



## **ESTABLISHMENT OF POSTGRADUATE EDUCATION AND TRAINING IN THE SPECIALISED AREAS OF DIAGNOSTIC IMAGING IN ZAMBIA**

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**ABSTRACT:** *Radiography involves the use of different imaging modalities for diagnostic and treatment of diseases and injuries. The undergraduate qualification in radiography focuses on general radiography and basic aspects of different diagnostic imaging modalities. At postgraduate level, the concentration is on training radiographers in specialised fields of diagnostic imaging, such as ultrasonography (US), image interpretation and reporting, computed tomography (CT), magnetic resonance imaging (MRI), nuclear medicine (NM), mammography, and radiation protection. The aim of this article is, therefore, to review the readiness of Zambia in establishing postgraduate training in specialised diagnostic imaging by examining its strengths, opportunities, weaknesses, threats and existing postgraduate courses provided abroad. The article recognises that the establishment of postgraduate courses would enable radiographers to specialise and obtain advanced knowledge and skills in areas of healthcare need and their interest. This would prepare them in taking up new, advanced roles and expanding their scope of practice. It is anticipated that this would improve the quality of diagnostic imaging services in Zambia.*

**KEYWORDS:** Diagnostic Imaging, Postgraduate Education, Radiographer, Zambia

### **INTRODUCTION**

Diagnostic imaging refers to techniques and processes used in medicine to image various parts of the human body for the purpose of diagnostic and treatment of diseases and injuries (Ehrlich & Coakes, 2020). In Zambia, diagnostic imaging services were introduced in the 1930s (Ministry of Health, 2007). The first radiography education and training programme was a two-year certificate course for X-ray assistants which was based at Livingstone Central Hospital of the Southern Province. The training was hospital-based and limited to basic radiographic techniques (Munsanje, 2013). With the advancement in radiography which resulted in increased responsibilities for X-ray assistants, there was a need to have a formal education programme to train radiographers (Munsanje, 2013). This saw the replacement of a two-year certificate training course with a three-year diploma in radiography which was established at Evelyn Hone College (EHC) in 1970 (EHC, 1980; TEVETA, 2018).

In Zambia, radiography training is currently offered at one technical institution and two universities in conjunction with the University Teaching Hospital (UTH) and other hospitals countrywide where radiography students undertake clinical practice. All three undergraduate programmes are accredited by the Health Professions Council of Zambia (HPCZ) which is a regulator of all medical and allied health professions. As mentioned earlier, the undergraduate



education programme at EHC is currently a three-year diploma qualification at Level 6 of the Zambia Qualifications Framework (ZQF). The training programme is structured to include essential aspects of general radiography and basic understanding of other diagnostic imaging modalities (TEVETA, 2018). Due to a shortage of radiographers and the need for graduates to have knowledge and skills in research, the Lusaka Apex Medical University (LAMU) and University of Zambia (UNZA) started offering a Bachelor of Science in Radiography in 2012 and 2018 respectively. The bachelors' degrees are at Level 7 of ZQF.

There are no postgraduate diagnostic imaging training programmes in Zambia. This contrasts with many countries abroad where the role of the radiographer has progressed through postgraduate qualification in specialised diagnostic imaging, such as ultrasonography (US), image interpretation and reporting, computed tomography (CT), magnetic resonance imaging (MRI), nuclear medicine, mammography, and radiation protection since the late 1980s (Du Plessis et al., 2012; College of Radiographers, 2019). It is only through postgraduate education and specialisation in different imaging modalities that radiographers can be prepared to take on new, advanced roles and expand the scope of practice (Du Plessis et al., 2012). In Zambia, to obtain a master's qualification, radiographers enrol abroad for their studies. For this reason, most radiographers who operate specialised imaging modalities only receive application specialist training or in-house training.

### Postgraduate Education and Training in Diagnostic Imaging

Postgraduate education and training encompass an advanced qualification that is undertaken by undergraduates to specialise in a specific area (Mubuuke & Pope, 2015). The United Kingdom model of postgraduate education and training in radiography consists of four levels: postgraduate certificate, diploma, master's and doctorate. Zambia, being a commonwealth country follows the UK model of education. The qualifications should be linked to the proposed four-tier structure which refers to the different clinical roles within the radiography profession: radiography technologist, radiographer, clinical specialist radiographer and consultant radiographer (Table 1).

