ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCES SCHOOL OF GRADUATE STUDIES DEPARTMENT OF RADIOLOGY

PROSPECTIVE STUDY OF CLINICAL APPLICATION OF JUSTIFICATION AND OPTIMIZATION PRINCIPLES OF ALARA IN PEDIATRIC CT IMAGING, TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA UNIVERSITY, ADDIS ABABA, ETHIOPIA.

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ADDIS ABABA, ETHIOPIA

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ACRONYMS

ALARA - As Low As Reasonably Achievable

CT - Computed Tomography

CW- Casiuality ward

DICOM - Digital Imaging and Communications in Medicine

ECHO - Echocardiography

G.C - Gregorian Calander

IAEA - International Atomic Energy Agency

ICRP - International Commission on Radiological Protection

IVP- Intravenous Pyelography

mAs - milliampere second

mGy - milligray

MSK- Musculoskeletal

mSv - millisievert

PNS - Paranasal sinuses

SPSS -Statistical Packages for Social Sciences

TASH - Tikur Anbessa Specialized Hospital

UN - United Nations

US - United states

ABSTRACT

Background : Despite the improvements in the diagnosis and treatment of numerous medical conditions in pediatric patients by medical imaging, radiation exposure, particularly with CT imaging, continues to be worrisome for children who are more vulnerable than adults from radiation associated cancer development. Recent studies indicate that a cumulative dose of 50mGy triples the risk of leukemia and a dose of 60mGytriples the risk of brain tumors in children.

Objective: To assess the clinical application of Justification and Optimization principles of ALARA in pediatric CT imaging in Tikur Anbesa Specialized Hospital.

Method: An institution based prospective cross sectional study was conducted from December 2017 to July 2018 G.C in TASH Addis Ababa. Data was collected by using a standardized CT request form with preset form fields which will have to be completed manually by the physician requesting the CT. All pediatric patients who came for CT imaging in the study period was included in the study. The collected data was entered and analyzed using SPSS version 25.

Result: Among the total of 429 CT requests received during the study period (8 months), 246 (57.3%) were male and 183(42.7%) were female. When we see the age distribution 52(12.1%) were less than 1 year, 153(35.7%) were 1 year to less than 5 years, 113(26.3%) were 5 year to less than 10 years and 111(2.9%) were 10 years to 14 years old. Out of the total 429 requests 28(6.5%) were rejected during the study period based on ALARA justification principle. From the rejected requests, for 11(39.2%) MRI was suggested instead of CT, for 6(21.42%) US were suggested instead of CT, additionally review of previous CT scan helped to reject 4(14.28%). Review of prior chest radiography helped in rejecting 2(7.14%) CT requests. For 5 (17.8%), other imaging modalities like Endoscopy, Echo, IVP and barium study were suggested. Nineteen (4.4%) Ct requests from 429 CT requests were optimized by applying principles optimization and thus received reduced radiation from CT imaging.

Conclusion: In general in this study 47(11%) patients were protected from unnecessary radiation exposure by applying optimization and justification principle of ALARA which indicates that applying ALARA principle has significant advantage in decreasing radiation exposure to children. The use of other alternating imaging modalities like US or MRI with no radiation exposure ha major role in replacing CT especially in pediatric patients who are more radiosensitive and have longer time to manifest radiation induced injury.

1. INTRODUCTION

1.1 Background

Exposure of tissues or organs to ionizing radiation can induce the death of cells on a scale that can be extensive enough to impair the function of the exposed tissue or organ. Effect of this type is called ‘deterministic effect’, which is clinically observable in an individual only if the radiation dose exceeds a certain threshold. Above this threshold dose, a deterministic effect is more severe for a higher dose. [1]

