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Effect of Continuous Medical Education on Awareness of Clinical Imaging Guidelines Among Imaging Referrers in Sub-Saharan Africa

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Abstract: Rationale and objectives: In recent decades, there has been an effort to improve the quality and safety of medical imaging globally. Such, has been promoted through the application of decision aid tools. Clinical Imaging Guidelines (CIGs) are systematically developed statements to assist referrers to make appropriate patient imaging decisions for screening, diagnosis and management of conditions. Awareness of such guidelines prompts their application thus enhancing safety of imaging procedures. There is evidence of low levels of awareness elsewhere but such hasn't been assessed in Sub-Saharan Africa. The study assessed the CIGs awareness level among imaging referrers before and after giving continuous medical education (CME) and awareness materials. Methods: A pre and post -CME mean score of 18 item questionnaire on awareness on CIGs for 109 referrers from 5 health facilities were compared. A statistical difference in the mean scores for the pre and post intervention assessment was determined using a paired T-test at $P > 0.05$ and Confidence interval of 95%. Results - At baseline, we found a 47% level of CIGs awareness and after the intervention we found a level of 59%. There was a significant statistical change of 12% level of CIGs awareness from pre-intervention 47% to post intervention 59% at P-value < 0.0001 and 95% confidence interval (7.8-16.4). Conclusion and Recommendation: Routine CMEs are a good to start platforms for enhancing awareness of CIGs and strengthening justification of medical exposures.

Keywords: Awareness, Clinical Imaging Guidelines, Continuous Medical Education, Imaging Referrers

1. Introduction

The continued innovation in diagnostic ionizing radiation technology such as multi-detector computerized tomography has increased its application in patients care with improved outcomes. However, some of CT examinations performed are not justified exposing patients to unnecessary radiation with increased risk of developing radiation induced cancers [1, 2]. One area where improvement can be made is in the area of justification of medical exposure [3].

Clinical imaging guidelines (CIGs) are practical tools effective in providing guidance to imaging referrers on appropriate imaging based on clinical indications for a particular individual. The process of developing CIGs has been noted to be rigorous, iterative and an expensive process which requires a lot of expertise and multidisciplinary teams [4]. This explains the fact why few countries especially in low resource settings like Africa don't have such decision

aiding tools for imaging [5].

To mitigate the challenges related to developing guidelines, Radiology organizations and societies have lent a hand to support or fully taken on the responsibility of developing these guidelines especially in the developed world. For countries where resources are limited and Radiology organizations or societies are in their infancy or don't exist, adaption and adoption of already developed guidelines from other settings has been done albeit challenges of applicability [2].

A number of guidelines have been developed elsewhere including the iRefer by the Royal College of Radiology, Canadian Association of Radiologists' Diagnostic Imaging Referral Guidelines, France's "Guide du bon usage des examens d'imagerie médicale", Western Australia Diagnostic Imaging Pathways, American College of Radiologists' Appropriate criteria and the European Society of Radiology's IGuide [6–9] to mention but a few.

Clinical Imaging guidelines have been evidenced to be practical evidence-based radiology tools for preventing unnecessary damages, providing benefits for patients, and fair action through removal of redundancy [10]. Such a role has been stated to satisfy the justification principle of radiation safety which requires that all imaging requests be evaluated to determine whether patients fit the recommended criteria for a specific procedure as requested. There is evidence to show the benefit of implementing these guidelines. A study done by Kawooya et al has shown that implementation of such guidelines reduced inappropriate imaging for CT procedures in Sub-Saharan Africa [11]. The referring clinician is the first contact for majority of the patients who seek radiological procedures. This implies that the referrer has the responsibility to prescribe the best choice imaging procedure for the patient basing on the clinical and administrative data useful for the validation of that choice. Such decision making for patient condition diagnosis and management is enhanced by decision aid tools or systems like CIGs and efforts have been made to provide such tools through developing or adopting and adapting the already developed. Most of these guidelines have been published both soft, hard copies or even integrated in online systems to aid use [12]. Much as this has been done, studies have indicated that majority of these are not aware or lack knowledge of decision aiding tools or systems like CIGs. A study done in Australia indicated that over 50% of chiropractors were not aware of the radiographic referral guidelines for low back pain [13]. In addition, a study done in Cameroon has indicated that most referrers do not have appropriate awareness about radiation doses for routine imaging procedures and only a smaller number of them have knowledge or awareness on CIGs [14].

