with criminal charges.

Radiographers practicing in the USA, Canada and Ireland are responsible for obtaining consent from patients prior to the administration of IVCM (OMARS 2010, The Irish Institute of Radiography and Radiation Therapy 2007: 5). The practice standards in Australia, however, are different to those in the USA, Canada and Ireland as obtaining consent is the responsibility of the radiologists. These radiologists, however, may delegate the responsibility to the radiographer, but the overall responsibility still remains that of the radiologist (Queensland Department of Health 2013: 2-3). The Royal College of Radiologists (2010: 5-6) in the UK, furthermore, recommend that informed consent be obtained by the individual administering the IVCM and that this individual should also be responsible for identifying the possible contraindications for the administration of IVCM. This is in keeping with the HPCSA's opinion that the individual administering the contrast medium should also be held responsible in order to ensure that the patient has received sufficient information and time to make an informed decision (HPCSA 2008a: 5-6). It is important to identify whose responsibility it should be to obtain patient consent, in the event that the administration of IVCM is included in the South African radiographers' future scope of practice.

2.7.1.2 Deciding on the type and dose

The radiologists in SA are currently responsible for deciding the type, dose and site of IVCM administrations (RSSA 2012). Radiographers practicing in

Europe and Australia are not permitted to decide on the type and dose of IVCM to be administered because CM falls under the prescribing of drugs (Queensland Department of Health 2013: 2; University of Malta, Department of Radiography 2010: 7). In Australia, it is the responsibility of the radiographer to compare the type and dose of the contrast medium with the departmental protocol before it is administered, however, the overall responsibility still remains that of the radiologist (Queensland Department of Health 2013: 3). In view of this, it is clear that there seems to be a general consensus (internationally) regarding whose responsibility it is to decide on the type and dose of IVCM to be administered. This research study sought to test this consensus locally, in SA.

2.7.1.3 Deciding on the site of administration

According to Larsan *et al.* (2014) one of the risks associated with infection is the site of IVCM administration. Therefore, in order to prevent the possible risk of infection, the individual administering the IVCM should be adequately trained in this regard. No literature was found on international practice and training pertaining to the responsibility for deciding on the site of IVCM administration. It was deemed necessary by this study, however, for it to be included.

2.7.1.4 Overall responsibility for managing the complications and adverse reactions

Radiologists in SA are currently responsible for managing the possible complications and adverse reactions that may occur after the administration of IVCM (RSSA 2011: 1-2). The radiologists have further acknowledged the fact that radiographers have not received formal, HPCSA accredited training

in pharmacology and are therefore unable to deal with the possibility of complications and adverse reactions should such an incident occur (RSSA 2011: 1-2). Radiologists in the UK and Australia are also responsible for managing the complications and adverse reactions due to the administration of IVCM (Munro *et al.* 2012: 32; Queensland Department of Health 2013: 2). Should the administration of IVCM become part of the South African radiographer's scope of practice in the future, the legal boundaries will need to be identified in terms of their responsibility for managing the possible complications and adverse reactions, therefore, this needed to be investigated.

2.7.2 Medico legal training

The international training offered to radiographers does not include an independent section for medico legal study units. The study of medico legal issues and legislation, however, is integrated into the theoretical training for radiographers in the UK (The College of Radiographers 2011: 7). In the 2014/2015 annual report from the president of the HPCSA, it was stated that all health professionals' training should include the study of medical law, human rights and ethics (Mokgokong 2015: 6). Medical law is defined as the social rules of conduct and non-conduct whereby the abuse of these rules may result in illegal liability (Brock and Mastroianni 2013). It is for this reason that the study of medical law, patient rights and ethics as well as the rights and responsibilities of a healthcare professional were investigated.

According to Bushong (2004: 459), there is distinct difference between QA and Quality Control (QC). QA deals with people whereas QC is a checklist designed to evaluate the performance standards and maintenance of equipment. The importance of QA associated with IVCM administrations has

been highlighted by The Irish Institute of Radiography and Radiation Therapy (The Irish Institute of Radiography and Radiation Therapy 2007: 10). It is for this reason that the further study of QA related to the administration of IVCM has been included in the research tool of this study. The QA related to IVCM may include, but is not limited to, the correct handling and storage of CM, accurate record keeping and equipment inspections, i.e. the power-injector.

2.8 Summary

The role and responsibilities of radiographers are changing and expanding globally. In some countries abroad, radiographers are allowed to administer IVCM after having successfully completed the necessary further training to do so. In SA, however, radiographers may not legally administer IVCM. The South African radiographer's scope of practice is currently under review to include possible areas of role extension, in particular, the administration of IVCM.

Local studies have identified the need for South African radiographers to close the gap between themselves and international practice. The importance of identifying the training requirements by the relevant stakeholders before receiving HPCSA accreditation has been highlighted. To date, no research has been conducted to identify the training requirements; therefore this was an area that still needed investigation through scientific research that would address local training needs for the administration of IVCM by South African radiographers.

CHAPTER 3
METHODOLOGY

3.1 Introduction

Research methodology describes the research type and design of a research study, the study setting and target population as well as the sample selection, the process of data collection and analysis (English and van Tonder 2009: 212).

3.2 Research type and design

A research paradigm can be defined as an innovative manner of viewing a situation (Mackenzie and Knipe 2006). The paradigm for this research study was a quantitative, positivist paradigm. Mackenzie and Knipe (2006) state that a positivist paradigm is where the researcher aims to test a theory or describe an experience. Positivists, in general, are aligned with quantitative data collection and analysis, similar to this research study. In the context of this study, the data collected was the knowledge, clinical competencies and medico legal responsibilities required by radiographers to safely administer IVCM, according to the radiologists' perspective.

A quantitative research study with a descriptive approach was conducted. The quantitative data approach was utilized to obtain objective answers to distinct research questions (USC 2014). Lues (2011: 29) states that a descriptive study may include questionnaires in order to collect the desired data. Descriptive research may also be used to describe the present standing

of a phenomenon or situation related to different variables or conditions (Laerd Statistics 2013). This was the most appropriate design to evaluate specific answers to specific questions, which in the context of this study, included the radiologists' perspectives of the knowledge, skills and medico legal responsibilities required for the administration of IVCM by radiographers which is one of the possible areas of role extension within the Radiography profession.

3.3 Study setting and target population

This research study was conducted within the province of KZN. A previous study on the role extension of radiographers was conducted in SA by the PBRCT and included both the radiographers and radiologists (Kekana, Swindon and Mathobisa 2014). Hayes (2011) defines a target population as a group of individuals which the researcher is interested in and to whom he/she would like to generalize the outcome of the research study. The target population for this study included all the qualified radiologists registered with the HPCSA and living in KZN.

The administration of IVCM currently falls within the radiologists' scope of practice (RSSA 2011: 2). The qualified radiologists have already acquired the necessary competencies (which are embedded within their training and curriculum) to safely and effectively administer IVCM. The selected target population was, therefore, the most appropriate population to provide the data needed to address the aim of this research study.

3.4 Sample selection

The term ‘sample’, in research, can be defined as a group of individuals who have been carefully selected from a larger population for the purpose of the research study (Mugo 2002). According to McLeod (2014), ‘total sampling’ also known as ‘total target population’ refers to an investigation of the entire population in question. The total target population (qualified radiologists in KZN) was, therefore, selected for this research study in an attempt to obtain the required minimum response rate.

The participants were identified by means of the online HPCSA register, which is available for public viewing. The search criteria used to obtain the participants were medical practitioners within the province of KZN registered under the specialty of Diagnostic Radiology. The register revealed a total number of 104 radiologists. Using a confidence level of 95 percent, it was recommended that a minimum of 87 responses needed to be collected. A confidence level of 95 percent is used by most researchers and is important in predicting a high accuracy of results according to the size of the target population.

Upon further consultation with the statistician, it was established that a minimum response rate of 60 percent (63 respondents) would be statistically acceptable for this research study as the exact number of qualified radiologists practicing and living within KZN (as per the HPCSA’s online register) could not be accurately determined due to the following reasons:

- Members of the HPCSA who are over the age of 65 are not required to renew their registration details.
- Deceased members may have still appeared as ‘active’ if their relatives have not removed their names from the register.

- Some radiologists may have maintained their HPCSA registration under the province of KZN even though they may be residing and practicing outside the province or country. Some may have deliberately maintained this local registration while others may have omitted to update their registration details.

The sampling technique selected for this research study was a purposive (non-probability) sampling technique. Lathan (2007: 9) defines purposive sampling as a selection of a sample based on the nature of the research study and its objectives. Purposive sampling can further be defined as the selection of a research sample based on the researcher's own knowledge of the population and the nature of the research aims. This technique is particularly useful to answer questions related to a specific situation (Latham 2007: 9), which in this context was professional role extension within the Radiography profession. In this research study, the total sample (radiologists in KZN) was selected in order to provide input on a specific topic (the administration of IVCM by radiographers), based on their own knowledge and experience. The refining, through stratification, was done by applying the inclusion and exclusion criteria below.

3.4.1 Inclusion criteria

The criteria used to select individuals into this study were:

- Qualified and registered with HPCSA under the specialty of Diagnostic Radiology.
- Living in the province of KZN.
- Practicing in the private and/or public sector.
- Retired.

3.4.2 Exclusion criteria

The criteria used to exclude individuals from participating in this study were:

- Radiologists who do not practice under the specialty of Diagnostic Radiology.
- Registrars (as they have not yet qualified as radiologists).

3.5 Type of data collected

The two main types of data are ‘primary data’ and ‘secondary data’. Primary data is the data collected by the researcher himself/herself for a specific reason or purpose whereas ‘secondary data' is the collection of data from existing literature, files or records, but for the same reason or purpose (Gibson 2008). The data collected for this research study at regular time intervals and over a period of three months was primary data.

The primary data collected included:

- Biographical information of the respondents.
- Work experience and current employment of the respondents.
- Radiologists’ perspective of the theoretical knowledge required by radiographers for the administration of IVCM.
- Radiologists’ perspective of the clinical competencies required by radiographers for the administration of IVCM.
- Radiologists’ perspective of the medico legal responsibilities required by radiographers for the administration of IVCM.

3.6 Data collection tool

The research study made use of a questionnaire as the research tool. The research tool consisted of five main sections with sub sections. The first two sections included questions on biographical information, work experience and current employment. The subsequent sections related specifically to the administration of IVCM. These included questions on theoretical (knowledge) (addressing the first objective), clinical competency (skills) (addressing the second objective) as well as medico legal responsibilities (addressing the third objective). The research tool consisted of closed-ended and some open-ended questions and statements. The questions and statements were aligned with the study objectives in order to obtain the required data to address the aim of this study.

The research tool was reviewed by a focus group, prior to the study, to ensure reliability and validity. Reliability refers to the reproducibility of the research tool whereas validity can be defined as how well the data collection tool measures what it is supposed to measure (Gqweta 2014: 28-29). A standardized, self-administered research tool was used for all the participants. The content of the questions was drawn primarily from peer reviewed academic research sources related to this study.

3.7 Focus group discussion

A focus group consists of a group of individuals who are experienced in a specific area and selected to provide opinions and recommendations for a particular research study or project (Lues 2011: 62). During this research study, a focus group consisting of one radiologist, two radiographers, the researcher, supervisor and co-supervisor reviewed the research tool during a

scheduled meeting. The focus group members were requested to sign a letter of confidentiality (Appendix A) to ensure that the contents of the research tool and research study remained confidential. The main purpose of the focus group was; therefore, to cross-examine the content of the research tool.

The meeting was chaired by the researcher and the proposed research tool was evaluated, discussed and edited to ensure accuracy, relevance and validity. The original research tool (Appendix B) was amended as per the consensus reached during this meeting. Appendix C presents the final amended research tool used to obtain the data for this research study. Brink, van der Walt and van Rensburg (2012: 166) indicate that a focus group will not only evaluate the content presented in the research tool, but also the content that has not been included. The content of the research tool was based primarily on variables obtained from previously published literature on the international practice of radiographers who administer IVCM as part of their scope of practice.

3.8 Data collection process

All participants were contacted in their personal capacity by means of email communication and social media. Each participant received a letter of information (Appendix D) which provided them with the necessary information regarding the research study. The participants were requested to sign informed consent (Appendix E) before completing the questionnaire. Those participants who completed the online survey, however, provided their consent by completing the survey. The survey was administered by means of SurveyMonkey, a software package commonly used for online survey administration (SurveyMonkey 2013).

A web-link for the online survey was sent to the participants by means of email communication. The participants were requested to follow the web-link and to complete the survey. The participants were allowed to exit the survey if they did not wish to participate. All data received from the participants were kept secure under password protection by the researcher as stipulated in the privacy policy of SurveyMonkey (SurveyMonkey 2013). The researcher monitored the number of responses at regular time intervals. Three reminders were sent by means of email communication to those individuals who had not completed the survey. The survey was designed such that it only allowed for one response per email address. This ensured that no participant completed the survey more than once.

3.9 Challenges experienced

During the process of collecting data, the researcher experienced the following challenges:

- Some respondents did not complete the questionnaire and left out important information required for data analysis. The incomplete questionnaires were therefore excluded from the data analysis.
- The researcher could not determine the exact number of qualified radiologists practicing and living in KZN. Those radiologists still listed as active KZN members on the HPCSA's online register who were known to be deceased or had relocated outside the province of KZN were identified and subtracted from the total number (target population). The deceased radiologists and those who had relocated were identified by word of mouth by the researcher.

3.10 Verification of data input

SurveyMonkey was utilized to obtain the necessary data for this research study. The raw data was downloaded and coded on a Microsoft Excel spread sheet by the researcher. The raw data was cross-checked for consistency and accuracy prior to statistical analysis.

3.11 Statistical analysis

The statistical analysis of the data for this research study was conducted by the researcher with the assistance of a professional statistician. The data was further analyzed by means of the Statistical Package for the Social Sciences (SPSS) software, version 23.0.

The statistical aspect of the research included the following:

- Descriptive statistics
- Inferential statistics
- Reliability using Cronbach's Alpha

Descriptive statistics involves the organizing and summarizing of quantitative data by investigating and describing the patterns evident from the results (Laerd Statistics 2013). The descriptive statistics used for the data of this study were presented in various tables and figures in Chapter 4.

Inferential statistics allows the researcher to draw conclusions from the sampled data by identifying significant differences between the variables (Laerd Statistics 2013). The data for this study was further analyzed by means of the Pearson's Chi Square Test. The inferential statistics used for the data of this study have been presented in tables in Chapter 4.

The reliability of the research tool was tested by using the Cronbach's Alpha coefficient which is used to identify how well different sets of variables measure for consistency. The data obtained by a reliable research tool will vary amongst the respondents due to their personal feelings, perceptions and opinions (Tavakol and Dennick 2011: 53).

3.12 Ethical considerations

- Ethical approval for conducting this study was obtained from the Institutional Research and Ethics Committee (IREC) at the Durban University of Technology (DUT) (Appendix F). The clearance number for the study is 'REC 18/15'.
- No institutional permission letters were necessary as the participants were contacted in their personal capacity.
- Participation in the study was voluntary and the principle of autonomy was therefore maintained.
- No participant received any form of remuneration.
- The participants were provided with information letters informing them of the study background and purpose (Appendix D).
- Participants indicated consent to participation by completing the online survey and by signing a letter of consent (Appendix E), where relevant.
- No identifiable details (name, surname or date of birth) were requested in the questionnaire. This ensured anonymity.
- All information obtained from this study was and will continue to be kept strictly confidential and is presented anonymously in the study. The results are referred to as the 'public' and 'private' sectors, thus ensuring the privacy of all the participants including their place of work.
- All the data has been analyzed and reported objectively by the researcher.

- Members of the focus group were requested to sign a letter of confidentiality to ensure that the content of the research study and/or questionnaire is kept confidential (Appendix A).
- The ethical principles of beneficence and non-maleficence were considered for this research study. The participants were not exposed to any risks or discomforts.

3.13 Summary

A quantitative, descriptive study, involving the sampling of qualified radiologists residing and practicing within the KZN province, was conducted. Ethics approval to perform this study was obtained from the DUT's IREC. All the participants were contacted in their personal capacity. The research tool used for this study was an online survey that included various questions and statements related to the administration of IVCM in order to meet the study objectives. The content of the research tool was evaluated, discussed and amended prior to distribution to ensure reliability and validity. All the data obtained from this research study was kept confidential and under password protection by the researcher.

CHAPTER 4
RESULTS

4.1 Introduction

The questionnaire (Appendix C) was the primary research tool used to obtain the responses of the participants. The data collected from the responses were analyzed using SPSS version 23.0. Descriptive statistics have been presented in the form of graphs, cross tabulations and other figures (i.e. pie charts) for the quantitative data that was collected. Inferential statistics include the use of chi square test values with significance set at $p < 0.05$ which were also presented in this Chapter. Chi square tests were used for the categorical data as this provides an indication of associations and differences, thereof (Franke, Ho and Christie 2011: 448).

4.2 Response rate

Of a total of 104 radiologists that were targeted in KZN, seven were identified as being deceased, resulting in a more accurate target population of 97 radiologists. Fifty-nine of the 97 radiologists participated in the research study, resulting in a 60.8 percent response rate. Twelve of these respondents were excluded from the statistical analysis due to incomplete surveys. The response rate, thereafter, was 48.5 percent.

4.3 Descriptive statistics

The sections that follow analyzed the scoring patterns of the respondents per variable in each section. Where applicable (in the figures), the two statements (i.e. negative statements) were combined to show a single category of 'disagree'. A similar practice was applied for the two statements of agreement (i.e. positive statements). The results were presented as mean percentages per variable. In the tables, however, all the statements of agreement and disagreement have been included and not combined.

The overall reliability of the research tool was tested using the Cronbach's Alpha coefficient which considers a reliability score of 0.70 and higher as 'acceptable' or 'reliable' (Tavakol and Dennick 2011: 53). The overall reliability score for each section of the questionnaire (sections C, D and E) was greater than the recommended value of 0.70 which indicated a high degree of consistent scoring by the respondents.

4.3.1 Demographics of the respondents

Table 1 provides the demographical information for those respondents who completed the online survey, in terms of gender, age and year of qualification.

Table 1: Demographics of the respondents

Demographics		Frequency (n)	Percent (%)
Gender	***Male***	37	78.7
	Female	10	21.3
Age	***30 to 39***	6	12.8
	40 to 49	24	51.1
	50 to 59	15	31.9
	60 to 69	2	4.3
Year of qualification	***1980 - 1989***	2	4.3
	1990 - 1999	15	31.9
	2000 - 2009	21	44.7
	2010 - 2015	9	19.1
Total		**47**	**100.0**

The ratio of males to females was approximately 4:1. The majority of the respondents were between 40-59 years of age (83 percent) and qualified after the year 2000 (63.8 percent).

4.3.2 Work profile of the respondents

Table 2 presents the respondents' years of experience as qualified radiologists, their current employment sectors, type of institution and employment classification.

Table 2: Work experience and current employment of the respondents

Work profile		Frequency (n)	Percent (%)
Years of experience as qualified radiologist	***0 to 9***	18	38.3
	10 to 19	15	31.9
	20 to 29	13	27.7
	30 to 39	1	2.1
Current employment sector	***Public***	11	23.4
	Private	32	68.1
	Both	4	8.5
Type of institution	***Tertiary Hospital***	8	17.0
	Regional Hospital	4	8.5
	District Hospital	1	2.1
	Private Practice	34	72.3
Classification of employment	***Urban***	38	80.9
	Rural	2	4.3
	Mix	7	14.9
Total		**47**	**100.0**

The majority of the respondents (70.2 percent) have been qualified as radiologists for between 0-19 years. In addition, a large proportion (72.3 percent) was working in private practice. The classification of employment demonstrated that 80.9 percent of the respondents work in urban areas. Interesting to note is that the total number of radiologists working in the public sector (23.4 percent) was significantly lower than the total number of radiologists working in the private sector (68.1 percent). This may be due to the national shortage of radiologists within the public sector.

