ORIGINAL ARTICLE

Role development and extension for radiographers in computed tomography: Literature review findings and their application to Zimbabwe

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ABSTRACT

Computed Tomography (CT) technology has evolved into avital diagnostic tool in modern medical practice, leading to the development and extension of the CT radiographer's role. While some countries have made progress in developing and extending radiographers' roles in CT, resource-constrained settings like Zimbabwe have been slower to implement these changes. The purpose of this review is to inform role changes for radiographers in Zimbabwe and similar settings by reviewing the literature on role development and extension for radiographers in CT. The review explores the concepts of role development and extension, emphasizing the necessity for changes in radiographers' roles in CT due to factors such as radiologistsshortages, cost containment, quality improvement needs, and technological advancements. It also addresses the opposition to role development and extension, emphasizing the fundamentalimpetus for these changes should be to provide high-quality and effective patient-centered care. The paper delves into specific areas of role development and extension for radiographers in CT, including intravenous (IV) cannulation and contrast media administration, performing CT colonoscopy examinations, reporting on CT brains, and the significance of research and clinical audit in CT. It underscores the potential benefits of these expanded roles, such as improved patient care, workflow efficiency, and the workload of radiologists, as well as advancements in education, service delivery, and technological innovations. The review underscores the need for further research to ensure evidence-based implementation of role development and extension for radiographers in CT. Embracing these changes and providing the necessary support and training can lead to improved patient care, address skill shortages, and advance the radiography profession in resource-constrained settings like Zimbabwe.

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INTRODUCTION

Since its introduction in the early 1970s, Computed Tomography (CT) technology has undergone significant advancements, evolving into an indispensable diagnostic tool in modern medical practice[1]. Initially designed for brain imaging, the improvements in CT speed and resolution have positioned it as a crucial tool for diagnosing, planning, and monitoring diseases throughout the body. This evolution has led to an expansion of the CT radiographer's role, requiring a versatile skill set to adapt to the demands of today's healthcare environment. The terms "role development" and "extension" are used to describe the changes in radiographers' responsibilities to align with advancements in CT technology. In certain European countries like the United Kingdom (UK) and the Netherlands, radiographers are increasingly developing and extending their CT roles to meet evolving imaging needs[2]. However, resource-constrained settings such as Zimbabwe have been slower to adopt changes in radiographers' CT roles. This may be due to a lack of awareness among stakeholders and resistance to change. Therefore, this paper aims to review the literature on role development and extension for radiographers in CT to inform role changes for radiographers in Zimbabwe and similar settings. Research evidence suggests that role extension and development have significantly enhanced service delivery to patients and improved the radiography profession in countries where such programs are established practice[3,4].

Role development and extension in radiography

Role development and extension represent fundamental shifts in the professional practice of radiographers[5]. The College of Radiographers' publication *"Role Development in Radiography"* (1996) defines role development as a quantitative and qualitative change in how radiographers contribute to patient management and healthcare services. On the contrary, role extension entails additional skills and responsibilities beyond the statutory responsibilities and competencies at the time of professional registration[6]. The necessity for developing and extending radiographers' roles in CT stems from various factors, including shortage of radiologists, cost containment, quality improvement needs, technological advancements, new medical interventions, health sector programs, and continuing professional development (CPD) demands, among others[5-7]. Despite the potential benefits of changes to radiographers' roles, there has been resistance from certain sectors of the medical community. Hardy *et al.* argue that the aim of role development or task-shifting is not for one profession to replace another[6]. The primary motivation for advancements or changes in practice, and/or role development, should be to provide high-quality and effective patient-centered care. In essence, the development and extension of roles for radiographers are intended for the benefit of the patient, rather than for the benefit of individual professional groups.

Currently, CT practice is regulated by the scope of the radiography profession as defined by the Allied Health Practitioners Council of Zimbabwe (AHPCZ) a statutory body established in terms of Part V of the Health Professions Act *(Chapter 27.19*). Radiographers with additional CT qualifications are registered as specialists. However, due to the relatively high cost of being on the specialist register without corresponding financial benefits, particularly in the public sector, many radiographers are hesitant to register their additional CT qualifications. Weng *et al.* suggest that organizations can enhance employee commitment by acknowledging and rewarding the acquisition of new skills and training[8]. However, this does not seem to be the case in the public sector, leading many radiographers to leave in search of better employment opportunities where their skills are recognized and rewarded[9].

