

Assessment and Optimization of Paediatric Radiation Dose in Computed Tomography***Kabir Jamaladdeen and Muhammad Bashir Gide**

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*Corresponding author's email: jamaladdeen.kabir@umyu.edu.ng**ABSTRACT**

The main aim of this study is to assess and enhance the effectiveness of radiation dose optimization techniques in pediatric CT scanning to ensure diagnostic quality while minimizing patient risk. Analyzing and reviewing past scans and employing scan statistics, it focuses on key dose metrics like volume computed tomography (CTDIvol) and dose length product (DLP). Radiology staff were interviewed to evaluate their understanding of dose – reduction protocols and their use of relevant technologies, such as minimizing tube current, minimizing tube potential, minimizing scan length Automatic Exposure Control, (AEC), iterative Reconstruction (IR), and artificial intelligence (AI). A study revealed significant variation in how CT scan is performed on children. While technologies like Automatic Exposure Control (AEC) and Iterative Reconstruction (IR) can reduce excess radiation, inconsistent staff training and equipment make it difficult to standardize safe radiation doses. Organized efforts for standardization have been spearheaded by professional societies such as the American Association of Physicists in guidelines, enhancing technologist training, and investing in new technology to develop safer radiological practices for children.

Keywords:

Computed tomography,
Dose length product,
Computed tomography dose
index.

INTRODUCTION

Computed tomography (CT) scan is recommended for children because of their accessibility, speed, accuracy, and flexibility. The main reason for this is the adoption of rapid spiral scanning technology, which removes the necessity for sedation by reducing motion artifacts, thus enabling imaging of younger or less cooperative children (Donnelly *et al*, 2001). The increase use of CT scans in children is mainly due to the significant reduction in scan time—now under one second—which largely removes the need for anesthesia or sedation to keep the child still during image capture (White,1996).At these ages, organs and tissues are naturally more sensitive to radiation because they contains a higher number of cells that actively dividing and replicating (Brenner,2001).The international Commission for Radiological protection (ICRP) reports that children are 2 to 3 times more sensitive to radiation than adults, mainly because of active cell division in their developing organs and their longer expected lifespan, which increases the chance of radiation-induced cancer developing over time (ICRP,1990).This makes it crucial to optimize the dose to ensure images remain diagnostically useful. That is radiation doses in pediatric imaging conform to the

ALARA principle for dose reduction (Mendonca *et al*.2025).

The multi-detector CT system allows significantly faster images acquisition, thereby reducing the potential for artifact caused by patient movement (Han *et al*. 2022). There are needs to justify every CT scan before undergoing any examination. MRI or ultrasound examination as the first options. Cases like trauma, cancer or brain injury, CT is the most pre arable. Ensure the dose provides a clear image and accurate diagnosis. Premature reduction of therapeutic doses can result in diagnosis errors. The integration of pediatric-specific imaging protocol in to both the picture Archiving and communication system (PACS) and Radiology information system (RIS) is a necessary hospital requirement. Certainly examining and adhering to national standards is a critical strategy for enhancing patient safeguarding across health care system (Tadia, 2021). Sustained scientific inquiry systematically improves the quality and efficiency of paediatric medical care. Multidisciplinary medical team integration promotes the formulation and adherence to evidence-base imaging guidelines that minimize patient risk. The goal is always to get the correct diagnosis using methods that pose the least risk to the child.

Due to children's increased sensitivity to radiation, minimizing dose in paediatric CT scans is crucial, as research links their exposure to a greater cancer risk than adult. It is thus vital to adopt sophisticated technologies that preserve diagnosis integrity. As Kim (2023) demonstrates, techniques like AEC and iterative reconstruction facilitate lower radiation exposure for patient while yielding high quality, noise free images. Another advancement in bone –based dose modulation, which protects critical organs like the thyroid and breast. Nonetheless, the adoption of these techniques is inconsistent across medical institutions. According to Alexander *et al* (2022), the absence of specific paediatric CT guidelines at some institution, or a failure to regularly update them, along with insufficient training in children's radiation safety, often leads to variable and ineffective practices. AI and machine learning could personalize radiation therapy, but few clinics can deploy them due to technological and regulatory limitations. Even available tools like dose tracking software are not used uniformly for quality assurance. Additionally lowering radiation too much risks degrading image quality, a significant concern for many specialists. Initiatives such as image gently work for safer children's imaging a persistent gap remains between their recommendation and actual clinical practice. (Ghorbanizadeh *et al* 2021) stated standardized guidelines, dedicated training and widespread technological adoption are essential. CT is indispensable in treating children for trauma, cancer and neurological condition, further study and better policies for its use are crucial. Therefore, efforts must concentrate on integrating technology, education and safety regulations to image children safety.