4.3.3 Knowledge (theoretical) component

The responses for the inclusion of the knowledge (theoretical) components of anatomy, physiology, pathology, CM and possible reactions as well as CPR, BLS and emergency medicines have been summarized.

4.3.3.1 Anatomy

The results for including the study of anatomy of the cardiovascular and urinary systems, the upper and lower limbs as well as the nervous system in the further training of radiographers, are presented in Figure 1.

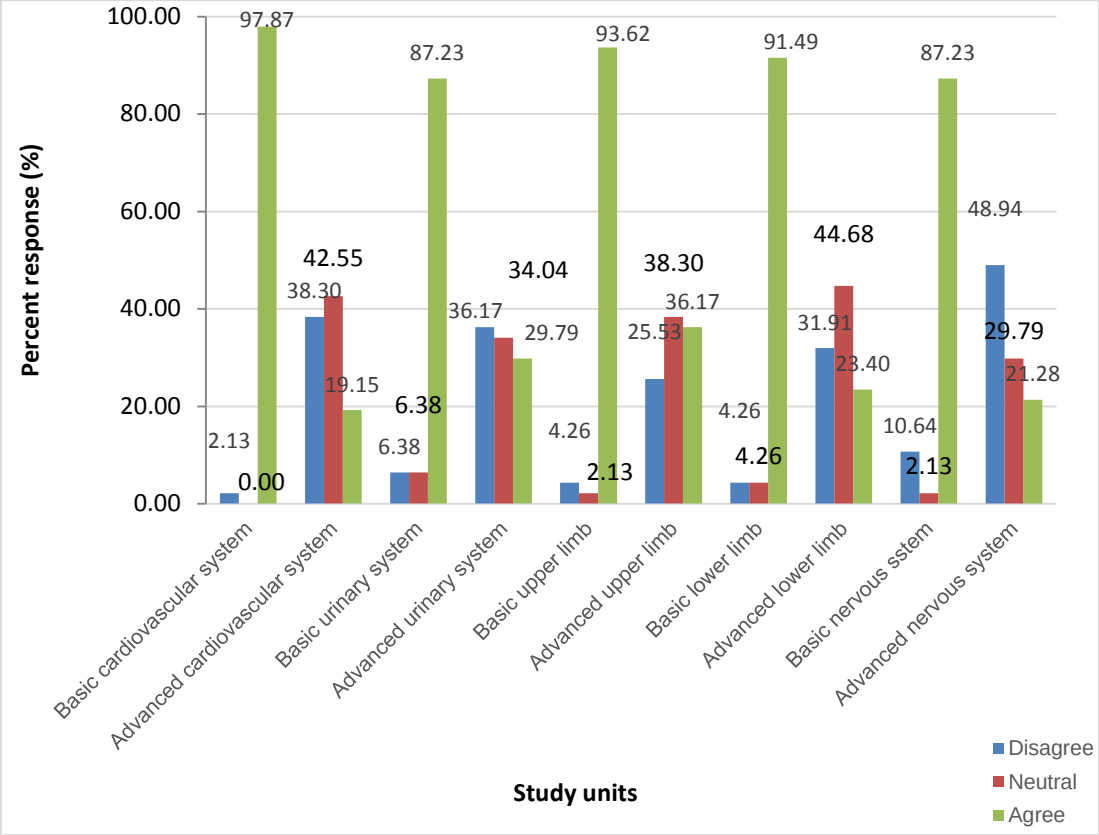

Figure 1: Study units for Anatomy

According to the results presented in Figure 1, almost all of the respondents agreed that the study of basic cardiovascular anatomy should be included as part of the further training for radiographers to administer IVCM (97.87 percent). Similarly, the majority of respondents indicated that a basic study of the urinary system anatomy (87.23 percent), upper limb (93.62 percent), lower limb (91.49 percent) and nervous system (87.23 percent) should also be included as part of the further training. With regards to the advanced study units listed in Figure 1, the majority of respondents were in disagreement thereof.

In addition to the previous mentioned results, the respondents identified a need for including the basic study of the anatomy of the respiratory system. This was supported by 12.8 percent of the respondents as an additional area of anatomy to be included in the further training for radiographers to administer IVCM.

Table 3 presents the percentage of agreement and disagreement for including the following study units: basic anatomy of the cardiovascular and urinary systems, the upper and lower limbs as well as the nervous system. The results were further analyzed versus the employment sector of the respondents. The respondents' employment sector was used to evaluate whether or not a difference of opinion exists between those radiologists working in the public and private sectors and the possible reason/s therefore.

Table 3: Percentage of agreement and disagreement for including the study of basic anatomy

Cardiovascular system	**Public**	**Private**	**Both**	**Total**
Disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Agree	4 (36.4)	13 (40.6)	3 (75.0)	**20**
Strongly agree	7 (63.6)	18 (56.3)	1 (25.0)	**26**
Total	**11**	**32**	**4**	**47 (100.0)**
Urinary system	**Public**	**Private**	**Both**	
Strongly disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Disagree	1 (9.1)	1 (3.1)	0 (0.0)	**2**
Neutral	0 (0.0)	3 (9.4)	0 (0.0)	**3**
Agree	3 (27.3)	11 (34.4)	3 (75.0)	**17**
Strongly agree	7 (63.6)	16 (50.0)	1 (25.0)	**24**
Total	**11**	**32**	**4**	**47 (100.0)**
Upper limb	**Public**	**Private**	**Both**	
Strongly disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Neutral	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Agree	3 (27.3)	11 (34.4)	3 (75.0)	**17**
Strongly agree	8 (72.7)	18 (56.3)	1 (25.0)	**27**
Total	**11**	**32**	**4**	**47 (100.0)**

Lower limb	**Public**	**Private**	**Both**	
Strongly disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Neutral	0 (0.0)	2 (6.3)	0 (0.0)	**2**
Agree	4 (36.4)	17 (53.1)	3 (75.0)	**24**
Strongly agree	7 (63.6)	11 (34.4)	1 (25.0)	**19**
Total	**11**	**32**	**4**	**47 (100.0)**
Nervous system	**Public**	**Private**	**Both**	
Strongly disagree	1 (9.1)	1 (3.1)	0 (0.0)	**2**
Disagree	0 (0.0)	3 (9.4)	0 (0.0)	**3**
Neutral	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Agree	6 (54.5)	17 (53.1)	3 (75.0)	**26**
Strongly agree	4 (36.4)	10 (31.3)	1 (25.0)	**15**
Total	**11**	**32**	**4**	**47 (100.0)**

Values represent frequency (n) with percentage (%) value in parenthesis

More than 80 percent from both the public and private sector respondents were in agreement for including the study of basic anatomy of the cardiovascular and urinary systems, the upper and lower limbs as well as the nervous system. One of the private sector respondents (2.1 percent), however, disagreed with the inclusion of the basic anatomy of the cardiovascular system. Similarly, two private sector respondents (4.3 percent) disagreed with the inclusion of the basic anatomy of the urinary system and five respondents (10.6 percent) disagreed with the inclusion of the basic anatomy of the nervous system. All of the public sector respondents (100.0 percent) agreed to include the basic anatomy of the upper and lower limbs in the further training of radiographers to administer IVCM indicating that they considered this as being exceptionally important.

4.3.3.2 Physiology

The results on the study of physiology pertaining to the cardiovascular and urinary systems, the upper and lower limbs as well as the nervous system are presented in Figure 2.

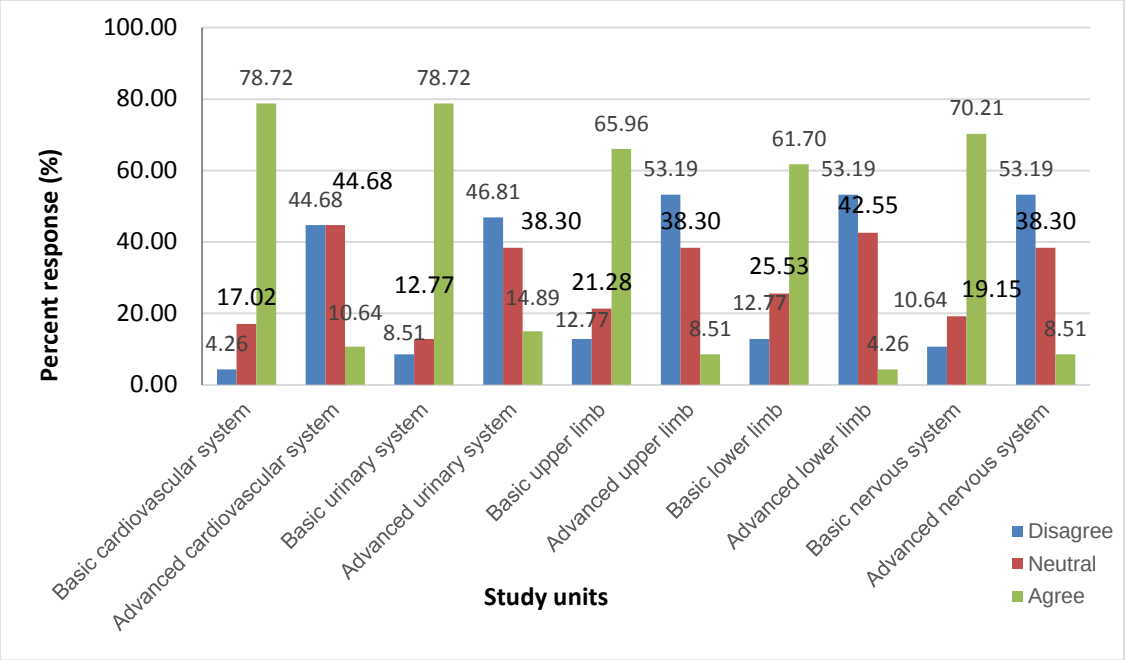

Figure 2: Study units for Physiology

The majority of respondents have agreed to include the study of basic physiology of all the systems listed in Figure 2 as part of the further training. Conversely, most of the respondents disagreed with including the advanced study of physiology. Similar to the previous section on anatomy, the study of basic physiology of the respiratory system has been identified for inclusion in the further training of radiographers to administer IVCM. This was supported by 8.5 percent of the respondents when asked if there are any additional areas of physiology to be included in the further training.

Table 4 presents the percentage of agreement and disagreement amongst the radiologists for including the basic physiology of the following: the cardiovascular and urinary systems, the upper and lower limbs as well as the nervous system. The responses were further analyzed according to the

radiologists' employment sector. It is important to identify the differences of opinion amongst the radiologists (if any) and the possible reasons therefore.

Table 4: Percentage of agreement and disagreement for including the study of basic physiology

Cardiovascular system	**Public**	**Private**	**Both**	**Total**
Disagree	0 (0.0)	2 (6.3)	0 (0.0)	**2**
Neutral	2 (18.2)	5 (15.6)	1 (25.0)	**8**
Agree	4 (36.4)	17 (53.1)	2 (50.0)	**23**
Strongly agree	5 (45.5)	8 (25.0)	1 (25.0)	**14**
Total	**11**	**32**	**4**	**47 (100.0)**
Urinary system	**Public**	**Private**	**Both**	**Total**
Disagree	1 (9.1)	3 (9.4)	0 (0.0)	**4**
Neutral	1 (9.1)	4 (12.5)	1 (25.0)	**6**
Agree	4 (36.4)	18 (56.2)	2 (50.0)	**24**
Strongly agree	5 (45.5)	7 (21.9)	1 (25.0)	**13**
Total	**11**	**32**	**4**	**47 (100.0)**
Upper limb	**Public**	**Private**	**Both**	**Total**
Strongly disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Disagree	0 (0.0)	5 (15.6)	0 (0.0)	**5**
Neutral	3 (27.3)	6 (18.8)	1 (25.0)	**10**
Agree	3 (27.3)	12 (37.5)	2 (50.0)	**17**
Strongly agree	5 (45.4)	8 (25.0)	1 (25.0)	**14**
Total	**11**	**32**	**4**	**47 (100.0)**
Lower limb	**Public**	**Private**	**Both**	**Total**
Disagree	1 (9.1)	5 (15.6)	0 (0.0)	**6**
Neutral	3 (27.3)	8 (25.0)	1 (25.0)	**12**
Agree	2 (18.2)	13 (40.6)	2 (50.0)	**17**
Strongly agree	5 (45.5)	6 (18.8)	1 (25.0)	**12**
Total	**11**	**32**	**4**	**47 (100.0)**
Nervous system	**Public**	**Private**	**Both**	**Total**
Disagree	0 (0.0)	5 (15.6)	0 (0.0)	**5**
Neutral	2 (18.2)	5 (15.6)	2 (50.0)	**9**
Agree	5 (45.5)	16 (50.0)	1 (25.0)	**22**
Strongly agree	4 (36.4)	6 (18.8)	1 (25.0)	**11**
Total	**11**	**32**	**4**	**47 (100.0)**

Values represent frequency (n) with percentage (%) value in parenthesis

Responses are similar to those obtained for the study of basic anatomy. Most of the private and public sector radiologists (> 55 percent) have agreed to include the study of basic physiology of the cardiovascular and urinary systems, the upper and lower limbs as well as the nervous system respectively. On the contrary, it was interesting to note that 15.6 percent of

the private sector radiologists disagreed with the inclusion of the nervous system whereas none of the public sector radiologists disagreed.

4.3.3.3 Pathology

The results on the study of pathology of the cardiovascular system, urinary system, upper and lower limbs as well as the nervous system are presented in Figure 3.

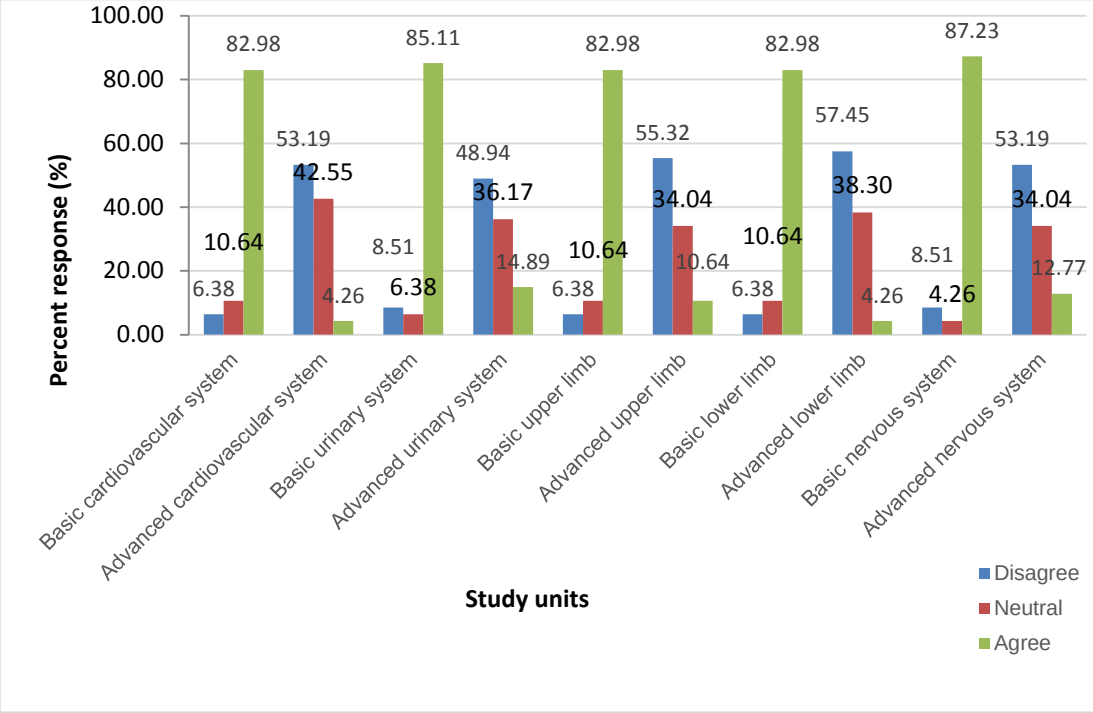

Figure 3: Study units for Pathology

Similar to the previous sections on including the study of basic anatomy and basic physiology, the majority of respondents agreed to include the study of basic pathology of the cardiovascular and urinary systems, the upper and lower limbs as well as the nervous system. The majority of the respondents

disagreed with including an advanced study of pathology, strongly indicating that this is not required in the further training for radiographers. In addition, 12.8 percent of the respondents indicated that the further training should also include the basic pathology of the respiratory system.

Table 5 presents the percentage of agreement and disagreement amongst the radiologists for including the study of basic pathology in the further training. The responses were based on the radiologists' employment sector (public, private and both), similar to the previous tables which illustrated the study of basic anatomy and physiology of the cardiovascular and urinary systems, the upper and lower limbs and the nervous system.

Table 5: Percentage of agreement and disagreement for including the study of basic pathology

Cardiovascular system	**Public**	**Private**	**Both**	**Total**
Strongly disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Disagree	1 (9.1)	1 (3.1)	0 (0.0)	**2**
Neutral	2 (18.2)	3 (9.4)	0 (0.0)	**5**
Agree	4 (36.4)	21 (65.6)	2 (50.0)	**27**
Strongly agree	4 (36.4)	6 (18.8)	2 (50.0)	**12**
Total	**11**	**32**	**4**	**47 (100.0)**
Urinary system	**Public**	**Private**	**Both**	**Total**
Strongly disagree	1 (9.1)	1 (3.1)	0 (0.0)	**2**
Disagree	1 (9.1)	1 (3.1)	0 (0.0)	**2**
Neutral	1 (9.1)	2 (6.3)	0 (0.0)	**3**
Agree	4 (36.4)	21 (65.6)	3 (75.0)	**28**
Strongly agree	4 (36.4)	7 (21.9)	1 (25.0)	**12**
Total	**11**	**32**	**4**	**47 (100.0)**
Upper limb	**Public**	**Private**	**Both**	**Total**
Strongly disagree	0 (0.0)	1 (3.1))	0 (0.0)	**1**
Disagree	0 (0.0)	2 (6.3)	0 (0.0)	**2**
Neutral	1 (9.1)	4 (12.5)	0 (0.0)	**5**
Agree	6 (54.5)	16 (50.0)	3 (75.0)	**25**
Strongly agree	4 (36.4)	9 (28.1)	1 (25.0)	**14**
Total	**11**	**32**	**4**	**47 (100.0)**
Lower limb	**Public**	**Private**	**Both**	**Total**
Strongly disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Disagree	0 (0.0)	2 (6.3)	0 (0.0)	**2**
Neutral	1 (9.1)	4 (12.5)	0 (0.0)	**5**
Agree	6 (54.5)	18 (56.2)	3 (75.0)	**27**
Strongly agree	4 (36.4)	7 (21.9)	1 (25.0)	**12**
Total	**11**	**32**	**4**	**47 (100.0)**

Nervous system	Public	Private	Both	Total
Strongly disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Disagree	0 (0.0)	3 (9.4)	0 (0.0)	**3**
Neutral	1 (0.1)	1 (3.1)	0 (0.0)	**2**
Agree	6 (54.5)	19 (59.4)	3 (75.0)	**28**
Strongly agree	4 (36.4)	8 (25.0)	1 (25.0)	**13**
Total	**11**	**32**	**4**	**47 (100.0)**

Values represent frequency (n) with percentage (%) value in parenthesis

Most of the private and public sector respondents agreed with the inclusion of the study of basic pathology of the cardiovascular and urinary systems, upper and lower limbs as well as the nervous system. The minority of respondents (< 20 percent) from both the public and private sector disagreed with including these study units suggesting that adequate knowledge on these components is necessary to safely administer IVCM.