Exposure to radiation can also induce the non-lethal transformation of cells, which may still retain their capacity for cell division. The human body’s immune system is very effective in detecting and destroying abnormal cells. However, there is a possibility that the non-lethal transformation of a cell could lead, after a latency period, to cancer in the individual exposed, if it is a somatic cell; or may lead to hereditary effects, if it is a germ cell. Such effects are called ‘stochastic’ effects. For the purposes of these Standards, it is assumed that the probability of the eventual occurrence of a stochastic effect is proportional to the dose received, with no threshold. [1]

Despite improvements in the diagnosis and treatment of numerous medical conditions in pediatric patients by medical imaging, radiation exposure, particularly with CT imaging, continues to be worrisome for children who are more vulnerable than adults from radiation associated cancer development. In fact, a recent study indicates that a cumulative dose of 50mGy triples the risk of leukemia and a dose of 60mGy triples the risk of brain tumors in children. [2]

The pediatric population is a very inhomogeneous group broadly encompassing those aged 0–18 years, the precise definition varying between countries in accordance with legal differences with respect to the upper age limit. The distinction in medicine between this group and adults is justified, given that the human body grows and matures up until roughly the age of 18 years. Growing or renewing tissues are more sensitive to the mutagenic effect of ionizing radiation (which is why in adults the tissues more susceptible to radiation damage are the bone marrow and the gastrointestinal tract epithelium). The younger the child, the larger the number of

growing cells; this implies that children are much more sensitive to radiation damage than adolescents and that the latter are more sensitive than adults. Using the current system of risk assessment, the risk of developing a solid tumor after radiation exposure is about 3 times higher for a 1-year-old child and 1.8 times higher for a 10-year-old child compared with an adult. Gender also influences the risk: compared with males, females are exposed to a further 50% increase in relative risk owing to the higher radio sensitivity of breast tissue and the associated incidence of breast cancer. An additional fact that contributes in explaining the higher radio sensitivity of children is their longer life expectancy. [3]

It is also to be borne in mind that a risk estimate is a statistical entity derived from the data available for much larger exposed populations such as the Japanese atomic bomb survivors or people living in Belarus and Ukraine at the time of the Chernobyl fallout. Although, for example, no epidemiological study has to date found a definite association between the diagnostic use of iodine-131 and increased risk of thyroid cancer, the utmost attention and care are required in children when balancing the potential impact of exposure associated with a diagnostic procedure against the expected benefit. [3]

Experts estimate that more than 62 million CT scans are performed each year in the U.S. Approximately 8-10% of CT examinations are performed in children. The growth in CT utilization is higher in the pediatric than adult population, particularly in teenagers undergoing chest CT in the emergency department. [4]

To meet the objectives of radiation protection the ICRP has recommended the use of a system of dose limitation composed of the following requirements; justification of practices involving radiation exposures, optimization of the level of protection for such practices and individual dose limitation. The third requirement is individual-related, and is the continuation of previous recommendations limiting the risk to individuals from exposure to radiation. The first two requirements, on the other hand, are source-related. They apply even if all individuals are so well protected that their risk is negligible, requiring that the radiation detriment from a given source be reduced by increasing protection to the optimum level, and that the practice (with its remaining radiation detriment) be justified by benefits.[5]

ALARA represents a practice mandate adhering to the principle of keeping radiation doses to patients and personnel **As Low As Reasonably Achievable**. This concept is strongly endorsed by the Society for Pediatric Radiology, particularly in the use of procedures and modalities involving higher radiation doses such as CT and fluoroscopic examinations of pediatric patients. [6]

1.2. Statement of the problem

The practice of ‘Justification’ and ‘Optimization’ principles of ALARA (as low as reasonably achievable) which can lead to elimination or reduction of unnecessary or additional radiation exposure associated with CT imaging is currently relatively well established in the developed countries. But there is scarcity of data in the experience in developing countries. The experience of the developed countries cannot be directly extrapolated to the developing countries because of differences in infrastructure and clinical practice patterns. It has been found that application of ‘Justification’ and ‘Optimization’ principles of ALARA before obtaining CT imaging in pediatric patients reduces potential radiation risks including development of brain cancer and leukemia. Thus, it would be important to assess if rigorous application of ‘Justification’ and ‘Optimization’ principles of ALARA in pediatric population in a developing country can lead to effective implementation of radiation protection and protect children from unnecessary radiation exposure from CT imaging. [2]

