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Self-perceived Versus Supervisor-rated Technical Competence in Plain Film X-ray Evaluation by Newly Graduated radiographers: Implications for Curriculum Development and Practice in Zambia

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Abstract

Purpose: The purpose of the study was to determine and compare the self-perceived versus supervisor-rated technical competence in plain film X-ray image evaluation using seven standard parameters among newly recruited radiographers working in tertiary teaching hospitals in Zambia. This was done to evaluate the value of measuring technical competence as a feedback to curriculum development and review.

Methods: A parallel convergent mixed-methods study was conducted. Two focus groups with a total of 17 radiography supervisors purposefully selected from teaching hospitals and training institutions across Zambia were held to solicit their views on technical image evaluation capability of the newly graduated radiographers. A descriptive cross-sectional survey involving 31 newly recruited radiographers from five Zambian teaching hospitals was conducted to assess self-perceived competence in plain film x-ray evaluation. We used thematic analysis to analyse qualitative data, whilst analysis for quantitative data, STATA version 13 and Graph pad prism 5 was used.

Results: Among the 17 radiography supervisors, 11 rated the technical competence of entry-level radiography graduates as low. Reasons advanced included insufficient clinical training, uncoordinated clinical training, lack of focus on core radiography training, and lack of attention and commitment to work. In the cross-sectional study, the mean score for self-evaluated competence was 76%. The frequency of performing chest X-rays predicted self-rated competence score ($p<0.001$).

Conclusions: There was variation between self-perceived and supervisor-rating of technical competence of entry-level radiography graduates in Zambia. A need exists to perform an actual workplace-based assessment to establish actual competence of the new graduates to inform curriculum development and review in Zambia.

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1. Introduction

Generally, clinical competency is the combination of skills, knowledge, attitudes, and the ability required to perform clinical roles with desirable outcomes.[1] Globally, there is a trend to ensure that medical training programmes respond to the needs of society.[2] Competency of a health professional is directly linked to the quality of care offered to patients.[3] To a greater extent, the performance of a training programme can be evaluated by assessing the clinical competency and performance of its graduates in actual clinical practice. The competency level of the health professional can be linked to the type of training and curriculum used.[4] One health professional that requires a high level of technical competency is a radiographer. Radiography competence is finely posed between the need to produce quality images and radiation protection requirements.[5] Technical competence of a radiographer can, therefore, be considered to be the knowledge, skills and attitudes that relate to technical aspects of radiography work.[6]

Studies in the medical field have shown a mismatch between expected competencies and actual competencies of medical students.[7,8] Mukwato et al. found a moderate correlation between experience and self-perceived competence of medical students.[9] Mukwato and Banda found a negative correlation between measured competency and self-perceived competency.[10] In their study, most of the participants' actual measured competency was lower than their perceived competency level.[10] Assessment of clinical competency of both qualified radiographers and radiography students has in the recent past attracted attention from relevant stakeholders.[11] Due to the rapidly evolving field of radiography characterised by advances in new imaging and diagnostic technologies, scientific discoveries, and innovations, the competency profile of anyone practising radiography is very critical to ensuring professional standards.[12] Sloane and Miller found that radiography managers raised concerns about a mismatch between competencies taught and those required in the practice.[13]

Zambia has scaled up radiography training with the coming on board of both public and private training institutions offering radiography programmes. At the time of writing, Zambia had three (3) higher learning institutions training radiographers at undergraduate diploma and bachelor degree levels, respectively. There is increasing pressure from communities that radiography graduates must have the necessary academic and practical skills.[14]

In Zambia, there is a paucity of evidence relating to technical competency of radiography graduates required to inform curriculum development and review. The study sought to compare self-evaluated technical competence in plain film chest x-ray evaluation to supervisor-perceived competency of the newly graduated radiographers practising in Zambia. A plain film chest x-ray was used as an exemplar because over 80% of medical imaging procedures in Zambia involve chest imaging.[15] Findings of this study were premised to inform competency gaps and quality improvement of contemporary training curricula.

2. Methods

2.1. Study design

This was a parallel convergent mixed-method study. Qualitative aspect utilised a case study typology while a cross-sectional study was employed to collect quantitative data. The study was conducted at five tertiary level teaching hospitals in three provinces (Lusaka, Copperbelt and Eastern province) of Zambia. These are hospitals used as clinical training sites for the Technical Education, Vocational, and Entrepreneurship Training Authority (TEVETA) training.

2.2. Study population and setting

The populations included supervisors of radiographers (with over ten years' experience in radiography practice) and the newly qualified (entry-level) radiographers practising at the tertiary public teaching hospitals in Zambia. Newly qualified were those with less than three years' work experience and graduated after 2010 from the TEVETA radiography training curriculum. A total of 17 radiography supervisors were purposively selected for the two FGDs. In the second

phase, a census approach was used to select participants because of the limited number fitting the eligibility criteria. A total of 31 radiographers participated in the study.

