Review Article

Image Interpretation and Reporting by Radiographers in Africa: Findings from the Literature Review and their Application to Zambia

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ABSTRACT

Background: The need for having reporting radiographers has been a part of the discussion in the last decade in Zambia. This is due to acritical shortage of radiologists, an increase in demand for imaging services, and the radiographers' desire for professional recognition in providing formal reports on radiographic images similar to those they undertake in ultrasonography.

Objective: The study aimed at reviewing the evidence relating to image interpretation and reporting by radiographers in Africa and apply the findings to Zambia.

Methodology: A literature review was used to bring together studies on image interpretation and reporting by radiographers in Africa. Online databases, radiography journals, cited references, grey literature, and the internet were searched for relevant studies.

Results: Thirteen studies were included in this review. The findings revealed that radiographers in Africa have a positive attitude towards image interpretation and reporting. In addition, their accuracy at image interpretation is comparable to radiologists. The main benefit identified by the establishment of reporting radiographers is improved access to imaging reports. The review also found that medical doctors are in support of the establishment of reporting radiographers. However, the main limitations are a lack of postgraduate courses in this speciality and the limitation of their scope of practice.

Conclusion: Reporting radiographers contribute significantly to the delivery of quality imaging services by assisting radiologists in reporting on radiographic images. There is a need for policymakers in Africa, including Zambia, to extend the scope of practice of radiographers and establish postgraduate image interpretation courses.

INTRODUCTION

The use of imaging in medicine is essential in the diagnosis of many diseases and injuries as well as assessing responses to treatment. The main imaging modality used is general (plain film) radiography. For this reason, the World Health Organisation (WHO) [1] has recommended the availability of general radiography services in all major healthcare facilities. However, the major challenge facing African countries is inequalities in access to imaging services due to a shortage of radiologists to report on

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radiographic images. [2-4] In Africa, there is an average of 3.6 radiologists per one million of the population.[5] This results in many unreported radiographic images and overburdened referring medical practitioners who have inadequate training in image interpretation. [4] This situation is also true for Zambia where only 9 radiologists are working in the public sector against a population of 18 million. To overcome these challenges, there is a necessity to train and extend the scope of practice of radiographers which would allow them to report on general radiographic images.

In Africa, image interpretation and reporting by radiographers is still in research and under discussion. Very few countries have a policy that allows radiographers to report on radiographic images. One country is Uganda, where radiographers have been allowed to report on general radiographic images. [6] In Nigeria, there are reports that radiographers are interpreting and reporting on general radiographic images outside their scope of practice.[7,8] This may attract medico-legal ramifications from the regulator and patients. In South Africa, the Health Professions Council of South Africa (HPCSA) is reviewing the regulations to extend the scope of practice of radiographers to include image interpretation and reporting on general radiographic images.[9] In Zambia, the scope of practice of radiographers is limited to the production of radiographic images. This means that radiographers are not allowed to report on radiographic images, except for ultrasonography.

Literature reports that radiographers give verbal opinion son general radiographic images when requested by referring medical practitioners.[2,4,7,10] In addition to this, medical doctors in Africa are in support of the establishment of reporting radiographers to assist radiologists. [2,4,10,11] However, the main challenge preventing radiographers from contributing positively to diagnostic reporting services is the statutory restrictions of their individual scope of practices.

In Zambia, there are discussions going on within the radiography profession regarding the establishment of image interpretation and reporting training programme and reporting radiographers. However, there is limited evidence to provide information to stakeholders and policymakers. This review, therefore, was aimed at evaluating the evidence on image interpretation and reporting by radiographers in Africa and applying the findings to Zambia.

METHODOLOGY

A literature review was employed to bring together primary studies on image interpretation and reporting by radiographers in Africa. Two bibliographic databases, PubMed/MEDLINE and Science Direct were searched in Marchand April2021 by the first author and crosschecked by the co-authors. The searched keywords included "image interpretation", "image reporting", "radiographers", and "Africa". The bibliographic database searches were supplemented by hand searching of internet search engines and radiography journals. The journals searched include the South African Radiographer Journal, Nigeria Journal of Radiography and Radiation Sciences, Radiography (UK), and Journal of Medical Radiation Sciences. The titles of citations in the reference lists of potentially relevant primary studies were also scanned to find additional articles missed in bibliographic databases and hand searching. Unpublished research dissertations and theses were also searched to avoid missing any relevant studies.