**Table 1: Radiography Qualifications Linked to Proposed Clinical Positions**

	Level of Qualification	Proposed Clinical Position
1	Diploma in radiography (Level 6 of ZQF)	Radiography technologist
2	Degree in radiography (Level 7 of ZQF)	Radiographer
3	Master's (Level 8 of ZQF)	Clinical specialist radiographer
4	Doctorate (Level 9 of ZQF)	Consultant radiographer

There are some reasons for undertaking education and training in specialised fields of diagnostic imaging. Firstly, there are advances in diagnostic imaging modalities, demanding a high level of knowledge and skills above the basic qualification (Ugwu et al., 2012; Du Plessis et al., 2012). Secondly, given the critical shortage of radiologists in Zambia, there is a need for radiographers to take on tasks which traditionally were within the domain of radiologists, such as image interpretation and reporting (Munsanje, 2013; Bwanga et al., 2019). This requires new knowledge and advanced skills in this speciality (Mubuuke & Pope, 2015). Thirdly, the undertaking of a postgraduate qualification could result in advanced career opportunities for



radiographers which is linked to job satisfaction and professional recognition (Williams, 2006; Mubuuke & Pope, 2015).

In a study conducted in South Africa by Du Plessis et al., (2012), the researchers noted that most radiographers preferred postgraduate training with a specialisation in a particular branch of diagnostic imaging. This conclusion is set against a background where, in postgraduate education and training programmes, the predominate requirement for qualification is a research dissertation. This radiographer's preference of specialisation supports the approach used in the UK (College of Radiographers, 2019), Ireland (University College Dublin, 2019; Trinity College Dublin, 2019) and Australia (University of Sydney, 2019). As mentioned earlier, at postgraduate education level, radiographers should specialise in different imaging modalities depending on the organisation needs and interest of radiographers (Du Plessis et al., 2012; Mubuuke & Pope, 2015). Specialisation could allow radiographers with postgraduate qualifications to be registered with the HPCZ as clinical specialists and be appointed as consultant radiographers (Table 1).

### **Environmental Assessment for the Establishment of Postgraduate Education and Training in Diagnostic Imaging**

An environmental assessment was undertaken using a SWOT analysis approach to survey how ready Zambia is for the establishment of postgraduate education and training in specialised fields of diagnostic imaging. SWOT is a framework which is used to analyse the strengths, weaknesses, opportunities and threats of an organisation, or in the context of this article, the radiography profession. The educational sector was taken as the central unit for analysis. The external environment was subdivided into micro external (consisting of health providers) and macro external (all other institutions with a bearing on health provision). The SWOT analysis follows:

**Strengths-** These are internal factors within the radiography profession that are likely to have a positive effect on achieving the objective of the establishment of postgraduate education and training in the specialised areas of diagnostic imaging.

- Availability of qualified radiographers to support postgraduate education and training. There is a good number of radiographers with postgraduate qualifications to teach trainees both in classroom and clinical environments.
- Clinical exposure for most areas in specialisations such as US, CT, image interpretation, mammography and radiation protection. Currently, there are 17 CT scanners, 16 mammographic units (10 in public and 6 in private health sectors), 5 MRI scanners (1 in public and 4 in private health sectors) in the country.
- Availability of radiography educational systems that support postgraduate education. There is available infrastructure at the three learning institutions offering undergraduate radiography programmes: EHC, LAMU and UNZA.
- Positive attitude amongst radiographers towards postgraduate education and training. This is evidenced by the good number of radiographers who have undertaken postgraduate studies abroad, such as Zimbabwe, Uganda, South Africa and the UK, mostly on self-sponsorship.



- Support from the Radiological Society of Zambia (RSZ). Currently, the RSZ is promoting postgraduate education and training amongst its members in order to acquire specialised and advanced knowledge and skills.