MATERIALS AND METHODS

This study employed a retrospective, observational, cross-sectional design and analyzed radiation dose management in pediatric CT imaging across multiple hospitals. Researchers collected and analyzed the CT scan records of patient aged seven month to sixteen years. Data on metrics like CTDIvol, DLP, scan area, patient age and weight, and scanning protocol were extracted from hospital system including PACS and dose –tracking software like Dose Watch and Radoimetrics. Structured interviews with radiologists and medical physicists are conducted to evaluate their proficiency, protocol adherences, and implementation of dose –reduction tools, including AEC, iterative reconstruction and AI-based technologies. Adherence to protocol is benchmarked against nationally or internationally established

Diagnostic Reference levels (DRLs). Staff feedback is examined using thematic coding to pinpoint deficiencies in training and procedural consistency. Ethical guidelines are observed by securing approval and ensuring patient confidentially throughout the research. This methodological framework was designed to analyze the interplay between technological applications and the human factors influencing pediatric CT scan.

RESULTS AND DISCUSSION

Each hospital controls the CT dose for paediatric differently due to the variation in their protocols, scanner capabilities radiographers training. It was found that there are still some institutions that does not yet implement pediatric protocols, consequently, the use of the default adult settings result in elevated DLP and CTDIvol reading (Arafat *et al.*2024). The inability to adjust KVP and mAs settings results in unnecessary radiation exposure for paediatric patients. AEC is not enabled in many scanners, despite the fact that it has been shown to lower scanner dose when used in conjunction with ASIR or MBIR. If the setting are not properly adjusted, using an MDCT system in a facility may occasionally result in increased radiation exposure (kanal & ming,2024). In addition, diagnostic errors such as inadequate scan planning or the incorrect application of automatic exposure control (AEC) often result in patient misalignment and the need for rescans. There is also an observed issue with the inconsistent stabilization of shields over radiation-sensitive organ including the brain and thyroids glands. The application of contrast – enhanced CT in paediatric patient is inconsistent. This is due to the use of protocols and timing parameters optimized for adult physiology, which are ill-suited to children's blood circulatory system. Consequently, scans often require multiple phases, leading to an increased radiation dose. Tools such as Dose Watch and redimetrics, which are essential for monitoring Diagnostic Reference levels (DRLs), are frequently unavailable in some hospitals. This lack of access makes comparing local radiation doses to established DRLs a challenging and inefficient process. (Crowley *et al*, 2021) The inability to consistently monitor dosage trends, such as CTDIvol and DLP, is often due to the lack of integrated tracking system within PACS. Compounding this issue is a widespread failure to perform technical audits or to engage medical physicist for protocol reviews (chekmeyan *et al.*2023). Given the unique needs of paediatric patients, facilities must use tailored CT potocols, employ monitoring software, and offer specialize training in radiation safety for children.