1.3. Significance of the study

The practice of ALARA (as low as reasonably achievable) principle in the developed world is currently well established. However, there is striking lack of published data regarding such experience in developing countries including our country Ethiopia. Therefore, the goal of this study is to prospectively evaluate CT request forms to assess how many children could be protected from harmful radiation exposure if 'Justification' and 'Optimization' principles of ALARA are applied before obtaining CT imaging in our hospital.

2. LITERATURE REVIEW

The ALARA principle and its application through justification and optimization were framed with in the general discussion of precaution in health in collaboration with the Dutch Health Council. As the ALARA principle can be considered as a precursor of the precautionary principle, cornerstone of sustain ability at UN level, optimization can be seen as a precautionary approach extending regulatory developed prevention in the context of uncertainty. [7]

The rapid pace of developments of CT scan technology has led to exponential increase in the use of CT scans, with consequent rise of radiation exposure to patients. Although CT represents only10 to 15% of all imaging, radiation from CT studies are some of the highest in diagnostic imaging contributing up to 67% of all radiation. [2]

In a study conducted to compare the dose length product and effective radiation dose to patients from CT examinations in British, Columbia and Canada, they compared data from 1070 CT exams and concluded that considerable variation existed in the dose length product and patient radiation dose for a specific exam. This study called attention to the need to optimize the effective dose to the patient and to conduct more research to determine which additional efforts are needed to minimize patient exposure. Optimizing technical factors for exams can help reduce the patient radiation dose, thereby reducing risks. [8]

In a study done to explore the risks of low-level radiation and CT, it was advocated following the ALARA principle. This study suggested a statistically significant, increased risk of fatal cancer from low-dose radiation in the range of 50 to 100 mSv. For example, a single CT of the abdomen could provide a dose of 11 mSv. If there are 3 phases in this examination, the actual dose will be 33 mSv (3 x 11 mSv). If this child is 1 of the 30% who have 3 or more examinations, the child will have received a dose equivalent to the lifetime dose of 100 mSv, clearly in the range of doses associated with induction of fatal cancer. [9]

Another study also drew parallels between the early decades of radiography and contemporary use of CT. It was pointed out that increasing use and potential misuse of examinations, the lack of attention to dose risks, particularly in children, and the delay in implementing dose reduction strategies, all of which combine to form an interesting parallel to the early days of radiology. One fact emerges clearly throughout the body of knowledge in radiology: Attention must be drawn to the ALARA principle, especially where pediatric patients and CT are concerned. [10]

The National Cancer Institute suggested several steps to reduce the radiation dose to children. First, only necessary CT examinations should be performed. Pediatricians and radiologists should consult to determine whether CT is the most appropriate examination. Second, if CT is the appropriate modality, exposure parameters should be adjusted to optimize the study and minimize the dose to the patient. Specifically, radiologic technologists should: limit the region scanned to the smallest possible area, optimize the mA settings for the organ systems to be examined (e.g, lower mA for skeletal and lung exams), adjust technique to the child's size and weight and determine appropriate scan resolution (e.g, a lower resolution may be sufficient for some diagnostic purposes). [11]

Similarly in another study which emphasized on the importance of adjusting pediatric radiographic settings during CT to minimize dose it was suggested that further clinical studies be conducted on pediatric CT dose. Despite the overwhelming public health benefits of CT, it was suggested to implement the following steps to protect an increasing population of children from cancer risks related to CT including: Focus on scanner protocols to reduce pediatric CT dose (mAs), use CT scanners with automatic exposure settings to limit dose, develop guidelines to compare dose indicators with standards, ensure that the indicator of CT dose is visible on the display console, include a DICOM (Digital Imaging and Communications in Medicine) file format tag for CT dose information and emphasize education regarding CT protocols and dose implications.[12]