**Weaknesses-** These are internal factors within the radiography profession that are likely to obstruct the establishment of postgraduate education and training:

- Limitation in clinical exposure to some areas of imaging specialisations, such as nuclear medicine and dual-energy X-ray absorptiometry (DEXA). Currently, there is 1 nuclear medicine unit and 2 DEXA scanners in the country.
- Poor culture towards postgraduate education and training amongst radiographers in management positions. This concern has been reported in the literature. In a study conducted by Mubuke et al., (2015), a lack of senior radiographers in management showing junior radiographers the relevance of postgraduate education was reported as a barrier.

**Opportunities-** These are external factors outside the radiography profession which are likely to have a positive effect on meeting or exceeding the objective of the establishment of postgraduate education and training in the specialised areas of diagnostic imaging:

- Increased demand for diagnostic imaging services following the recent introduction of different imaging modalities in the health sector and changes in disease profile, with communicable diseases such as HIV/AIDS and tuberculosis (TB) and non-communicable diseases such as cancer (MOH, 2017). According to the Ministry of Health (2007), approximately 70% of patients attending health facilities in Zambia are referred for diagnostic imaging. This demand requires an increase of staffing levels and equipping them with specialised knowledge and skills.
- Availability of supporting teaching staff, such as radiologists and medical physicists to supplement teaching in image interpretation and radiation protection respectively. Others include consultant medical doctors and officials from the Radiation Protection Authority of Zambia (RPAZ).
- Availability of clinical practice infrastructure at teaching hospitals countrywide, such as the UTH, CDH, Levy Mwanawasa University Teaching Hospital (LMUTH), Ndola Teaching Hospital (NTH) and Kitwe Teaching Hospital (KTH).
- Availability of two health profession education programmes at UNZA and Levy Mwanawasa Medical University (LMMU) to equip lecturers with knowledge and skills in lecturing.
- Support of specialisation from Ministry of Health. Currently, the Ministry of Health is promoting specialisation amongst healthcare professionals. This has resulted in the opening of LMMU.
- Availability of internet to support teaching and learning.



**Threats-** These are external factors and conditions outside the radiography profession that are likely to harm the objective of establishment of postgraduate education and training:

- There is limited funding from the government allocated to the development of education and training programmes.
- There are no availabilities of modern lecture rooms at all three training institutions offering undergraduate radiography programmes, including skills labs to support postgraduate education and training.
- Poor hospital managerial culture towards postgraduate education and training. For example, it is difficult for radiographers to access study leave. This barrier has been reported in the literature. In a study by Du Plessi et al., (2012) employers reported staff shortages as the major reason for their unwillingness to allow radiographers from work to attend classes.

### **Possible Specialised Areas for Postgraduate Education and Training in Diagnostic Imaging**

The availability of different diagnostic imaging modalities in Zambia and several radiographers with postgraduate qualifications make it possible to develop training programmes in specialised imaging, such as image interpretation and reporting, radiation protection, ultrasonography, CT, MRI and mammography. These trainings can be offered on a phased basis and at any postgraduate level (certificate, diploma, master's and doctorate) depending on the resources, including lecturing staff.

#### **Image Interpretation and Reporting Training Programme**

The first postgraduate qualification which should be established is image interpretation and reporting. For the last two decades, radiographers in the UK have extended their role by reporting on plain film radiographs, mammography, CT and MRI images (College of Radiographers, 2019). These changes were introduced due to an increase in demand for diagnostic imaging services and a shortage of radiologists (Williams, 2006; Bwanga et al., 2019). According to the College of Radiographers (2019), there are currently 16 postgraduate training programmes in image interpretation in the UK. In Africa, Ernest Cook Ultrasound Research and Education Institute (ECUREI) of Uganda also offer a one-year diploma in image interpretation (ECUREI, 2019). The aforementioned training programmes are only some of a wide variety provided globally. Zambia is also experiencing a shortage of radiologists with only 5, working in the Ministry of Health and servicing a population of approximately 17 million (Bwanga et al., 2019). To fill up the gap created due to such a shortage of radiologists, there is a need to introduce an image interpretation course and change the scope of practice to allow trained radiographers to give formal written reports.