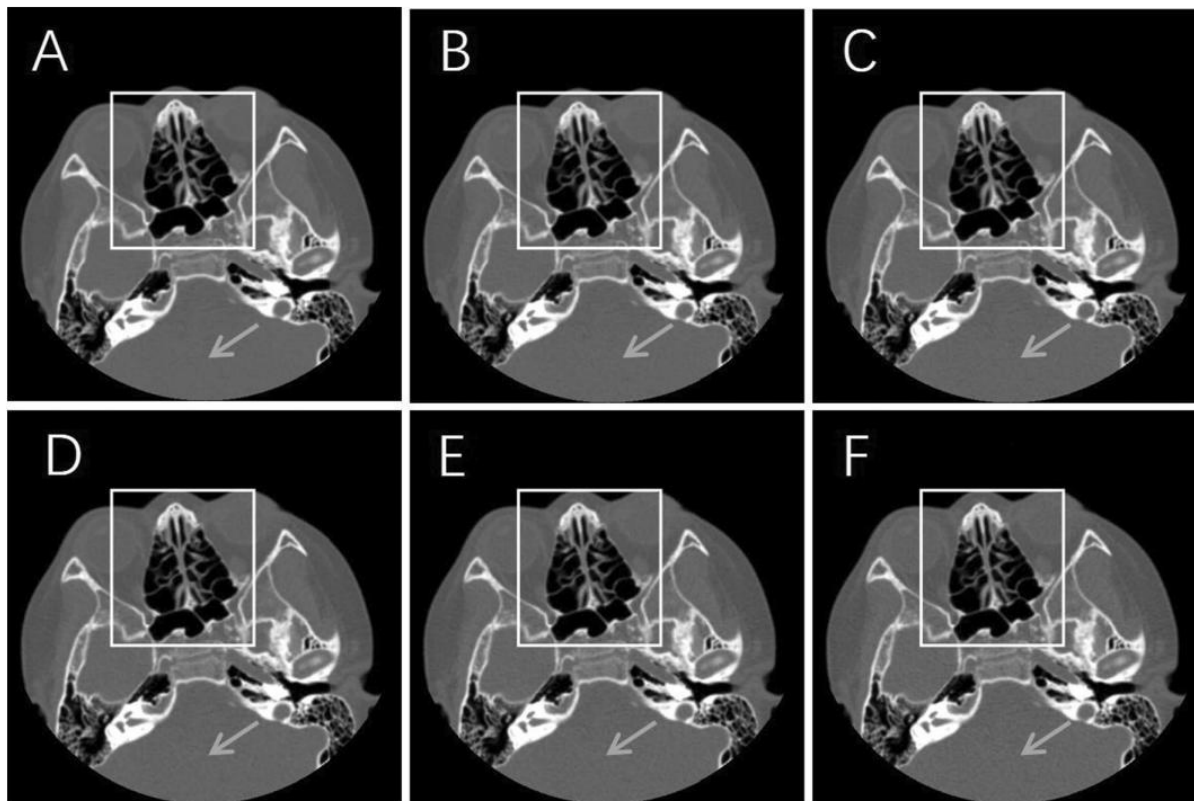


Figure 1: Axial CT bone window images from different reconstruction algorithms. A DLIR-high, B DLIR-medium, C DLIR-low, D AsirV-50%, E AsirV-30% (Source: Li *et al.* 2022)

The impact of Automatic exposure control on radiation dose optimization

To optimize radiological imaging, the radiation dose is minimized while maintaining sufficient image quality for accurate diagnosis. During a CT scan, the patient is exposed to X-ray photons, which are partially absorbed by the body. Only a small portion of these photons pass through and reach the detector, where they are used to create the image. When the size of an image section increases and X-ray absorption becomes more significant, higher radiation exposure is required to prevent excessive image noise and ensure adequate image quality. In CT scans, radiation exposure is directly related to the tube current, which is primarily regulated by adjusting the tube current. Automatic exposure control (AEC) automatically adjusts the tube current based on specific parameters. Based on the level of X-ray absorption, which is primarily determined from the localizer images (Lee *et al.*, 2008). AEC adjust the radiation dose by increasing the tube current when imaging thicker body parts or larger patients. This ensured that a uniform image quality is maintained throughout the examination.

For optical CT scanning, radiation dose must be tailored to the patient's size. The standard indices for monitoring this dose are the volume CT dose index (CTDIvol) and

the dose-length product (DLP), the latter being the cumulative CTDIvol across the examination range. The effective diameter, which serves as a fundamental measure of an image section's size, is calculated as the geometric mean of its anteroposterior and lateral diameter (AAPM, 2011). Even if the effective diameter is the same across-section containing more bone exhibit greater attenuation, while one with more air shows less. The water equivalent diameter (WED) is a more advanced metric for section size as it is derived by accounting for the varying attenuation properties of different tissue (AAPM, 2014). Optimal radiation dose modulation involves adjusting both the tube current and CTDIvol based on water Equivalent Diameter (WED). While AEC is acknowledged as an effective tool for optimizing CT radiation dose, its use in paediatric brain scans is not as widespread as in paediatric body CT. Studies indicate that approximately half of medical facilities do not employ AEC for paediatric brain CT examination. (Granata *et al.*, 2015) Differences in head size are generally smaller than those in body size but are still present, especially among young children. AEC may likely aid radiation dose optimization in paediatric brain CT by decreasing the tube current according to the head size.

