Training requirements for the administration of intravenous contrast media by radiographers: Radiologists' perspective

G G V Koch,[1] MHSc: Radiography (D); **L D Swindon**,[1] MEd (HE), BTech: Radiography (D); **J D Pillay**,[2] PhD (Physiology)

[1] *Department of Radiography, Faculty of Health Sciences, Durban University of Technology, South Africa*

[2] *Department of Basic Medical Sciences, Faculty of Health Sciences, Durban University of Technology, South Africa*

Corresponding author: *G G V Koch (erhardkoch9@gmail.com)*

Background. The administration of intravenous contrast media (IVCM) is one of the key areas currently under investigation for inclusion in the South African (SA) radiographers' scope of practice. However, for the radiographers to legally administer IVCM, training guidelines must first be identified, developed and accredited by the Health Professions Council of SA.

Objective. To investigate the radiologists' perspective of the knowledge, skills and medicolegal training required of radiographers for the administration of IVCM to provide input for the development of national training guidelines.

Methods. A quantitative, cross-sectional research study using an online survey, administered by SurveyMonkey, was conducted. The target population included all radiologists residing and practising in the province of KwaZulu-Natal, SA.

Results. Fifty-nine participants (60.8%) completed the online survey. Twelve were excluded owing to incomplete surveys, resulting in a final response rate of 48.5% (n=47). The study revealed that various theoretical, clinical/practical and medicolegal study units should be included in the training, i.e. the study of the pharmacology of contrast media, practical training on cardiopulmonary resuscitation and basic life support, as well as the rights and responsibilities of a healthcare professional. In addition, both theory and practical/clinical assessments need to be included.

Conclusion. Key data have been provided for the development of national training guidelines for radiographers to administer IVCM, based on scientific evidence that is relevant to the SA context. The study may be of value to other related health professions where scopes of practice are expanded through transforming the education and training curricula.

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The healthcare system is driven by rapidly advancing technologies and international trends. In view of this, healthcare needs are constantly evolving. To meet these needs, the scope of practice of healthcare professionals requires regular re-evaluation. This is achieved through transforming higher education (HE) and training and obtaining approval and accreditation from the relevant professional boards. It is important that the input for transforming HE and training and expanding the scope of practice is based on scientific evidence that has been obtained through local research. This is necessary for HE and training to be contextualised, while remaining aligned with international trends.

Radiography is a vital component in the medical field; however, the roles and responsibilities of radiographers and radiologists are often misunderstood. Radiologists are medical physicians specialised in radiology and responsible for diagnosing and managing patients, whereas radiographers are healthcare professionals responsible for producing the medical images needed by radiologists to make an accurate diagnosis.[1] Although radiographers and radiologists work in close collaboration, their roles, responsibilities and professional scopes of practice are different, and are determined by the scope of their relevant professions and training.[2]

Radiographers, globally, have significantly different scopes of practice. In Ireland, Canada and Europe they are permitted to administer intravenous contrast media (IVCM) after having completed advanced training.[3-5] IVCM can be defined as imaging agents administered to a patient during specialised radiographic investigations to enhance the visibility of the internal anatomical structures.[6] Radiographers practising in the USA may also administer IVCM after certification by either the American Registry of Radiologic Technologists (ARRT) or the American Registry of Magnetic Resonance Imaging Technologists (ARMRIT).[7] Similarly, radiographers in the UK are able to advance to the levels of 'consultant' and 'advanced practice' radiographers.[8,9] The scopes of radiographers in these countries are defined by their training, which may differ between countries.

Radiographers in South Africa (SA) have been found to perform, illegally, the task of IVCM administration, which currently falls within the scope of radiologists.[10] This practice may be motivated by the national shortage of radiologists and subsequent service delivery constraints.[11,12] In SA, the radiologist-to-patient ratio is in the region of 1:57 937.[11] Radiographers in SA are not legally permitted to administer IVCM, as no formal Health Professions Council of SA (HPCSA)-accredited training is currently offered.[13] They are, therefore, performing a criminal act and may be penalised accordingly.