This study sought to assess for the awareness of CIGs among imaging referrers in five selected health facilities sub-Saharan Africa and the effect of simple interventions such as continuous medical education and awareness materials.

2. Methods

The study was carried out at 5 health facilities and involved a total of 124 referrers who included intern doctors, medical officers and specialist doctors. Administrative clearance was granted by each of the 5 participating hospitals and ethical approval obtained from School of Medicine Research and Ethics Committee (SOMREC) and National Council for Science and Technology. The hospitals were selected based on the following criteria: regional representation, ease and feasibility of controlling the environment, representation of the main facilities providing the CT scan services (public, private, teaching, national and regional referral) and functional CT equipment during the duration of the study. In addition, having accessible to hard copies of paper-based CT requisition forms for the required duration for the second part of the study.

A baseline and post intervention level of awareness for principles of radiation protection and CIGs was determined by obtaining a mean score of all participant.

2.1. Questionnaire

The questionnaire was reviewed and validated by five experts (2 radiologist, epidemiologist and 1 physician and one medical officer) and developed based on the experience of the authors as well as content gathered from a literature search [15].

The validity of the questionnaire was assessed based on the content validity. The content validity was determined based on the experts' review of each question regarding its relevance, simplicity, and clarity. A pilot study was conducted in which the finalized questionnaire was administered to 20 head CT referrers at Mengo Hospital, Uganda. The internal consistency reliability was calculated using Cronbach's alpha ($\alpha = 0.83$).

The anonymous 18-item questionnaire was distributed to all participants who consented before the respective hospital CME (baseline). The participants were given a 30-min period within which to complete and return the questionnaires to ensure that participants did not search for the correct answers to the questions related to their awareness of radiation safety practices and CIGs. The structured questionnaire was divided into 3 themes with a particular number of questions (General radiation protection knowledge-3, introduction to and definition of CIGs-4 questions and application of CIGs for various clinical conditions -11 questions).

2.2. Intervention

The Intervention consisted of 2-3-hours session by two radiologists (senior consultant and a professor, a senior imaging technologist and epidemiologist) during routine CMEs. The power point presentation consistent of basic principles of radiation protection, radiation doses from common imaging procedures equivalent to number of chest x-rays, risks of radiations, causes of inappropriate CT requisitions, other imaging alternatives that don't use ionizing radiation, appropriate CT imaging requisitions and

CIGs. This was followed by practical session to access and use the European Society of Radiology - iGuide. This included accessing the website, registering and downloading the iGuide app on laptops, smart phones or desk tops. There was a live interactive session demonstration on how to use the app for different case scenarios.

The trainees were also given a variety of educational materials, including slides, overheads, International Atomic Energy Agency posters on radiation protection and justification of CT scans which were pinned in the work stations.

The same structured questionnaire was re-administered after 6-12 months to check on the level of awareness after a second similar CME.

2.3. Data Analysis

Scores were summarized as proportions. A percentage difference between the pre and post-intervention scores for each sub-theme was calculated to determine knowledge retention.

A statistical difference in the mean scores for the pre and post intervention assessment was determined using a paired T-test at P>0.05 and Confidence interval of 95%.

3. Results

There were 109 respondents at baseline and 124 post intervention from 5 selected participating hospitals. However, 15 respondents who didn't attend the baseline analysis were excluded from the analysis. The number of attendees per CMEs session ranged from 29 to 57 (average 42). These included specialists, radiologists, radiographers, medical officers, residents, nurses, and clinical officers.