The effect of iterative reconstruction on image quality and radiation dose optimization

In pediatric techniques distinguish themselves from conventional FBP by statistically modeling noise directly from the raw data and employing an iterative cycle to achieve noise reduction. IR enables dose reduction far beyond what was possible with filtered back project (FBP), often achieving 50-80% lower radiation exposure while maintaining acceptable image quality. In terms of size-specific protocols children vary enormously in terms of size. IR allows low-dose protocols tailored to weight or

age without noise. Advanced technique such as ASIR, MBIR, and SAFIRE imaging procedure can reduce dose requirement by up to 60% compared to using FBP method (Pendem *et al* 2024). IR algorithm give radiologist the dual benefits of enhanced control over diagnostic confidence and reduced radiation exposure, allowing for protocols to be customized based on body part and clinical rationale. Advances in CT technology, combined with deep learning, may enable reduced radiation exposure without compromising the image accuracy needed for paediatric diagnosis.

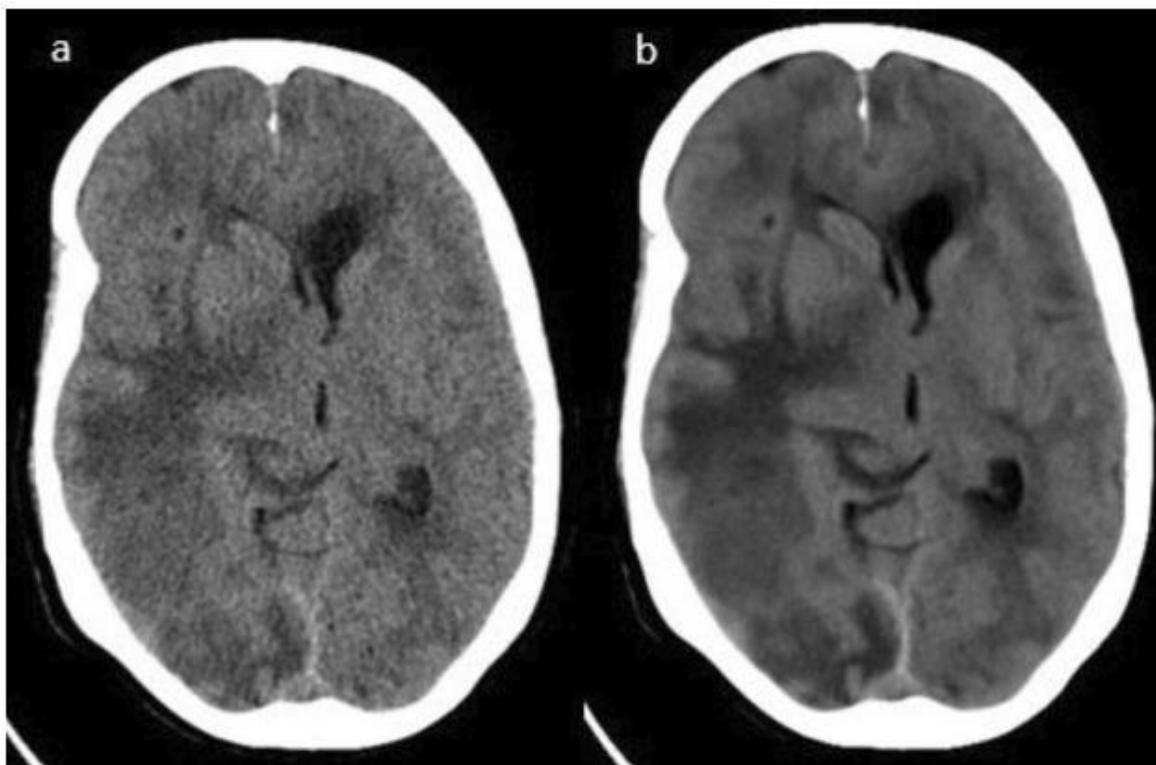


Figure 2: Axial CT images showing the improved image quality with (a) iDose4 compared to (b) DLIR-standard. (Source: Pendem *et al.* 2024)

Training Gaps in paediatric imaging safety

The high radiation dose from Computed tomography scan is a significant concern, even though they are crucial tool in modern medicine. In pediatric clinical practice, CT is primarily used to diagnose head abnormalities (kanal *et al*, 2024). Children who receive brain CT scan have been shown to have a higher morbidity rate from brain tumors. This risk is elevated because children are more sensitive to radiation and have a longer remaining lifespan, allowing potential cancers to manifest many years. A high morbidity of brain tumors has been reported for children who underwent brain CT (Pearce *et al*, 2012). Children are more radiosensitive than adults, and their long-expected lifetime allows the development of cancer after a long latency period. Therefore, optimization and justification in pediatric brain CT are essential