In a study done in India on clinical application of ‘Justification’ and ‘Optimization’ principles of ALARA in pediatric CT imaging a total of 1302 consecutive CT request forms were received during 6 months. Of these, 866 (66.51%) were for males and 436 (33.49%) for females. 46 (3.53%) were <1 month old, 262 (20.12%) had ages between 1month and one year, and the remaining 994 (76.34%) were aged over a year. Out of the total of 1302 CT request forms, 641 requests (49.23%) were received from outpatient departments of the hospital, while 661 CT requests were received from inpatient departments. 1245 forms (95.62%) were deemed to have adequate history required to request a CT. The maximum numbers of requests received were for CT imaging of the head region (780 out of 1392 requests: 56.03%). Of these, 343 (43.97%) CT request forms were for non-contrast scans and 382 (48.97%) were for contrast enhanced scans of the head and 55 forms (7.05%) had requested both a non-contrast as well as a contrast scan. In addition, there were CT imaging requests of the chest (251 requests: 18.03%) and abdomen (174 requests: 12.50%). [2]

In the above Indian study 64 (4.60%) CT requests from a total of 1392 CT requests were declined during the study period based only on applying principles of ‘Justification’ and these children were thus protected from unnecessary radiation. 47(3.38%) CT requests were optimized on applying principles of ‘Optimization’ and these children thus received reduced radiation from CT imaging. Therefore, this led to a total of 105 children (8.06%) out of 1302 patients who either avoided radiation or received reduced amount of radiation from CT imaging after the principles of ‘Justification’ and ‘Optimization ’were applied.[2]

In a study done in Finland to assess prevalence of unjustified CT imaging in younger patients about 30% of all the 200 examinations evaluated were unjustified. From these 30 CT examinations of the lumbar spine (77%), 37% of the abdomen, 36% of head, and 3% of the cervical spine were considered not justified. [13]

3. OBJECTIVES

3.1 General objective:-

- To assess the clinical application of 'Justification' and 'Optimization' principle of ALARA in pediatric CT imaging in Tikur Anbesa Specialized Hospital.

3.2 Specific objectives:-

- To assess how many children can be protected from unnecessary radiation by applying principles of ALARA in pediatric CT imaging

- To assess anatomic region of interest in pediatric CT imaging

- To assess the socio demographic characteristics of pediatric patients who came for CT imaging

4. METHODS AND MATERIALS

4.1. STUDY AREA

The study was conducted at TASH, College of Health Science, Addis Ababa University, Addis Ababa, Ethiopia. TASH is located in Addis Ababa, and is the largest referral and main teaching hospital in the country. The pediatrics unit of radiology department in the hospital sees on average 5 CT imaging requests per day.

4.2. STUDY DESIGN AND PERIOD

An institution based prospective cross sectional study was conducted from December 2017 to July 2018 G.C.

4.3. SOURCE POPULATION

The source population was all pediatric patients who visited the hospital during the study period.

4.4. STUDY POPULATION

The study population was all pediatric patients who were evaluated at the radiology department for CT imaging during the study period.

4.5. SAMPLE SIZE AND SAMPLING PROCEDURE

Convenience sampling method was used and all pediatric patients who came for CT imaging in the study period were included in the study.

4.6. INCLUSION CRITERIA

Patients who were: ≤ 14 years old and came for CT imaging

4.7. EXCLUSION CRITERIA:

Patients who came during duty hours were excluded

4.8. DATA COLLECTION PROCEDURES

Data was collected by using a standardized CT request form with preset form fields which had to be completed manually by the physician requesting the CT imaging. Completeness and adequacy of the data in CT request forms was ensured in all cases. We assessed if the history provided was adequate for justifying the scan requested. If the information was felt to be inadequate, completeness of the history was ensured by directly communicating with the requesting physician or requesting information from the patient files. Previous radiological investigations were also be requested even if details were not provided in the CT request form.