At baseline, the referrers had a mean percentage score of 47% while after the intervention we found a mean score of 59% as shown in the table below.

Table 1. *Pre-intervention and Post-intervention mean scores among referrers at 5 selected Health facilities in Uganda.*

S/N	Question	Choices	Baseline (%)	Post (%)	Difference (%)
1	What are Clinical Imaging Guidelines/Clinical Referral Guideline (CIGs)?	A. Decision support tools for assisting the referrer to choose the best investigation for a patient presenting with a specific signs and symptoms	62.4	72.58	10.18
		B. A set of regulations which the referrer should follow whenever he/she requests for an imaging investigation	16.5	10.48	-6.02
		C. Standards developed by the professional societies together with health authorities to ensure referrers use them for all the patients needing imaging	21.1	16.94	-4.16
2	How do clinical imaging guidelines differ from Clinical Practice Guidelines?	A. They are basically the same except that the imaging guidelines give more emphasis to imaging in addition to other management requirements for the patient	28.4	23.39	-5.01
		B. Imaging guidelines are just developed to support imaging decisions whereas practice guidelines are general supporting all practice decisions in the patient care cycle	61.5	60.48	-1.02
		C. Imaging guidelines are extracted from the practice guidelines and are therefore a true sub-set of the practice guidelines	10.1	15.32	5.22
3	What is the principle of "justification" with reference to radiation protection of patients?	A. Justification referrers to "doing the right thing right"	46.7	16.13	-30.57
		B. Justification means acting justly without prejudice and without bias, and ensuring all patients is equitability and fairness	4.7	15.32	10.62
		C. Justification referrers to "doing the right thing for a patient with specific set of symptoms and signs, but also taking into consideration other factors like available resources, the patients values, opinions and preferences"	48.6	66.94	18.34
4	What is the principle of "optimisation" with reference to radiation protection of patients?	A. Optimization means choosing the most optimal type of imaging examination for the patient	32.7	17.74	-14.96
		B. Optimization is ensuring that optimal technical factors are used when the radiographer/technician is performing a procedure, including choosing the right KV (kilovolatage) and ma (milli-ampere) for to produce a diagnostic image	54.8	69.35	14.55
		C. Optimization is ensuring that all factors used in acquiring an image give the best or highest quality of image for that patient	12.5	10.48	-2.02
5	Who is responsible for the justification of imaging procedures?	A. The radiologist	14.8	25.00	10.2
		B. The radiographer	2.8	4.03	1.23
		C. The referring clinician	12.1	10.48	-1.62
		D. All the above	70.4	58.87	-11.53
6	Why is it important to use the best evidence available when writing clinical imaging guidelines?	A. Evidence is scientific proof to support a clinical decision and we need the best scientific proof	80.2	91.94	11.74
		B. Evidence from Europe is unlikely to work in Africa since these are two very different setting	7.5	1.61	-5.89
		C. The better the evidence, the better the quality of the image produced	12.3	4.84	-7.46