Radiologists in SA have agreed in principle with the idea of having the radiographers' professional scope of practice expanded to include the administration of IVCM, provided the necessary further training is formalised and undertaken.[14] As the administration of IVCM currently falls within the legal scope of practice of radiologists, it is logical that radiologists would be able to provide valuable information in this regard. Possible advantages of role extension may include an improvement in the delivery of radiology services and the alignment of radiography with international standards.[10]

The Professional Board for Radiography and Clinical Technology (PBRCT) is currently addressing role extension for radiographers, and research studies conducted locally have identified the need for the further training of radiographers to administer IVCM.[10,12] Our research study, therefore, hopes to provide input for the HPCSA for the development of national training guidelines that are based on local scientific evidence.

Methods

Research design and study participants

A quantitative, cross-sectional survey was conducted in the province of KwaZulu-Natal (KZN), SA. The study was limited to radiologists who were registered with the HPCSA and who were practising and residing in KZN. The target population was identified by means of the HPCSA's online register, which is available to the public. In addition, the researcher identified participants by word of mouth and social media, i.e. Facebook and LinkedIn. The HPCSA register listed a total of 104 radiologists and, using a confidence level of 95%, it was found that a minimum of 87 responses were needed. However, the exact number of radiologists living and/or practising in KZN could not be determined, as some members who appear 'active' on the register could be deceased or have relocated. Therefore, as the total population was unknown, a 60% response rate was deemed to be statistically acceptable.

Sampling

A purposive (non-probability) sampling technique was used, which was selected to provide input on a distinct research topic, the administration of IVCM by radiographers. The total target population was used in an attempt to obtain the minimum response rate.

Ethical considerations

Ethical clearance for the study was obtained from the Institutional Research and Ethics Committee, Durban University of Technology (ref. no. REC 18/15). A letter of information was included in the email communication sent to the participants, providing them with an outline of the research study and stating that the results may be published in a suitable journal. Consent was assumed when participants completed the survey. No identifiable details were requested from the participants, thus ensuring confidentiality and anonymity. The participants were free to exit the survey at any time.

Research tool and data collection

An online survey administered by SurveyMonkey was used to collect data. The participants were emailed a web link for the survey and a request for participation. The survey included questions and statements relating to the knowledge, skills and medicolegal training required by radiographers to administer IVCM. The content of the survey was benchmarked against international practice standards and training requirements of the radiography profession. The questions and statements in the survey were reviewed by a focus group prior to the data collection process to ensure validity and reliability. The structure of the survey was altered to follow the practical sequence of contrast media administration, i.e. placement of aspects related to patient preparation before those related to administration of the contrast media. The focus group consisted of the authors, a radiologist and two radiographers. They were selected based on their experience in the field of this research study.

Data analysis

The data obtained from this research study were analysed using the Statistical Package for the Social Sciences (SPSS), version 23.0 (IBM Corp., USA). Descriptive and inferential statistics were applied. Factor analysis and reliability testing using Cronbach's alpha were included. Statistical significance was set at $p<0.05$.

Results

Fifty-nine participants (60.8%) completed the online survey. Twelve were excluded owing to incomplete surveys, resulting in a final response rate of 48.5% (n=47). The majority of respondents were practising in the private sector (68.1%), 98.0% had been qualified as radiologists between 0 and 29 years, the majority were males (78.7%) and more than half (51.1%) were between 40 and 49 years of age.

Agreement on knowledge components

Table 1 provides the level of agreement (represented as a percentage) among the respondents for the inclusion of the anatomy, physiology and pathology of the cardiovascular, urinary and nervous system and the upper and lower limbs.

The level of agreement was significantly high among the respondents with regard to the inclusion of basic anatomy, physiology and pathology of the cardiovascular, urinary and nervous system and the upper and lower limbs. However, the level of agreement for including the physiology component of the upper and lower limbs was lower compared with that for the inclusion of anatomy and pathology. Although the respiratory system was not included in the survey, the study respondents identified it as being necessary for inclusion in the further training. The respiratory system was considered important, based on the possibility of complications and adverse reactions occurring owing to the administration of IVCM. Therefore, it is necessary to be able to recognise the signs and symptoms associated with respiratory distress.

Table 2 provides information based on the need for further training in areas/systems related to contrast media and possible reactions.