4.9. OPERATIONAL DEFINITION

Justification of medical exposures: - All medical imaging exposures must show a sufficient net benefit when balanced against possible detriment that the examination might cause.

Optimization is a cyclical process comprising evaluation of clinical image quality and patient dose to identify the need for action, identification of the possible alternatives to maintain necessary image quality and minimizing patient absorbed doses, selection of the best imaging option under the given circumstances, implementation of the selected option and regular review of image quality and patient dose to evaluate if either requires further action.

CT done with protocol:- as the agreement within the department to reduce radiation exposure single phase post contrast CT is done for all pediatrics patients except in some cases like fracture, stone, foreign body aspiration, high resolution temporal CT where pre contrast CT is done, liver masses where triphasic CT is done and CT urography.

Pediatrics includes those less than or equal to 14 years of age (based on our hospitals definition)

4.10. DATA MANAGEMENT AND ANALYSIS PROCEDURE

Data collected was checked visually for completeness, coded and entered into SPSS version 25.The data collected was analyzed using SPSS version 25 statistical package.

4.11. ETHICAL CONSIDERATION

Before the data collection permission was obtained from TASH. During data collection, all methodological and ethical considerations was taken care of. All information obtained in the course of this study would be treated with confidentiality and would not be used outside the scope of the study.

4.12. DISSEMINATION OF RESULT

After the research paper gets approved by the advisor, the findings of the study will be submitted to TASH. The findings of this study will be presented in different conferences and seminars whenever possible.

5. RESULTS

5.1. Study population

Among the total of 429 CT requests received during the study period (8 months), 246 (57.3%) were male and 183(42.7%) were female. When we see the age distribution 52(12.1%) were less than 1 year, 153(35.7%) were 1 year to less than 5 years, 113(26.3%) were 5 year to less than 10 years and 111(2.9%) were 10 years to 14 years old. From the total of 429 requests 81(18.9%) were received from in patient unit, 127(29.6%) were received from outpatient unit, 35(8.2%) were received from CW and 186(43.4%) the unit were not mentioned on the request form. Out of the total requests received, 424(98.8%) had complete clinical data documented on the request form and 5(1.2%) had incomplete clinical data from which for 3 of them the requesting physician were communicated and for 2 of the patients chart is reviewed.

Variable	Frequency	Percentage
Sex		
Male	246	57.3%
Female	183	42.7%
Age (years)		
<1	52	12.1%
[1-5)	153	35.7%
[5-10)	113	26.3%
[10-14]	111	25.9%

Table 1:- socio-demographic characteristics of pediatric patients come for CT in Tikur Anbesa Hospital, Addis Abeba, Ethiopia, from December 2017 to July 2018 G.C.

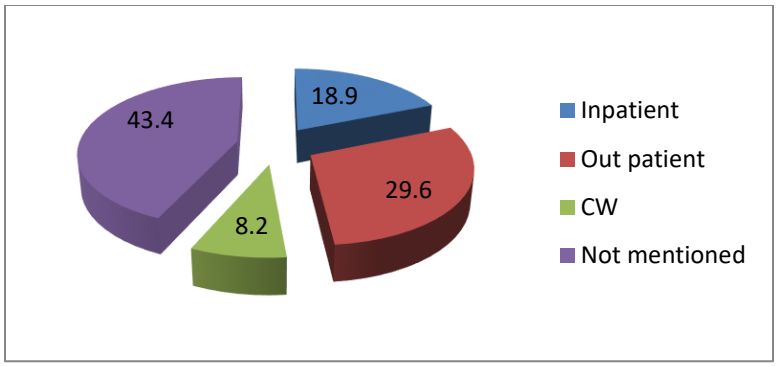

Figure 1:- Unit from where CT request was sent for CT of pediatric patients seen in Tikur Anbesa Hospital, Addis Abeba, Ethiopia, from December 2017 to July 2018 G.C.