(Nakamura, *et al*, 2022). Simply having better dose reduction technology is ineffective because many radiology staff lack sufficient training in safe technique. This is especially true for paediatric CT, as professional often receive little formal education on imaging children, leaving them ill-equipped to set crucial parameters like tube voltage (kVp), milliampere-seconds (mAs), pitch factor, and scan length (Irsal *et al.* 2022). A clinical audit found that about 40% of radiology staff do not correctly choose CT scan setting for children based on their weight. As a result, they may use setting meant for adults, which exposes children to unnecessary high levels of radiation, as shown by CTDIvol and DLP indexes. The underutilization of both AEC and iterative reconstruction is primarily due to technologist's lack of familiarity with these tools and a persistent concern that their use will

compromise image quality compared to conventional methods (Gould *et al.* 2021). In paediatric imaging, several factors contribute to excessive radiation exposure. Uncooperative children who are not properly restrained cause motion artifact leading to repeat scan. Many radiologists are also untrained in dose modulation and selecting ideal Scan phase for multiphase studies. This is because paediatric radiation safety is often excluded from mandatory CPD curricula, and refresher courses are not always required for (Morgan *et al.* 2023). Continuous learning is critical; otherwise, seasoned technologists might rely on habitual techniques. To bridge this knowledge gap and guarantee compliance with ALARA and paediatric safety protocols, institution should enforce designated training, certifications and regular audits. If they do not keep learning new techniques, even seasoned technologists might apply the same methods they are used to. Ensuring that designated training, certifications, and audits are used helps close the gap in knowledge and makes sure ALARA rules and high safety in pediatric imaging are followed.

How AI and digital tools can make dose optimization faster and more accurate

The integration of AI and digital technologies is revolutionizing dose optimization in paediatric CT. Algorithms now analyze pre-scan digital data to provide instantaneous, patient-specific recommendations for technical parameters-including tube voltage, tube current, pitch and scan range-there by enhancing safety through customized imaging protocols (Golbus *et al.* 2024). AI intelligently position the patient at the center and identifies the necessary anatomy, ensuring the AEC

and collimation control function with maximum accuracy (Beysang *et al.* 2024). This deep learning technique enables high quality CT scans with exceptional tissue clarity using very low radiation doses. For example, in paediatric head scan, it can clearly distinguish gray and white matter even at doses below 2 mGy, ensuring both diagnostic accuracy and patient safety. Furthermore, monitoring software like Remimetrics, dosewatch, and Teamplay automatically collect dose data (CTDIvol. and DLP), allowing hospitals to compare results against recommended diagnostic reference levels (DRLs) (Alanazi *et al.* 2024). This software acts as a vigilant safety tool, sending immediate alert when scan parameters exceeds safe limits, prompting an instant protocol review. AI can identify significant scans and track formulate radiation doses, which is critical in chronic care like paediatric oncology, furthermore, by leveraging large datasets from multiple hospital, machine learning help determine the optimal imaging test for a specific clinical scenario. Machine learning leverages aggregated patient data from multiple hospitals to recommend the most appropriate imaging tests based on clinical presentation age, weight and prior results. This data-driven approach reduces diagnostic variability and errors while promoting standardize practices. When AI is embedded within the clinical workflow via PACS and RIS integration, it provides direct support for diagnostic decision-making (Orellana García *et al.* 2023). These technologies face challenges, such as the need to ensure interoperability, adhere to established guidelines, and undergo regular testing across diverse pediatric populations. Nevertheless, AI has the potential to significantly enhance and standardize the safety of CT scans for children.