The eligibility criteria for this review were primary studies on image interpretation and reporting by radiographers conducted in Africa and published in the English language. Given that image interpretation and reporting by radiographers in Africa is a new practice that was first discussed in September 2006, [12] the search period was from 2006 to April 2021 (time of search). The scoping literature search did not reveal any study conducted before 2006. All three study designs: qualitative, quantitative, and mixed methods were included in the review. Excluded were reviews, opinion articles, and case reports.

RESULTS

The selection process of studies to include in this review was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[13] This was conducted by the first author and crosschecked by co-authors.The combined initial search from all sources yielded 214 articles. After careful assessment, 11 articles were eliminated because they were duplicates. Following a reading of titles, abstracts, and keywords, another 187 were eliminated as they were deemed to be irrelevant to this review. The remaining 16 articles were retrieved and read in full and three were excluded because they did not meet the inclusion criteria, leaving thirteen studies in this review. Figure 1 shows the results of the selection process of the studies.

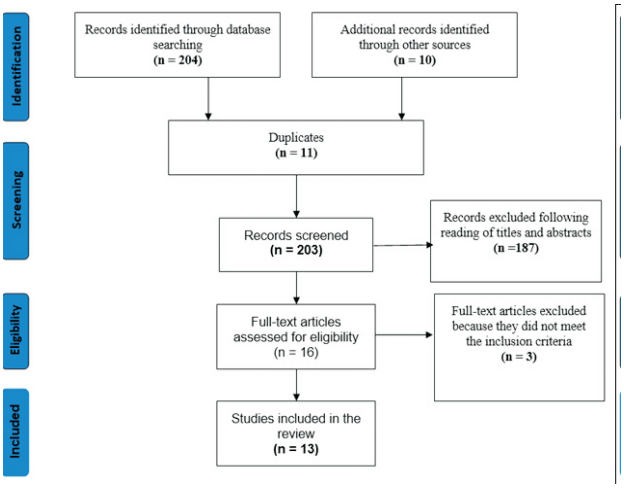

Figure 1: PRISMA flow chart showing the selection process of studies

The included studies were conducted from five countries [South Africa (N=8); Zambia (N=1); Kenya (N=1); Ghana (N=2); Nigeria (N=1)]and were published between 2009 to 2021. The population included three groups: radiographers, radiologists, and medical doctors. The main findings and characteristics of the included studies are summarised in Table 1.

The findings of this review are grouped into six themes: attitudes of radiographers towards image interpretation and reporting, roles of reporting radiographers, benefits of having reporting radiographers, accuracy of radiographers reporting on radiographic images, challenges to the establishment of reporting radiographers, and postgraduate education and training in image interpretation and reporting.

DISCUSSION

Thirteen studies were identified to have been conducted in Africa on image interpretation and reporting by radiographers. This review found that most (N=8/13) studies have been conducted in South Africa, with only one in Zambia. The discussion follows according to the six themes identified in this review.

Attitudes of radiographers towards image interpretation and reporting

One study conducted in Kenya by Daniel and Motto[6] specifically focused on the attitudes of radiographers towards image interpretation and reporting. The study found that most (99%) of Kenyan radiographers were willing to train in image interpretation of the chest and musculoskeletal systems. The remaining studies included in our review partially investigated the attitudes of radiographers towards this role. This is evidenced by their participation in training programmes and their willingness to assist medical doctors on image interpretation of radiographic images. [2,11,15,16,20] The positive attitude of radiographers is in line with the previous study conducted outside Africa. [21]This has resulted in the establishment of reporting radiographers in the UK, United States of America (USA), and Uganda. [6,12,22] This is a positive development as the practice of radiography is developing and changing in Africa.