5.2. Anatomic regions scanned

From the 429 requests, on 316(73.7%) requests only one anatomic region were ordered, 103(24%) two anatomic regions were ordered and 10(2.3%) three anatomic regions were ordered. The maximum number of CT done were for CT of abdomen which 154(35.9%) and the minimum being CT of spine and MSK CT which is 3(0.7%) each. The remaining CT imaging requests include head CT 111(25.9%), neck CT 52(12.1%), PNS 12(2.8%), temporal6(1.4%), chest 126(29.4%) and pelvic 38(8.9%).

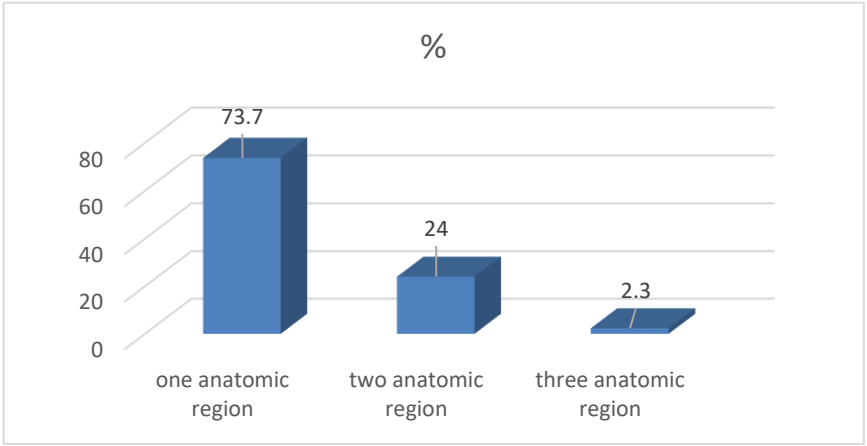

Figure 2:- Number of anatomic regions of pediatric patients requested for CT in Tikur Anbesa Hospital, Addis Abeba, Ethiopia, from December 2017 to July 2018 G.C.

Area to be scanned	Frequency	Percentage
Head	111	25.9%
Neck	52	12.1%
PNS	12	2.8%
Temporal	6	1.4%
Chest	126	29.4%
Abdomen	154	35.9%
Pelvis	38	8.9%
Spine	3	0.7%
MSK	3	0.7%

Table 2:- Anatomic regions requested for CT of pediatric patients seen in Tikur Anbesa Hospital, Addis Abeba, Ethiopia, from December 2017 to July 2018 G.C.

5.3. Modified or rejected due to optimization and justification of ALARA principle

From the total of 429 requests 28(6.5%) were rejected during the study period based on ALARA justification principle. From the rejected requests, for 11(39.2%) MRI was suggested instead of CT, for 6(21.42%) US were suggested instead of CT, additionally review of previous CT scan helped to reject 4(14.28%). Review of prior chest radiography helped in rejecting 2(7.14%) CT requests. For 5 (17.8%), other imaging modalities like Endoscopy, Echo, IVP and barium study were suggested. Nineteen (4.4%) Ct requests from 429 CT requests were optimized by applying principles optimization and thus received reduced radiation from CT imaging. Among those patients in whom CT was either rejected or modified 24(51.06%) were female.

