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Radiological Justification Criteria of Pediatric Computed Tomography in Kenya

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1. Introduction

Computed Tomography (CT) usage, particularly in pediatrics, is rapidly upsurging worldwide due to its speed, accuracy, adaptability, and non-invasiveness which improve the comfort of the patient. Moreover, CT imaging in children is alarming due to their susceptibility to the effects of ionizing radiation. In part, this is because their developing organs and tissues are more sensitive to the stochastic effects of radiation. In fact, it is estimated that a dose of 60 mGy triples the risk of brain tumors and a cumulative dose of 50 mGy triples the risk of leukemia in children [1].

In Kenya, the CT usage on children has increased rapidly over the past decade. The Kenyan national pediatric patient annual examination frequencies in 2010, indicate that 22,141 (2%) out of 1,700,047 annual pediatric examinations, are CT examinations [2]. Moreover, the study conducted in 2011 indicated that 99% of pediatric CT examinations were distributed as follows: brain (82%), sinuses (9%), abdomen (4%) and chest (4%) [3]. The important questions worthy of consideration include: Are all Kenyan pediatric CT examinations medically justifiable? Are there pediatric referral guidelines in place to provide advice on the appropriateness of imaging modalities? What are the roles and requirements of referring physicians, radiologists and radiographers in justifying pediatric CT exams?

Although Section 12 of the Kenya Radiation Protection Standards Regulations (1986) emphasizes that unnecessary exposures should be avoided and necessary exposures should be justifiable in terms of medical benefits. Quite a number of unjustified pediatric CT examinations have been reported in the country. In part, this is due to: low awareness of radiation doses and associated risks by referring physicians, unavailability of national imaging referral guidelines, unawareness of or not considering alternative non ionizing radiation imaging modalities.

Lately, substantial effort has been made by individual researchers, professionals, and experts at Kenyatta National Hospital and Gertrude's Children's Hospital to propose specific measures to enhance optimization of CT usage in pediatrics. However, specific measures regarding justification of pediatric CT examinations have not been explored. Therefore, there is a paucity of information regarding appropriate justification guidelines in the country.

This study aims to identify and propose appropriate pediatric CT justification criteria applicable in Kenyan hospitals. A review of international guidelines of ICRP and IAEA on pediatric CT justification and published referral guidelines will be conducted. Findings obtained from this study will assist in the development of pediatric CT referral guidelines and enhancement of suitable practices in Kenya in order to curb unnecessary or additional radiation exposure in pediatric patient.

2. Methodology

Justification of a CT procedure is vital in reducing or eliminating unnecessary radiation exposure in children. An extensive literature review on pediatric CT justification was explored based on: the international guidelines of ICRP and IAEA and the established widely known referral guidelines of the United Kingdom (the Royal College of Radiologists' Making the Best Use of Clinical Radiology Services), the European Commission (Referral guidelines for imaging) and the United States of America (American College of Radiologists' Appropriateness Criteria).

The review mainly focused on three pillars: awareness, appropriateness, and audits as tools to assure proper justification. A proposal was made of how these three pillars can be applicable to Kenyan hospitals in order to fill gaps identified in past studies. During this study, a paucity of information from Kenya and other developing countries including a dearth of multi-national studies on pediatric CT

justification was encountered. Therefore, this study will be a contribution to the body of knowledge and understanding in the clinical field of pediatric CT justification.

3. Results and Discussions

This section highlights the identified key factors that can improve CT justification for pediatric patients in Kenya.

3.1. International guidelines from ICRP applicable on pediatric CT justification

ICRP has greatly endorsed justification as a cornerstone of its system of protection. ICRP publication 105 [4] gives a basic systematic guideline on medical justification that can be used by Kenyan hospitals to aid the process of judging the best modality to use in children. According to ICRP publication 105 has classified medical justification into three levels. See Figure 1.