4.3.3.4 Intravenous contrast media, possible complications and adverse reactions

This section required the respondents to indicate whether or not the study units indicated in Figure 4 should be included as part of the theoretical component for the further training for radiographers to administer IVCM.

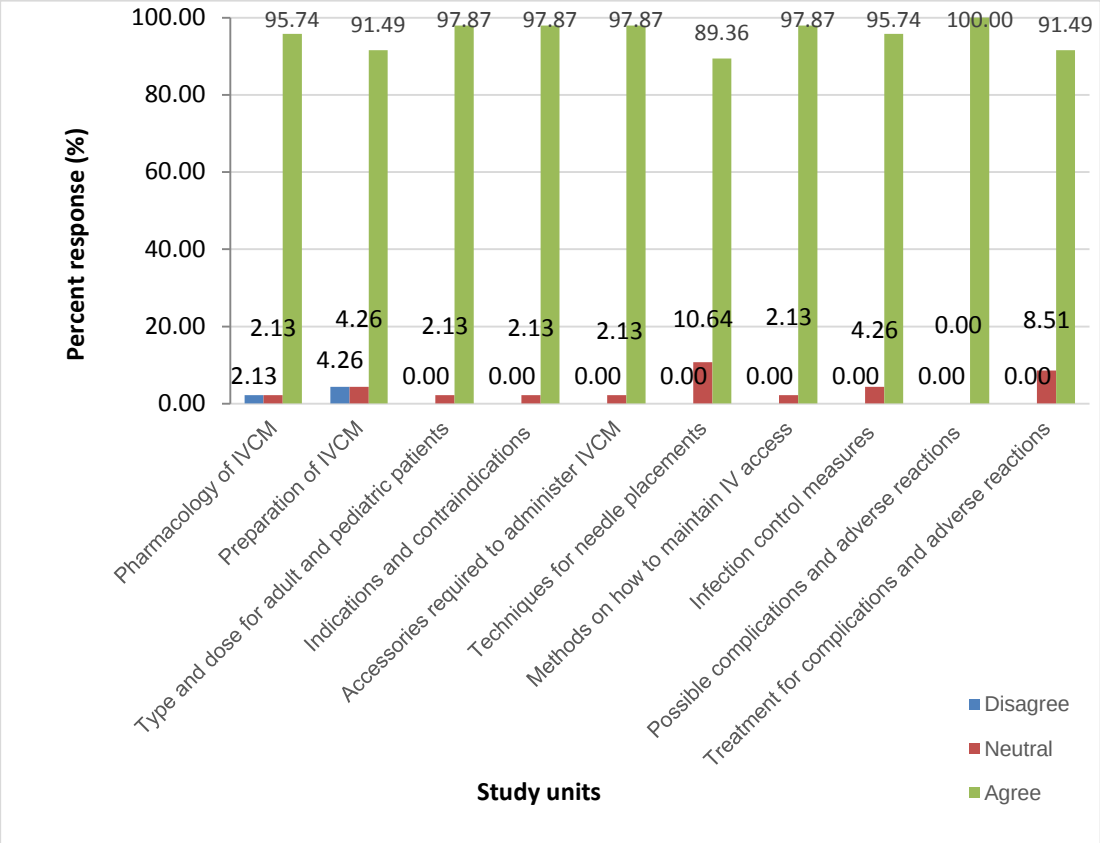

Figure 4: Intravenous contrast media, possible complications and adverse reactions

It is interesting to note that the percentage of agreement amongst the respondents was almost 100 percent and is thus substantially higher than the percentage of disagreement in this section. A minority of respondents (4.26 percent) were neutral and disagreed with including the preparation of IVCM indicating that this is important for inclusion in the further training. A similar pattern was noted for the study of pharmacology of CM with a total percentage of 2.13 percent. Furthermore, all of the respondents (100.0 percent) agreed to have the study of possible complications and adverse reactions of IVCM included in the further training for radiographers. This indicates just how important it is for the individual administering IVCM to be knowledgeable in this area to prevent it from occurring.

Table 6 presents the percentage of agreement and disagreement amongst the radiologists for including the study of CM and possible reactions in the further training. The responses were based on the radiologists' years of experience. The radiologists' years of experience were selected to identify any differences in opinion between those radiologists with little experience compared to those radiologists with many years' of experience.

Table 6: Percentage of agreement and disagreement for the inclusion of contrast media and possible reactions

Pharmacology of IVCM	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Strongly disagree	0 (0.0)	1 (6.7)	0 (0.0)	0 (0.0)	**1**
Neutral	0 (0.0)	1 (6.7)	0 (0.0)	0 (0.0)	**1**
Agree	10 (55.6)	4 (26.6)	8 (61.5)	1 (100.0)	**23**
Strongly agree	8 (44.4)	9 (60.0)	5 (38.5)	0 (0.0)	**22**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Preparation of IVCM	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Strongly disagree	0 (0.0)	1 (6.7)	0 (0.0)	0 (0.0)	**1**
Disagree	0 (0.0)	0 (0.0)	1 (7.6)	0 (0.0)	**1**
Neutral	0 (0.0)	1 (6.7)	0 (0.0)	1 (100.0)	**2**
Agree	7 (38.9)	7 (46.7)	6 (46.2)	0 (0.0)	**20**
Strongly agree	11 (61.1)	6 (40.0)	6 (46.2)	0 (0.0)	**23**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Type and dose for adult and pediatric patients	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Neutral	0 (0.0)	1 (6.7)	0 (0.0)	0 (0.0)	**1**
Agree	6 (33.3)	6 (40.0)	5 (38.5)	1 (100.0)	**18**
Strongly agree	12 (66.7)	8 (53.3)	8 (61.5)	0 (0.0)	**28**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Indications and contraindications	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Neutral	0 (0.0)	1 (6.7)	0 (0.0)	0 (0.0)	**1**
Agree	3 (16.7)	5 (33.3)	7 (53.8)	1 (100.0)	**16**
Strongly agree	15 (83.3)	9 (60.0)	6 (46.2)	0 (0.0)	**30**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Accessories required for administering IVCM	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Neutral	0 (0.0)	1 (6.7)	0 (0.0)	0 (0.0)	**1**
Agree	7 (38.9)	7 (46.7)	4 (30.8)	1 (100.0)	**19**
Strongly agree	11 (61.1)	7 (46.7)	9 (69.2)	0 (0.0)	**27**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Techniques for needle placements	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Neutral	2 (11.1)	1 (6.7)	2 (15.4)	0 (0.0)	**5**
Agree	3 (16.7)	5 (33.3)	3 (23.1)	1 (100.0)	**12**
Strongly agree	13 (72.2)	9 (60.0)	8 (61.5)	0 (0.0)	**30**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**

Methods on how to maintain IV access	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Neutral	0 (0.0)	1 (6.7)	0 (0.0)	0 (0.0)	**1**
Agree	5 (27.8)	5 (33.3)	4 (30.8)	1 (100.0)	**15**
Strongly agree	13 (72.2)	9 (60.0)	9 (69.2)	0 (0.0)	**31**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Infection control measures	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Neutral	1 (5.6)	1 (6.7)	0 (0.0)	0 (0.0)	**2**
Agree	2 (11.1)	2 (13.3)	2 (15.4)	1 (100.0)	**7**
Strongly agree	15 (83.3)	12 (80.0)	11 (84.6)	0 (0.0)	**38**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Possible complications and adverse reactions	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Agree	3 (16.7)	1 (6.7)	2 (15.4)	1 (100.0)	**7**
Strongly agree	15 (83.3)	14 (93.3)	11 (84.6)	0 (0.0)	**40**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Treatment for complications and adverse reactions	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Neutral	1 (5.6)	3 (20.0)	0 (0.0)	0 (0.0)	**4**
Agree	4 (22.2)	4 (26.7)	6 (46.2)	1 (100.0)	**15**
Strongly agree	13 (72.2)	8 (53.3)	7 (53.8)	0 (0.0)	**28**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**

Values represent frequency (n) with percentage (%) value in parenthesis

None of the respondents disagreed with the inclusion of infection control measures in the further training. This suggests that applying proper infection control measures was considered a vital component for the further training amongst all of the respondents, regardless of their years of experience. The only respondent with between 30-39 years of experience agreed to all components except for the preparation of IVCM where he/she took a neutral stance.

4.3.3.5 Cardiopulmonary resuscitation, basic life support, emergency medicines and drugs

This section required the respondents to indicate whether or not the study of CPR, BLS, the pharmacology of emergency medicines and the administration of emergency medicines should be included as part of the

theoretical component for the further training of radiographers to administer IVCM.

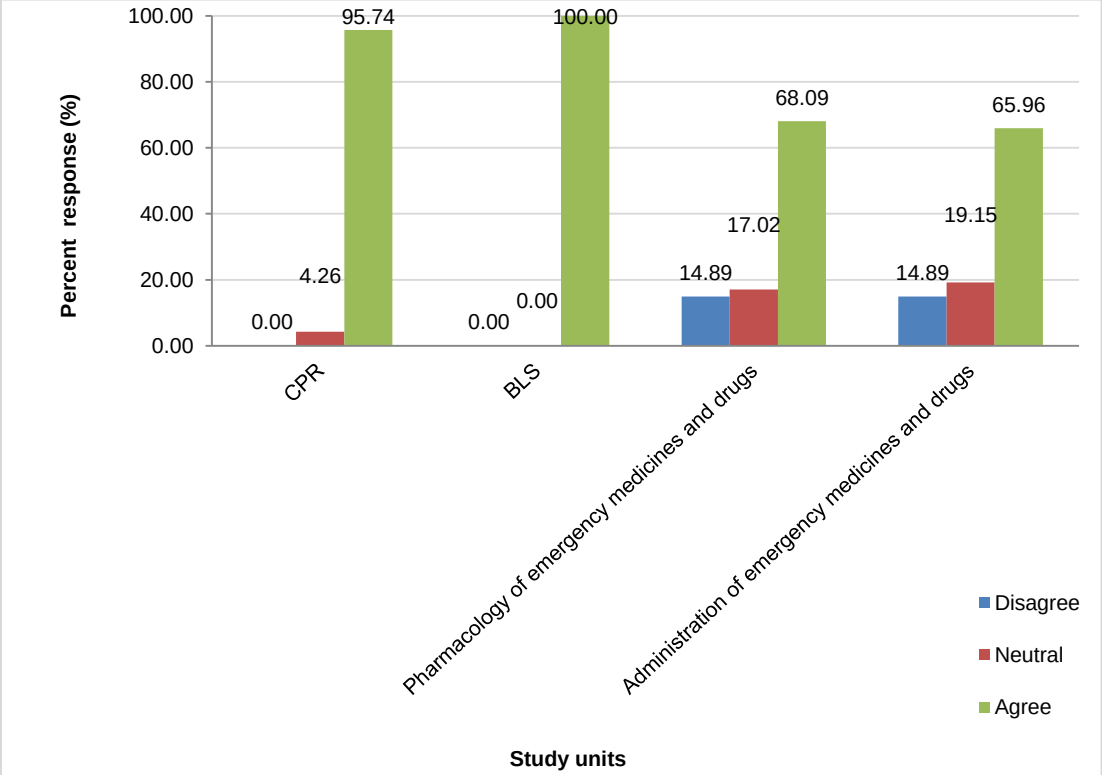

Figure 5: Cardiopulmonary resuscitation, basic life support, emergency medicines and drugs

There was a substantially high percentage of agreement for the inclusion of theoretical training on CPR and BLS in the further training. In addition, there was moderate agreement on the inclusion of the administration and pharmacology of emergency medicines, with a significantly low percentage of disagreement. This could mean that the pharmacology of emergency medicines and the administration thereof were not considered as important as CPR and BLS for the further training of radiographers.

Table 7 presents the percentage of agreement and disagreement amongst the radiologists for including the study of CPR, BLS and emergency medicines in the further training, similar to what has been presented in Figure 5. The responses in Table 7, however, were based on the radiologists' years of experience.

Table 7: Percentage of agreement and disagreement for the inclusion of cardiopulmonary resuscitation, basic life support, emergency medicines and drugs

CPR	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Neutral	2 (11.1)	0 (0.0)	0 (0.0)	0 (0.0)	**2**
Agree	3 (16.7)	5 (33.3)	1 (7.7)	1 (100.0)	**10**
Strongly agree	13 (72.2)	10 (66.7)	12 (92.3)	0 (0.0)	**35**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
BLS	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Agree	5 (27.8)	3 (20.0)	2 (15.4)	1 (100.0)	**11**
Strongly agree	13 (72.2)	12 (80.0)	11 (84.6)	0 (0.0)	**36**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Pharmacology of emergency medicines and drugs	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Disagree	4 (22.2)	2 (13.3)	1 (7.7)	0 (0.0)	**7**
Neutral	3 (16.7)	3 (20.0)	2 (15.4)	0 (0.0)	**8**
Agree	2 (11.1)	4 (26.7)	6 (46.2)	1 (100.0)	**13**
Strongly agree	9 (50.0)	6 (40.0)	4 (30.8)	0 (0.0)	**19**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Administration of emergency medicines and drugs	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Disagree	3 (16.7)	3 (20.0)	1 (7.7)	0 (0.0)	**7**
Neutral	4 (22.2)	4 (26.7)	1 (7.7)	0 (0.0)	**9**
Agree	5 (27.8)	3 (20.0)	5 (38.5)	1 (100.0)	**14**
Strongly agree	6 (33.3)	5 (33.3)	6 (46.2)	0 (0.0)	**17**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**

Values represent frequency (n) with percentage (%) value in parenthesis

None of the respondents disagreed with the inclusion of CPR and BLS in the further training. Few respondents with 0-29 years of experience (< 25 percent), however, disagreed with the inclusion of the pharmacology of emergency medicines and the administration thereof. The only respondent with 30-39 years of experience agreed to the inclusion of the pharmacology of

emergency medicines and the administration thereof. This group represents those radiologists who have been qualified the longest.

4.3.3.6 Theoretical assessment

There was a general consensus (87.2 percent) for the inclusion of a theoretical (written) assessment in the further training of radiographers to administer IVCM. Of all the respondents, 53.2 percent felt that the weighting of this assessment should be 0.25 of the final mark.

4.3.4 Clinical competence (skills) component

Results for the clinical competence (skills) component for the further training of radiographers to administer IVCM are presented in this section. In this study, the practical aspect refers to the practice without a patient as opposed to the clinical aspect which involves the physical practice on a patient.

4.3.4.1 Technique/s

This section required the respondents to indicate their opinion for the inclusion of the following techniques (in Figure 6) as part of the clinical competency (skills) component.

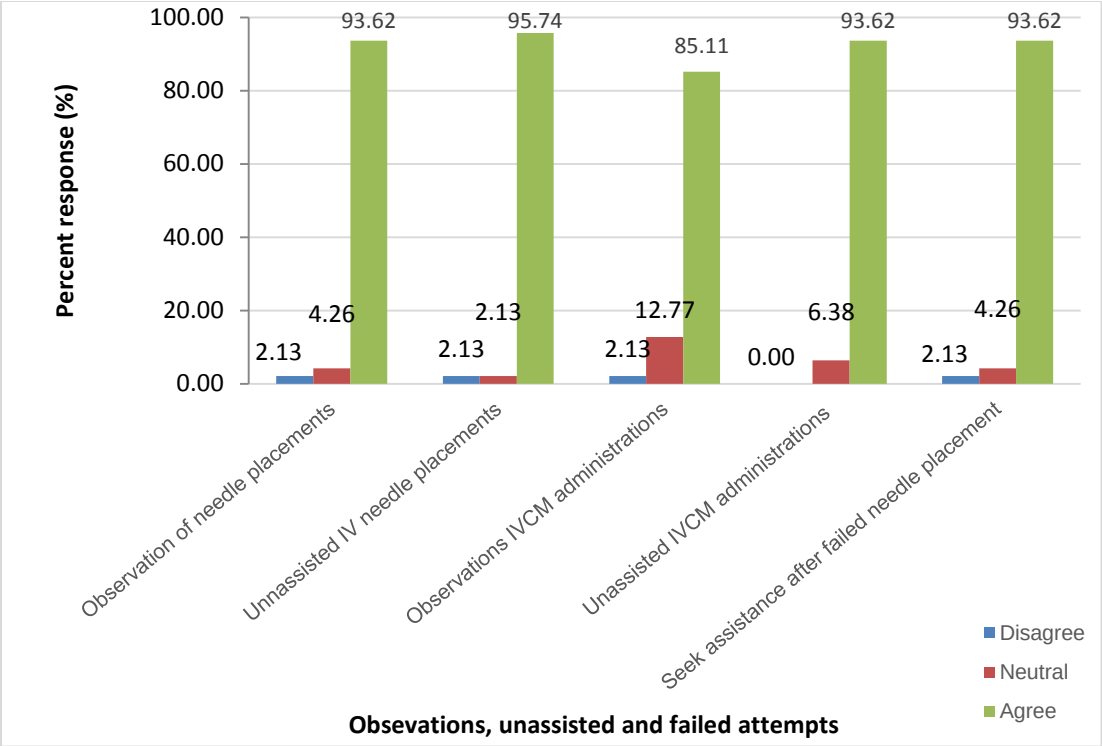

Figure 6: Technique/s

A high percentage of agreement (> 85 percent) amongst the respondents was noted relating to the observation of and unassisted practice of needle placements and IVCM administrations. Furthermore, the respondents (93.62 percent) indicated that assistance must be sought after a failed attempt of placing a needle.

Table 8 provides further information relating to the results from Figure 6. The participants were requested to explain their answer/s by specifying the minimum number of observations, independent needle placements and IVCM administrations as well as the number of failed attempts after which the radiographer should seek assistance.

Table 8: Percentage of agreement on the minimum number of observations, unassisted independent and failed attempts of needle placements and intravenous contrast media administrations

Recommended minimum number		Frequency (n)	Percent (%)	Mean
Observations for needle placements	***10***	14	29.8	30
	20	8	17.0	
	5	5	10.6	
	Other	20	42.6	
Unassisted, independent needle placements	***20***	11	23.4	33
	50	10	21.3	
	25	7	14.9	
	10	5	10.6	
	Other	14	29.8	
Observations for IVCM administrations	***20***	9	19.1	29
	10	8	17.0	
	35	8	17.0	
	5	7	14.8	
	Other	15	32.1	
Unassisted, independent IVCM administrations	***20***	11	23.4	33
	50	10	21.3	
	5	5	10.6	
	10	5	10.6	
	Other	16	34.1	
Failed attempts before seeking assistance	***2***	30	63.8	3
	3	10	21.3	
	Other	7	14.8	
Total		**47**	**100.0**	

The majority of respondents (29.8 percent) suggested that the radiographer observe 10 needle placements before attempting to do so unassisted, whereas the mean of the responses were 30 observations. The minimum number of unassisted, independent needle placements, according to the majority respondents (23.4 percent), resulted to 20. The mean value of independent needle placements, as per the responses, was 33. In addition, it was recommended that 20 IVCM administrations be observed before the radiographer attempts to do so unassisted. The mean value for the observations of IVCM administrations was 29. The minimum number of unassisted, independent IVCM administrations, according to the results, was 20. The mean value for independent IVCM administrations was 33. It is also evident from the results that the radiographer should seek assistance after two failed attempts of placing a needle.