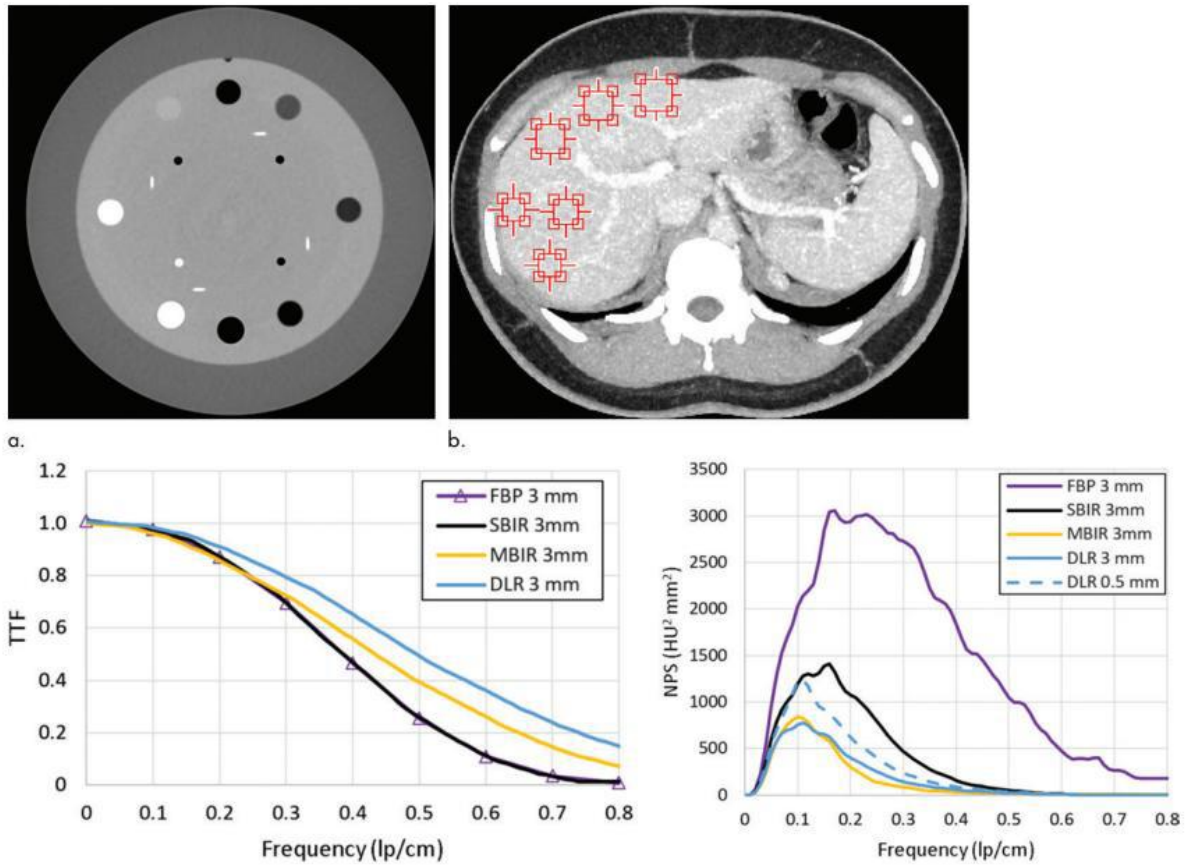


Figure 3: Evaluation of Image Quality Metrics in CT Scanning: TTF and NPS Calculations Using Various Reconstruction Algorithms and Sensitometry Inserts (Source: Brady *et al.* 2021)

CONCLUSION

The research underscores that a central advancement and continued concern in paediatric imaging is the reduction of CT radiation dose. This can be achieved through automatic exposure control and iterative reconstruction, which lower exposure while maintaining diagnostic accuracy. Ensuring consistent dosing in paediatric CT is difficult due to diverse techniques, varying equipment and insufficient training. Thus, rigorous implementation of standardized acquisition protocol, coupled with systematic improvement in radiology training, constitutes a critical strategy for mitigating interpretive errors and elevating the quality of diagnostic imaging. Achieving safe, high-quality scans with optimized radiation exposure hinges on integration of advance technology specialize staff training and multidisciplinary collaboration-principles that must become the modern standard to ensure diagnostic integrity and patient safety.

REFERENCES

Alexander, R., Waite, S., Bruno, M.A., Krupinski, E.A., Berlin, L., Macknik, S. & Martinez-Conde, S. (2022). Mandating limits on workload, duty, and speed in

radiology. *Radiology*, 304(2), pp.274-282. <https://doi.org/10.1148/radiol.212631>

Arfat, M., Haq, A., Beg, T. & Jaleel, G., 2024. Optimization of CT radiation dose: Insight into DLP and CTDI. *Future Health*, 2(2), pp.148-152. <https://Futurehealthjournal.com>

American Association of Physicists in Medicine (AAPM). Size-Specific Dose Estimates (SSDE) in Pediatric and Adult Body CT Examinations (Task Group 204); American Association of Physicists in Medicine: College Park, MD, USA, 2011. <https://doi.org/10.37206/146>

American Association of Physicists in Medicine (AAPM). Use of Water Equivalent Diameter for Calculating Patient Size and Size-Specific Dose Estimates (SSDE) in CT (Task Group 220); American Association of Physicists in Medicine: College Park, MD, USA, 2014. https://www.aapm.org/pubs/reports/RPT_220.pdf