#### **Radiation Protection Training Programme**

The second postgraduate educational programme which should be considered is radiation protection. Some institutions abroad offer postgraduate training in radiation protection. In Ireland, Trinity College Dublin (TCD) offers a one-year master's in radiation safety (TCD, 2019), while in the UK, the University of Surrey offers a two-year master's in radiation and environmental protection (University of Surrey, 2019). In Zambia, radiation protection has



been integrated in the curricula of all three undergraduate radiography programmes as per International Commission on Radiation Protection recommendations (ICRP, 2009). However, this is basic knowledge; specialised education and training is necessary for healthcare professionals with a special responsibility in radiation protection, such as Radiation Protection Officers (ICRP, 2009; Martin et al., 2019; Bwanga & Chanda, 2020). The Ionising Radiation Protection Act No. 2011 of the Laws of Zambia (2011), requires the appointment of a competent person as a Radiation Protection Officer (RPO) in each institution using radiation, and these are often radiographers. The RPAZ often hosts workshops to facilitate the training of RPOs' (Kawesha, 2017). However, an accredited formal training programme is vital to acquire appropriate knowledge and skills, including research. There are plans to introduce a diploma in radiation protection at EHC.

### **Computed Tomography (CT) Training Programme**

The third postgraduate educational programme which needs consideration is CT. In Zambia, CT services became available in 1994 when the first scanner was installed at Nkana Mine Hospital (now Sinozam Hospital). Unfortunately, there is no training programme in CT. In contrast, there are several CT courses being provided abroad. In Ireland, TCD offers a one-year master's in CT, whilst University College Dublin (UCD) has a 16-month master's in CT (TCD, 2019; UCD, 2019). In the UK, there are 7 postgraduate CT courses being offered in various universities (College of Radiographers, 2019). In Australia, the University of Sydney has a master's in CT (University of Sydney, 2019). These CT training courses mentioned are just a snapshot of a wide variety offered at higher education institutions worldwide. In Zambia, there are 17 CT scanners, both in public and private health sectors. The availability of this modality makes it possible to quickly make a diagnosis and treat various diseases (MOH, 2017). Unfortunately, this modality is a source of high radiation doses. It is estimated that 90% of man-made radiation exposure to the population in medicine, 40% is due to CT (Martin et al., 2019). Furthermore, CT is a highly computerised modality. Therefore, specialisation training to radiographers who operate CT is essential in order to produce high quality images whilst keeping radiation doses as reasonable as is practicable. With more scanners being installed across the country, there is a need to introduce a postgraduate training programme in CT.

### **Mammography Training Programme**

The fourth postgraduate qualification needed in Zambia is mammography. The internet search found some institutions offering training in mammography abroad. The University of Pretoria (UP) in South Africa offers a one-year certificate course in mammography (UP, 2019). In Ireland, UCD offers a two-year master's in mammography (UCD, 2019). In the UK, there are 7 universities offering training in mammography (College of Radiographers, 2019). In Australia, Charles Sturt University (CSU) offers a one-year graduate diploma of mammography (CSU, 2019). The aforementioned courses are only some of a wide variety available overseas. In Zambia, the first mammographic unit in public health sector was installed at CDH in 2006. Currently, there are about 16 mammographic units across the country, with no training programme. According to the Ministry of Health, breast cancer is the second most common cancer after cervix cancer in women in Zambia (MOH, 2019). This has resulted in the implementation of a mammographic screening programme in the country (MOH, 2019). For these reasons, the number of mammographic units is expected to increase due to an increase in demand for this imaging service. Therefore, a local postgraduate course is required to equip radiographers with specialised knowledge and skills in this field.



## **Magnetic Resonance Imaging (MRI) Training Programme**

The other specialised area that should be considered for postgraduate training programme is MRI. There are several institutions providing postgraduate education in MRI abroad. In South Africa, Cape Peninsula University of Technology (CPUT) offers a 5-month short course in MRI (CPUT, 2019). In Ireland, UCD offers a 16-month master's in MRI, while TCD has a one-year master's in MRI (TCD, 2019; UCD, 2019). In the UK, 6 universities offer MRI courses (College of Radiographers, 2019). In Australia, the University of Sydney offers a master's in MRI (University of Sydney, 2019). The stated MRI courses are just a snapshot of what is provided globally. In Zambia, MRI services became available in 2010, when the first scanner was installed at CDH. Currently, there are 5 MRI scanners in the country. There is a need to introduce a postgraduate training programme in this area to equip radiographers with specialised knowledge and skills.