4.3.4.2 Clinical and practical components

This section contains information relating to the percentage of agreement and disagreement for the clinical and practical components required for the further training of radiographers to administer IVCM. The clinical training refers to the patient preparation, management and aftercare as well as infection control measures and precautions. The practical training refers to the hands-on training for CPR, BLS as well as the administration of emergency medicines and drugs. The results are presented in Figure 7.

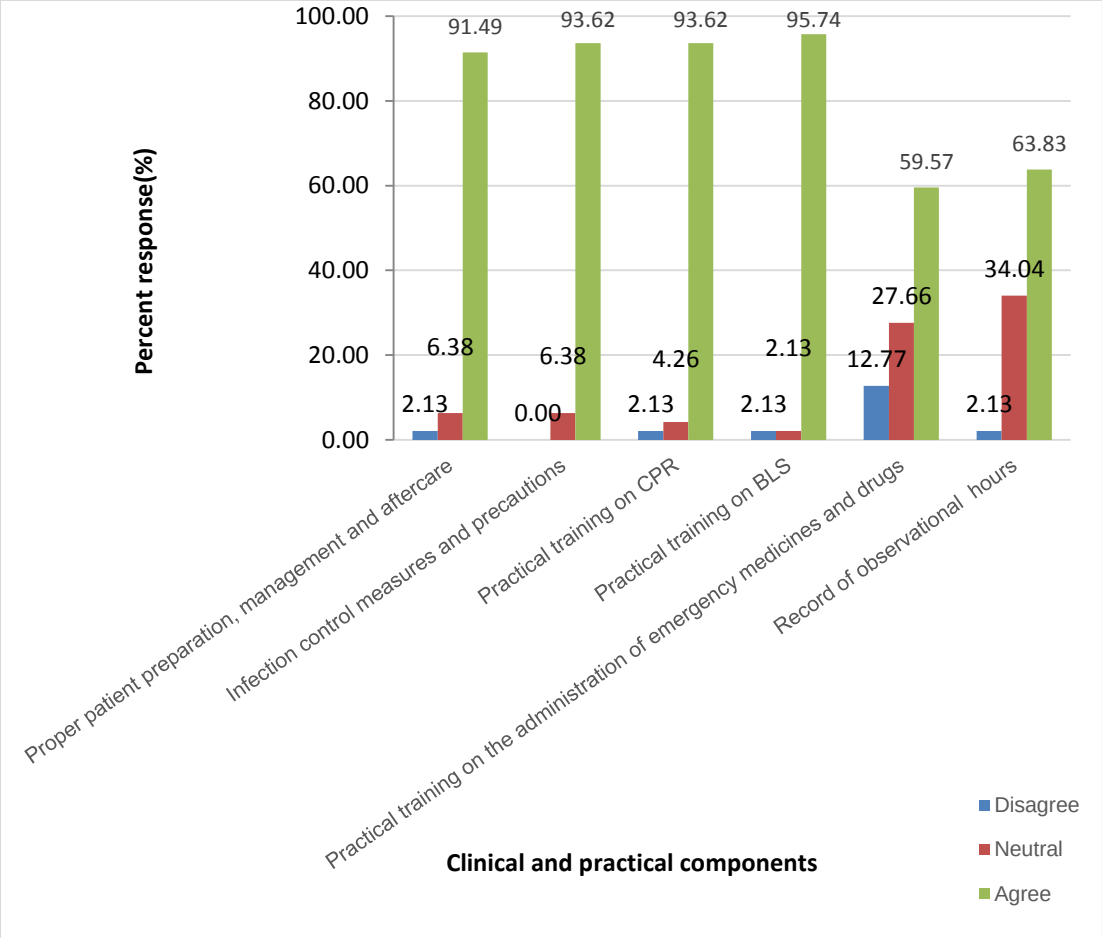

Figure 7: Clinical and practical components

Figure 7 revealed a high percentage of agreement amongst the respondents for including patient preparation, management and aftercare, infection control as well as the practical training on CPR and BLS in the further training of radiographers to administer IVCM. Slightly more than half of the respondents agreed that the practical training of administering emergency medicines and drugs should also be included in the training as well as that of keeping a record of observational hours for IVCM administrations. With regard to these two areas, the neutral responses were fairly significant compared to the neutral responses in the other components.

The majority of the respondents (63.83 percent) in Figure 7 indicated that a record of observational hours for contrasted studies should be kept. Figure 8 below further presents the respondents' opinions regarding the number of hours to be recorded.

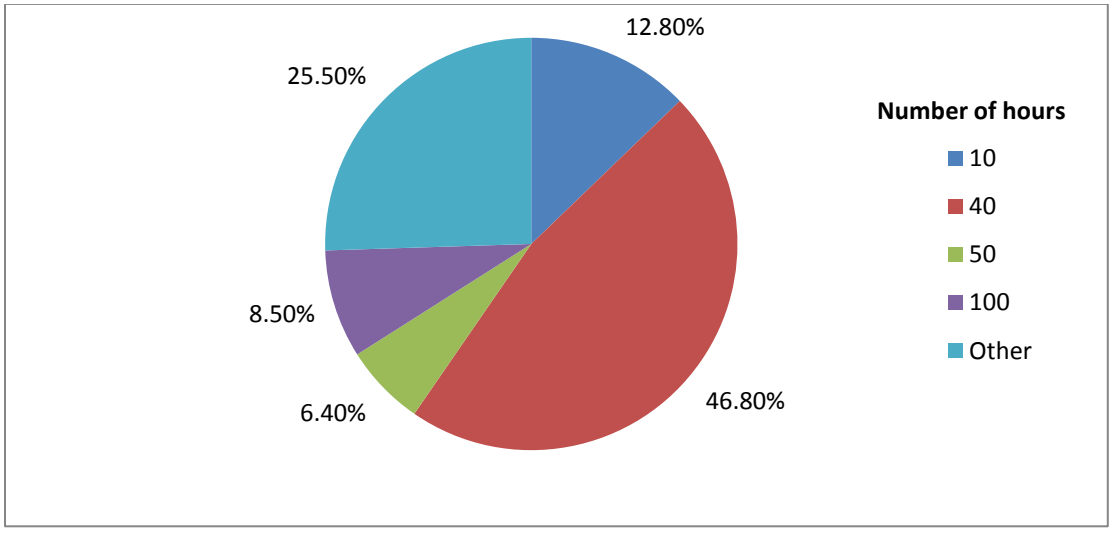

Figure 8: Observational hours for contrasted studies

The majority of respondents (46.8 percent) agreed that the student should observe and record a minimum of 40 hours of contrasted studies as part of

their record of clinical competencies. In addition, 8.5 percent of the respondents felt that the students should observe 100 hours. This is a fairly substantial difference when compared to the 40 hours suggested by 46.8 percent of respondents.

Table 9 presents the percentage of agreement and disagreement amongst the radiologists for including the following clinical and practical components in the further training. The responses were based on the radiologists' years of experience.

Table 9: Percentage of agreement and disagreement for the inclusion of clinical and practical components

Proper patient preparation, management and aftercare	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Disagree	0 (0.0)	1 (6.7)	0 (0.0)	0 (0.0)	**1**
Neutral	1 (5.6)	2 (13.3)	0 (0.0)	0 (0.0)	**3**
Agree	8 (44.4)	6 (40.0)	4 (30.8)	1 (100.0)	**19**
Strongly agree	9 (50.0)	6 (40.0)	9 (69.2)	0 (0.0)	**24**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Infection control	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Neutral	1 (5.6)	1 (6.7)	1 (7.7)	0 (0.0)	**3**
Agree	8 (44.4)	5 (33.3)	3 (23.1)	1 (100.0)	**17**
Strongly agree	9 (50.0)	9 (60.0)	9 (69.2)	0 (0.0)	**27**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Practical training on CPR	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Strongly disagree	0 (0.0)	1 (6.7)	0 (0.0)	0 (0.0)	**1**
Neutral	1 (5.6)	1 (6.7)	0 (0.0)	0 (0.0)	**2**
Agree	5 (27.8)	3 (20.0)	2 (15.4)	1 (100.0)	**11**
Strongly agree	12 (66.7)	10 (66.7)	11 (84.6)	0 (0.0)	**33**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Practical training on BLS	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Strongly disagree	0 (0.0)	1 (6.7)	0 (0.0)	0 (0.0)	**1**
Neutral	0 (0.0)	0 (0.0)	1 (7.7)	0 (0.0)	**1**
Agree	8 (44.4)	3 (20.0)	3 (23.1)	1 (100.0)	**15**
Strongly agree	10 (55.6)	11 (73.3)	9 (69.2)	0 (0.0)	**30**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**

Practical training on the administration of emergency medicines	Years of experience				Total
	0-9	10-19	20-29	30-39	
Strongly disagree	0 (0.0)	1 (6.7)	0 (0.0)	0 (0.0)	**1**
Disagree	2 (11.1)	1 (6.7)	2 (15.4)	0 (0.0)	**5**
Neutral	6 (33.3)	5 (33.3)	2 (15.4)	0 (0.0)	**13**
Agree	5 (27.8)	5 (33.3)	5 (38.5)	1 (100.0)	**16**
Strongly agree	5 (27.8)	3 (20.0)	4 (30.8)	0 (0.0)	**12**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**
Record of observational hours	**Years of experience**				**Total**
	0-9	**10-19**	**20-29**	**30-39**	
Disagree	0 (0.0)	1 (6.7)	0 (0.0)	0 (0.0)	**1**
Neutral	7 (38.9)	5 (33.3)	4 (30.8)	0 (0.0)	**16**
Agree	5 (27.8)	4 (26.7)	5 (38.5)	1 (100.0)	**15**
Strongly agree	6 (33.3)	5 (33.3)	4 (30.8)	0 (0.0)	**15**
Total	**18**	**15**	**13**	**1**	**47 (100.0)**

Values represent frequency (n) with percentage (%) value in parenthesis

The majority of radiologists with between 0-39 years of experience (> 80 percent) have agreed, respectively, with the inclusion of patient preparation, management and aftercare, infection control as well as the practical training of CPR and BLS in the further training of radiographers to administer IVCM. Those radiologists with between 0-19 years of experience were not as strongly convinced as those radiologists with 20-39 years of experience in terms of including practical training on the administration of emergency medicines and drugs. Slightly more than 30 percent of the respondents with between 0-29 years of experience have taken a neutral stance pertaining to the keeping of a record for observational hours of contrasted studies. The respondent with the most experience, between 0-39 years, once again agreed to all the clinical and practical components as listed in Table 9.

4.3.4.3 Record of clinical competencies and clinical assessment

The majority (95.7 percent) of respondents further agreed that a record of clinical competencies should be used as an assessment and should constitute a total weighting of 0.25 towards the final course mark. In addition,

93.6 percent of the respondents were also in favour of the students being assessed clinically for competency with a weighting of 0.25 towards the final course mark.

4.3.5 Medico legal factors

This section provides information on the medico legal responsibilities and training required by radiographers should the administration of IVCM be included in their professional and legal scope of practice.

4.3.5.1 Medico legal responsibilities

The medico legal responsibilities included obtaining informed consent, the responsibility for deciding on the type and dose of IVCM to be administered, the site of administration as well as who should ultimately be responsible for managing the possible complications and adverse reactions to IVCM that may occur. The results are presented in Figures 9 to 12 and Tables 10 to 13.

In Tables 10 to 13, the researcher compared the responses with the age of the radiologists. This was done to establish whether or not a difference of opinion existed amongst the older and younger radiologists seeing that the administration of IVCM is based on the needs of the modern healthcare system and service delivery. The traditional radiologist-radiographer relationship was very much autocratic compared to the current democratic approach.

4.3.5.1.1 Obtaining informed consent

Figure 9 provides the percentage of agreement amongst the respondents on whose responsibility it should be to obtain informed consent from the patient prior to the administration of IVCM (i.e. the radiographer, radiologist or other).

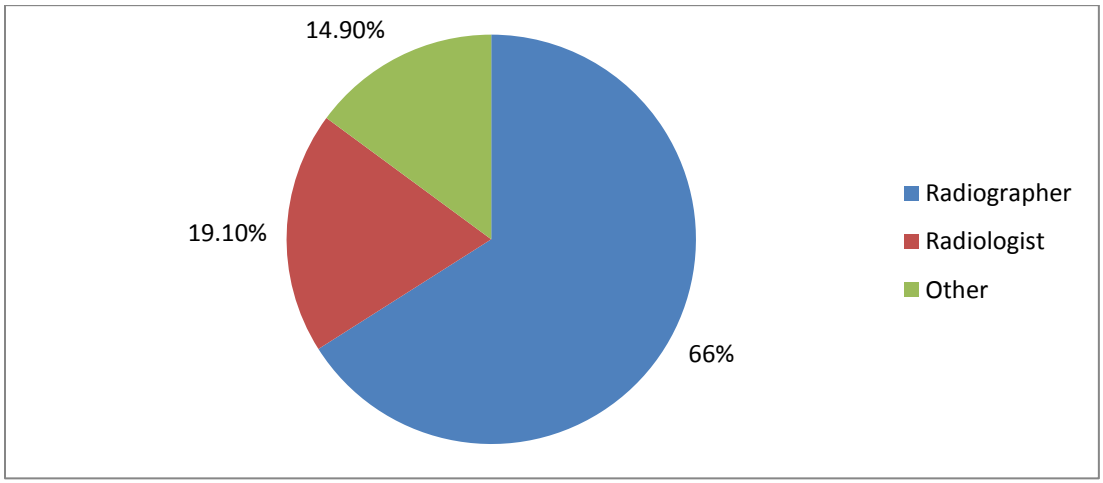

Figure 9: Individual responsible for obtaining informed consent

It was felt that radiographers should be responsible for obtaining informed consent seeing that 66.0 percent presents the largest portion of the respondents. Of the 14.9 percent who responded to 'Other', three respondents (6.4 percent) agreed that it should be the responsibility of both the radiographer and radiologist to obtain informed consent whereas two of the respondents (4.3 percent) in this group indicated that the referring clinician should also be responsible for obtaining consent.

Table 10 goes on to stratify the responses of the radiologists (as per Figure 9) based on their respective age.

Table 10: Percentage of agreement for whose responsibility it should be to obtain informed consent based on the respondents' age

Informed consent	Age				Total
	30-39	40-49	50-59	60-69	
Radiographer	3 (50.0)	18 (75.0)	8 (53.3)	2 (100.0)	**31**
Radiologist	2 (33.3)	4 (16.7)	3 (20.0)	0 (0.0)	**9**
Other	1 (16.7)	2 (8.3)	4 (26.7)	0 (0.0)	**7**
Total	**6**	**24**	**15**	**2**	**47 (100.0)**

Values represent frequency (n) with percentage (%) value in parenthesis

The majority of the respondents who indicated that the radiographer should be responsible for obtaining informed consent are in the 40-49 year age group. All radiologists in the 60-69 year age group (100.0 percent) agreed that it should be responsibility of the radiographer to obtain consent.

4.3.5.1.2 Deciding on the type and dose

Figure 10 provides the percentage of agreement amongst the respondents on who should be responsible for determining the type and dose of IVCM to be used.

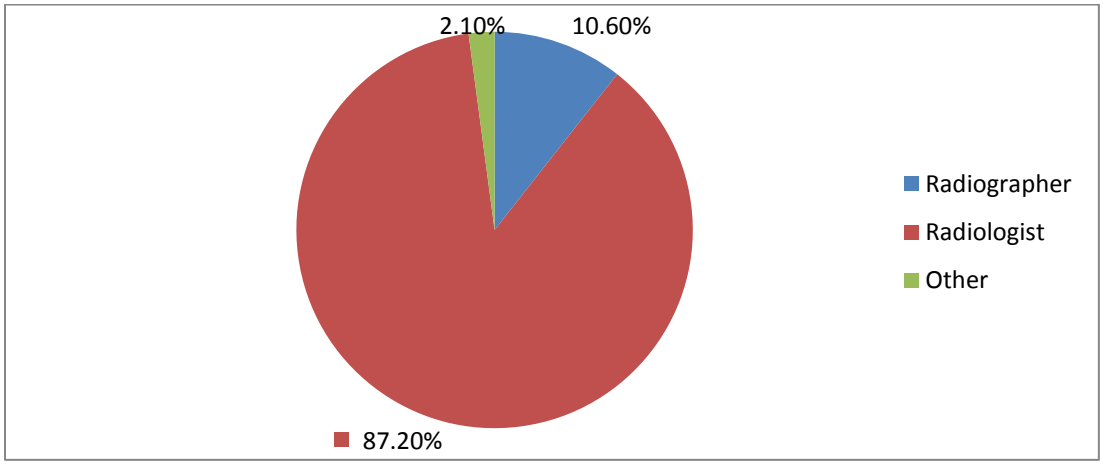

Figure 10: Individual responsible for deciding on the type and dose of intravenous contrast media to be used

The vast majority of respondents (87.2 percent) indicated that it should be the responsibility of the radiologist to determine the type and dose of IVCM to be administered.

Table 11 further presents the percentage of agreement amongst the radiologists for determining whose responsibility it should be for deciding on the type and dose of IVCM, based on their respective age.

Table 11: Percentage of agreement for whose responsibility it should be to decide on the type and dose of intravenous contrast media

Type and dose of IVCM	Age				Total
	30-39	40-49	50-59	60-69	
Radiographer	1 (16.7)	3 (12.5)	1 (6.7)	0 (0.0)	**5**
Radiologist	5 (83.3)	21 (87.5)	13 (86.7)	2 (100.0)	**41**
Other	0 (0.0)	0 (0.0)	1 (6.7)	0 (0.0)	**1**
Total	**6**	**24**	**15**	**2**	**47 (100.0)**

Values represent frequency (n) with percentage (%) value in parenthesis

The majority of the respondents who indicated that the radiologists should remain responsible for deciding on the type and dose of CM were between the age groups 40-49 and 60-69 respectively.

4.3.5.1.3 Deciding on the site of administration

Figure 11 provides the percentage of agreement amongst the respondents on who should ultimately be held responsible for deciding on the site of IVCM administration.

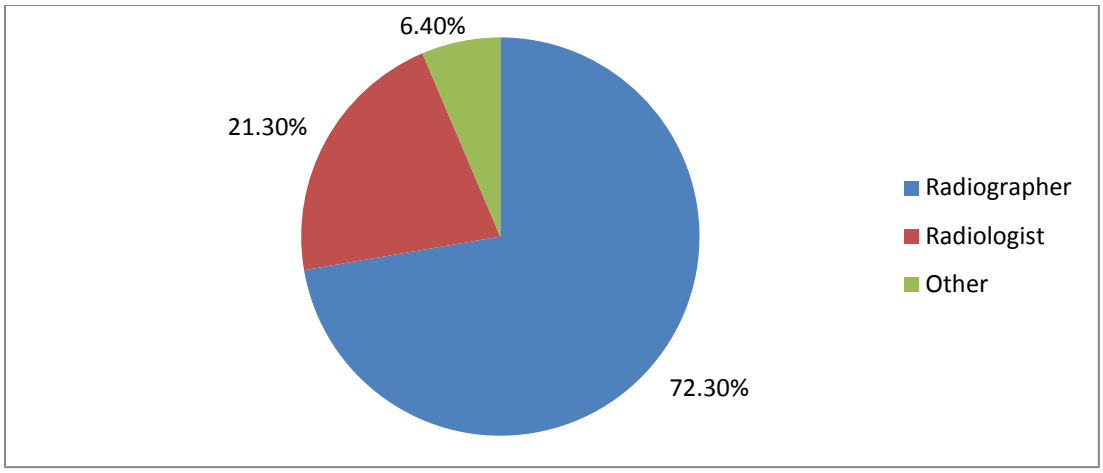

Figure 11: Individual responsible for deciding on the site of intravenous contrast media administration

It was felt by the majority of respondents (72.3 percent) that the decision for selecting the site of administration should be the responsibility of the radiographer administering the IVCM. Interestingly, one of the respondents who indicated "Other" was of the opinion that it should remain the responsibility of the radiographer except for complex vascular cases where it should then be the responsibility of the radiologist.