- Alanazi, M., Kench, P., Taba, S. & Ekpo, E., 2024. Evaluating the impact of dose monitoring software alerts on radiation dose reduction in computed tomography: A systematic review. *European Journal of Radiology*, p.111892. <https://doi.org/10.1016/j.ejrad.2024.111892>
- Beysang, A., Villani, N., Boubaker, F., Puel, U., Eliezer, M., Hossu, G., Haioun, K., Blum, A., Teixeira, P.A.G., Parietti-Winkler, C. and Gillet, R., 2024. Ultra-high-resolution CT of the temporal bone: comparison between deep learning reconstruction and hybrid and model-based iterative reconstruction. *Diagnostic and Interventional Imaging*, 105(6), pp.233-242. <https://doi.org/10.1016/j.diii.2024.02.001>
- Brenner DJ, Elliston CD, Hall EJ, Berdon WE, Estimated risks of radiation-induced fatal cancer from pediatric CT. *American Journal of Roentgenology (AJR Am J Roentgenol)*. 2001; 176(2): 289-96 <https://doi.org/10.2214/ajr.176.2.1760289>
- Brady, S.L., Trout, A.T., Somasundaram, E., Anton, C.G., Li, Y. and Dillman, J.R., 2021. Improving image quality and reducing radiation dose for pediatric CT by using deep learning reconstruction. *Radiology*, 298(1), pp.180-188. <https://doi.org/10.1148/radiol.2021200380>
- Crowley, C., Ekpo, E.U., Carey, B.W., Joyce, S., Kennedy, C., Grey, T., Duffy, B., Kavanagh, R., James, K., Moloney, F. and Normoyle, B., 2021. Radiation dose tracking in computed tomography: Red alerts and feedback. Implementing a radiation dose alert system in CT. "Radiography", 27(1), pp.67-74. <https://doi.org/10.1016/j.radi.2020.06.004>
- Chekmeyan, M., Baccei, S.J. and Garwood, E.R., 2023. Cross-Check QA: A Quality Assurance Workflow to Prevent Missed Diagnoses by Alerting Inadvertent Discordance Between the Radiologist and Artificial Intelligence in the Interpretation of High-Acuity CT Scans. *Journal of the American College of Radiology*, 20(12), pp.1225-1230. <https://doi.org/10.1016/j.jacr.2023.06.010>
- Donnelly LF, Emery KH, Brody AS, Laor T, Gylys-Morin VM, Anton CG, et al. Minimizing radiation dose for pediatric body applications of single-detector helical CT: Strategies at a large Children's Hospital. *AJR Am J Roentgenol* 2001; 176:303-6. <https://doi.org/10.2214/ajr.176.2.1760303>
- Granata, C.; Origgi, D.; Palorini, F.; Matranga, D.; Salerno, S. Radiation dose from multidetector CT studies in children: Results from the first Italian nationwide survey. *Pediatr. Radiol.* 2015, 45, 695–705. <https://doi.org/10.1007/s00247-014-3201-z>
- Golbus, A.E., Schuzer, J.L., Steveson, C., Rollison, S.F., Matthews, J., Henry-Ellis, J., Razeto, M. and Chen, M.Y., 2024. Reduced dose helical CT scout imaging on next generation wide volume CT system decreases scan length and overall radiation exposure. *European Journal of Radiology Open*, 13, p.100578. <https://doi.org/10.1016/j.ejro.2024.100578>
- Gould, S.M., Mackewn, J., Chicklore, S., Cook, G.J., Mallia, A. and Pike, L., 2021. Optimisation of CT protocols in PET-CT across different scanner models using different automatic exposure control methods and iterative reconstruction algorithms. *EJNMMI physics*, 8, pp.1-15 <https://doi.org/10.1186/s40658-021-00404-4>
- Ghorbanizadeh, S., Raziani, Y., Amraei, M. and Heydarian, M., 2021. Care and precautions in performing CT Scans in children. *Journal of Pharmaceutical Negative Results*, 12(1), p.54. <https://www.pnrjournal.com/index.php/home/article/view/167>
- Han, M., Kim, H.J., Choi, J.W., Park, D.Y. and Han, J.G., 2022. Diagnostic usefulness of cone-beam computed tomography versus multi-detector computed tomography for sinonasal structure evaluation. *Laryngoscope Investigative Otolaryngology*, 7(3), pp.662-670 <https://doi.org/10.1002/lio2.803>
- ICRP, 1991. 1990 Recommendations of the International Commission on Radiological Protection. ICRP Publication 60. *Ann. ICRP* 21 (1-3). <https://icrp.org/publication.asp?id=ICRP+Publication+60>
- Irsal, M., Mukhtar, A.N., Winarno, G. and Sari, G., 2022. The Effect of Kilovoltage and Milliampere-Second Parameters on CT Number: Study Phantom Quality Control CT Scan. *SANITAS J. Teknol. dan Seni Kesehatan*, 13(2), pp.237-244. <https://www.neliti.com/journals/sanitas>
- White KS. Helical/spiral CT scanning: a pediatric radiology perspective. *Pediatr Radiol* 1996; 26:5-14. <https://doi.org/10.1007/BF01403695>
- Kanal, K.M., Butler, P.F., Chatfield, M.B., Wells, J., Samei, E., Simanowith, M., Golden, D., Gress, D.A., Burleson, J., Sensakovic, W.F., et al. (2022). *Radiology*, 302(1), 164–174. <https://doi.org/10.1148/radiol.2021211241>
- Kim, S.H., 2023. Dose Reduction Method for Chest CT using a Combination of Examination Condition Control and Iterative Reconstruction. *Journal of the Korean*