2.3. Data collection

In the qualitative component, focus group discussions (FGDs) were employed. Participants (radiography supervisors) were asked to rate the technical competency of the newly graduated radiographers working under their charge. Three reference levels were provided as follows: low, moderate and high technical competence, respectively. In addition to the rating, the supervisors were required to provide reasons for their reasoning. Their responses were recorded and then transcribed.

In the second phase, a self-administered structured questionnaire was utilised. The questionnaire collected data on demographics, clinical experience, self-rating of technical competency in chest x-ray evaluation using seven standard parameters (anatomy coverage, patient positioning, film exposure, film contrast, image sharpness, identification requirement, and radiation protection measures). In each of these categories, a five[5] point Likert scale was used for self-rating (5: Excellent, 4: Very good, 3: Good, 2: Moderate, and 1: Poor). A summed score was used as an aggregate determinate of overall competence rating.

2.4. Data analysis

The analysis for the qualitative part was conducted using thematic analysis. The analysis began with listening to the audiotapes and then transcribing the verbatim discussion. Three phases open, axial and selective coding were then used. NVivo version 11 software was used for qualitative data management. The final themes were then cross-checked through a peer debriefing process.

For the quantitative data, the Shapiro–Wilk test with alpha set at 0.05 was used to confirm normality. Where data were normally distributed, parametric tests were used and non-parametric tests were not normally distributed data. An unpaired 't' test was used to test the difference in the competence score between the female and male. The Mann–Whitney test was used to compare the competence score between the two categories in terms of the number of chest x-rays performed per week. The differences in competence score among the hospitals were tested using Kruskal–Wallis test. All statistical computations were done using Stata version 13 (STATA Corp., College Station, TX, USA) and Graph Pad Prism 5 (Graph Pad Software Inc., La Jolla, California, USA).

2.5. Ethical considerations

Participant inclusion was based on written informed consent. All data collected were confidentially kept at all times. All names and possible identification parameters were anonymised and not used at any time. Ethical approval was obtained from the University of Zambia Biomedical Research Ethics Committee (IRB00001131 of IORG0000774) (Approval reference No 012-06-17).

3. Results

3.1. Participant demographics

Table 1 below illustrates the characteristics of the participants.

3.2. Radiography supervisors' rating of technical competency

All the supervisors rated the subordinates as having low to moderate levels of technical competence. Reasons advanced for their rating included poor clinical output and low technical capabilities. This was evidenced by the following statements:

> ***'For example, when I tried to review the images that were to be dispatched, I returned 90% of them because they were wrong as they may have been exposed or captured using wrong technique.'*** Participant F, FGD1

Table 1
Baseline characteristics of study participants.

Variable	FGD 1	FGD 2	Cross-sectional study
Sex (F:M)	2:8	3:4	17:14
Age (mean age: SD)			25 (1.63)
Years of Experience	–	–	
< 2	–	–	31
10 to 15	5	5	–
15 to 20	3	2	–
Over 20	2	–	–
Qualifications			
Masters Degree	5	1	–
Undergraduate Degree	5	2	–
Undergraduate Diploma	–	4	31

Table 2
Frequency of performing certain types of plain film examinations.

Examination	Frequency				
	<5	≥5<10	≥10>15	≥15<20	≥20
Chest X-ray	1		5	3	22
Abdomen	5	4	13	6	3
Pelvis	4	9	11	3	4
Spine	5	10	7	7	2
Skull	4	11	6	4	6
Upper Limb	1		5	2	23
Lower limb	1	2	1	6	21

'they have a lot of problems in the technical competence aspect and issues of interpersonal professional competences' Participant C, FGD2

The reasons provided for the low levels of competence were summarised into four (4) thematic groups as illustrated in Fig. 1 below:

There was a perception among the participants that there was insufficient clinical training. In explaining reasons for their low rating one participant said

'we do not see the students in clinical sites if they come it is only for a few hours. How do you expect them to learn anything' participant A FGD1

Some of the participants also noted that the time spent in the clinical sites was uncoordinated with very little communication between the academic and clinical training teams.

'students are sent without proper planning, we do not even know what to teach them' participant C FGD2

'We are wondering what is happening to the schools where they are coming from these days' participant B FGD2

There was a perception amongst the participants that the current radiography training included too many aspects, such as ultrasound at the expense of the core technical subjects in radiography.