Table 12 further stratifies the responses of the radiologists (as per Figure 11) based on their respective age.

Table 12: Percentage of agreement for whose responsibility it should be to decide on the site of administration

Site of IVCM administration	Age				Total
	30-39	40-49	50-59	60-69	
Radiographer	2 (33.3)	20 (83.3)	10 (66.7)	2 (100.0)	**34**
Radiologist	3 (50.0)	4 (16.7)	3 (20.0)	0 (0.0)	**10**
Other	1 (16.7)	0 (0.0)	2 (13.3)	0 (0.0)	**3**
Total	**6**	**24**	**15**	**2**	**47 (100.0)**

Values represent frequency (n) with percentage (%) value in parenthesis

The majority of the respondents who indicated that the radiographer should be responsible for deciding on the site of IVCM administration were between the age groups 40-49 and 50-59 respectively. Interesting to note was that 50 percent of the respondents in the age group of 30-39 years, felt that it should be the responsibility of the radiologist. The overall percentage of agreement, however, was in favour of the radiographers being responsible for deciding on the site of administration for IVCM investigations.

4.3.5.1.4 Overall responsibility for managing the complications and adverse reactions

Figure 12 provides the percentage of agreement on who should be held responsible for the possible complications and adverse reactions (i.e. the radiographer, radiologist or other).

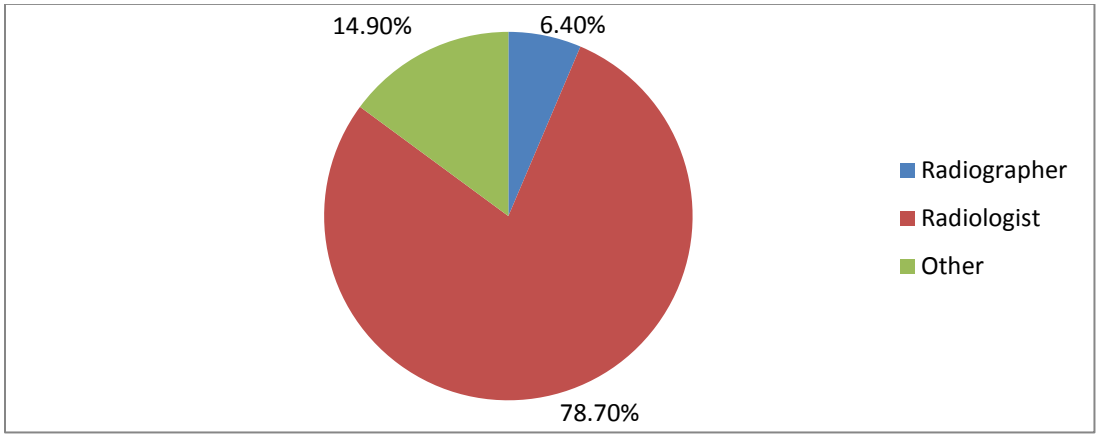

Figure 12: Individual responsible for the possible complications and adverse reactions to intravenous contrast media

The majority of respondents (78.7 percent) were of the opinion that the radiologists should remain responsible for the possible complications and adverse reactions that may occur after the administration of IVCM. Three of

the respondents who indicated 'Other' suggested that the responsibility should be that of the individual who administers the IVCM.

Similar to the previous Tables 10, 11 and 12, Table 13 stratifies the responses of the radiologists (as per Figure 12) based on their respective age.

Table 13: Percentage of agreement for whose responsibility it should be to manage the possible complications and adverse reactions of intravenous contrast media

Possible complications and adverse reactions to IVCM	Age 30 -39	40-49	50-59	60-69	Total
Radiographer	0 (0.0)	3 (12.5)	0 (0.0)	0 (0.0)	**3**
Radiologist	5 (83.3)	18 (75.0)	12 (80.0)	2 (100.0)	**37**
Other	1 (16.7)	3 (12.5)	3 (20.0)	0 (0.0)	**7**
Total	**6**	**24**	**15**	**2**	**47 (100.0)**

Values represent frequency (n) with percentage (%) value in parenthesis.

The majority of the respondents who indicated that the radiologists should remain responsible for deciding on the type and dose of IVCM were between the age groups 30-39 and 60-69 respectively. It is safe to conclude, therefore, that the respondents, regardless of their age, were in a strong agreement as to whose responsibility it should be to manage the possible complications and adverse reactions due to the administration of IVCM.

4.3.5.2 Medico legal training

This section summarized the results for the medico legal training (study units) considered necessary for inclusion in the further training of radiographers to administer IVCM. The results are presented in Figure 13.

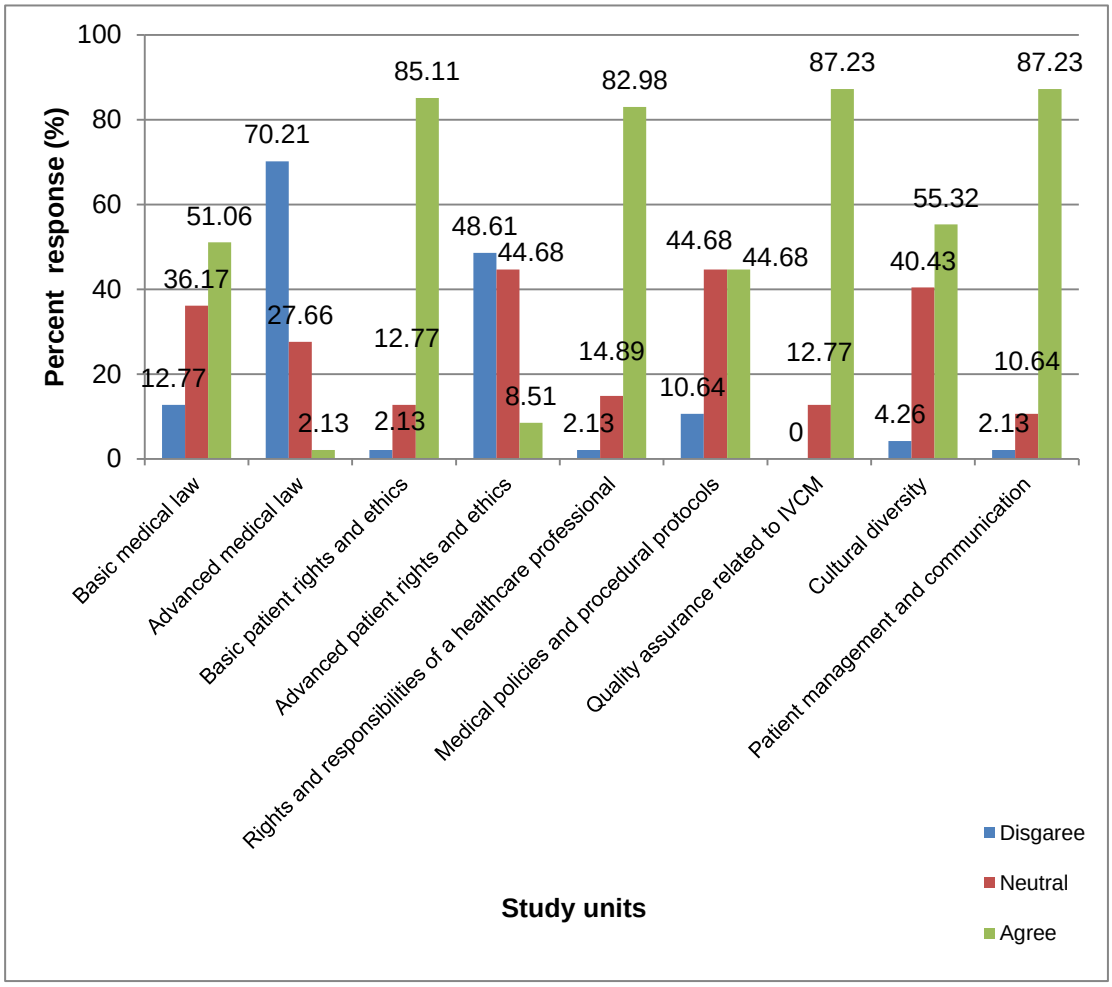

Figure 13: Medico legal study units

There was a high percentage of agreement (> 80 percent) between the respondents for including the basic study of medico legal study units as opposed to the advanced study thereof. The study of medical policies and procedural protocols, however, yielded an equal percentage of agreement and neutrality.

Table 14 presents the percentage of agreement and disagreement amongst the radiologists for including the various medico legal study units in the further

training. The responses were based on the radiologists' employment sector (public, private and both). Only the basic training study units have been listed in Table 14 below as per the consensus in Figure 13.

Table 14: Percentage of agreement and disagreement for the inclusion of medico legal study units

Basic medial law	**Public**	**Private**	**Both**	**Total**
Strongly disagree	1 (9.1)	0 (0.0)	0 (0.0)	**1**
Disagree	0 (0.0)	4 (12.5)	1 (25.0)	**5**
Neutral	4 (36.4)	12 (37.5)	1 (25.0)	**17**
Agree	3 (27.3)	13 (40.6)	1 (25.0)	**17**
Strongly agree	3 (27.3)	3 (9.4)	1 (25.0)	**7**
Total	**11**	**32**	**4**	**47 (100.0)**
Basic patient rights and ethics	**Public**	**Private**	**Both**	**Total**
Disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Neutral	0 (0.0)	5 (15.6)	1 (25.0)	**6**
Agree	7 (63.6)	20 (62.5)	1 (25.0)	**28**
Strongly agree	4 (36.4)	6 (18.8)	2 (50.0)	**12**
Total	**11**	**32**	**4**	**47 (100.0)**
Rights and responsibilities of a healthcare professional	**Public**	**Private**	**Both**	**Total**
Disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Neutral	0 (0.0)	6 (18.8)	1 (25.0)	**7**
Agree	6 (54.5)	17 (53.1)	1 (25.0)	**24**
Strongly agree	5 (45.5)	8 (25.0)	2 (50.0)	**15**
Total	**11**	**32**	**4**	**47 (100.0)**
Medical policies and procedural protocols	**Public**	**Private**	**Both**	**Total**
Strongly disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Disagree	1 (9.1)	3 (9.4)	0 (0.0)	**4**
Neutral	5 (45.5)	15 (46.8)	1 (25.0)	**21**
Agree	3 (27.3)	10 (31.3)	2 (50.0)	**15**
Total	**11**	**32**	**4**	**47 (100.0)**
Quality assurance related to IVCM	**Public**	**Private**	**Both**	**Total**
Neutral	0 (0.0)	5 (15.6)	1 (25.0)	**6**
Agree	8 (72.7)	21 (65.6)	1 (25.0)	**30**
Strongly agree	3 (27.3)	6 (18.8)	2 (50.0)	**11**
Total	**11**	**32**	**4**	**47 (100.0)**
Cultural diversity	**Public**	**Private**	**Both**	**Total**
Strongly disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Neutral	4 (36.4)	12 (37.5)	3 (75.0)	**19**
Agree	5 (45.5)	16 (50.0)	1 (25.0)	**22**
Strongly agree	2 (18.2)	2 (6.3)	0 (0.0)	**4**
Total	**11**	**32**	**4**	**47 (100.0)**

Patient management and communication	Public	Private	Both	Total
Disagree	0 (0.0)	1 (3.1)	0 (0.0)	**1**
Neutral	2 (18.2)	1 (3.1)	2 (50.0)	**5**
Agree	6 (54.5)	21 (65.6)	1 (25.0)	**28**
Strongly agree	3 (27.3)	9 (28.1)	1 (25.0)	**13**
Total	**11**	**32**	**4**	**47 (100.0)**

Values represent frequency (n) with percentage (%) value in parenthesis

Amongst both the public and private sector respondents, more than 25 percent took a neutral stance for including the study of basic medical law. Higher percentages of agreement, however, were evident for including the study of basic patient rights and ethics. All of the public sector respondents (100.0 percent) agreed on the inclusion of QA in the further training of radiographers to administer IVCM. Slightly more than 30 percent of both the public and private sector respondents took a neutral stance for the inclusion of cultural diversity as a study unit in the further training.

4.4 Inferential statistics

The traditional approach to reporting a result requires a statement of statistical significance. A p-value is generated from a statistical test. A significant result is indicated with '$p < 0.05$'. In simple terms, should a significant p-value be generated, it shows that there is a significant relationship between the two variables, i.e. the classification of employment of the respondents played an important role in how the respondents perceived the observation of needle placements as part of the further training for radiographers to administer IVCM.

The Pearson's Chi Square Test was performed to determine whether or not there is a statistically significant relationship between the variables. The

demographical information and work profile of the respondents were addressed and related to the research objectives.

4.4.1 Objective 1: To determine the theoretical knowledge for radiographers to administer intravenous contrast media

Table 15 provides a summary pertaining to the study of basic anatomy versus the demographics information of the respondents.

Table 15: The inclusion of basic anatomy versus the demographics of the respondents

Study unit	Gender	Age	Current employment sector	Type of institution	Classification of employment
Basic anatomy cardiovascular system	0.599	0.536	0.787	0.942	0.000 *
Basic anatomy urinary system	0.582	0.217	0.752	0.599	0.103
Basic anatomy upper limb	0.119	0.956	0.826	0.976	0.002 *
Basic anatomy lower limb	0.466	0.977	0.727	0.947	0.012 *
Basic anatomy nervous system	0.867	0.949	0.887	0.879	0.427

*Significant value ($p < 0.05$)

There were significant relationships between the basic anatomy of the cardiovascular system and classification of employment ($p < 0.05$) as well as that of the upper limb ($p < 0.05$) and lower limb ($p < 0.05$). These results indicate that the classification of employment of the respondents did play a role in terms of how the respondents viewed these variables (study units). The respondents who indicated higher levels of agreement are currently working in urban areas.

Table 16 provides a summary pertaining to the study of basic physiology versus the demographics of the respondents.

Table 16: The inclusion of basic physiology versus the demographics of the respondents

Study unit	Gender	Age	Current employment sector	Type of institution	Classification of employment
Basic physiology cardiovascular system	0.737	0.762	0.886	0.327	0.816
Basic physiology urinary system	0.448	0.489	0.913	0.048 *	0.151
Basic physiology upper limb	0.545	0.498	0.508	0.677	0.536
Basic physiology lower limb	0.374	0.919	0.91	0.051	0.565
Basic physiology nervous system	0.693	0.707	0.287	0.872	0.362

*Significant value ($p < 0.05$)

The results indicated that the type of institution of the respondents did play a role in terms of how the respondents viewed the variables (study units). A significant relationship was noted between the basic physiology of the urinary system and the type of institution of the respondents. The majority of respondents who agreed with this are currently working in the private sector. These respondents, especially, felt that the basic physiology of the urinary system is important for inclusion in the further training.

Table 17 provides a summary pertaining to the study of basic pathology versus the demographics of the respondents.

Table 17: The inclusion of basic pathology versus the demographics of the respondents

Study unit	Gender	Age	Current employment sector	Type of institution	Classification of employment
Basic pathology cardiovascular system	0.392	0.457	0.785	0.007 *	0.133
Basic pathology of the urinary system	0.09	0.765	0.654	0.032 *	0.000 *
Basic pathology upper limb	0.87	0.967	0.685	0.92	0.084
Basic pathology lower Limb	0.87	0.737	0.685	0.92	0.084
Basic pathology nervous system	0.579	0.672	0.58	0.775	0.231

*Significant value ($p < 0.05$)

The study of the basic pathology of the cardiovascular system and type of institution of the respondents indicated a significant relationship ($p < 0.05$). In addition, a significant relationship was noted pertaining to those respondents working in the private sector and the basic pathology of the urinary system.

Table 18 provides a summary pertaining to the study of CM and possible reactions versus the demographics of the respondents.

Table 18: The inclusion of contrast media and possible reactions versus the demographics of the respondents

Study unit	Gender	Age	Current employment sector	Type of institution	Classification of employment
Pharmacology of IVCM	0.903	0.991	0.67	0.882	0.844
The preparation of IVCM	0.87	0.89	0.952	0.98	0.002 *
Differences between the type and dose - adult and pediatric patients	0.869	0.84	0.836	0.574	0.982
Clinical and biomedical indications and contraindications	0.15	0.781	0.302	0.31	0.749
Different types of needles and accessories	0.867	0.974	0.948	0.544	0.988

Technique for needle placements	0.466	0.316	0.832	0.218	0.616
Methods on how to maintain IV access	0.854	0.718	0.807	0.46	0.787
Infection control	0.645	0.847	0.799	0.172	0.651
Complications and adverse reactions including their severity	0.624	0.854	0.731	0.046 *	0.361
Treatment for complications and adverse reactions	0.242	0.927	0.319	0.166	0.583

***Significant value ($p < 0.05$)

A significant relationship was evident between the preparation of IVCM and classification of employment ($p < 0.05$) indicating that those respondents in the urban areas were of the opinion that the study of IVCM preparation is exceptionally important. Similarly, the same principle applied to those respondents working in the private sector for including the study of IVCM complications and adverse reactions ($p < 0.05$). This may be due to a higher risk of litigation within the private healthcare sector.

Table 19 provides a summary pertaining to the study of CPR, BLS and emergency medicines/drugs versus the demographics of the respondents.

Table 19: The inclusion of cardiopulmonary resuscitation, basic life support, emergency medicines and drugs versus the demographics of the respondents

Study unit	Gender	Age	Current employment sector	Type of institution	Classification of employment
Theoretical training on CPR	0.425	0.012 *	0.109	0.000 *	0.792
Theoretical training on BLS	0.774	0.784	0.409	0.157	0.573
Pharmacology of emergency medicines and drugs	0.191	0.157	0.365	0.112	0.628
Administration of emergency medicines and drugs	0.344	0.796	0.861	0.322	0.348

***Significant value ($p < 0.05$)

The age of the respondents and type of institution shared a significant relationship with the theoretical training of CPR ($p < 0.05$). It was noted that respondents between the age group 30 to 69 felt that the theoretical training of CPR is extremely important, especially those currently working in the private practice.

4.4.2 Objective 2: To determine the clinical competencies required for radiographers to effectively administer intravenous contrast media

Table 20 provides a summary pertaining to technique/s versus the demographics of the respondents.

Table 20: The inclusion of technique/s versus the demographics of the respondents

Techniques	Gender	Age	Current employment sector	Type of institution	Classification of employment
Observation of IV needle placements	0.537	0.985	0.957	0.715	0.026 *
Independent, unassisted IV needle placements	0.355	0.915	0.882	0.776	0.394
Observation of IVCM administrations	0.85	0.884	0.937	0.86	0.751
Independent, unassisted IVCM administrations	0.628	0.55	0.965	0.387	0.906
Seek assistance after a certain number of failed attempts to administer the IVCM	0.82	0.793	0.964	0.604	0.932

***Significant value ($p < 0.05$)

Only one significant relationship was noted pertaining to the technique/s and the demographics of the respondents, which included the observation of needle placements and those radiologists working in the urban areas ($p < 0.05$).