The level of agreement related to the knowledge components of contrast media and possible reactions was >85% in all instances. The results, therefore, suggest that these components are essential for inclusion in the training requirements for radiographers to administer IVCM. In addition to the results presented in Table 2, the theory of cardiopulmonary resuscitation (CPR) and basic life support (BLS) was considered important for further training, with agreement levels of 95.74% and 100.00%, respectively. The study of the pharmacology of emergency medicines and the administration thereof, however, indicated lower levels of agreement (68.09% and 65.96%, respectively). The majority of respondents (87.20%) were of the opinion that a theoretical assessment should be conducted towards the end of the training and should contribute a minimum weighting of 0.25 towards the final mark.

Agreement on skills components

Fig. 1 presents information pertaining to the technique/s for administering IVCM.

All the skills components demonstrate a high level of agreement (95%), apart from the component related to observations of IVCM administration, which indicated an average level of agreement of 85%. Notwithstanding this, the results demonstrate high levels of agreement among the majority of

Table 1. Level of agreement on knowledge components in anatomy, physiology and pathology

Component	Level	Disagree, %	Neutral, %	Agree, %
Anatomy				
Cardiovascular system	Basic	2.13	0.00	97.87
	Advanced	38.30	42.55	19.15
Urinary system	Basic	6.38	6.38	87.23
	Advanced	36.17	34.04	29.79
Nervous system	Basic	10.64	2.13	87.23
	Advanced	48.94	29.79	21.3
Upper limb	Basic	4.26	2.13	93.62
	Advanced	25.53	38.30	36.17
Lower limb	Basic	4.26	4.26	91.49
	Advanced	31.91	44.68	23.40
Physiology				
Cardiovascular system	Basic	4.26	17.02	78.72
	Advanced	44.68	44.68	10.64
Urinary system	Basic	8.51	12.77	78.72
	Advanced	46.81	38.30	14.89
Nervous system	Basic	10.64	19.15	70.21
	Advanced	53.19	38.30	8.51
Upper limb	Basic	12.77	21.28	65.96
	Advanced	53.19	38.30	8.51
Lower limb	Basic	12.77	25.53	61.70
	Advanced	53.19	42.55	4.26
Pathology				
Cardiovascular system	Basic	6.38	10.64	82.98
	Advanced	53.19	42.55	4.26
Urinary system	Basic	8.51	6.38	85.11
	Advanced	48.94	36.17	14.89
Nervous system	Basic	8.51	4.26	87.23
	Advanced	53.19	34.04	12.77
Upper limb	Basic	6.38	10.64	82.98
	Advanced	55.32	34.04	10.64
Lower limb	Basic	6.38	10.64	82.98
	Advanced	57.45	38.30	4.26

Table 2. Level of agreement on knowledge components in contrast media and possible reactions

Study unit	Disagree, %	Neutral, %	Agree, %
Pharmacology	2.13	2.13	95.74
Preparation	4.26	4.26	91.49
Type and dose administered for the adult and paediatric patient	0.00	2.13	97.87
Clinical/biomedical indications and contraindications	0.00	2.13	97.87
Types of needles and accessories	0.00	2.13	97.87
Techniques for needle placement	0.00	10.64	89.36
Methods of maintaining intravenous access	0.00	2.13	97.87
Infection control	0.00	4.26	95.74
Complications and adverse reactions	0.00	0.00	100.00
Treatment of complications and adverse reactions	0.00	8.51	91.49

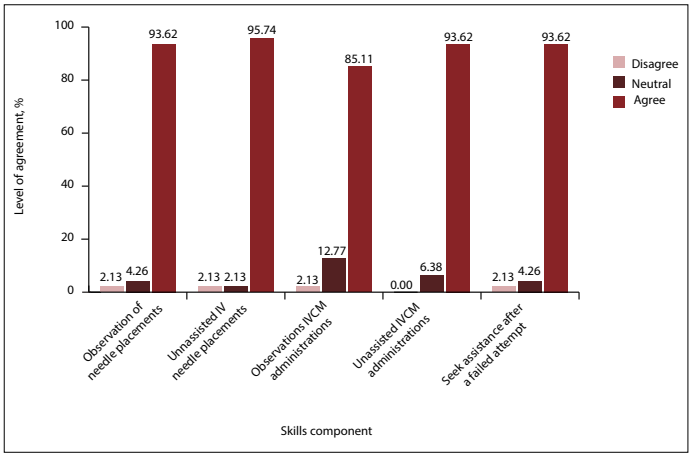

Fig. 1. Technique/s. (IV = intravenous; IVCM = intravenous contrast media.)

respondents with regard to the observation of needle placement and IVCM administration, as well as the unassisted practice of these two skills.