'it seems like their trainers leave out a lot of things where I feel they only focus on ultrasound and imaging and leave out other important issue' Participant F FGD 2

The last theme derived from the data was the lack of focus by new graduates on the performance of their core jobs. Participants felt there was a lack of concentration and commitment to tasks. This was evident from the following;

'they don't do things as instructed every time. You find that you tell them to do something and you have given them proper instructions but after some time you find that they have done nothing and they give excuses even in small things' Participant E FGD 2

3.3. Self-perceived rating of technical competency among entry-level radiographers

Table 2 shows the frequency with which participants undertook various imaging procedures. Chest x-rays, upper limb and lower limb examination were the most undertaken. This illustrated by the number of participants who indicated that they conducted this examination more than 20 times in a week.

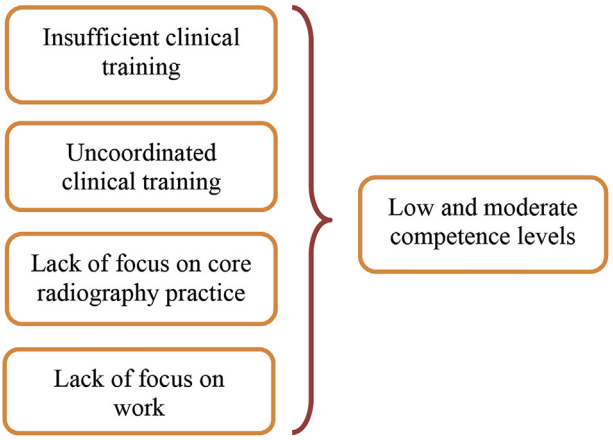

Fig. 1. Theme describing supervisors' perceptions of competence level.

Table 3
Comparison of self-competence and dependent variables.

		Number (N)	Mean score	Mean (SD)	P –value and/or R square
Sex	Female	14	26.8	4.4	p=0.398[a]
	Male	17	26.7	4.1	
Chest X-ray performed per week??	<20	9	23.2	4	p=0.019[b]
	>20	22	28.2	3.3	
Hospital	A	5	22.4	6.2	p=0.227[c]
	B	3	29.3	3.1	
	C	7	26.4	4.7	
	D	12	28	2.6	
	E	4	27.3	2.1	

[a] t-test.
[b] Mann Whitney test.
[c] Kruskal–Wallis.

None of the participants rated themselves as poor on any of the above chest x-ray film requirements. In terms of aggregated self-assessment scores, the mean score out of 35 was 26.77 (SD 4.18) (76%). Aggregated anatomy score places the self-assessment performance at good to very good (Mean 3.52 ± 0.85). The median score for positioning, exposure, image annotation, and radiation protection was 4 IQR 4–5 which placed the aggregated self-performance at very good. The aggregated self-assessment performance for contrast and sharpness was rated as good.(See Fig. 2)

There was a significant variation with regard to the self-assessment across the different assessment categories (p-value <0.0001). There was no statistically significant difference noted with sex, hospital facility, and frequency of performing chest x-rays (Table 3.

Finally, an investigator-led multiple linear regression model was constructed using a backward stepwise approach with probability to be included in the final model set at 20%. The adjusted R squared for the model was 0.47. Compared to those that performed less than five[5] chest x-rays per week, the group that performed between 15 and 20 chest x-rays per week had a higher self-competence score (p <0.001). Furthermore, participants with a longer period between graduation and our study were likely to report higher self-confidence score (p=0.03).) (see Table 4)

Table 4
Linear regression analysis of the self-perceived score and dependent variables.

	Coefficient.	95% CI		P-value
Duration post-graduation	0.3059	−0.0194	0.6312	0.064
15–20 Chest X-rays performed	−2.937	−6.976	1.101	0.147
10–15 Chest X-rays performed	−6.750	−9.867	−3.633	<0.001
Age	−2.709	−6.240	0.807	0.125

CI – Confidence interval.

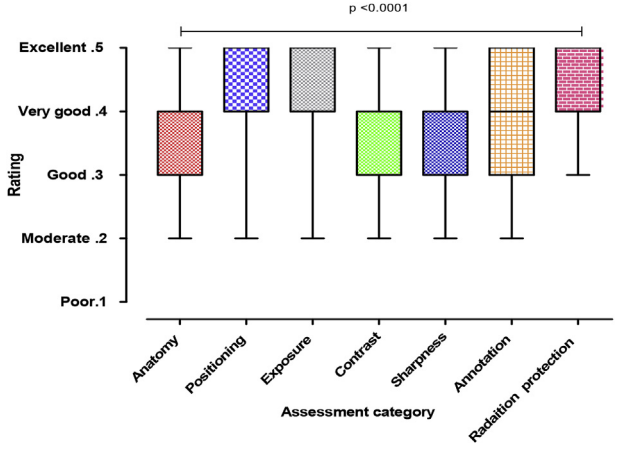

Fig. 2. Showing participants' self-rating of technical competence on film chest x-ray.