S/N	Question	Choices	Baseline (%)	Post (%)	Difference (%)
7	Why is it important to regularly update the guidelines?	A. ICT (Information Communication Technology) evolves very rapidly and this is what drives health interventions, since guidelines are displayed on ICT like mobile phones and computers	33.7	5.65	-28.05
		B. Doctors come out with new knowledge in managing disease and the guidelines should keep up with the knowledge of the clinicians	25.0	7.26	-17.74
		C. Evidence for accuracy or diagnostic modalities continually emerges as new research is done, and imaging technology is also constantly improving	41.3	83.06	-41.76
8	In what format are guidelines availed to the user?	A. Mobile phone	38.68	3.25	-35.43
		B. Tablet app	10.38	3.25	-7.13
		C. Web-based	13.21	12.20	-1.01
		D. Computerized Decision Support E. Tools integrated into patient workflow	3.77	8.94	5.17
		F. Print form	33.96	13.01	-20.95
		G. or all the above	0	57.72	57.72
9	What are the key components of a clinical imaging guideline?	A. The clinical condition e. g seizure, cough, abdominal pain	31.37	17.74	-13.63
		B. The imaging procedure e. g. CT, x-ray, MRI	9.80	3.23	-6.57
		C. The patients age and sex Body mass index (BMI)	6.86	1.61	-5.25
		D. Relative radiation level (dose) for the listed imaging procedures	1.96	7.26	5.3
		E. Rating for the most appropriate imaging procedure based on evidence	1.96	5.65	3.69
		F. All the above	35.29	37.10	1.81
		G. All the above except “c”	12.75	27.42	14.67
10	Why is it important that a relative radiation level for every type of examination is shown for each guideline?	A. To give the referrer an indication of which procedure delivers more dose, and the radiation dose implication for the procedure he/she choses	69.90	78.23	8.33
		B. To ensure that the referrer choses the procedure with the least dose	14.56	11.29	-3.27
		C. To educate the referrer about radiation doses in imaging	15.53	8.06	-7.47
11	In which circumstances would you use clinical referral guidelines?	A. In all clinical circumstances I come across	36.54	64.52	27.98
		B. In my early years of practice when am still learning	12.50	7.26	-5.24
		C. Whenever there is a clinical condition where I am in doubt as to the most appropriate imaging choice for that particular patient	50.96	26.61	-24.35
12	If the best option imaging for a given clinical condition is not available in your hospital, should you take the next best option or should you refer the patient abroad for the best option?	A. Yes I would refer abroad since it is the best thing to do	20.59	12.10	-8.49
		B. I would consider other listed options which are available and affordable	73.53	82.26	6.73
		C. I would leave the choice to that patient and the relatives the decision is about money and that’s a family issue	5.88	4.84	-1.04
13	Who is supposed to use the clinical imaging guidelines?	A. Initially the referrer but if in doubt, he/she can consult the radiologist and if there is no radiologist seek the opinion of the radiographer	67.33	76.61	9.28
		B. The referring clinician together with the patient while engaging the radiologist	26.73	8.87	-17.86
		C. The radiologist who may or may not have to consult the referring clinician	5.94	13.71	7.77
14	At what point in the patients care cycle should one first refer to the clinical imaging guidelines?	A. At the point of care, when the referrer is writing the requisition	87.00	77.42	-9.58
		B. When the requisition is rejected by the radiology department	4	16.94	12.94
		C. When the requisition reaches the radiology department	9	4.84	-4.16
15	Should one use clinical imaging guidelines for every patient?	A. Yes	61.17	72.58	11.41
		B. No	12.62	12.10	-0.52
		C. It depends on circumstances	26.21	15.32	-10.89
16	The following need special attention if the imaging request form is to be appropriate	A. The patients clinical condition, including the symptoms and signs should warrant imaging	60.61	32.26	-28.35
		B. The results from imaging should have a potential of influencing the patients management	5.05	4.84	-0.21
		C. The patient should not have had the same examination in the recent past	1.01	1.61	0.6
		D. If the information I expect from imaging is already available from clinical assessment, laboratory findings, or	1.01	1.61	0.6