## **Diagnostic Medical Ultrasound Training Programme**

There are several ultrasound courses offered overseas. In Uganda, ECUREI offers ultrasound courses at three levels: ordinary diploma, degree and master's (ECUREI, 2019). In South Africa, CPUT and UP offer a Bachelor of Science and Diploma in Ultrasound respectively (CPUT, 2019; UP, 2019). In the UK, there are about 16 universities offering ultrasound courses at master's level (Consortium for the Accreditation of Sonographic Education, 2019). In Ireland, UCD offers an 18-month master's in ultrasound (UCD, 2019). This is just a snapshot, there are several other educational institutions offering ultrasound courses worldwide. In Zambia, there is a two-year diploma in ultrasound offered at EHC which started in 2007. This ultrasound training programme is not a postgraduate programme because it is at Level 6 of ZQF. There is currently a huge demand to train radiographers, medical doctors, clinical licentiate officers, clinical officers and nurses in performing ultrasonography. This has resulted in most of the training being conducted through workshops (Kawooya, 2012). LAMU is considering introducing postgraduate diploma qualification in medical diagnostic ultrasound. There is a necessity to provide more ultrasound courses, especially at master's levels to equip health professionals with knowledge and skills in ultrasound.

## **Other Future Postgraduate Training Programmes**

Other diagnostic imaging services available in Zambia include nuclear medicine and DEXA. Nuclear medicine is a diagnostic imaging technique which uses radioactive isotopes (radionuclides) to assess bodily functions and to diagnose and treat diseases (Ehrlich & Coakes, 2020). The first nuclear medicine equipment was installed at UTH in 2000 and is the only one in the country. On the other hand, DEXA uses low doses of ionising radiation to produce images to assess the density of the bones, mostly the spine and pelvis (Blake & Fogelman, 2007). There is also only two DEXA scanners available in the country. The first DEXA scanner was installed at UTH in 2016 and the second at Midland Private Hospital in 2017. Due to the limited equipment available for these two imaging modalities, the establishment of postgraduate education and training programmes in these specialities may be considered when there are more scanners available for clinical practice.

## **Model of Delivery for Postgraduate Education and Training Programmes**

Literature search revealed that the model of delivery for postgraduate training programmes varies from institution to institution. This is as a result of many factors, ranging from available



human resource to an employers' preferences. Most employers would not allow their radiographers to go on leave for a full-time training programme due to staff shortages (Du Plessis et al., 2012; Ugwu et al., 2012). In addition, full-time study can have a negative effect on the family and on childcare responsibilities (Ugwu et al., 2012). Taking into consideration these factors, the preferred model of delivery would be part-time study using blended learning. Harden and Laidlaw (2017) describe blended learning as a combination of face-to-face instruction and distance learning/online learning. Literature revealed that blended learning is the option most preferred by radiographers and employers for postgraduate training in radiography (Du Plessis et al., 2012; Ugwu et al., 2012; Mubuuke et al., 2015), as it minimises the challenges stated above. The number of days to attend classes and clinical practice could be best determined through a need's assessment study for each training programme.

## CONCLUSION

The global practice requirements for radiography are changing. The radiographer is required to play a major role in the whole process of imaging; no longer limited to image production only (Cowling, 2008; Snaith et al., 2014). These role advances should be undertaken only with appropriate education and training. Countries such as Zambia, where radiologists are few need to take advantage of improving medical imaging service delivery by utilising the many radiographers that are already in the healthcare system (Bwanga et al., 2019). However, to undertake such an approach without providing them with the necessary knowledge and skills requisites would be detrimental to the radiography profession and healthcare delivery. Even with the resource constraints, it is possible to offer such skills development programmes. The inclusion of such skills training would provide an opportunity for radiographers in Zambia to upgrade their competences and deliver improved service delivery in the medical imaging sector. Lastly, this proposed model for establishment of postgraduate education and training in specialised areas of diagnostic imaging in Zambia is still amenable for implementation.

## Conflict of Interest

The authors declare no conflict of interest.

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