Zambian radiographers are more than willing to extend their scope of practice by reporting on radiography images.[3,11] This is a positive

Table 1: **Characteristics of included studies (N=13)**

No	Author(s)	Year	Title	Design and data collection method (s)	Main findings	Country
1	*Williams*[14]	2009	Reporting trauma and emergency plain film radiographs: radiologist support for role extension of South African radiographers	Quantitative and questionnaire	• Most (68%) of the radiologists indicated willingness to support establishment of reporting radiographers. • The supports include assessment of clinical competence, clinical mentor, supervisor, and classroom lecturing. • The need for postgraduate training in image interpretation and reporting was identified.	South Africa
2	Gqweta[10]	2012	Role extension: the needs, perceptions, and experiences of South African radiographers in primary health care	Qualitative and a questionnaire with open-ended questions	• Radiographers helped junior medical doctors by giving verbal image interpretation opinions but were not willing to give a written report due to the limitation of their scope of practice. • The benefits of having reporting radiographers included reduction of patient waiting times, job satisfaction, prompt service delivery, optimum utilisation of the • Most of the radiographers indicated that the undergraduate radiography education prepared them to give a verbal opinion but suggested the need for postgraduate training in image interpretation.	South Africa
3	Hlongwane & Pitcher[15]	2013	Accuracy of after-hour 'red dot' trauma radiograph triage by radiographers in a South African regional hospital	Quantitative with a checklist using retrospective data	• The overall accuracy of reporting by radiographers was 93.7%, with 74.4% sensitivity for fracture detection. • Experienced radiographers evaluating appendicular fractures in adults achieved the highest sensitivity (89.9%), which was not significantly different from that of a consultant radiologist (p=0.88).	South Africa
4	Munsanje [11]	2013	Frontline radiographic human capital development- a case of Zambia and way forward	Action research and a questionnaire, interviews, and test of radiographic images	• Bridge the gap created by the critical shortage of radiologists and improve imaging service delivery. • Radiographers accurately interpreted and provided descriptive written diagnostic chest X-ray reports following training. • Patients and medical practitioners were satisfied with reporting by radiographers. • Medical practitioners supported the idea of having reporting radiographers. • The need for postgraduate training in image interpretation and reporting was identified.	Zambia
			Chest image interpretation: the current skills of	Quantitative with a questionnaire	• Radiographers were able to identify abnormalities on chest images.However, they could not accurately describe their findings.	South

5	Gqweta & Naidoo[16]	2014	Chest image interpretation: the current skills of diagnostic radiographers in eThekwini health district of KwaZulu-Natal	Quantitative with a questionnaire and test of radiographic images	• Radiographers were able to identify abnormalities on chest images.However, they could not accurately describe their findings. • Concern over potential medico-legal consequences. • The need for postgraduate training in image interpretation and reporting was suggested.	South Africa
6	Du Plessis & Pitcher[17]	2015	Towards task shifting. A comparison of the accuracy of acute trauma-radiograph reporting by medical officers and senior radiographers in an African hospital	Quantitative and test of radiographic images	• Senior radiographers achieved significantly higher reporting accuracy and sensitivity than medical doctors (81.5% vs 67.8%).	South Africa
7	Kekana et al.,[18]	2015	A survey of South African radiographers' and radiologists' opinions on role extension for radiographers	Quantitative and questionnaire	• Radiographers reported giving image interpretation verbal opinion when requested by medical doctors. • Few (11.6%) of radiologists agreed to have reporting radiographers. • Radiographers suggested the need for postgraduate training in image interpretation and reporting.	South Africa
8	Hazell et al.,[19]	2015	The influence of image interpretation training on the accuracy of abnormality detection and written comments on musculoskeletal radiographs by South African radiographers	Quantitative with pre-and post-tests of radiographic images	• Radiographers provided verbal image interpretationopinion when requested bymedical doctors. • Radiographer accuracy increased from 71.04% to 78%, sensitivity from 83.73% to 87.28%, and specificity from 59.62% to 70.34%) after training. • Vocabulary used when describing abnormalities improved after training.	South Africa
9	Ekpo et al.,[7]	2015	Radiographers' performance in chest X-ray interpretation: the Nigerian experience	Quantitative and test of radiographic images	• Radiographers in the private health sector perform image reporting outside their scope of practice. • Without radiographers undergoingtraining, the mean sensitivity and specificity were 76.9% and 79.8%, respectively.	Nigeria
10	Van de Venter et	2017	Reporting of trauma-related radiographic images in after-hours trauma units: experiences of radiographers and medical practitioners in	Qualitative and interviews	• Consultation between radiographers anddoctors was performed on an informal basis (verbal opinion) because of the limitations of the radiographers' scope of practice. • Not all radiographers provided a verbal opinion to doctors because of the fear that they may misconstrue their opinion as a final diagnosis, which may give rise to malpractice claims and litigation. • Scope of practice limited radiographers to provision of written diagnostic report.	South Africa

