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Assessment of Radiological Practices: Knowledge of Irradiation, Medical Imaging Prescriptions, and Clinical Imaging Referral Guidelines among Physicians

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Abstract

Background: Clinical imaging guidelines (CIGs) serve as valuable tools for improving the justification of imaging procedures among physicians.

Objective: This study aims to assess physicians' knowledge regarding irradiation, their self-perception of imaging prescriptions, and the utilization of CIGs.

Materials and Methods: A questionnaire comprising 21 items was self-administered to 155 referring physicians working in seven university-affiliated hospitals . The questionnaire covered aspects such as imaging referral practices, the use and need for CIGs, knowledge of radiation doses for specific radiologic procedures, and awareness of the harmful effects of radiation. Scores were assigned to each question to gauge participants' knowledge.

Results: Out of 180 administered questionnaires, 155 were completed (86.1% response rate). Participants included 90 (58%) females, 63 (40.64%) specialists, 53 (34.20%) residents/interns, and 39 (25.16%) general practitioners, with an average professional experience of 7.4 years (ranging from 1 to 25 years). The mean knowledge score was 11.5 out of 59, with no significant influence of sex, years of experience, or professional category. Users of CIGs scored higher than non-users (means 14.2 versus 10.6; $p < 0.01$). Most physicians (80%) underestimated radiation doses for routine imaging exams. About half of the participants were aware of CIGs, with half of them utilizing these guidelines. Criteria such as "impact on diagnosis" and "impact on treatment decision" were commonly used for justifying imaging requests, while unjustified requests often stemmed from "patient expectation or will" or "research motivations." The majority (96%) of interviewees believed that the availability of national CIGs would improve justification practices.

Conclusion: The study highlights a lack of awareness among physicians regarding radiation doses for routine imaging procedures. While some physicians are familiar with CIGs, there is a general consensus on the potential benefits of national CIGs in improving the justification of imaging procedures. Continuous training on radiation protection and the implementation of national CIGs are recommended to enhance practices in this area.

Introduction

The medical use of ionizing radiation is becoming the most significant man-made source of exposure for the population in the western world and also in developing countries. In a community-based level, to reduce the burden of medical imaging radiation, we need to apply the two cornerstones of radiation protection of patient which are justification and optimization of exposures. (Ujah et al., 2012)

This concerns all the steps of the imaging process starting from the elaboration of the request forms by referring physicians to the validation, realization, and interpretation of the imaging examinations. The last two are those that deserve the quality of the imaging procedure and are on the responsibility of radiographers and radiologists. The referring physician has the responsibility to prescribe the best imaging procedure for the patient clinical condition, giving the clinical and administrative data useful for the validation of that choice. (United Nations, 2010)

Many countries develop or adopt clinical imaging guidelines (CIGs) to support the physicians' prescription of the most suitable imaging procedure for the patient clinical condition. These CIGs are justification-based tools expressing for a given clinical setting possible imaging procedures and for each imaging procedure the level of indication, the level of scientific proof (reliability and accuracy), the level of irradiation, and some comments (procedure for substitution, etc.). Hence, referring clinicians must be aware of the level of patients' doses and the possible harmful effects of this exposure in order to justify irradiating medical imaging procedure. (ACR Appropriateness Criteria®, 2014)

Thrre are evidences of the lack of completeness of imaging request forms. Many studies on radiation protection established the poor knowledge of medical professionals on standards and principles of radiation protection. This is enhanced by the lack of training on radiation protection and the absence of “guide for better use of medical imaging procedure”. Various studies from different parts of the world have demonstrated general lack of knowledge on radiation doses and their adverse potential in the absence of referral guidelines among referring physicians. This situation in many developing countries is unlikely to be as much as this. The level of awareness concerning radiation doses of a given imaging exam influences clinician behaviors. If they do not have enough information related to radiation doses and safety, their actions will not be safe and will result in adverse effects. (European Commission, 2014)

As part of a project to improve best clinical practices, with a view of clinicians' awareness on radiation risk and justification of the request of medical imaging procedures, we conducted a survey to investigate the radiation dose knowledge and use of CIGs among physicians in relation to their referral practice in a pool of seven first reference hospitals (Moifo et al., 2013)

Materials and Methods

This cross-sectional study took place in seven university-affiliated hospitals . Confidentiality and anonymity were maintained as per the regulations of the Research Ethics Committee

Target:

Physicians were recruited through convenience sampling, and participation was voluntary. Participants were informed that their responses would be used solely for scientific research purposes.

Questionnaire:

A self-administered questionnaire was completed by physicians in the presence of the investigator, who collected it immediately. The questionnaire was based on a model used in a previous study in Norway. Questions covered reasons for referring patients for imaging procedures, knowledge and use of clinical imaging referral guidelines (CIGs), understanding of radiation doses associated with common medical imaging procedures, awareness of stochastic and deterministic effects of radiation, the need for training on ionizing radiation, and the importance of CIGs. Questions specific to national contexts, such as past training on justification or radioprotection and institutional support for CIGs, were included for better understanding. Demographic information such as age, gender, professional category, place of degree graduation, and years of professional experience was also collected.

Statistical Analysis:

A total radiation knowledge score was calculated on a scale of 0 to 59, following a scoring system used in the Norwegian study . Correct answers on imaging procedures were assigned 3 points each (maximum 33 points), knowledge of adverse effects of radiation was assigned 2 points, correct identification of radiation doses and international units earned 4 points each, understanding of stochastic and deterministic effects of radiation earned 4 points, and correct categorization of detrimental effects earned 2 points each (maximum

16 points). Missing data were scored as 0 points, and a total radiation knowledge score was calculated for each participant.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS 19.0) to determine descriptive statistics such as frequency distribution, mean, standard deviation, and percentages. Levels of knowledge, attitudes, and practices were assessed based on the percentage of correct answers in each section, with levels below 50% considered indicative of poor knowledge. ANOVA, Student's t-test, and Chi-square tests were used for comparisons between professional categories, levels of experience, and services as appropriate.