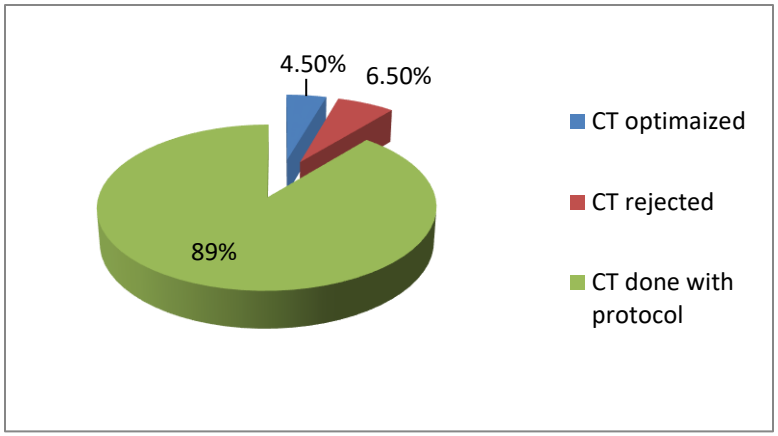

Figure 3:- Number of CTs modified, rejected and done with protocol for pediatric patients seen in Tikur Anbesa Hospital, Addis Abeba, Ethiopia, from December 2017 to July 2018 G.C.

Reason for optimizing or rejecting CT	Frequency	Percentage
Us reviewed to provide needed information	6	1.4%
MRI was advised instead of CT	11	2.6%
Review of previous imaging studies was sufficient	4	0.9%
CXR reviewed to provide necessary information	2	0.5%
One area scan is enough with review of other imaging	14	3.3%
Collominated to specific area of interest	5	1.2%
Other investigations like IVP, Barium, Echo and endoscopy are preferred	5	1.2%

Table 3:- Reasons for optimization and rejection of CT scan requested for pediatric patients in Tikur Anbesa Hospital, Addis Abeba, Ethiopia, from December 2017 to July 2018 G.C.

5.4. Age group of patients who were protected from unnecessary CT imaging

Eight (15.3%) out of 52 children which is less than 1 year, 16(10.4) out of 153 children between 1 and 5 years old, 14(12.3%) out of 113 children between age 5 and 10 years old, 9(8.1%) out of 111 children between ages 10 and 14 were protected unwanted radiation exposure when justification and optimization principles o ALARA were applied.

Age (years)	Frequency	Number of CT rejected or optimized	Percentage
<1	52	8	15.3%
[1-5)	153	16	10.4%
[5-10)	113	14	12.3%
[10-14]	111	9	8.1%

Table 4:- age wise distribution of requested and modified or rejected CT scans of pediatric patients seen in Tikur Anbesa Hospital, Addis Abeba, Ethiopia, from December 2017 to July 2018 G.C.

6. Discussion

In our department for pediatric patients with age group less than or equal to 14 years old only single phase CT scan which is post contrast CT is taken with only some exceptions like in patients who sustained trauma and CT is required to rule out fracture some anatomic regions and high resolution temporal CT for which only pre contrast image is taken and or patients with suspicion for ureteric stone for which low dose CT is done. The use of pre contrast CT scan hardly ever results in clinically relevant extra information and usually should be abandoned so multiphase CT scan examination should be avoided. [4]

In some cases like patents with liver mass seen on US and CT needed for further characterization, triphasic abdominal CT is ordered. In these cases the physicians usually write triphasic abdominal CT on the request paper since they have the recommendation from the abdominal US. In most other cases the physicians write only the anatomic regions to be scanned other than specifying pre contrast, post contrast or both and the request papers are protocolled in the pediatric radiology unit.

Since only single phase which is only post contrast CT done for almost all patients with some exceptions described above and it is not considered as optimization in this study.

In this study from the total of 429 CT requests, 47(11%) were either modified or rejected using optimization or justification principle of ALARA. Out of the 47 requests 28 were rejected and 19 were modified. In similar study done in Chandigarh, India out of 1302 requests 105(8.06%) of CT requests were either optimized or rejected using optimization or justification principle of ALARA. [2] The results of the two studies are almost comparable. In the study done in India changing the requests from two phase to one phase is considered as optimization while in this study it is not taken as optimization.