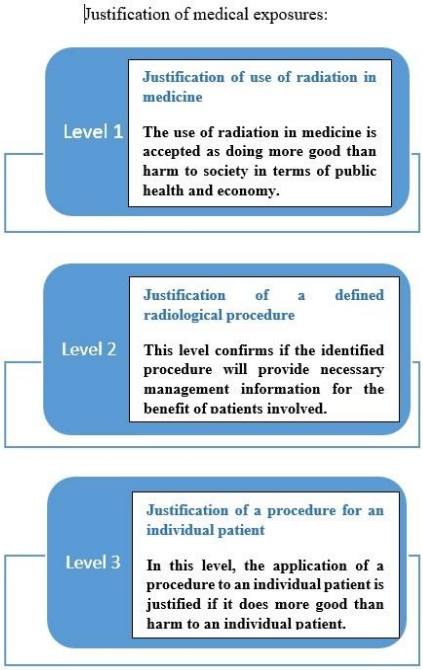

Fig. 1 Justification of medical exposures as identified by ICRP

Proper justification of a pediatric CT procedure as per ICRP level 2 can be enhanced by availability of pediatric referral guidelines. Referral guidelines can be helpful to referring physicians in decision making in order to avoid a pediatric CT procedure where a suitable and effective non-ionizing alternative modality exists. On the other hand, ICRP level 3 requires awareness among referring physicians and radiological practitioners to obtain guidance on the best choice of test within resource constraints and the associated radiation dose.

3.2. International guidelines by IAEA applicable to pediatric CT justification

The IAEA publication on Radiation Protection in Pediatric Radiology [5] provides extensive details on key aspects of justification. This publication outlines significant steps that can enhance the process of pediatric CT justification:

- Pediatric CT examination is required to be rigorously justified and inappropriate referrals eliminated.
- Only necessary pediatric CT examinations are to be performed.
- The number of multiple scans using contrast material needs to be reduced.
- The referring physician, patient and/or carer needs to be asked about previous procedures.
- Referral guidelines need to be used appropriately.
- Alternative approaches, such as ultrasound or MRI, need to be used whenever appropriate.
- Information needs to be provided to the patient in accordance with the BSS or national standards.
- Justification needs to be included in clinical audits.

In addition, IAEA through consultations has identified 3 possible approaches to remedying serious problems in regard to pediatric medical justification. These include 3A's: awareness, appropriateness, and audit.

3.2.1 Awareness among referring physicians and radiological practitioners

Awareness requires a referring physician or radiologist to possess a working knowledge of possible radiation risks posed to pediatrics to be able to justify imaging procedures appropriately. Education and training is very crucial for effective justification for pediatric CT justification. It is claimed from the published literature that, some of Kenyan referring physicians may have limited knowledge on radiation doses and risks associated with pediatric CT

examination. Therefore. It is essential for Kenyan referring medical practitioners to possess adequate knowledge. The knowledge required for pediatric justification includes:

- The clinical history, including examinations already performed;
- Potential benefits of the action;
- Awareness of short term and long term consequences, including the risks;
- Up to date knowledge of any available alternative actions;
- Knowledge of the consequences of not taking any action;
- Knowledge of referral guidelines and/or acceptability criteria where they are available.

3.2.2 Referral and/or appropriateness guidelines

Appropriateness of modalities in pediatrics can be achieved through the use of pediatric referral or appropriateness guidelines. Pediatric referral guidelines generally cover a wide variety of diagnostic problems in children that physicians face daily and define the relevant diagnostic tools to use for each scenario. IAEA recommend use of referral guidelines for pediatric diagnostic radiology as one of the tools to avoid unnecessary medical exposures in pediatrics.

Referral guidelines both for children and adults, have been published in countries such as United Kingdom (the Royal College of Radiologists' Making the Best Use of Clinical Radiology), the United States of America (American College of Radiology's Appropriateness Criteria), European Commission (Referral guidelines for imaging), Australia and others. Unfortunately, in most developing countries, particularly in Africa, there is absence or unclear referral guidelines on justification. Therefore, there is need for African countries to conduct more studies on referral guidelines. The IAEA publication on Radiation Protection in Pediatric Radiology adopted a representative version of the referral guidelines for pediatric radiology published by the EC in 2008 to be a reference to others countries that need to establish and use pediatric referral guidelines.

3.2.2 Clinical audit of medical justification

Clinical **audit** of justification of pediatric medical exposures is a neglected aspect. Therefore, periodic clinical audit should be undertaken to assess compliance with referral guidelines and the quality of communication with patients.