The respondents further agreed that a minimum of 10 needle placements be observed and a minimum of 20 unassisted, independent needle placements should be recorded. It is felt that the radiographers should observe a minimum of 20 IVCM administrations and also record a minimum of 20 unassisted, independent IVCM administrations. There is agreement that the radiographer should seek assistance after two failed attempts at placing the needle.

Fig. 2 presents information pertaining to the clinical/practical components for inclusion in the further training of radiographers to administer IVCM.

Patient preparation, management and aftercare, infection control, and CPR and BLS practical training were agreed upon by the majority of respondents for inclusion in the further training of radiographers to administer IVCM. More than 55% of the respondents felt that practical training regarding the administration of emergency medicines and record keeping of observational hours of IVCM administrations (40 hours) should be included in the further training. It is noted, however, that of all the clinical/practical components presented in Fig. 2, practical training regarding the administration of emergency medicines received the highest level of disagreement (12.77%).

The majority of respondents (93.6%) were of the opinion that a clinical assessment be conducted towards the end of the training, which should contribute a minimum weighting of 0.25 towards the final mark. In addition, the results reveal that the students should keep a record of clinical competencies, which should be used as an assessment, with a minimum weighting of 0.25 towards the final mark.

Agreement on medicolegal components

Table 3 provides information based on the medicolegal study units to be included as part of the further training for radiographers to administer IVCM.

High levels of agreement (>80%) were indicated for the study of basic patient rights and ethics, the rights and responsibilities of a

Table 3. Level of agreement on medicolegal study units

Study unit	Level	Disagree, %	Neutral, %	Agree, %
Medical law	Basic	12.77	36.17	51.06
	Advanced	70.21	27.66	2.13
Patient rights and ethics	Basic	2.13	12.77	85.11
	Advanced	46.81	44.68	8.51
Rights and responsibilities of a healthcare professional	-	2.13	14.89	82.89
Designing medical policies and procedural protocols	-	10.64	44.68	44.68
Quality assurance	-	0.00	12.77	87.23
Cultural diversity	-	4.26	40.43	55.32
Patient management and communication	-	2.13	10.64	87.23

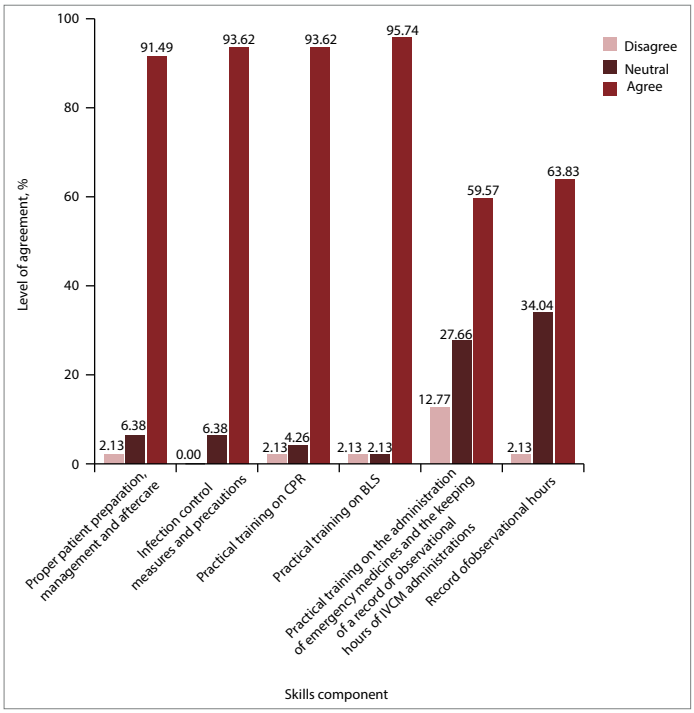

Fig. 2. Clinical/practical component. (CPR = cardiopulmonary resuscitation; BLS = basic life support; IVCM = intravenous contrast media.)

healthcare professional, quality assurance, and patient management and communication. In contrast, the study of basic medical law, designing medical policies and procedural protocols, and cultural diversity collectively received lower levels of agreement (<60%) and higher levels of neutrality (>35%), indicating that these were possibly not critical areas for training.