4.4.3 Objective 3: To determine the medico legal responsibilities related to the administration of intravenous contrast media

Table 21 provides a summary pertaining to medico legal study units versus the demographics of the respondents.

Table 21: The inclusion of medico legal study units versus the demographics of the respondents

Study unit	Gender	Age	Current employment sector	Type of institution	Classification of employment
Basic medical law	0.526	0.973	0.425	0.171	0.745
Advanced medical law	0.761	0.325	0.494	0.766	0.212
Basic patient rights and ethics	0.663	0.537	0.488	0.388	0.232
Advanced patient rights and ethics	0.511	0.707	0.217	0.293	0.869
Rights and responsibilities of a health care professional	0.864	0.449	0.569	0.545	0.29
Designing medical policies and procedural protocols	0.436	0.172	0.951	0.673	0.981
Quality assurance	0.38	0.821	0.314	0.627	0.49
Cultural diversity	0.963	0.99	0.814	0.897	0.978
Patient management and communication	0.96	0.946	0.141	0.893	0.83

No significant relationships were noted between the medico legal study units and the demographics of the respondents. This indicates that the respondents overall, with no exception to their gender, age, current employment sector, type of institution or classification of employment, took a similar view based on the inclusion of the medico legal study units listed in Table 21.

4.5 Summary

This research study investigated the opinions of 47 qualified radiologists in KZN in terms of the training required for radiographers to administer IVCM. The data was captured and analyzed to answer the three objectives of this research study. The ratio of male to female responses was approximately 4:1 with the majority of the respondents employed in the private sector. Overall, the results indicated that the study of basic anatomy, physiology, pathology of the cardiovascular and urinary systems, upper and lower limbs as well as the nervous system be included in the further training as opposed to the advanced study thereof. In addition, the respondents raised the importance of including the study of the basic anatomy, physiology and pathology of the respiratory system.

It was felt that the final mark for the training should include a theoretical and clinical assessment as well as a record of clinical competencies. The majority of the respondents also indicated that the radiographers first observe needle placements and IVCM administrations before attempting to do so unassisted, but yet under supervision. The recommended minimum number for IVCM observations and unassisted (under supervision) IVCM administrations was 20.

Results further illustrated that the study of basic medical law, basic patient rights and ethics as well as the rights and responsibilities of a health care professional should be included in the further training for radiographers to administer IVCM. QA, cultural diversity as well as patient management and communication were also deemed important for further training under the medico legal component.

In addition, the results highlighted significant relationships between the theoretical knowledge, clinical competencies and medico legal responsibilities required by radiographers to administer IVCM with the demographics, current employment and work experience of the respondents.

CHAPTER 5
DISCUSSION

5.1 Introduction

The response rate, profile of the respondents and study objectives have been discussed followed by the proposed assessments needed for the further training of radiographers to administer IVCM. Additionally, the limitations and strengths of the research study were listed followed by a brief summary.

5.2 Response rate

The final response rate for this study was 48.5 percent. A similar pattern was observed in two recent studies targeting the radiologists in KZN (Ackah 2016: 99) and the radiologists throughout SA (Kekana, Swindon and Mathobisa 2015: 1117). In the study conducted by Ackah none of the radiologists targeted were able to participate. The response rate in the Kekana study was not mentioned. It would appear, however, that the return rate was 6.4 percent as only 57 radiologists out of 885 were included for statistical analysis. Although the response rate for this research study may have appeared to be low, it is above the minimum 33.3 percent recommended in literature (Nulty 2008: 302). Sauermann and Roach (2012: 273) further highlighted that online surveys, tend to yield lower response rates. The response rate for this research study can therefore be considered acceptable. It is possible that high clinical workloads and resulting constraints amongst the respondents (radiologists) may have contributed to the lower response rate.

5.3 Profile of respondents

The majority of the respondents in this study were between 40-59 years of age. The higher participation rate from this age group (as opposed to the older age group 60-69 years) may be due to their more advanced technological skills and easier access to the internet for completion of the online research tool. It is important to note that the currently qualified radiologists specialized in Radiology only after having qualified as medical doctors, which may explain the high mean age of the respondents.

The respondents in this study qualified as radiologists between 1980-2015 indicating that the findings represent a generalized perception from well experienced and recently qualified radiologists (with less experience). This is important as the content of the training offered for the more experienced radiologists may have been different from what is currently offered, thus providing different perceptions on the necessary training. Additionally, the majority of the respondents were from the private sector. This may be related to an increased earning potential in the private sector as opposed to working in the public sector where the working environment is possibly more challenging.

5.4 Objective 1: To determine the theoretical knowledge required for radiographers to administer intravenous contrast media

This research study found that a basic study of the anatomy, physiology and pathology of the cardiovascular, urinary, respiratory and nervous systems as well as the upper and lower limbs should be included in the further training for radiographers to administer IVCM. The response percentage of agreement for including these study units were above 85 percent. The suggested study

units are similar to those included in the training offered in Southern Europe (University of Malta, Department of Radiography 2010: 5) and the UK (The College of Radiographers 2011: 7). For example, the study of anatomy and physiology of the upper and lower limb forms part of the theoretical training at the University of Malta and in the UK. The training offered in other countries, however, does not specify whether a basic or advanced study of these units has been included in their training. The findings of this research study are therefore unique, as no other guidelines have specified this. Furthermore, this research study is unique by having identified the respiratory system as an additional study unit. Many respondents, however, disagreed with including the advanced study of the previously mentioned study units, indicating that it should not form part of the training requirements.

In Canada, the theoretical study units related to venous anatomy and pathology are considered as essential and radiographers who successfully complete the further training must be knowledgeable in this area (OMARS 2010). According to Bae (2010: 34), it is important for the individual administering the contrast medium to have adequate knowledge of these study units in order to be competent in needle placement and IVCM administration. Adequate knowledge on these study units will allow for a deeper understanding of the circulatory distribution of IVCM within the cardiovascular system and the associated complications and adverse reactions that may occur (Bae 2010: 34). An example of a complication that may occur is soft tissue extravasation. This is due to the needle not being placed correctly in the lumen of the vein and upon the administration of the contrast medium; it is forced into the surrounding soft tissues (Hesley and Hartman 2008: 24).

The majority of the respondents are in agreement regarding the study of the pharmacology and preparation of CM and emergency medicines. Similarly, these study units also form part of the European, UK and Canadian training (OMARS 2010; The College of Radiographers 2011: 6; University of Malta, Department of Radiography 2010: 5). For those investigations which require hand administrations, i.e. CT brain studies, the contrast medium is generally pre-heated in a warmer. It is important to have a methodical understanding based on the pharmacology of CM and emergency medicines in order to comprehend its different uses and effects, as defined by Dreyer *et al.* (2012: 1).

The study of the different types and dosages of IVCM to be administered for the adult and pediatric patient was, furthermore, agreed upon by the respondents for inclusion in the further training. According to Robbins and Pozniak (2010: 13), the dose of IVCM administered for the pediatric patient is lower than that compared to the dose administered for the adult patient and may be calculated based upon the weight of the child. Dillman (2013) indicates that the dose should be calculated as 2ml/kg, i.e. if the weight of the child is 5kg, the recommended dose to be administered would be 10ml. According to the 'Medicines and Related Substances Act 101 of 1965', only medical practitioners and dentists are permitted to prescribe substances between schedule two and six (HPCSA 2002: 23). Radiographers in SA are currently not permitted to prescribe medicines and are therefore not able to make decisions regarding the type and dose of CM to be used. Similarly, radiographers in Europe and Australia are also not permitted to decide on the type and dose of the contrast medium to be used (Queensland Department of Health 2013: 2; University of Malta, Department of Radiography 2010: 7). This will be discussed further under the medico legal section.

This study found that an exploration into the clinical and biomedical indications and contraindications as well as the possible complications and adverse reactions and the treatment thereof should be included in the theoretical component of the further training. This finding is supported by the training offered in Canada, the UK and Ireland (OMARS 2010; The College of Radiographers 2011: 6; The Irish Institute of Radiography and Radiation Therapy 2007: 4). Clinical and biomedical indications and contraindications for the use of IVCM can be considered as one of the most important factors when assessing a patient for a contrast enhanced investigation. The correct identification of contraindications may prevent a patient from experiencing complications and adverse reactions due to the administration of IVCM.

The results of this study indicate that the study of the different accessories needed for the administration of IVCM should be included in the further training. The research tool for the current study did not require the respondents to specify which accessories need to be included; however, the training offered for Australian radiographers includes the use of the power-injector as part of the accessories for the administration of IVCM (Queensland Department of Health 2013: 4). Since it has been included in the training for Australian radiographers, the researcher assumed that it is important and should be included in the further training for South African radiographers. According to the Medical Center, University of California (2014: 1) it is important to confirm the position of the needle or central line before activating the power-injector so as to prevent the extravasation of the contrast medium into the surrounding soft tissues. In view of this, it is important to understand the different components of the power-injector to be able to successfully prepare it by drawing up the contrast medium and connecting it to the patient.

In addition, the techniques associated with needle placements, methods on how to maintain IV access and infection control was deemed important by the study respondents for inclusion in the further training. This is in keeping with the training offered in Canada and the UK (OMARS 2010; The College of Radiographers 2011: 7). Morrison and Odle (2007: 6) state that due to the possible occurrence of needle stick injuries when placing the needle, a basic knowledge of infection control is necessary, not only for the safety of the patient, but also for the individual administering the contrast medium. According to Evans (2015), more than 2 330 needle stick injuries were reported locally by healthcare professionals in the province of Gauteng, SA. In view of this and to prevent needle stick injuries from occurring, adequate training and clinical competency when placing and removing the needle, is necessary.

A question relating to CPR and BLS was included in the research tool as studies conducted both locally and internationally have found that radiographers and other allied healthcare professionals are not knowledgeable in CPR and BLS (Koch 2014: 28, Chandrasekaran *et al.* 2010: 125). In the study conducted by Koch, 67 percent of the respondents (radiographers) indicated that they have in the past been required to assist a medical doctor during emergency medical situations by performing CPR and BLS. Furthermore, 50 percent of the same respondents were of the opinion that they did not feel competent to assist (Koch 2014: 27). This question was important in the research tool due to the possible occurrence of complications and adverse reactions to the administration of IVCM. It is noted in literature that the study of CPR and BLS is not included as part of the international theoretical training, but does appear under the practical training components. The need for the inclusion of CPR and BLS as training requirements has been reported in a local study conducted by Kekana, Swindon and Mathobisa

(2015: 1123) on the opinions of radiographers. The results from this current research study, which were based on radiologists' opinions, therefore support those of previous studies conducted locally.

In summary, this research study found that the following theoretical study units should be included as part of the further training for radiographers to administer IVCM:

- Basic anatomy, physiology and pathology of the cardiovascular, urinary, nervous and respiratory systems as well as that of the upper and lower limbs.
- The pharmacology of IVCM.
- The preparation of IVCM for administration.
- Differences between the adult and pediatric types and doses of IVCM administered.
- The clinical and biomedical indications and contraindications of IVCM.
- The accessories required for IVCM administrations.
- The technique/s associated with needle placements.
- The methods of maintaining IV access.
- Infection control measures and precautions before, during and after IVCM administration.
- The possible complications and adverse reactions to IVCM including the severity thereof.
- The treatment and management of IVCM complications and adverse reactions according to their severity.
- Theoretical training pertaining to CPR and BLS.
- The pharmacology of emergency medicines and drugs.
- The administration of emergency medicines and drugs.

5.5 Objective 2: To determine the clinical competencies required for radiographers to effectively administer intravenous contrast media

This research study suggested that the radiographer should first observe 10 needle placements and only then, should they be allowed to place a needle under supervision. It was further agreed that the radiographer should record a minimum of 20 unassisted, independent needle placements within a record of clinical competencies. No international literature was found pertaining to a minimum number for observations or independent practice when placing a needle. It is important to bear in mind that the act of placing a needle and administering IVCM are two different concepts and procedures.

In addition, this study further found that a minimum of 20 observations and a minimum of 20 independent IVCM administrations should be recorded. In contrast to this, in Europe, a minimum of five observations and 50 independent IVCM administrations are required as part of the skills component for the training of radiographers (University of Malta, Department of Radiography 2010: 6). This is contrary to the requirements for the training offered in the UK, where radiographers are required to record five observations and 20 independent IVCM administrations (The College of Radiographers 2011: 9-10). The results from this study support the UK practice standards and can be considered to be significant as the UK is one of the first countries to have successfully implemented and more importantly, maintained this extended form of practice for radiographers to administer IVCM (Cowling 2008: 29).

With regard to seeking assistance when placing the needle, the results of this study supported the practice standards recommended by the University of

Malta which states that the radiographer must seek assistance after any two successive failed attempts at placing a needle (University of Malta, Department of Radiography 2010: 12). This is important as the incorrect placement of a needle may encourage complications such as the extravasation of CM into the surrounding soft tissue. Extravasation is painful and should be prevented at all times when administering IVCM (Chew 2010: 81; The Irish Institute of Radiography and Radiation Therapy 2007: 9). It is, therefore, imperative that patients should not be subjected to numerous failed attempts. The number of failed attempts may be an indication of the clinical competence of the individual placing the needle so it is important that he/she receive adequate training.

The majority of respondents in this research study were in agreement that patient preparation, management and aftercare for the administration of IVCM should be included as part of the clinical and practical training. According to Singh and Daftary (2008: 71–74), proper patient care is essential in examinations where IVCM is being administered. The IVCM administration protocol compiled by the Queensland Department of Health (2013: 4) in Australia recommends that the patient remain in the department for a minimum of 15 minutes after the examination to rule out the possibility of complications and adverse reactions that may occur. This is an important aspect when applying patient aftercare. The current research study, however, did not investigate the minimum time for a patient to remain in the department after the administration of IVCM. Adverse reactions to IVCM may vary from mild (nausea and vomiting) to moderate (tachycardia or bradycardia) and severe (death) (Robbins and Pozniak 2010: 4; Rawson and Pelletier 2013: 314; Lightfoot *et al.* 2009: 692). According to statistics, soft tissue CM extravasations, which can also be classified under the mild category, occur in 0.3 to 0.6 percent of all patients receiving IVCM (Hesley and Hartman 2008:

24). It is, therefore, important that those individuals administering IVCM receive the necessary training to prevent the possibility of both acute and delayed reactions.

This study found that practical training on infection control measures and precautions should be included in the further training in addition to the theoretical training thereof. Infection control is also considered as an area which requires competency for Canadian radiographers before receiving the enhanced practice certificate in intravenous injection of CM (OMARS 2010). The Irish Institute of Radiography and Radiation Therapy (2007: 7) emphasizes the importance of adequate hand washing techniques, the wearing of gloves whilst placing the needle and administering the IVCM as well as covering cuts and abrasions to prevent the cross contamination of body fluids.

The large majority of respondents from this study strongly agreed with the inclusion of practical training for CPR and BLS. Practical training for CPR is included in the course contents for radiographers in Europe, Australia, New Zealand, the UK and Canada (University of Malta, Department of Radiography 2010: 9; The Royal Australian and New Zealand College of Radiologists 2016: 24; OAMRS 2010). This is further supported in a local study by Koch (2014: 28), who states that the possibility of complications and adverse reactions can occur at any given time or place and without prior warning signs and symptoms, especially during specialized examinations that require the use of IVCM. It is, therefore, essential that the individual administering IVCM should be able to respond and assist by performing CPR and BLS should the need arise.

Practical training on the administration of emergency medicines and drugs was found to be another important component for further training. Although the respondents in this study agreed on the inclusion of practical training on the administration of emergency medicines they also agreed that radiologists should remain responsible for treating the complications and adverse reactions that may occur. In view of this, it is safe to assume that the radiologists would prefer the radiographers to be knowledgeable in this area so as to assist them during emergency situations rather than administer the emergency medicines and drugs. According to the Health Professions Act no. 56 of 1974, radiographers are responsible for assisting medical doctors in terms of medicine control (HPCSA 1997: 2). This excludes radiographers from administering IVCM, however, it should be noted that the term ‘assist’ is ambiguous and open to different interpretations. It is important for the individual administering the contrast medium to be clinically competent to do so in order to minimize the possibility of complications and adverse reactions that may lead to the death of a patient. It is for this reason that the radiologists in SA recommend that radiographers be formally trained to administer IVCM before attempting to do so independently (RSSA 2011: 2; Tuft 2016: 7).

The majority of the respondents were in agreement that a record of 40 observational hours should be recorded for contrasted studies in a record of clinical competencies. It was recommended by the expert focus group of this study to include this question in the research tool. This can be considered a unique finding, as there are no international training requirements for recording observational hours pertaining to contrasted studies.

In summary, this research study found that the following practical and clinical competencies should be considered and included as part of the further training for radiographers to administer IVCM:

- A minimum of: 10 observations of needle placements and a record of 20 unassisted, independent needle placements.
- A minimum of: 20 observations of IVCM administrations and a record of 20 unassisted, independent IVCM administrations.
- Proper patient preparation, management and aftercare pertaining to IVCM administrations.
- Practical training on infection control measures.
- Practical training in CPR and BLS.
- Practical training on the administration of emergency medicines and drugs.
- A minimum of 40 hours observation of contrast studies.

5.6 Objective 3: To determine the medico legal responsibilities related to the administration of intravenous contrast media

This research study has identified specific medico legal study units for inclusion in the further training. The study of basic medical law, basic patient rights and ethics as well as the rights and responsibilities of a health care professional, QA, cultural diversity as well as patient management and communication were agreed on by the majority of respondents as being important for inclusion in the further training. This is in keeping with the recommendation made in the 2014/2015 annual report from the president of the HPCSA, stating that all health professionals' training should include the study of medical law, human rights and ethics (Mokgokong 2015: 6) and it is for this reason that the study of medical law, patients' rights and ethics have been included in the research tool. Adequate knowledge on these study units may prevent the possible risk of litigation.

It is important that medico legal boundaries be identified should this extended scope of practice for radiographers be approved and accredited by the HPCSA. A local study conducted by Munro *et al.* (2012: 32) noted that a large majority (98 percent) of the respondents, who were radiographers, felt that malpractice insurance is essential should the administration of IVCM be included in their future scope of practice. This may be due to the possible risk of litigation. No literature was found pertaining to litigation against radiographers administering IVCM, however, literature does suggest that criminal charges against radiologists are well documented pertaining to the administration of IVCM (Eisenberg and Berlin 2002: 332).

This study further found that the study of medical policies and procedural protocols is not considered to be important for inclusion in the further training. The international training offered to radiographers does not seem to include an independent study unit for medico legal aspects or assessment, however, the study of medico legal issues and legislation as well as the written schemes of work and protocols are included in the theoretical training for radiographers in the UK (The College of Radiographers 2011: 7). No other literature pertaining to international training guidelines has included this.

The research tool used in this study did not include the option for record keeping as a study unit and none of the respondents recommended any additional medico legal study units for this. Radiographers in Australia, however, are expected to record the name of the radiographer who administered the contrast medium, the site of IV access as well as the type and dose of the contrast medium used in the patient's medical records (Queensland Department of Health 2013: 4). This supports the fact that accurate record keeping is critical. In a booklet issued by the HPCSA (2008b: 6) titled 'Guidelines on the keeping of patient records' it is considered

compulsory by South African law that the type and dose of medicines/substances administered to a patient be recorded. It is the opinion of the researcher that record keeping should be embedded in content of the further training. It is important to note that this research study identified the possible study units for inclusion in the further training and not the specific content pertaining to each of the study units. The results of this research study should therefore be used only as a framework for further curriculum development.