In this study 28(6.5%) out of 429 CT requests were rejected based on optimization and justification principle of ALARA while in the study done in India 64(4.6%) out of 1302 requests

were rejected. In this study out of the rejected requests, for 11(39.2%) of cases MRI is suggested instead of CT and for 6(21.4%) of cases US was suggested instead of CT while in the study from India for 15(13.5%) of cases US and MRI was suggested instead of CT for each.

In this study the main reason for either optimization or rejection was found to be only one area scan is enough with review of other imaging and in the study done in India, the main reason for optimization or rejection is only single phase of CT scan was sufficient to answer the clinical question.

In previously published study done in Finland on unjustified CT examination in young patients 77% of CT examination of lumbar spine, 37% of abdominal CT, 36% of head CT and 3% of cervical spine CT were found to be unjustified. [3]

In this study 316 (76.7%) of requests had one anatomic region requested, 103(24%) had two anatomic regions requested and 10 (2.3%) had three anatomic regions requested. When we see study done in India 1216(93.4%) CT requests had one anatomic region requested, 82(6.3%) has two anatomic regions requested and 4(0.3%) had three anatomic regions requested

In study done in India the maximum number of requests received where for CT of head (780/56.03%) while in this research the maximum number of requests where for CT of abdomen (154/35.9%).

Finally the result of this study showed that significant number of pediatric patients can be protected from unnecessary or additional radiation exposure from CT imaging when justification and optimization principles of ALARA are applied before obtaining CT imaging.

7. Conclusion and Recommendation

7.1. Conclusion

In general in this study 47(11%) patients were protected from unnecessary radiation exposure by applying optimization and justification principle of ALARA which indicates that applying ALARA principle has significant advantage in decreasing radiation exposure to children. The use of other alternating imaging modalities like US or MRI with no radiation exposure ha major role in replacing CT especially in pediatric patients who are more radiosensitive and have longer time to manifest radiation induced injury.

7.2. Recommendation

For requesting Physicians: Detailed clinical data and specific indication for imaging should be mentioned in the request form and if the patient has any previous imaging, it should also be mentioned

For radiology residents and radiologists: Should revise the clinical data as well as the previous imagings before approving the current imaging.

For department of radiology: Should take initiative to create awareness about the risk of radiation in pediatric patients and the value of alternative imaging modalities in joint sessions and other panels.

For the University and Ministry of Health: Should take part in giving training and making other alternative imaging modalities with no radiation risk like MRI in different institutions.

8. REFEREENCE

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9. ANNEXES

Annexes 1Data collecting tool

Yikkar Ambesa Specialized Hospital, CHS, Department of Radiology

CT Request Form

Date:

Patient information:

Name: Age: Sex:

Address: Medical record No.: Previous images: Yes No

Previous CT/MRI No.:

Email:

Receipt No.: Out patient:

In patient: Ward:

Mobility Status: Walking Wheel chair Stretcher Ambulance

The following must be filled by the referring physician:

Does the patient have a history of kidney disease? Yes No

Is the patient diabetic? Yes No

Does the patient have known allergy? Yes No

Previous reaction to IV contrast? Yes No

If yes question #1 & or # 2 please provide blood work

Current Lab values BUN: Creatinine: eGFR:

Exam information:

Area To be Scanned (Be Specific):

Clinical information/Indication:

Relevant other current Lab. Information:

Referring Physician Name: Signature:

Address: Date:

Medical Imaging Use Only:

Appointment date and time:

Appointing Personnel Signature:

Radiologic technologist/Radiographer Name:

Signature:

If the patient has a known contrast allergy, the radiology resident or consultant is responsible for organizing the pre-medication prior to the patients scan.

Form must be complete including referring physician signature.

Incomplete or illegible requests will be returned

Annexes 2

Data collecting format

Date	Age	sex	MRN	In pt/out pt/CW	Clinical data	Area to be scanned	Ct done with protocol	Ct Done with modification (type of modification)	CT Rejected (reason for rejection)