3.3 Developing evidence-based pediatric referral guidelines in Kenya

As mentioned earlier, quite a number of unjustified pediatric CT examination have been reported in the country. In part, this is due to lack of established national pediatric referral criteria to guide referring physicians when to recommend pediatric CT examinations. This has become a worrisome state for children since they are more vulnerable to radiation associated cancer development than adults. Therefore, establishing appropriate Kenyan national pediatric referral guidelines should be a priority. Furthermore, these guidelines will help in: the choice of the right radiological investigation, reassure the patient and add confidence to the clinician's diagnosis, and act as reference when the referring physician might be in doubt.

Evidence from past studies suggest that use of referral guidelines has substantially reduced inappropriate justified pediatric CT procedures. For instance, application of Royal College of Radiologists' (RCR), European Commission's, and American College of Radiology's guidelines has minimized unnecessary medical procedures including pediatric CT procedures. Additionally, RCR has outlined a strategy that can be applied in Kenyan hospitals to avoid unnecessary pediatric CT exposures as summarized below:

1. Avoid repeat pediatric CT investigations.
2. Avoid pediatric CT investigations when results are unlikely to affect patient management.
3. Avoid pediatric CT investigations too early.
4. Avoid the wrong investigation.
5. Ensure adequate and appropriate clinical information is available with a defined question to be answered by pediatric CT investigation.
6. Avoid pediatric CT over-investigation.

Establishment and implementation of referral guidelines at national level is a complex issue requiring leadership, organizational change, education, infrastructure and others. Figure 2 represent a commonly used and easy to follow model for successful implementation of referral guidelines that can be adopted in the country.

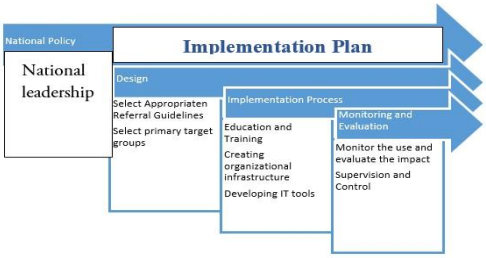

Fig. 2 Referral guidelines implementation model at national level

4.0 Conclusion and Recommendations

This study has shown that the process of applying the Justification Principle is crucial and can result in substantial reduction of unnecessary radiation exposure to children in Kenya. The previously discussed 3 A's have been highlighted as important solution to facilitate and enhance justification.

Furthermore, it is extremely indispensable to establish and implement evidence-based referral guidelines at the national level to aid the process of choosing appropriate imaging modality in children. Continuing education of the medical residents in all the pediatric subspecialties regarding radiation exposures may minimize unnecessary pediatric CT scan requests to some extent. However, the enormous responsibility of 'Justification' would be vested with the radiologist, along with the referring physician. Therefore, overall adherence to the Justification Principle must continue to be important guidance for all referring physicians in pediatric care.

Improvements concerning justification of pediatric CT examinations can be achieved by:

- **Proper education and training**. The country should ensure different levels of training for all referring physicians and the radiological medical practitioners in matters concerning justification are conducted. For instance, basic training for medical school students on radioprotection should be made mandatory. On-job trainings for referring physicians, radiologists and radiographers are vital in supporting the importance behind justification and dose awareness. Special trainings in patient radioprotection should be made mandatory for all persons using ionizing radiation on patients.
- **Establishment of evidence-based national pediatric referral guidelines**. Experts from major stakeholders i.e. Radiation Protection Board of Kenya, Society of Radiographers in Kenya, Kenya Association of Radiologists, East Africa Association for Radiation Protection and representative learning institutions and hospitals should collaborate to spearhead the establishment of evidence-based national pediatric referral guidelines. Referral guidelines for pediatric radiology published by the EC in 2008 can be used as a reference.
- **Clinical audits on justification** should be undertaken periodically to: improve the quality of pediatric care, effectively use of available resources, recognize quality and awareness of good practices, recognize outdated practices, and increase quality performance of medical practitioners.

Moreover, there is a need to carry out vast surveys of Kenyan hospitals to identify the current situation of pediatric CT justification in the country.

5.0 References

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