In addition to the medico legal study units above, areas of responsibility associated with the task of administering IVCM were also identified. This study found that the radiographer should be responsible for obtaining consent from the patient. Radiographers practicing in the USA, Canada and Ireland are also responsible for obtaining informed consent from the patient prior to the examination (OMARS 2010, The Irish Institute of Radiography and Radiation Therapy 2007: 5). The results from this research study were therefore in keeping with the USA, Canada and Ireland. In contrast to this, however, in Australia, it is the responsibility of the radiologists to obtain consent from the patient. These radiologists may delegate this responsibility to the radiographer, but the overall responsibility remains that of the radiologist (Queensland Department of Health 2013: 2-3). The Royal College of Radiologists (2010: 7) in the UK recommend that informed consent should be obtained by the individual administering the contrast medium and that this individual should also be responsible for identifying the possibility of contraindications for the administration of IVCM. This is in keeping with the results of this research study should the radiographers in SA be legally allowed to administer the IVCM. It is important to consider and identify the legal implications for the South African radiographers should the

administration of IVCM become a part of their legal scope of practice in order to protect them from litigation.

The responsibility for deciding on the type and dose of CM to be used, according to the results of this study, should remain that of the radiologists. Similarly, radiographers practicing in Australia are not permitted to decide on the type and dose of IVCM because CM falls under the prescribing of drugs (Queensland Department of Health 2013: 2). In addition, it is the responsibility of the radiographer to compare and check the type and dose of the contrast medium with the departmental protocol before administering it (Queensland Department of Health 2013: 3). The respondents in the current research study were in agreement with the Australian practice standards regarding the type and dose of CM to be used. No international guidelines or recommendations were found regarding whose responsibility it should be to decide on the site of IVCM administration. This study, however, indicated that it should be the responsibility of the radiographer to make this decision.

This study found that the radiologists should remain responsible for the treatment and management of the complications and adverse reactions due to IVCM. Radiologists in the UK and Australia are also responsible for managing the possible reactions and complications due to the administration of IVCM (Munro *et al.* 2012: 32; Queensland Department of Health 2013: 2). The current research study is in agreement with this practice from the UK and Australia. A high level of agreement (> 75 percent) was noted amongst the study respondents in this regard. In view of this, the risk of litigation for the radiographer may be considerably lower compared to the radiologist.

In summary, this research study found that the following medico legal study units should be included as part of the further training for radiographers to administer IVCM:

- Basic medical law, basic patient rights and ethics.
- The rights and responsibilities of a healthcare professional.
- QA pertaining to the administration of IVCM.
- Cultural diversity.
- Patient management and communication.

In addition to the medico legal study units, the following medico legal responsibilities have been identified should the administration of IVCM be included in the radiographer's future scope of practice:

- The radiographer should be responsible for obtaining patient consent.
- The radiologists should remain responsible for deciding on the type and dose of CM to be used.
- The radiographer should be responsible for deciding on the site of IVCM administration.
- The radiologists should remain responsible for the overall wellbeing of the patient, i.e. managing the possible complications and adverse reactions.

5.7 Recommendations for assessment

The findings of this study indicated that three compulsory assessments be conducted. These should include a theoretical and clinical assessment as well as a record of clinical competencies. In contrast to this, the training offered in Europe at the University of Malta includes two assessments only, a theoretical and clinical assessment (University of Malta, Department of Radiography 2010: 5). According to Dikli (2013: 13), assessments are conducted to evaluate the growth and overall performance of a student. In

context of this research study, the three assessments should be conducted to evaluate the theoretical and clinical competence of those radiographers completing the necessary training to be able to legally administer IVCM.

The majority of respondents from this study recommend that each of the three assessments should carry a weighting of 0.25 towards the final course mark. The three assessments together would compute to a composite weighting of 0.75. No additional areas of assessment were identified amongst the respondents. This may, however, be a limitation of the research tool as the respondents were provided with a list of three options for assessment only. According to Wolf and Stevens (2007: 6) assessments are weighted in terms of importance and value, thus an assumption could be made that the respondents felt that these three assessments are of equal importance and value in the training of South African radiographers to administer IVCM regardless of how many assessments there are. The theoretical assessment at the University of Malta constitutes a 0.60 weighting towards the course mark and the clinical assessment 0.40 (University of Malta, Department of Radiography 2010: 5).

Radiographers in Canada are required to complete an annual competency (clinical) assessment after their training to ensure that they remain competent in the practice of IVCM administration (OMARS 2010). This, however, requires further investigation in the South African context, as the research tool used for this study did not include any statements or questions pertaining to an annual competency assessment.

5.8 Limitations of the study

- The target population included only those radiologists currently residing and practicing in KZN and not the whole of SA. This could be seen as a limiting factor as the study was aimed at identifying the training requirements that could be implemented nationally.
- The majority of responses came from private sector radiologists indicating that their perception of the necessary training guidelines may have outweighed that of the public sector radiologists.
- The research tool did not allow the respondents to indicate any additional areas of assessment.
- The need for an annual clinical competency assessment was not addressed and needs further investigation. It is important that those radiographers who successfully complete the further training remain competent in performing this extended task.

5.9 Strengths of the study

- This research study is the first of its kind in SA where the training requirements for radiographers to administer IVCM have been investigated thereby providing local scientific evidence.
- This research study obtained input from qualified radiologists who have already been trained for IVCM administration as opposed to other local studies that have been limited to the opinions of radiographers.

5.10 Summary

Although the results obtained from the current research study are aligned with the majority of the international training guidelines, additional study units and

practical/clinical competencies have been identified and expanded on. The level and duration of the training of radiographers to administer IVCM can only be determined once it has been approved and accredited by the statutory body for Radiography, i.e the HPCSA. It is only after further training has been approved and offered by HE institutions that the South African radiographer will be able to expand his/her professional scope of practice and consequently meet the needs of the current healthcare system.

CHAPTER 6
CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

Guidelines for inclusion in the further training of radiographers to administer IVCM have been identified during this study to support the challenges faced within the local healthcare system and service delivery. The components suggested include various theoretical, clinical and practical as well as medico legal training required by radiographers to administer IVCM, as highlighted below.

6.2 Theoretical components

- Basic anatomy, physiology and pathology of the cardiovascular, urinary, nervous and respiratory systems as well as that of the upper and lower limbs.
- The pharmacology of IVCM.
- The preparation of IVCM for administration.
- Types and doses of IVCM for administration to adult and pediatric patients.
- The clinical and biomedical indications and contraindications of IVCM.
- Accessories required for IVCM administrations.
- Technique/s associated with needle placements.
- Methods for maintaining IV access.
- Infection control measures and precautions before, during and after IVCM administration.

- The possible complications and adverse reactions to IVCM including the severity thereof.
- The treatment and management of IVCM complications and adverse reactions according to their severity.
- Theoretical training on CPR and BLS.
- The pharmacology of emergency medicines and drugs.
- The administration of emergency medicines and drugs.

6.3 Clinical and practical components

- A minimum of: 10 observations of needle placements and a record of 20 unassisted, independent needle placements.
- A minimum of: 20 observations of IVCM administrations and a record of 20 unassisted, independent IVCM administrations.
- Proper patient preparation, management and aftercare pertaining to IVCM administrations.
- Practical training on infection control measures.
- Practical training for CPR and BLS.
- Practical training on the administration of emergency medicines and drugs.
- A minimum of 40 hours observation of contrast studies.

6.4 Medico legal components

- Basic medical law, basic patient rights and ethics.
- The rights and responsibilities of a healthcare professional.
- QA pertaining to the administration of IVCM.
- Cultural diversity.
- Patient management and communication.

In addition to the medico legal study units, the following medico legal responsibilities have been identified should the administration of IVCM be included in the radiographer's future scope of practice:

- The radiographer should be responsible for obtaining patient consent.
- The radiologists should remain responsible for deciding on the type and dose of CM to be used.
- The radiographer should be responsible for deciding on the site of IVCM administration.
- The radiologists should remain responsible for the overall wellbeing of the patient, i.e. managing the possible complications and adverse reactions.

6.5 Recommendations for assessments

- A theoretical assessment weighted at 0.25 – i.e. 25 percent of the final mark for the course.
- A clinical assessment weighted at 0.25 – i.e. 25 percent of the final mark for the course.
- A record of clinical competencies weighted at 0.25 – i.e. 25 percent of the final mark for the course.

It has been noted that the proposed assessments, together, carry a weighting of 0.75. As discussed previously, this may be a limitation of the research tool. The equal weightings of the assessments, however, are significant and could, therefore, make up the final mark for the course. The need for an additional assessment to make up a 1.00 weighting, if deemed necessary by the relevant stakeholders, would need further investigation.

6.6 Recommendations for future studies

- The research tool used for collecting the data is not content specific as it included only the main headings of the study units. The content required for the proposed study units needs further investigation and input from local stakeholders (i.e. those HE institutions offering training in Radiography).
- This study can be repeated on a national scale to include all the radiologists currently practicing and residing in SA. This will identify training guidelines that meet national needs.

6.7 Summary

This study, in providing key data for the development of training guidelines for radiographers to administer IVCM, demonstrates the importance of HE and training in addressing the transformation of health care services with particular reference to professional scopes of practice. Furthermore, it reinforces the need for local research that will inform HE and training and hence a scope of practice that meets local healthcare needs in SA.

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APPENDIX A: LETTER OF CONFIDENTIALITY

Dear participant,

Thank you for agreeing to be a participant in the focus group that will review and evaluate the research study questionnaire. It is important that the contents of the questionnaire are not discussed outside of the focus group. I therefore request your cooperation in signing this letter of confidentiality.

Title of the Research Study:
Knowledge, clinical competencies and medico legal responsibilities required for the administration of intravenous contrast media by radiographers.

Principal Investigator/ Researcher:
Full names and surname : Gerhardus George Visser Koch

Co-Investigator/s/ Supervisor/s:
1. Full names and surname : Lynda Dawn Swindon (Supervisor)
2. Full names and surname : Julian David Pillay (Co- supervisor)

Participation is entirely voluntary and you may withdraw from participating at any time. Although you will not receive any form of remuneration for participating in this study, we value your input and assure you that all information provided will remain anonymous at all times.

Yours faithfully,

Mr. GGV Koch
Principal researcher

By placing your signature below, you confirm agreement to the following:

- I shall not discuss the content of this research study/ questionnaire with anyone other than the researcher, supervisor, co- supervisor and the statistical advisor.

_____	_____	_____
Name and Surname *(Focus Group Member)*	Date	Signature
_____	_____	_____
Name and Surname *(Witness)*	Date	Signature

APPENDIX B: ORIGINAL RESEARCH TOOL

This questionnaire consists of statements and questions relating to the administration of intravenous contrast media (IVCM). Responses will be used to contribute towards the training guidelines for diagnostic radiographers in South Africa to administer contrast media. **Your responses will remain anonymous at all times. Participation is voluntary. By completing this questionnaire, you are providing consent to participation.** Thank you for your participation, your contribution is highly appreciated.

If you have already completed this questionnaire/ online survey, please indicate so below by placing an "X" in the block that best describes your answer and kindly return it to the researcher.

I have already completed and returned a hard copy of this questionnaire.		**I have already completed the online survey that I received via email.**	

INSTRUCTION/S:

Please answer all of the following questions/statements by placing an "X" in the block that best describes your answer and write the answer when requested to specify and/ or explain.

SECTION A: BIOGRAPHICAL INFORMATION

1. Gender	Male	Female

2. Age (please specify)	

3. Are you currently registered with the HPCSA?	Yes	No

4. In which year did you qualify as a radiologist? Please specify.	

5. In which country did you qualify as a radiologist? Please specify.	

SECTION B: WORK EXPERIENCE AND CURRENT EMPLOYMENT

6. How many years of experience do you have as a qualified, practicing radiologist? Please specify.	

7. Current employment sector	Public	Private	Both	Retired

8. Type of institution	Tertiary Hospital	Regional Hospital	District Hospital	Private Practice	Not Applicable

9. Classification of employment	Urban	Rural	Mix

<u>SECTION C:</u> KNOWLEDGE (THEORETICAL) COMPONENT FOR FURTHER TRAINING

The following statements include possible study units for theoretical training. Do you think the following training units need to be included as part of the theoretical training for radiographers?

Section C1: Anatomy

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
10. Basic anatomy of the cardiovascular system.	1	2	3	4	5
11. Advanced anatomy of the cardiovascular system.	1	2	3	4	5
12. Basic anatomy of the urinary system.	1	2	3	4	5
13. Advanced anatomy of the urinary system.	1	2	3	4	5
14. Basic anatomy of the upper limb.	1	2	3	4	5
15. Advanced anatomy of the upper limb.	1	2	3	4	5
16. Basic anatomy of the lower limb.	1	2	3	4	5
17. Advanced anatomy of the lower limb.	1	2	3	4	5

18. Are there any additional areas of anatomy to be included for the training of radiographers? Please explain your answer.

_____

_____

Section C2: Physiology

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
19. Basic physiology of the cardiovascular system.	1	2	3	4	5
20. Advanced physiology of the cardiovascular system.	1	2	3	4	5
21. Basic physiology of the	1	2	3	4	5

urinary system.					
22. Advanced physiology of the urinary system.	1	2	3	4	5
23. Basic physiology of the upper limb.	1	2	3	4	5
24. Advanced physiology of the upper limb.	1	2	3	4	5
25. Basic physiology of the lower limb.	1	2	3	4	5
26. Advanced physiology of the lower limb.	1	2	3	4	5

27. Are there any additional areas of physiology to be included for the training of radiographers? Please explain your answer.

_____

_____

Section C3: Pathology

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
28. Basic pathology of the cardiovascular system.	1	2	3	4	5
29. Advanced pathology of the cardiovascular system.	1	2	3	4	5
30. Basic pathology of the urinary system.	1	2	3	4	5
31. Advanced pathology of the urinary system.	1	2	3	4	5
32. Basic pathology of the upper limb.	1	2	3	4	5
33. Advanced pathology of the upper limb.	1	2	3	4	5
34. Basic pathology of the lower limb.	1	2	3	4	5
35. Advanced pathology of the lower limb.	1	2	3	4	5

36. Are there any additional areas of pathology to be included for the training of radiographers? Please explain your answer.

_____

_____

Section C4: Neurology

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
37. Basic neurology of the cardiovascular system.	1	2	3	4	5
38. Advanced neurology of the cardiovascular system.	1	2	3	4	5
39. Basic neurology of the urinary system.	1	2	3	4	5
40. Advanced neurology of the urinary system.	1	2	3	4	5
41. Basic neurology of the upper limb.	1	2	3	4	5
42. Advanced neurology of the upper limb.	1	2	3	4	5
43. Basic neurology of the lower limb.	1	2	3	4	5
44. Advanced neurology of the lower limb.	1	2	3	4	5

45. Are there any additional areas of neurology to be included for the training of radiographers? Please explain your answer.

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Section C5: Contrast media and possible reactions (IV CM = Intravenous Contrast Media)

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
46. Principles, types and composition of IV CM (Pharmacology).	1	2	3	4	5
47. The preparation of IV CM used in the field of Diagnostic Radiology.	1	2	3	4	5
48. Differences between the type and dose administered for adult- and pediatric patients.	1	2	3	4	5
49. Indications and contra-indications for the use of IV CM.	1	2	3	4	5
50. Different types of needles and accessories required to administer IV CM.	1	2	3	4	5
51. Different techniques for	1	2	3	4	5

needle placements.					
52. Methods on how to maintain IV access.	1	2	3	4	5
53. Infection control measures and precautions during, before and after administration.	1	2	3	4	5
54. Possible complications and/ or reactions to IV CM including the severity of the complications and/ or reactions.	1	2	3	4	5
55. Treatment for complications and/ or reactions to IV CM based on their severity.	1	2	3	4	5

56. Are there any additional areas of contrast media and possible reactions to be included for the training of radiographers? Please explain your answer.

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Section C6: Cardiopulmonary resuscitation (CPR), Basic- Life- Support (BLS) and emergency medicines/ -drugs

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
57. Theoretical training on CPR.	1	2	3	4	5
58. Theoretical training on BLS.	1	2	3	4	5
59. Theoretical training on the pharmacology of emergency medicines and basic drugs for the management of adverse reactions.	1	2	3	4	5
60. The theory of administration of emergency medicines/ drugs.	1	2	3	4	5

61. Are there any additional areas of CPR, BLS and/or emergency medicines/-drugs to be included for the training of radiographers? Please explain your answer.

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Section C7: Theoretical assessment

62. A theory assessment must be conducted towards the end of the training including all of the theoretical study units.	Yes		Not sure	No	
63. If you answered "Yes" for statement number 62 above, kindly indicate the weighting that this assessment should have towards the final mark.	25%	50%	75%	100%	Other

64. If you answered "Other" in statement number 63 above, please provide an explanation.

_____

_____

SECTION D: CLINICAL COMPETENCY COMPONENT FOR FURTHER TRAINING

The following statements include possible study units for clinical training. This includes the practical aspect which refers to the practice without a patient as opposed to clinical training which involves the physical practice on a patient. Do you think the following should be included in the practical/clinical training for radiographers? Please specify your answer where applicable.

Section D1: Technique

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
65. There should be an observation of a minimum number of needle placements before the student attempts to perform this unassisted.	1	2	3	4	5
If you answered "Agree" or "Strongly Agree" in statement 65 above, please specify the minimum number of observations for needle placements.					

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
66. There should be an observation of a minimum number of IV CM administrations before the student attempts to perform this unassisted.	1	2	3	4	5
If you answered "Agree" or "Strongly Agree" in statement 66 above, please specify the minimum number of observations for IV CM administrations.					

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
67. There should be a record of a minimum number of IV needle placements that the student has performed unassisted and successfully before being considered competent.	1	2	3	4	5
If you answered "Agree" or "Strongly Agree" in statement 67 above, please specify the minimum number of IV needle placements to be recorded.					

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
68. There should be a record in a log book of a minimum number of IV CM administrations that the student has performed unassisted and successfully before being considered competent.	1	2	3	4	5
If you answered "Agree" or "Strongly Agree" in statement 68 above, please specify the minimum number of IV CM administrations to be recorded in a log book.					

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
69. The student must seek assistance after a certain number of failed attempts to administer the IV CM.	1	2	3	4	5
If you answered "Agree" or "Strongly Agree" in statement 69 above, please specify the number of failed attempts after which the student should seek assistance.					

Section D2: Clinical/ Practical

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
70. Proper patient preparation, management and aftercare must be demonstrated.	1	2	3	4	5
71. Infection control measures and precautions must be	1	2	3	4	5

demonstrated.					
72. Practical training on CPR.	1	2	3	4	5
73. Practical training on BLS.	1	2	3	4	5
74. Practical training on the administration of emergency medicines/drugs.	1	2	3	4	5

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
75. There should be a record of a minimum number of recorded hours that the student has observed for contrasted studies.	1	2	3	4	5
If you answered "Yes" in statement 75 above, please specify the minimum number of observational reporting hours to be recorded.					

76. Are there any additional clinical/practical areas to be included for the training of radiographers? Please explain your answer.