Despite the challenges of skill shortages in Zimbabwe, there is a lack of literature addressing the readiness of Zimbabwean radiographers for role

development and extension. This highlights the necessity for research in these areas to ensure evidence-based implementation of radiographer role extension in CT and other areas in the imaging field. In addition, there is a need to bring awareness to imaging stakeholders on this topic in Zimbabwe and other similar settings in Africa.

Areas of role development and extension for CT radiographers

Four areas of role development and extension for CT radiographers were found during the review of the literature (Figure 1).

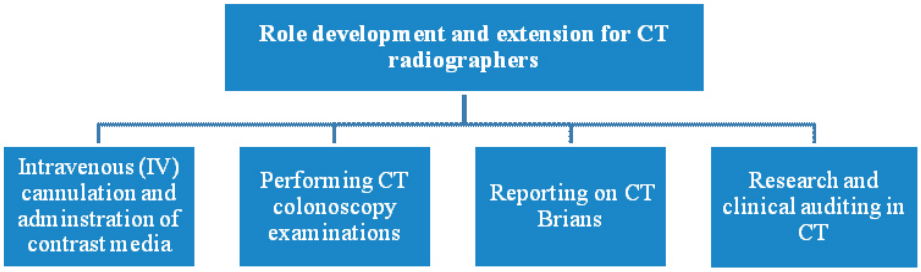

Figure 1: Areas of role development and extension for CT radiographers

i. Intravenous cannulation (IV) and administration of contrast media to CT patients

In the CT department, iodinated contrast media are used frequently to help visualize most body organs and blood vessels. This is administered intravenously. It is estimated that approximately 120 million doses of contrast-enhanced CT examinations are conducted in the United States of America (USA) each year, with several hundred million doses applied worldwide annually[10]. Historically, IV cannulation and administration of contrast media to imaging patients were within the domain of radiologists. However, due to a shortage of radiologists and an increase in demand for contrast-aided medical imaging examinations, nurses started performing this role in the UK[6]. In the 1990s, there was a need for radiographers working in the UK and the Republic of Ireland to extend their role in this area to improve the delivery of medical imaging services[11,12]. To support radiographers, the College of Radiographers developed a postgraduate course that includes the anatomy of the upper and lower limbs, physiology, emergencies, medical-legal, infection control, injection procedures, and contrast agents[11]. The six (6) months course consists of three (3) components: theoretical, practical-based learning, and assessment. This is the same as what is offered in the Republic of Ireland[12]. Therefore, performing IV cannulation and administration of contrast media was the first area where CT radiographers extended their role in developed countries.

A substantial body of evidence indicates that allowing radiographers to lead IV cannulations and administer contrast media positively impacts patient care, as radiographers are directly involved in CT examinations [13]. Reported benefits in the literature include improved departmental workflow, reduced patient waiting times, and alleviated pressure on radiologists, enabling them to focus on more complex tasks, such as interventional procedures[3,14,15]. In other African countries such as Namibia, to adapt to these evolving changes, the Allied Health Professions Council of Namibia (AHPCN) revised the scope of practice for radiographers in 2020, allowing for the administration of IV contrast by radiographers [13]. In most African countries, nurses are performing IV cannulation and administration of contrast media to imaging patients[13,16]. This includes Zimbabwe. However, there are reports from some African countries that CT radiographersare performing this new role outside the scope of their practice due to a significant shortage of radiologists, an increase in contrast-aided examinations, and a reduction of

frustrations experienced by CT radiographers when waiting for a nurse or radiologist[13,16]. Given the rising demand for imaging examinations and the severe shortage of radiologists[9,17], the Zimbabwean healthcare system stands to gain from formally permitting radiographers to perform IV cannulations and administer contrast media for CT imaging examinations.

While radiographers in Zimbabwe receive theoretical lectures on drug administration routes during their training at local higher education institutions, they lack practical training on IV cannulation. The curriculum includes theoretical lectures on contrast media and their reactions, as well as first aid training and Cardiopulmonary Resuscitation. Therefore, increasing practical placements for IV cannulation and contrast administration by radiography students is essential to adequately prepare them for CT advanced practice. Higher Education Institutions offering radiography in Zimbabwe should also start planning for postgraduate training programs in IV cannulation and administration of contrast media by radiographers. In addition, the Radiography Association of Zimbabwe (RAZ) should be organising CPD learning activities on this subject to impart knowledge to radiographers.