- Society of Radiology*, 17(7), pp.1025-1031. <http://jksronline.org/index.php>
- Li, Y., Liu, X., Zhuang, X. H., Wang, M. J., & Song, X. F. (2022). Assessment of low-dose paranasal sinus CT imaging using a new deep learning image reconstruction technique in children compared to adaptive statistical iterative reconstruction. "BMC Medical Imaging", 22(1), 106. <https://doi.org/10.1186/s12880-022-00834-1>
- Lee, C.H.; Goo, J.M.; Ye, H.J.; Ye, S.J.; Park, C.M.; Chun, E.J.; Im, J.G. Radiation dose modulation techniques in the multidetector CT era: From basics to practice. *Radiographics* 2008, 28, 1451–1459. <https://doi.org/10.1148/rg.285075075>
- Morgan, T., Ku, M., Berg, M. and Halkett, G.K., 2023. Australian medical radiation practitioners perspectives of continuing professional development: An online cross-sectional study. *Journal of Medical Radiation Sciences*, 70(3), pp.270-282. <https://doi.org/10.1002/jmrs.691>
- Mendonça, R. P. D., Estrela, C., Bueno, M. R., Carvalho, T. C. A. S. G., Estrela, L. R. D. A., & Chilvarquer, I. (2025). Principles of radiological protection and application of ALARA, ALADA, and ALADAIP: A critical review. "Brazilian Oral Research, 39", e14. <https://doi.org/10.1590/1807-3107bor-2025.vol39.0014>
- Orellana García, A., Vega Izaguirre, L., Ceruto Marrero, G., & Méndez Mederos, A. (2023). Plataforma XAVIA PACS-RIS y su contribución al diagnóstico por imágenes médicas digitales en Cuba. *Revista Cubana de Ciencias Informáticas*, 17 (4). http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S227-18992023000400005
- Pearce, M.S.; Salotti, J.A.; Little, M.P.; McHugh, K.; Lee, C.; Kim, K.P.; Howe, N.L.; Ronckers, C.M.; Rajaraman, P.; Craft, A.W.; et al. Radiation exposure from CT scans in childhood and subsequent risk of leukaemia and brain tumours: A retrospective cohort study. *Lancet* 2012, 380, 499–505. <https://www.enviroresearch.org/climate-impacts>
- Pendem, S., Priya, P. S., Chacko, C., & Kadavigere, R. (2024). Comparison of image quality between Deep learning image reconstruction and Iterative reconstruction technique for CT Brain - a pilot study. *F1000Research*, 13, 691. <https://f1000research.com/articles/13-691>
- Tadia, V. K. (2021). Evaluation of Radiology Information Systems including PACS at Two Tertiary Hospitals in India from User's Perspective. *Medico-Legal Update*, 21(1), 1171. <https://doi.org/10.37506/mlu.v21i1.2477>
- Nakamura, Y., Itoh, H., Miyatake, H., Hata, H., Sasa, R., Shiibashi, N., & Mitsui, K. (2022). Automatic Exposure Control Attains Radiation Dose Modulation Matched with the Head Size in Pediatric Brain CT. *Tomography*, 8(6), 2929–2938. <https://doi.org/10.3390/tomography8060246>