Results

Demographics:

Out of 180 physicians approached, 155 completed the questionnaires (86.1% response rate), while 25 declined to participate. The mean age of participants was 34.8 years (range: 23–56), with a predominance of females (58%). On average, physicians had 7.4 years of professional experience (range: 1–25 years), including postgraduate training. The Internal Medicine unit had the highest representation among the respondents (68/155), and 63 (40.7%) were specialists.

Global Knowledge Score on Irradiation:

The average total knowledge score on irradiation was 11.5 out of 59, with minor differences between men (11.3) and women (11.7) participants. When categorized based on clinical experience (more than or less than 10 years), the mean scores were 11.6 and 11.0, respectively. However, these differences were not statistically significant.

Knowledge on Irradiation during Imaging Procedures:

All respondents acknowledged the harmful effects of ionizing radiation, but 95.5% were mistaken about the international dose unit (millisievert). None of them accurately estimated the dose of a frontal chest X-ray exam, which is a commonly prescribed procedure.

Over 85% of physicians underestimated radiation doses for various imaging procedures, including CT scans and X-rays. MRI and ultrasound were incorrectly perceived as radiating procedures by a significant proportion of respondents.

Physicians' Perception on Imaging Prescriptions and Clinical Referral Guidelines:

About half of the respondents (50.3%) had knowledge of clinical referral guidelines, but only half of them (36) had used them. There was no significant difference in guideline use based on professional category, experience, training location, or hospital unit.

Physicians' reasons for ordering imaging exams varied, with the impact on diagnosis being the most significant factor. However, many physicians admitted to occasionally ordering imaging that might not impact treatment or diagnosis, citing patient expectations or research motivations.

Training on radiation protection was lacking for most physicians (72.9%), although a majority (67.7%) claimed awareness of patient irradiation risks. Almost all respondents (95.5%) expressed a desire for national clinical imaging guidelines (CIGs), with a preference for digital versions.

Knowledge on Irradiation in Relation to Imaging Requests and CIGs:

Physicians using CIGs demonstrated a better knowledge score on irradiation compared to non-users (average score: 14.2 vs. 10.6). However, knowledge scores were similar among physicians with and without training on justification and radiation protection, as well as among those who sometimes prescribed imaging tests unlikely to affect treatment or diagnosis.

Discussion

Strengths and Limitations:

This study, sheds light on the attitudes and knowledge of referring clinicians regarding radiation exposure in common radiology investigations and their familiarity with irradiation doses, exposure units, and their self-assessment of medical imaging requests. However, the use of questionnaires comes with inherent limitations, such as subjective opinions influencing responses. While immediate questionnaire completion in the investigator's presence reduced post-consultation bias, the anonymity of responses made individual

assessments challenging. The study's non-random sampling method limits national generalization, although the high participation rate (86%) is notable. The overrepresentation of specialists reflects the distribution of medical professionals in university-affiliated hospitals. (Ongolo-Zogo et al., 2013)

Global Radiation Knowledge Score:

The study revealed poor radiation knowledge among clinicians , with a mean score below 20% (11.5/59). This aligns with findings from other studies globally. Notably, only 23% of clinicians reported using clinical imaging referral guidelines (CIGs), consistent with usage levels in other settings (10–40%). Lack of national CIGs and insufficient training on justification contribute to this low utilization. Clinicians who did not use referral guidelines demonstrated poorer knowledge on radiation. However, training on justification or radiation protection did not significantly improve overall knowledge. This suggests a need for broader educational efforts on radiation awareness. (Ahidjo et al., 2012)

Specific Knowledge on Irradiation during Imaging Procedures:

Similar to findings in other African and global studies, this research highlighted clinicians' underestimation of radiation doses in common imaging exams. Despite recognizing the harmful effects of ionizing radiation, participants showed superficial knowledge, likely acquired during medical training. Notably, none accurately estimated patient doses for imaging procedures, with a high proportion misidentifying MRI as an ionizing exam. This lack of understanding, compounded by insufficient training on radiation protection, indicates a concerning gap in knowledge. (Singh et al., 2015)

Self-Perception of Imaging Prescriptions and Use of Referral Guidelines:

Physicians' imaging referral practices reflected their limited awareness of clinical imaging issues. Poor consideration of radiation dose as a criteria for imaging choice, alongside a high proportion of requests unlikely to impact treatment/diagnosis, underscores the need for better guidelines and education. While awareness of CIGs was limited, those who used them demonstrated better knowledge on irradiation. Incorporating CIGs into imaging justification processes could reduce unnecessary exams. The preference for digital CIGs highlights the importance of integrating technology for wider adoption. (Brenner and Hricak, 2010)

In conclusion, this study emphasizes the urgent need for comprehensive education on radiation awareness, improved access to national CIGs, and technological integration to support better imaging practices among clinicians. (Borgen et al., 2010)

Conclusion

The awareness level among clinicians regarding irradiation during imaging procedures is notably low and superficial, impacting the quality of their imaging prescriptions. This situation is exacerbated by insufficient training on radiation protection and limited familiarity with clinical imaging referral guidelines (CIGs). Improving the justification of imaging requests necessitates ongoing training on radiation protection for both undergraduate and postgraduate clinicians, alongside the adoption and dissemination of national CIGs, particularly through Information Technology and Communication (ITC) platforms for broader accessibility and utilization.

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