11	Daniel & Motto[6]	2017	Kenyan radiographers' willingness to train in image interpretation of the chest and musculoskeletal systems	Quantitative and questionnaire	• Most (99%) of the radiographers were willing to train in image interpretation of the chest and musculoskeletal systems. • Bridge the gap created by the shortage of radiologists, reduction of radiologists' workload, reduce patient waiting time, improve patient satisfaction, improve patient management, reduction in unreported images leading to prompt intervention by clinicians and an overall improvement in quality imaging delivery. • Radiographers suggested postgraduate training in image interpretation and reporting at the masters' level.	Kenya
12	Ofori-Manteaw & Dzidzornu[20]	2019	Accuracy of appendicular radiographic image interpretation by radiographers and junior doctors in Ghana: Can this be improved by training?	Quantitative with pre-and post-tests of radiographic images	• The radiographers achieved higher sensitivitythan the doctors in both pre and post-test analysis (pre-test, 69.2% vs 67.8%: post-test, 83.3% vs 77.2%) • Medical doctors attained higher specificity scores than radiographers (pre-test, 75.6% vs 68.3%: post-test, 86.7% vs 83.3%). • Medical doctors recorded a higher mean accuracy score than the radiographers in the pre-test (71.6% vs 68.8%), the opposite was observed for the radiographers in the post-test analysis (83.3% vs 81.9%).	Ghana
13	Wuni et al.,[4]	2021	Developing a policy framework to support role extension in diagnostic radiography in Ghana	Qualitative and interviews	• Radiographers reported giving image interpretation verbal opinion when requested by medical doctors. • The training of radiographers in image interpretation would bridge the gap created by the shortage of radiologists, professional recognition, job satisfaction and improve quality of care. • Most of the medical doctors supported the idea of having reporting radiographers. • Some radiologists supported the idea of having reporting radiographers. • Radiographers suggested postgraduate image interpretation course.	Ghana

development because it will bring image reporting services as close to the family as possible which is currently lacking due to the critical shortage of radiologists in the country. However, the main challenge is the legal restriction placed on radiographers by the Health Professions Act No.24 of 2009 of the Laws of Zambia, [23] which prohibits radiographers to report on radiographic images. Interestingly, the same legislation permits radiographers with appropriate qualifications to perform and report on ultrasound examinations. It can be argued that reporting on sonographic examinations is user dependant and therefore, places a higher burden of responsibility compared to reporting on plain film images whose interpretation can be second checked by the clinician outside the image acquisition process. To respond to this challenge, the Radiological Society of Zambia (RSZ) should advocate for the change of radiographers' scope of practice to include image reporting.