Nonetheless, with greater involvement in healthcare provision and increased personal and professional development, there also comes increased professional responsibility and legal liability to achieve and maintain appropriate standards of clinical care. Issues that must be addressed regarding radiographer-performed IV injections in CT include appropriate training and assessment of competence, departmental protocols, allocation of responsibility, cost-effectiveness, and performance monitoring. All of these are developed within a framework of audit and research[15]. The regulators and professional bodies, such as the AHPCZ and the Radiography Association of Zimbabwe (RAZ), respectively play a crucial role in developing the framework in consultation with other relevant international organizations and standards.

ii. Performing CT colonoscopy examinations

CT colonoscopy(CTC) is a minimally invasive imaging examination for identifying colorectal cancer[18]. CTC is more sensitive than the traditional barium enema in the diagnosis of colorectal cancer[18,19]. It has the added advantage of characterising extra colonic structures[18]. Colorectal cancer is the third most common cancer, accounting for approximately 10% of all cancer cases, and is the second leading cause of cancer-related deaths worldwide[20]. In 2020, it is estimated that more than 1.9 million new cases of colorectal cancer and 930,000 associated deaths occurred worldwide[20]. Early diagnosis results in a cure in the majority of patients[21] and radiographers play a major role in the diagnosis and treatment of this disease. Traditionally, the CTC procedure is performed by a radiologist while the CT radiographer undertakes imaging. However, this practice has changed in the UK, CT radiographers are performing both the procedure and imaging of the patient[22]. This is due to an increase in the number of CTC examinations, a shortage of radiologists, and the need to improve the delivery of imaging services.

Over the past decades, mortality from colorectal cancer substantially decreased in Western countries; in the USA, a 45% reduction was observed between 1975 and 2010 [23].This is most likely partly due to the adoption of screening interventions such as CTColonoscopy(CTC)[23].These screening programs have been successful because CT radiographers have extended their role in performing CTC examinations[22]. Robust evidence indicates that CTC is safe, well tolerated, and highly accurate for the detection of colorectal cancer and large polyps, which are the targets of screening[21,23]. n a meta-analysis including 11,151 patients, the sensitivity of CTC for the detection of colorectal cancer was 96.1% (95% CI, 93.8% to 97.7%), which is similar to optical colonoscopy[24]. In the future, CTC could play a larger role in colorectal cancer screening

programs in Zimbabwe, as it is considered safe and better tolerated by patients. In fact, CTC has become an option for colorectal cancer screening in other developed countries[25].

Interpreting CTC can be challenging and requires specific training. Therefore, it's important to have well-trained radiologists to ensure accurate reporting. One way to reduce errors is to involve two reporting opinions, which has been shown to increase the correct detection of intra-colonic lesions by 15%[26]. Another option is to include CTC radiographers in a double reporting role, which has been proven to be cost-effective, can help reduce the workload of radiologists and reduce diagnostic errors[25]. Additionally, when performed by specially trained CT radiographers, this approach allows for rapid staging completion in a single visit without the need for a radiologist to be present. This radiographer-led service offers benefits such as reduced wait times for results, potentially lower costs, and an improved patient experience[22].Several studies have shown that radiographers trained in CTC evaluation achieved sensitivity and specificity in polyp detection comparable to radiologists[19,21,27,28].

Colorectal cancer is also becoming more common in Zimbabwe and other similar settings. The reported incidence of colorectal cancer increased gradually in Harare, Zimbabwe, between 1991 and 2010, by an average of 4% each year[29]. This has been attributed to dietary changes and improvement in diagnosis[30]. While previously considered a Western disease, the statistics paint a different picture, highlighting colorectal cancer as a significant issue in Zimbabwe. This calls for policy change in the way CT imaging services are currently being offered and adopt initiatives that have worked well in other countries such as radiographer-led services. In Zimbabwe, CT radiographers are limited to imaging of a patient during CTC. The rest of the procedure including reporting is performed by radiologists. With the critical shortage of radiologists, CT radiographers could be allowed to extend their role in this area, including assisting in reviewing CTC images (double reporting), potentially aiding in the early diagnosis of colorectal cancer. Therefore, it suggests that CTC could be another area where Zimbabwean radiographers can expand their roles.

iii. Reporting on CT Brains

In the UK, radiographers have formally been reporting on general radiographic images since the 1990s[22]. The evidence base grew and confirmed that reporting radiographers can contribute effectively at high-quality standards, and this has improved the delivery of medical imaging services[25,31,32]. A survey by the Society and College of Radiographers (ScoR) found that at least 17 sites in the UK are now supporting the extension of radiographers' roles to assist in service provision[33]. Clinical reporting by radiographers has continued to expand, with radiographers now reporting CT Brians in the last two decades[22,32]. The Royal College of Radiologists (RCR) and the ScoR team have been promoting support to develop radiographers' roles in reporting on CT brains through working guidance[33]. Evidence has shown that trained radiographers possess high levels of diagnostic performance accuracy in the interpretation of CT head examinations[31,33]. Radiographers who extend their role to CT Brian reporting should already be approximately trained and experienced in reporting on general radiographic images[34].