_____

_____

Section D3: Clinical/ Practical assessment

77. A record of clinical competencies should be used as an assessment.	Yes		Not sure		No
78. If you answered "Yes" for statement number 77 above, kindly indicate the weighting that this assessment should have towards the final mark.	25%	50%	75%	100%	Other

79. If you answered "Other" in statement number 78 above, please provide an explanation.

_____

_____

80. A clinical assessment must be conducted towards the end of the training to include all of the necessary competencies.	Yes		Not sure		No
81. If you answered "Yes" for statement number 80 above, kindly indicate the weighting that this assessment should have towards the final mark.	25%	50%	75%	100%	Other

82. If you answered “Other” in statement number 81 above, please provide an explanation.

_____

_____

<u>SECTION E:</u> MEDICO LEGAL RESPONSIBILITIES AND TRAINING

The following statement/s and/or question/s relates to the medico legal responsibilities and training for the administration of IV CM.

83. Who should be responsible for obtaining the consent from the patient?	Radiographer	Radiologist	Other
If you answered “Other” in question 83 above, please specify who should be responsible.			

84. Who should be responsible for deciding the type of CM to be used and the dose?	Radiographer	Radiologist	Other
If you answered “Other” in question 84 above, please specify who should be responsible.			

85. Who should be responsible for deciding the method of administration for IV CM?	Radiographer	Radiologist	Other
If you answered “Other” in question 85 above, please specify who should be responsible.			

86. Who should ultimately be held responsible for the patient and the possible reactions to CM?	Radiographer	Radiologist	Other
If you answered “Other” in question 86 above, please specify who should be responsible.			

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
87. The study of basic medical law must be included as part of the training.	1	2	3	4	5
88. The study of advanced medical law must be included as part of the training.	1	2	3	4	5
89. The study of basic patient rights and ethics must be included as part of the training.	1	2	3	4	5

90. The study of advanced patient rights and ethics must be included as part of the training.	1	2	3	4	5
91. The study of the rights and responsibilities of a health care professional.	1	2	3	4	5
92. The study of writing and designing medical policies and procedure protocols.	1	2	3	4	5
93. The study of departmental organisation and rules.	1	2	3	4	5
94. The study of quality management and assurance relating to the administration of IV CM.	1	2	3	4	5
95. The study of cultural diversity issues in the medical environment.	1	2	3	4	5
96. The study of patient management and communication.	1	2	3	4	5

97. Are there any additional medico legal responsibilities or training to be included for the training of radiographers? Please explain your answer.

_____

_____

Thank you for participating in this research study. Your contribution and opinions are highly appreciated. If you have any further comments and/or recommendations, please do so in the space provided below:

_____

_____

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Any additional comments and enquiries can also be addressed directly to the researcher and supervisor at the following contact information:

	Researcher (Mr. G.G.V. Koch)	**Supervisor (Mrs. L.D. Swindon)**
Cell number	071 868 4079	072 268 4355
Email address	erhardkoch9@gmail.com	lyndas@dut.ac.za

Yours sincerely,

Gerhardus George Visser Koch

Principal researcher

APPENDIX C: AMENDED (FINAL) RESEARCH TOOL

This questionnaire consists of statements and questions relating to the administration of intravenous contrast media (IVCM). Responses will be used to contribute towards the training guidelines for radiographers in South Africa to administer contrast media. The questionnaire consists of five (5) sections which will include biographical information, work experience and current employment, a theoretical (knowledge component), a clinical competency component as well as medico legal responsibilities and training. **Your responses will remain anonymous at all times. Participation is voluntary. By completing this questionnaire, you are providing consent to participation.** Thank you for your participation, your contribution is highly appreciated.

If you have already completed this questionnaire/online survey, please indicate so below by placing an "X" in the block that best describes your answer and kindly return it to the researcher.

I have already completed and returned a hard copy of this questionnaire.		**I have already completed the online survey that I received via email.**	

INSTRUCTION/S:

Please answer all of the following questions/statements by placing an "X" in the block that best describes your answer and write the answer when requested to specify and/or explain.

SECTION A: BIOGRAPHICAL INFORMATION

1. Gender	Male	Female
2. Age		
3. Are you **currently** registered with the HPCSA?	Yes	No
4. In which year did you qualify as a radiologist?		
5. In which country did you qualify as a radiologist?		

SECTION B: WORK EXPERIENCE AND CURRENT EMPLOYMENT

6. How many years of experience do you have as a qualified, practicing radiologist?					
7. Current employment sector	Public		Private	Both	Retired
8. Type of institution	Quaternary/ Tertiary Hospital	Regional Hospital	District Hospital	Private Practice	Other
9. Please specify if you have selected "Other" in statement number 8 above.					

10. Classification of employment	Urban	Rural	Mix

SECTION C: KNOWLEDGE (THEORETICAL) COMPONENT FOR FURTHER TRAINING

The following statements include possible study units for the THEORETICAL ASPECT OF THE TRAINING. Do you think the following need to be included for the training for radiographers?

Section C1: Anatomy

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
11. Basic anatomy of the cardiovascular system.	1	2	3	4	5
12. Advanced anatomy of the cardiovascular system.	1	2	3	4	5
13. Basic anatomy of the urinary system.	1	2	3	4	5
14. Advanced anatomy of the urinary system.	1	2	3	4	5
15. Basic anatomy of the upper limb.	1	2	3	4	5
16. Advanced anatomy of the upper limb.	1	2	3	4	5
17. Basic anatomy of the lower limb.	1	2	3	4	5
18. Advanced anatomy of the lower limb.	1	2	3	4	5
19. Basic anatomy of the nervous system.	1	2	3	4	5
20. Advanced anatomy of the nervous system.	1	2	3	4	5

21. Are there any additional areas of anatomy to be included for the training of radiographers? Please explain your answer.

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Section C2: Physiology

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
22. Basic physiology of the cardiovascular system.	1	2	3	4	5
23. Advanced physiology of the cardiovascular system.	1	2	3	4	5

24. Basic physiology of the urinary system.	1	2	3	4	5
25. Advanced physiology of the urinary system.	1	2	3	4	5
26. Basic physiology of the upper limb.	1	2	3	4	5
27. Advanced physiology of the upper limb.	1	2	3	4	5
28. Basic physiology of the lower limb.	1	2	3	4	5
29. Advanced physiology of the lower limb.	1	2	3	4	5
30. Basic physiology of the nervous system.	1	2	3	4	5
31. Advanced physiology of the nervous system.	1	2	3	4	5

32. Are there any additional areas of physiology to be included for the training of radiographers? Please explain your answer.

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Section C3: Pathology

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
33. Basic pathology of the cardiovascular system.	1	2	3	4	5
34. Advanced pathology of the cardiovascular system.	1	2	3	4	5
35. Basic pathology of the urinary system.	1	2	3	4	5
36. Advanced pathology of the urinary system.	1	2	3	4	5
37. Basic pathology of the upper limb.	1	2	3	4	5
38. Advanced pathology of the upper limb.	1	2	3	4	5
39. Basic pathology of the lower limb.	1	2	3	4	5
40. Advanced pathology of the lower limb.	1	2	3	4	5
41. Basic pathology of the nervous system.	1	2	3	4	5
42. Advanced pathology of the nervous system.	1	2	3	4	5

43. Are there any additional areas of pathology to be included for the training of radiographers? Please explain your answer.

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Section C4: Contrast media and possible reactions (IVCM = Intravenous Contrast Media)

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
44. Principles, types and composition of IVCM (Pharmacology).	1	2	3	4	5
45. The preparation of IVCM used in the field of Diagnostic Radiology.	1	2	3	4	5
46. Differences between the type and dose administered for adult and pediatric patients.	1	2	3	4	5
47. Clinical and biomedical indications and contraindications for the use of IVCM.	1	2	3	4	5
48. Different types of needles and accessories required to administer IVCM.	1	2	3	4	5
49. Different techniques for needle placements.	1	2	3	4	5
50. Methods on how to maintain IV access.	1	2	3	4	5
51. Infection control measures and precautions during, before and after IVCM administration.	1	2	3	4	5
52. Possible complications and reactions to IVCM including the severity of the complications and reactions.	1	2	3	4	5
53. Treatment/management for complications and reactions to IVCM based on their severity.	1	2	3	4	5

54. Are there any additional areas of contrast media and possible reactions to be included for the training of radiographers? Please explain your answer.

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Section C5: Cardiopulmonary resuscitation (CPR), Basic Life Support (BLS) and emergency medicines/drugs

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
55. Theoretical training on CPR.	1	2	3	4	5
56. Theoretical training on BLS.	1	2	3	4	5
57. Theoretical training on the pharmacology of emergency medicines and basic drugs for the management of adverse reactions.	1	2	3	4	5
58. The theory of the administration of emergency medicines/drugs.	1	2	3	4	5

59. Are there any additional areas of CPR, BLS and/or emergency medicines/drugs to be included for the training of radiographers? Please explain your answer.

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Section C6: Theoretical Assessment

60. A theory assessment must be conducted towards the end of the training including all of the theoretical study units.	Yes		Not sure	No	
61. Kindly indicate the weighting that this assessment should have towards the final mark.	25%	50%	75%	100%	Other

62. If you answered “Other” in statement number 61 above, please provide an explanation.

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SECTION D: CLINICAL COMPETENCY COMPONENT FOR FURTHER TRAINING

The following statements include possible study units for the PRACTICAL AND CLINICAL ASPECTS OF THE TRAINING. The practical aspect refers to the practice without a patient as opposed to clinical aspect which involves the physical practice on a patient. Do you think the following should be included in the practical/clinical training for radiographers? Please specify your answer where applicable.

Section D1: Techniques

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
63. There should be a recorded number for the observation of needle placements before the student attempts to perform this unassisted and under supervision.	1	2	3	4	5
64. If you answered "Agree" or "Strongly Agree" in statement 63 above, please specify the minimum number of observations for needle placements.					

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
65. There should be a recorded number of IV needle placements that the student has successfully performed unassisted and under supervision, before being considered competent.	1	2	3	4	5
66. If you answered "Agree" or "Strongly Agree" in statement 65 above, please specify the minimum number of IV needle placements to be recorded.					

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
67. There should be a recorded number for the observation of IVCM administrations before the student attempts to perform this unassisted and under supervision.	1	2	3	4	5

68. If you answered “Agree” or “Strongly Agree” in statement 67 above, please specify the minimum number of observations for IVCM administrations.	

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
69. There should be a recorded number of IVCM administrations that the student has successfully performed unassisted and under supervision, before being considered competent.	1	2	3	4	5
70. If you answered “Agree” or “Strongly Agree” in statement 69 above, please specify the minimum number of IVCM administrations to be recorded.					

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
71. The student must seek assistance after a certain number of failed attempts to administer the IVCM.	1	2	3	4	5
72. If you answered “Agree” or “Strongly Agree” in statement 71 above, please specify the number of failed attempts after which the student should seek assistance.					

Section D2: Clinical/Practical Components

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
73. Proper patient preparation, management and aftercare.	1	2	3	4	5
74. Infection control measures and precautions.	1	2	3	4	5
75. Practical training on CPR.	1	2	3	4	5
76. Practical training on BLS.	1	2	3	4	5
77. Practical training on the administration of emergency medicines/drugs.	1	2	3	4	5

	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
78. There should be a record of the hours that the student has observed for contrasted	1	2	3	4	5

studies.					
79. If you answered "Yes" in statement 78 above, please specify the minimum number for the observational hours to be recorded.					

80. Are there any additional clinical/practical areas to be included for the training of radiographers? Please explain your answer.

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Section D3: Clinical/ Practical Assessment

81. A record of clinical competencies should be used as an assessment.	Yes		No		Not sure
82. Kindly indicate the weighting that this assessment should have towards the final mark.	25%	50%	75%	100%	Other

83. If you answered "Other" in statement number 82 above, please provide an explanation.

_____

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84. A clinical assessment must be conducted towards the end of the training to include all of the necessary competencies.	Yes		No		Not sure
85. Kindly indicate the weighting that this assessment should have towards the final mark.	25%	50%	75%	100%	Other

86. If you answered "Other" in statement number 85 above, please provide an explanation.

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<u>SECTION E:</u> MEDICO LEGAL RESPONSIBILITIES AND TRAINING

The following statement/s and/or question/s relate to the MEDICO LEGAL RESPONSIBILITIES AND TRAINING for the administration of IVCM.

87. Who should be responsible for obtaining the consent from the patient?	Radiographer	Radiologist	Other
88. If you answered "Other" in question 87 above, please specify who should be responsible.			

89. Who should be responsible for determining the type and dose of the CM to be used?	Radiographer	Radiologist	Other
90. If you answered “Other” in question 89 above, please specify who should be responsible.			

91. Who should be responsible for determining the site of administration for IVCM?	Radiographer	Radiologist	Other
92. If you answered “Other” in question 91 above, please specify who should be responsible.			

93. Who should ultimately be held responsible for the patient and the possible reactions to CM?	Radiographer	Radiologist	Other
94. If you answered “Other” in question 93 above, please specify who should be responsible.			

	1 Strongly Disagree	**2 Disagree**	**3 Neutral**	**4 Agree**	**5 Strongly Agree**
95. The study of basic medical law must be included as part of the training.	1	2	3	4	5
96. The study of advanced medical law must be included as part of the training.	1	2	3	4	5
97. The study of basic patient rights and ethics must be included as part of the training.	1	2	3	4	5
98. The study of advanced patient rights and ethics must be included as part of the training.	1	2	3	4	5
99. The study of the rights and responsibilities of a health care professional must be included as part of the training.	1	2	3	4	5
100. The study of designing medical policies and procedural protocols must be included as part of the training.	1	2	3	4	5
101. The study of quality assurance relating to the administration of IVCM must be included as part	1	2	3	4	5

	of the training.					
102.	The study of cultural diversity issues in the medical environment must be included as part of the training.	1	2	3	4	5
103.	The study of patient management and communication must be included as part of the training.	1	2	3	4	5

104. Are there any additional medico legal responsibilities and training to be included for the training of radiographers? Please explain your answer.

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Thank you for participating in this research study. Your contribution and opinions are highly appreciated. If you have any further comments and/or recommendations, please do so in the space provided below:

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Any additional comments and/or enquiries can also be addressed directly to the researcher and/or supervisor at the following contact information:

	Researcher (Mr. G.G.V. Koch)	**Supervisor (Mrs. L.D. Swindon)**
Cell number	071 868 4079	072 268 4355
Email address	erhardkoch9@gmail.com	lyndas@dut.ac.za

Yours sincerely,

Gerhardus George Visser Koch

APPENDIX D: LETTER OF INFORMATION

Dear participant,

Thank you for taking the time to read this letter and for considering participating in this research study.

Title of the research study:
Knowledge, skills and medico legal responsibilities required for the administration of intravenous contrast media by radiographers.

Principal investigator/s/ researcher:

Full names and surname	:	Gerhardus George Visser Koch (erhardkoch9@gmail.com)
Qualifications	:	B.Tech in Radiography (D) (CUT)
	:	National Diploma in Radiography (D) (CPUT)

Co-investigator/s/ supervisor/s:

3.	Full names and surname	:	Lynda Dawn Swindon (lyndas@dut.ac.za)
	Qualifications	:	M. Ed (HE) (UKZN)
		:	B.Tech Radiography (D) (Natal Technikon)
4.	Full names and surname	:	Julian David Pillay (pillayjd@dut.ac.za)
	Qualifications	:	PhD: Physiology (UCT)

Brief introduction and purpose of the study:
The administration of contrast media by radiographers in South Africa (SA) has been debated for a number of years and is one of the key areas for their professional role extension. To date, the administration of intravenous contrast media is not within the professional scope of practice of the South African radiographer, but is included in the scope of practice of radiologists in SA. It is for this reason that your input in this research study will be particularly valuable. The professional scope of practice of the South African radiographer is currently under review and new qualifications are being implemented where training will be required for radiographers in order to administer contrast media. This research study hopes to make a recommendation for the training.

Outline of the procedures:
You will be requested to complete a once-off questionnaire which will take approximately twenty (20) minutes. The questionnaire consists of a series of questions and statements regarding the knowledge, skills and medico legal responsibilities required in order to administer intravenous contrast media competently and safely. The outcome of this study will provide key data for the development of relevant and appropriate training guidelines for radiographers in SA in order to administer contrast. The study will include all qualified radiologists who are registered with the Health Professions Council of South Africa

(HPCSA) and who are currently practicing in the public or private sectors within the province of Kwa Zulu Natal (KZN).

Risks or discomforts to the participant:
This research study is a questionnaire-based study and therefore poses no anticipated risks or discomfort to the participant of any kind. Questionnaires will be anonymous.

Benefits:
You will contribute to the development of training guidelines for the South African diagnostic radiographer in terms of administering intravenous contrast media. It is important to bear in mind that the diagnostic radiographer and radiologist, together, form a vital part of the radiology team as well as service delivery. Benefits for the researchers may include a publication and/ or presentation of the results at a seminar/ congress/ academic journal.

Withdrawal from the study:
You may withdraw from the research study at any given time without penalty/ consequence.

Remuneration:
You will not receive any form of remuneration for your participation in this research study.

Costs of the study:
You will not be liable for any financial contribution/s towards this research study.

Confidentiality:
The information provided by you will be treated as highly confidential and will remain anonymous at all times. You will not be required to include your name or any identifiable details when completing the questionnaire. Data records may be inspected for data analysis by relevant Ethics Committees.

Persons to contact in the event of any problems or queries:
You may contact the researcher, Mr. Gerhardus Koch (031- 373 3055/ 071 868 4079) or the study supervisors, Mrs. Lynda Swindon (031- 373 2508/ 072 268 4355) and Dr. Julian Pillay (031- 373 2398/ 082 6039 111). You may also contact the Institutional Research Ethics administrator on 031-373 2900.

Complaints can be reported to the DVC: TIP, Prof F. Otieno on 031- 373 2382 or dvctip@dut.ac.za.

Yours faithfully,
Mr. GGV Koch
(Principal researcher)

APPENDIX E: LETTER OF INFORMED CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Mr. Gerhardus Koch about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: **REC 18/15**.
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth and initials will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

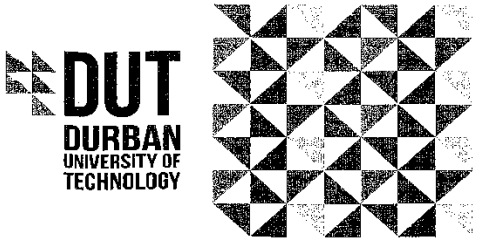
_____	_____	_____	_____
Full Name of Participant	**Date**	**Time**	**Signature**

I, Mr. Gerhardus Koch, herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the proposed research study.

_____	_____	_____
Full Name of Researcher	**Date**	**Signature**

_____	_____	_____
Full Name of Witness (If applicable)	**Date**	**Signature**

APPENDIX F: ETHICS APPROVAL LETTER



Institutional Research Ethics Committee
Faculty of Health Sciences
Room MS 49, Mansfield School Site
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Durban University of Technology

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www.dut.ac.za

25 May 2015

IREC Reference Number: **REC 18/15**

Mr G G V Koch
33 Silverdale
47 Madeline Road
Morningside
Durban
4001

Dear Mr Koch

Knowledge, clinical competencies and medico-legal responsibilities required for the administration of intravenous contrast media by radiographers

The Institutional Research Ethics Committee acknowledges receipt of your final data collection tool for review.

We are pleased to inform you that the questionnaire has been APPROVED; you may now proceed with data collection on the proposed project.

Kindly ensure that participants used for the pilot study are not part of the main study.

Yours Sincerely

[redacted]

Professor J K Adam
Chairperson: IREC