4. Discussion

There was a high self-perceived competence level among the radiographers that participated in this study (mean score for self-evaluated competence was 76%). This was against a low to moderate (less than 60%) qualitative estimate by their supervisors. In a study conducted by Vanckavičienė et al. radiographers and radiologists' perception of radiographer competency were evaluated.[12] They concluded that the overall level of radiographers' competence was high or very high. Similar findings were also found by Mackay et al. when the readiness for practise of newly qualified radiographers was assessed.[16] A fundamental difference could be the level of experience of radiographers. Our study examined relatively inexperienced radiographers with less than two[2] years of experience.

Katowa-Mukwato and Banda, in their study of competence among medical students at the University of Zambia, found that medical students' perception of competence and actual measured competence in clinical skills were at variance. Similarly, the student rating was actually higher than the actual performance rating following an objective assessment in their study.[17] Even though the setting was different in terms of the participant characteristics, this finding was consistent with the current study.

This differences in opinions between the entry-level radiographers and their supervisors in our study raise several questions; Are the seniors not adequately supervising or providing mentorship to the new radiographers? Are mentorship programmes in place in the current institutions? Is there a system of quality assurance that enables a learning environment for skills improvement? And, is continuous professional development activities being provided to the newer generations of radiographers in Zambia? These are potential study questions for the future.

The finding that the number of years of practice post-graduation and the frequency of performing chest X-rays were predictors of high self-rated technical competence score among radiographers was not surprising. Although there is a paucity of literature on predictors of technical competence among newly qualified radiographers, other studies such as by Istomina et al. conducted in a population of nurses found that in nurse education, years of practice experience, professional development, independence, and work satisfaction, as well as the evaluation of the quality of nursing care, were factors associated with nurse competence.[18] In a study by Wangensteen et al. the predictors of competence among nurses were gender, university education, healthcare practise experiences, work area, and critical thinking.[19] It would be interesting to further evaluate and compare predictors of radiographer's competence in other similar practise settings.

In this study, the number of chest x-rays conducted per week was used as a surrogate for practical experience in plain film imaging. A growing body of evidence has demonstrated that individuals that have a longer practice history and a high frequency of conducting particular imaging investigation tend to have a high self-perceived competence.[20–22] Our findings are consistent with other studies that found practice experience as an important factor in the determination of technical and procedural competence.[20–22]

The reason advanced by the clinical managers with regard to low levels of competence were; insufficient clinical training, uncoordinated clinical training, lack of focus on core radiography training, and lack of attention and commitment to work. In a systematic review of nursing education by Bwanga and Chanda, found that a lack of coordination between the academic institution and clinical training site was a source of worry in clinical training. Furthermore, they noted that a deliberate planning system needs to be established between the institutions in order to support clinical educators and ensure effective monitoring of students.[23] Similar findings were reported by Williams and colleagues who listed management and organisation as an important factor in clinical training.[4] Therefore, our finding offer plausible explanation for the low rating of competence by the radiography supervisors.

The issue of including other non-radiography components such as ultrasound as suggested by radiography supervisors in this study was a complex matter. A situation in Zambia has arisen where the available number of ultrasound units has increased hence driving the need to have suitably trained personnel to operate these units. The current TEVETA curriculum for training radiographers has adopted basic ultrasound into the training. The question that arises is whether the current radiography programmes offered by the training institutions in Zambia have sufficient time to impart the required competencies for both basic radiography and ultrasound. Sloane and Miller noted that a balance must be reached between society requirements and technological changes on one hand with the demands for training on the other.[13]

The concept of radiographers' attitude has been investigated from the perspective of patient satisfaction

with service.[24] It was found that bad work practices are evident and affect patient satisfaction negatively. The poor work ethic and commitment to tasks that were also reported by the radiography supervisors in our study also collaborates this evidence. Inference can be drawn that where an individual has bad work etiquette, the technical competence of such an individual may be affected and brought into question.[25] Further studies are required to elucidate contextual drivers and solutions to address professionalism aspects of radiography practice.

5. Limitations and delimitations of the study

A limitation of the study was that self-reported and qualitative assessment of competence approach was utilised. Evidence points to the fact that actual objective assessment of competence provides a more robust method for comparison.[9] Invariably, self-estimation may lead to overestimation.[9] However, the viewing of the phenomena using two lenses provides an insight that requires further investigation.

6. Conclusion

The study showed inconsistency between supervisor perceptions and self-rated technical competency of junior radiographers. The workplace supervisors indicated a low level of technical competency whereas the junior radiographers indicated a high self-rating of competency in plain film chest x-ray evaluation. Inadequate clinical training and attitude towards technical tasks were among reasons for the low rating by radiography supervisors. The findings demonstrate the value of competency evaluation in providing information that can be used in programme and curriculum evaluation.

Declaration

This article is linked to research for JMS's PhD, using the same ethics number.

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Declaration of Competing Interest

None.

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