In Africa, image interpretation and reporting by radiographers is in its infancy. However, the shortage of radiologists is even worse than in European countries where radiographers have extended their role in this area. In Africa, there is an average of 3.6 radiologists per one million of the population[35]. This is against 12.8 radiologists per 100,000 population in Europe[36]. A recent survey by Kawooya*et al.,*[37] reported the number of radiologists in a few African countries: Egypt (N=1250), South Africa (N=1200), Nigeria (N=688), Ghana (N=60), Uganda (N=55), Zimbabwe (N=25), Zambia (N=12), Malawi (N=3), and Swaziland (N=1). This is negatively affecting the delivery of imaging services due to unreported examinations. To

overcome these challenges, Uganda established reporting radiographers a decade ago and there are reports that radiographers in Nigeria and Ghana are providing commentary reports on general radiographic examinations[38]. This is the right direction in developing radiography.

In Zimbabwe, the scope of practice for radiographers is limited to the production of images, except for ultrasonography where radiographers/sonographers are reporting. In Zimbabwe, an important factor driving the extension of roles is the severe shortage of radiologists, particularly in the public sector. With only about 25 radiologists in the country and only one employed in the public sector[39], the majority of imaging examinations, including CT images go unreported by a specialist radiologist[9]. Therefore, it is crucial for radiographers to expand their roles in this area. Chinene *etal.,* argue that radiographers make up the majority of imaging professionals in the country and are present in most medical facilities offering medical imaging services in Zimbabwe[39]. Additionally, radiographers already have a solid foundation in cross-sectional anatomy, imaging principles, and applications. In line with the best practice, consideration should be made to allow radiographers to extend their role in image interpretation and reporting on general radiographic images before CT head reporting. However, postgraduate training is necessary to obtain a develop prerequisite competencies in image interpretation and reporting. Also, specific Scope of Practice and Scheme of Work documents should reflect this hybrid role and be agreed upon and signed off by the employer and employee[5]. The Radiography Association of Zimbabwe (RAZ) should initiate discussions on this subject with key stakeholders such as the Association of Radiologists and Radiotherapists of Zimbabwe (ARROZ), the Zimbabwe Medical Association(ZIMA),and AHPCZ.

iv. Research and clinical auditing in CT

Research is one area undergoing rapid development in radiography. Historically, radiography was consideredsemi-professional since much of its knowledge base was built on the research conducted by medical doctors (including radiologists) and physicists, rather than by radiographers[40]. In recent years, the research being conducted by radiographers has increased, but there is still a need for a substantial body of knowledge to underpin practice[41]. While many radiographers engage in research at various points in their careers, this involvement is often short-term and project-driven rather than a continuous aspect of their work. There is a national imperative to foster and advocate for sustained participation in research by radiographers. Be that as it may, infrastructure problems, such as inadequate research equipment and poor communication facilities, are significant barriers to medical research in Zimbabwe. These issues are mainly attributed to a lack of funding. Nevertheless, the AHPCZ requires radiographers to engage in evidence-based practice in CT and all other imaging modalities. Research plays a crucial role in advancing education, service delivery, patient care, technological innovations, and workforce development[29]. The College of Radiographers (CoR) of the UK expects all radiographers to be involved in research, as it is a fundamental aspect of advanced and consultant-level practice[5]. The CoR has established a research strategy outlining key patient-focused research priorities.

Considering how Zimbabwe and other similar settings are under-researched, radiographers are well-positioned to explore various areas, such as the use and development of CT equipment/ protocols, testing the effectiveness of diagnosing disorders with new protocols,CT diagnostic reference levels (DRL),understanding the biology/physiology of diagnosing conditions and implementing new ways of working[29]. A research CT radiographer's role involves conducting or facilitating research, and applying their CT knowledge to research activities. Research radiographers can work in diverse settings, including clinical, academic, educational, management, and business, either independently or as part of a team.