Roles of reporting radiographers

In our review, all the included studies focused on the clinical role of a reporting radiographer interpreting and reporting on radiographic images. However, literature also revealed non-clinical roles of reporting radiographers which include the provision of professional leadership, practice and service development, participation in education and

training, and research. [22,24] Reporting radiographers can also be appointed as consultant radiographers. [24] The successful implementation of reporting radiographers on general radiographic images in the UK and the realisation of their abilities at image interpretation resulted in additional responsibilities in specialised imaging examination such as Computed Tomography (CT),Magnetic Resonance Imaging (MRI), and Breast Imaging. [25-27] This is encouraging to countries such as Zambia where the establishment of such initiatives could improve the delivery of imaging services. This is against a background where the Zambian Government and private sector have embarked on improving access to medical imaging services through the installation of several pieces of imaging equipment across the country.

Benefits of having reporting radiographers

Literature shows that in the absence of a radiologist report, the establishment of reporting radiographers improves clinical decision-making. [9,22,28,29] Some studies included in our review found that having reporting radiographers bridges the gap created by the shortage of radiologists. [4,6,10,11,18] Our findings are consistent with the UK studies. [25, 26,29] Other benefits identified in our review include reduction of patient waiting times, better career opportunities and increased job satisfaction, prompt service delivery, optimum utilisation of the radiographers' skills and knowledge, and overall improved service delivery. These benefits have also been reported in studies conducted in the UK.[26,29] The benefits outlined in the literature that would accrue by the establishment of reporting radiographers are also true for Zambia.

The Zambian situation regarding the shortage of radiologists is worse than the UK and some African countries such as South Africa, Uganda, Nigeria, Kenya, and Ghana.[4,6,7, 9,26] In Zambia, only 9 radiologists are currently working in public hospitals against a population of 18 million. There is also an increase in demand for imaging services due to an increase in the population and a high incidence of communicable diseases such as Tuberculosis (TB) and Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS). [31] This has put pressure on imaging services. Zambia could benefit even more from having reporting radiographers than the UK and USA where the role is well established. Thus, the establishment of reporting radiographers needs urgent attention by relevant authorities to improve imaging services.

Accuracy of radiographers interpreting and reporting on radiographic images

Four studies[7,15-17] included in our review assessed the abilities of radiographers at image interpretation without intervention training. In a study by Hlongwane and Pitcher, [15] the overall accuracy of reporting by South African radiographers was 93.7%, with 74.4% sensitivity for fracture detection. Experienced radiographers evaluating appendicular fractures in adults achieved the highest sensitivity (89.9%), which was not significantly different from that of a consultant radiologist (p=0.88). This finding is concordant with the UK studies which shows that reporting radiographers provide imaging reports at a level comparable to radiologists.[27,30] In another study conducted by Ekpo and others, [7] Nigerian radiographers were able to interpret chest X-rays with mean sensitivity and specificity of 76.9% and 79.8%, respectively. In a study by Du Plessis and Pitcher, [17] South African senior radiographers achieved significantly higher reporting accuracy and sensitivity percentages than medical doctors, with81.5% and 67.8%, respectively. The accuracy, sensitivity, and specificity match with the UK radiographers.[28] The other study conducted in South Africa by Gqweta and Naidoo [16]found thatradiographers were able to identify abnormalities on chest X-ray images. However, they could not accurately describe their findings. This weaknesscould be improved by training.[11,19,20] This shows the importance of postgraduate training in image interpretation and reporting.

In this review, three studies [11,19, 20]assessed the abilities of radiographers at image interpretation following an educational intervention programme. In a study conducted by Munsanje, [11] Zambian radiographers accurately interpreted and provided descriptive written diagnostic chest X-ray reports following training. In another study conducted by Hazell and others, [19] South African radiographers' accuracy increased from 71.04% to 78%, sensitivity from 83.73% to 87.28%, and specificity from 59.62% to 70.34%after training. A study conducted in Ghana by Ofori-Manteaw and Dzidzornu [20] compared the abilities of radiographers with medical doctors. The radiographers achieved higher sensitivity than the medical doctors in both pre and post-test analysis (pre-test, 69.2% vs 67.8%: post-test, 83.3% vs 77.2%). Regarding specificity, medical doctors attained higher specificity scores than radiographers (pre-test, 75.6% vs 68.3%: post-test, 86.7% vs 83.3%).With regards to accuracy, medical doctors recorded a higher mean accuracy score than the radiographers in the pre-test (71.6% vs 68.8%), the opposite was observed for the radiographers in the post-test analysis (83.3% vs 81.9%). This finding agrees with the UK literature on the impact of training.[26,28] This shows that educational intervention programmes have a positive effect on image interpretation abilities of radiographers.