S/N	Question	Choices	Baseline (%)	Post (%)	Difference (%)
		other different imaging investigations, I should not request for imaging			
		E. If I don't provide adequate clinical information to facilitate the imaging practitioner to image optimally, request is likely to be considered inappropriate	4.04	4.84	0.8
		F. If a CT scan which has just been done for the same region of the body gives images of less quality, I have a justification for requesting the same examination but with better quality	12.12	4.84	-7.28
		G. All the above	16.16	22.58	6.42
		H. All the above apart from option "f"	0	26.61	26.61
17	When would one ignore using the guidelines?	A. In emergency situations	38.83	27.42	-11.41
		B. When resources are not available	21.36	20.16	-1.2
		C. In unique situations dictated by; the patient's condition or patients preferences or availability of expertise and resources in the radiology department or a combination of these	39.81	50.81	11
18	What is the role of the imaging practitioner (radiologist and radiographer) in the use of clinical imaging guidelines?	A. He/she is to be consulted by the referrer when the referrer is in doubt regarding choice of imaging for a particular clinical scenario	85.86	96.77	10.91
		B. He/she is to make the final decision since he is most knowledgeable in the management team	7.07	0.81	-6.26
		C. Radiologist and radiographer reject all requisitions which they deem inappropriate regardless of what the clinician says	7.07	1.61	-5.46
	Average scores%		46.72	58.81	12.1

We tested for a statistical significance of the referrers' mean scores and the output below was obtained:

Table 2. *A Paired t Test to test a difference in the pre and post mean scores.*

Variable	Obs	Mean	Std. Err.	Std. Dev	95% conf. Interval
Post Baseline	109	58.82	1.25	13.03	56.34 61.29
Baseline	109	46.72	1.81	18.94	43.11 50.31
diff	109	12.1	2.18	22.70	7.79 16.41

Mean (diff)=mean (post-Baseline) t=5.56
$H_{0:}$ mean (diff)=0 degrees of freedom=108
$H_{a:}$ mean (diff)<0 H_a: mean (diff)! =0 H_a: mean (diff)>0
Pr (T<t) =1.0000 Pr (|T|>|t|) =0.0000 Pr (T>t) =0.0000

From the output above, the mean difference is 12.1% with P-value <0.0001 and 95% confidence interval (7.8-16.4). This implies that we reject the null hypothesis and conclude that there is a significant statistical difference between the mean pre-intervention and mean post intervention score.

4. Discussion

The mean score at baseline was 47%. This score indicates a low level of CIGs awareness among referrers at baseline. Such a low level of awareness was as a result of the majority of referrers obtaining low scores obtained from attempting the questions on CIGs. This finding may be explained by the fact that physicians, intern doctors and clinicians are not provided with Radiation protection and basic Radiology knowledge during training at medical schools. In addition, currently there is no policy or law by the Ministry of Health making for developing and mandatory use of such guidelines in Uganda. This leaves referrers with no prompting to use or learn about CIGs. This finding varied in relation to results from the RCR Audit-Live collections for example one audit was carried out at Barts Health NHS Trust in November 2018 across a sample of 55 foundation doctors (referrers) found that 29% were aware of any legislation regarding use of ionizing radiation [16]. In addition, using the same data source in 2015, Moussa et al found that only 26% had knowledge and were aware of radiation regulations in the UK [17].

The results of this study showed an increase in the average score after creating awareness through CMEs from 46.7% pre-intervention to 58.8% post- intervention. This finding indicates a 12.1% increment in the level of awareness with a P-value<0.0001 and 95% Confidence Interval (7.7-16.4) among referrers. This finding may be explained by the fact that CMEs have been found to be effective at the acquisition and retention of knowledge, awareness, attitudes, skills, behaviors and clinical outcomes among health workers [18]. This is further emphasized by Audits done by Moussa et al 2015 and Lai et al 2017 which reported an improvement of 38% and 100% respectively in the level of awareness of CIGs or radiation regulations following an intervention of creating awareness through continuous training or education [19, 20].

5. Conclusion

The limitation of this study is the small sample size that may affect generalizability of the findings. However, it's important to note that there not many health facilities with CT equipment in Uganda. Only a few referrers could be accessed especially in these CT centers. The findings of this

study indicated a 12.1% increase in awareness of issues concerning CIGs and radiation protection among imaging referrers in sub-Saharan Africa after an intervention of CMEs. This implies that routine CMEs are a good to start platforms for creating and increasing awareness for CIGs and radiation protection among medical imaging referrers to enhance justification and appropriateness of medical exposures.

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