CT radiographers are increasingly being involved in clinical auditing in developed countries. The International Atomic Energy Agency (IAEA) defines clinical audit as a systematic examination or review of radiological procedures, comparing it against an agreed standard, and making changes in practice to reach the chosen standard if necessary[42]. The Irish Institute of Radiography and Radiation Therapy (IIRRT) encourages radiographers to actively engage in clinical audits within CT to improve their knowledge base and promote best practices[12]. Clinical audits improve the quality of patient care, promote the effective use of resources, allow radiographers to engage in CPD learning activity, and offer enhanced job satisfaction[43]. In Europe, **i**t is also a legal requirement to conduct clinical audits for European Union (EU) member states[44]. Some of the CT practices that can be audited include patient radiation doses, CT radiology request forms, and IV cannulation and administration of contrast media incidents. Like research, clinical auditing is not fully developed in Zimbabwe and other Southern African Development Community (SADC) countries. To promote best practices in radiology, SADC member states should consider making clinical audits of imaging practices mandatory.

Potential challenges and recommendations in implementing role development and extension in Zimbabwe

Implementing role development and extension for CT radiographers in Zimbabwe presents several challenges. One of the main obstacles is the shortage of qualified CT educators or specialist CT radiographers in the country. With no higher education institutions offering postgraduate courses in CT[1], finding educators who can effectively impart the necessary knowledge to radiographers seeking specialization becomes challenging. This limited access to continuing education and professional development programs can impede radiographers' progression in acquiring new CT skills and competencies. This highlights the importance of implementing a structured program to send radiographers abroad to acquire the necessary skills. They can then return to Zimbabwe and join higher education institutions to impart their knowledge to other radiographers seeking to develop and extend their roles in CT.

Furthermore, there is an inadequate number of CT scanners and resources in many healthcare facilities in Zimbabwe. The scarcity of modern CT equipment and software can restrict the scope of practice for CT radiographers, hindering their ability to take on expanded roles. Zimbabwe, like many African countries, has limited access to advanced CT training facilities, with only about 22 CT scanners in the entire country, half of which are in the private sector[1]. This scarcity of resources results in insufficient placements for radiographers interested in expanding their roles or developing expertise in CT. The public sector, known for equipment down times and shortages of consumables[1,9,17], may compromise the quality of CT training, hindering the development of specialized skills required for role extension. Nevertheless, to address the shortage of CT units for training, a promising strategy is the use of software simulation-based training [45]. This approach allows students at all levels to practice and develop the clinical skills needed to improve the quality of CT services in a safe and effective environment.

Regulatory and legal barriers can pose challenges to implementing CT role development and extension in CT. The absence of clear guidelines and regulations governing CT radiographers' scope of practice can create uncertainty and barriers to role expansion. Outdated legislation may restrict radiographers from performing certain tasks, even with the prerequisite training and skills. This, therefore underscores the importance of starting discussions about radiographer role changes at the policy level, involving regulatory bodies such as the HPA and the AHPCZ.

Socio-economic factors, such as limited healthcare funding and inequalities in access to services, also

impact role development and extension in CT. In resource-constrained settings like Zimbabwe, healthcare institutions may prioritize basic healthcare services (e.g. HIV/AIDS, TB, malaria, maternal health, etc.) over investing in training and expanding the roles of CT radiographers. Lastly, the traditional beliefs and practices of other healthcare professionals can cause resistance in the acceptance of new roles for CT radiographers within the healthcare system.

CONCLUSION

The evolution of CT imaging technology has transformed the role of radiographers, necessitating a versatile skill set to adapt to the demands of modern healthcare. While some countries have made progress in developing and extending radiographers' roles in CT, resource-constrained settings like Zimbabwe have been slower to implement these changes. This literature review highlights the potential for role development and extension to significantly improve the practice of radiographers in CT, Zimbabwe, and other resource-constrained settings. The potential benefits of these expanded roles are substantial. Allowing radiographers to conduct tasks such as IV cannulation and contrast media administration can positively impact patient care, workflow efficiency, and the workload of radiologists. Similarly, the implementation of CTC examinations and reporting on CT brains by radiographers can address the shortage of radiologists, leading to improved patient outcomes and reduced wait times for results. Furthermore, radiographers' participation in research and clinical audit activities can lead to breakthroughs in education, service delivery, and technological innovations, all of which benefit patients. By accepting these changes and providing the required support and training, Zimbabwe can improve patient care, address skill shortages, and advance the radiography profession in a meaningful way. This review underscores the importance of evidence-based implementation, as well as the need for future research to ensure the successful integration of role development and extension for radiographers in CT and in general. Lastly, medical professionals should see radiographers as partners in enhancing the delivery of quality imaging services.

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