Challenges to the establishment of reporting radiographers

Resistance by some radiologists to support radiographers in extending their individual scope of practice is one of the challenges identified in our review. For example, in a study conducted by Kekana and others, [18] most (88.4%) radiologists opposed the idea of having reporting radiographers in South Africa. Our finding is consistent with studies conducted outside Africa. [26,32] However, this is in contrast with studies conducted in South Africa by Williams [14] and in Ghana by Wuni et al., [4] where most of the radiologists indicated their support for the establishment of reporting radiographers. It should be mentioned that radiologists have an important role to play in the role extension of radiographers. A study by Williams [14] identified four areas that require support from radiologists: assessment of radiographers' clinical competence, being clinical mentors and supervisors, and lecturing in image interpretation and reporting.

Other challenges reported in the literature include competition with student radiologists, difficulties in releasing radiographers for training due to staff shortages, financial constraints, and appropriate remuneration for the reporting radiographers. [3,12,33] In studies by Gqweta and Naidoo [16]and Van de Venter and others, [2] radiographers had a concern regarding the potential medico-legal consequences. However, it is noteworthy to consider that medical litigation may arise in all areas of medical imaging. [22] For example, absence or wrong anatomical side markers for a patient undergoing surgery procedure may result in a serious error and medico-legal consequences. The most important thing is for radiographers to practice within their individual scope of practice and qualifications.

Given the above, the engagement of key stakeholders and careful planning is essential to overcome the identified challenges to the establishment of reporting radiographers in Africa. In the Zambian context, this means the Radiological Society of Zambia (RSZ) engaging the Ministry of Health (MOH), Radiologists, Zambia Medical Association (ZMA), and HPCZ as key stakeholders. This can ensure smooth policy and practice changes that contribute to the improvement of imaging services in the country.

Postgraduate education and training in image interpretation and reporting

The other important area identified in this review is the need for postgraduate education and training for radiographers taking up the role of image reporting. It should be mentioned that increased professional responsibilities should not be undertaken at the expense of quality.[14] To ensure the quality of imaging

services, specialised training is required to develop the knowledge and skills of radiographers at image interpretation. This finding is in accord with findings in other reviews conducted in the UK [28] and Australia. [22] The postgraduate education and training must be at master's level. [12,25, 24,34,35] This should be supplemented with continuous professional development (CPD) to maintain knowledge, skills, and competence.

The main challenge facing African countries on this subject is a lack of image interpretation and reporting courses. Currently, only two postgraduate courses are being offered by Ernest Cook Ultrasound Research and Education Institute (ECURE) of Uganda and Nnamdi Azikiwe University of Nigeria. ECURE offers a one-year diploma in image interpretation and reporting course which has been running for a decade, [36] whilst Nnamdi Azikiwe University offers a masters in image interpretation. [8] This is in contrast with the UK where 16 universities offer image interpretation courses. [34] In Zambia, there are plans by the University of Zambia (UNZA) to establish an image interpretation and reporting training programme while the RSZ is advocating for an extension of the scope of practice of radiographers working in Zambia.

CONCLUSION

This review found that radiographers in Africa have a positive attitude towards image interpretation and reporting. In addition, medical doctors, including radiologists, are in support of the establishment of reporting radiographers to assist radiologists. However, the main hindrance is on their scope of practice and a lack of local postgraduate courses in this area. In the Zambian context, there is a lack of research on this subject to support the establishment of reporting radiographers. Therefore, there is a necessity to conduct research on the opinion of radiographers and radiologists towards reporting radiographers, comparison of abilities of radiographers and clinical officers/medical doctors in image interpretation, and accuracy of radiographers in image interpretation following an interventional training programme.

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