Discussion

Trends in HE and training, coupled with the changing needs of healthcare service delivery, are well documented. The integration of HE and training with the professional needs of the radiography profession is of vital importance, as the profession is changing and expanding globally.[15]

It is important to investigate, compare and reflect on the training that other countries have in place so that the quality of the training guidelines for health professionals in SA can be improved through benchmarking, while still maintaining a local context. The need for scientific (local) research to be conducted, is deemed particularly important for addressing the specific healthcare needs of SA. The level and duration of the training of SA radiographers can only be established once the national training guidelines have been identified and approved by the PBRCT. Only then can educational institutions offer training that extends the scope of practice and raises the status of the profession.

This research study revealed that both a theoretical and skills component of training should be included for radiographers to administer IVCM. This is similar to the training offered in southern Europe at the University of Malta and in the UK.[5,16] For example, the theoretical components offered at the University of Malta and in the UK include the study of the anatomy of the upper and lower limbs, general physiology, contrast media, patient parameters (e.g. blood pressure), emergency medicines and equipment, infection control, technique associated with needle placements and IVCM administrations, as well as the study of medicolegal issues and legislation.[5,16]

With regard to the skills component, the training offered at the University of Malta requires that radiographers need to observe a minimum of five IVCM administrations and to record a minimum of 50 unassisted, independent IVCM administrations. The radiographers are also expected to seek assistance after two failed attempts at placing the needle.[5] The results from this research study revealed a similar pattern regarding the minimum number of failed attempts at placing the needle; however, there is agreement regarding the minimum number of 20 unassisted, independent IVCM administrations included in the training guidelines for UK radiographers.[16]

International training standards state that the practical CPR training must be updated annually.[5,17,18] The competency profile for further training issued by the Ontario Association of Medical Radiation Sciences (OAMRS) in Canada, recommends that in addition to this, an annual clinical competency assessment should be conducted.[18] This, however, requires further investigation, as the research tool for our study did not include the relevant questions. With regard to medicolegal training, the results are in favour of the study units included internationally.

Both theoretical and clinical assessments are conducted internationally and are in line with the recommendations of this study. Our study indicated that the assessments should contribute a minimum weighting of 0.25 towards the final mark. The weightings of the assessments internationally, however, are different. The theoretical assessment at the University of Malta contributes a weighting of 0.60 towards the final mark and the remaining weighting of 0.40 is calculated from clinical practice, which includes a record of clinical competencies.[5]

Summary of recommendations with regard to training guidelines

The findings of this study highlight the need for theoretical, clinical/practical and medicolegal elements forming essential components of training, and the assessment thereof.

Theoretical components

- Basic anatomy, physiology and pathology of the cardiovascular, urinary, nervous and respiratory system and of the upper and lower limbs.
- The preparation and pharmacology of IVCM, as well as clinical and biomedical indications and contraindications.
- Infection control, the different types of needles and accessories, as well as the technique/s for placing the needle and how to maintain IV access.
- The different types and dose of IVCM administered for adult and paediatric patients.
- The possible complications of and adverse reactions to IVCM and the treatment/management thereof.
- CPR, BLS, the pharmacology of emergency medicines and drugs, as well as the administration thereof.

Clinical/practical components

- Observation of 10 needle placements and a record of 20 unassisted, independent needle placements.
- Observation of 20 IVCM administrations and a record 20 unassisted, independent IVCM administrations.
- Patient preparation, management and after-care, as well as practical training regarding infection control, CPR and BLS.
- Practical training on the administration of emergency medicines and drugs.
- Observation of 40 hours of studies involving contrast media.

Medicolegal components

- The study of basic medical law, basic patient rights and ethics, as well as the rights and responsibilities of a healthcare professional.
- Quality assurance, cultural diversity, patient management and communication.

Assessments

- A theoretical assessment, contributing a minimum weighting of 0.25 towards the final course mark.
- A clinical assessment, contributing a minimum weighting of 0.25 towards the final course mark.
- A record of clinical competencies, contributing a minimum weighting of 0.25 towards the final course mark.

Conclusion

The 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 transformation in health services, with particular reference to the professional scope 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.

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Conflicts of interest. None.

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