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Review of guidelines and legislative documents regarding the use of patient contact out-of-field shielding

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Purpose: To review current recommendations and legislative documents on the use of out-of-field patient-contact shielding, including those from national authorities, international and national organisations and professional bodies. Protection relates to highly attenuating material placed over the patient outside the imaging field of view in X-ray imaging.
Materials and Method: The review was performed within the framework of the activities of the EURADOS Working Group 12 covering 81 legislative documents and recommendations published over the last 40 years from 34 countries (mainly Europe) and 6 international organisations. The documents covered available recommendations on the use of patient shielding in adult, pregnant and paediatric patients in general radiography, fluoroscopy, computed tomography, mammography and dental radiology.
Results: There is a wide variation in countries/organisations between those that recommend out-of-field shielding, those that do not recommend its use, and those that do not state anything about it. Additionally, many legislative documents and recommendations are not specific enough. When the use of out-of-field shielding is recommended it is because it is implicitly considered as good radiological practice and appropriate (e.g. if it does not mask diagnostic information nor compromises the performance of the procedure) or its use reassures the patient in a sense that he/she feels protected and safe. It is generally accepted that if shielding shall be used then it is only for organs at risk within 5 cm from the field edge. Yet, this requires caution and careful positioning to avoid the introduction of artefacts in the image. In addition, shielding can impact the AEC performance, leading to increased radiation exposure. For organs that are further away from the primary beam (>5 cm), no particular conclusion can be derived, but shielding is occasionally used only to reassure patients, carers and comforters.
Conclusions: There is no common standing on this topic. Therefore, a joint internationally accepted statement regarding the use of out-of-field shielding is urgently needed. Furthermore, health professionals must be adequately trained on when and how to use patient shielding so that patients receive adequate information. Written procedures based on regulations, available guidance and scientific evidence are necessary to ensure consistent practice and a widely shared approach.
Keywords: out of field shielding, patient shielding, shielding guidelines.

OL54

Dosimetric and radiation cancer risk evaluation of high resolution thorax CT during COVID-19 outbreak

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Purpose: The aim of this work was to evaluate the dosimetric impact of high-resolution thorax CT during COVID19 outbreak in the University Hospital of Parma. In two months we have performed a huge number of thorax CT scans collecting effective and equivalent organ doses and evaluating also the lifetime attributable risk (LAR) of lung and other major cancers.
Materials and Method: From February 24th to April 28th, 3224 high-resolution thorax CT were acquired. For all patients we have examined the volumetric computed tomography dose index (CTDIvol), the dose length product (DLP), the size-specific dose estimate (SSDE) and effective dose (E103) using a dose tracking

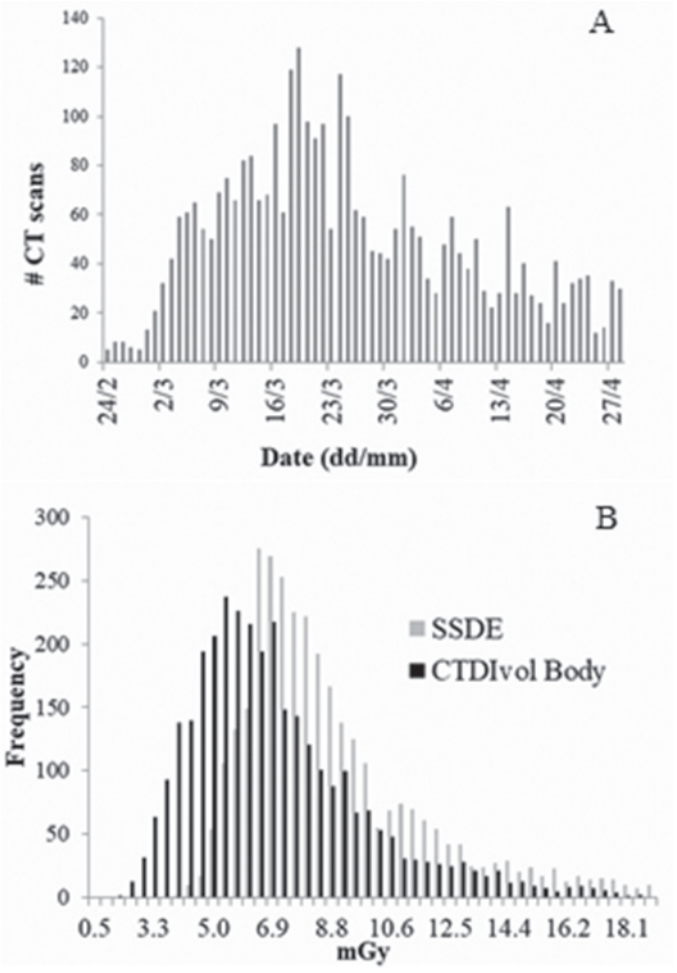

Fig. 1 (abstract OL54). (A) The number of CT scans for suspected COVID-19 performed daily at the University Hospital of Parma from February 24th to April 28th. (B) SSDE and CTDIvol_Body frequency distributions.

software (Radimetrics Bayer HealthCare). From the equivalent dose to organs for each patient, LAR for lung and major cancers were estimated following the method proposed in BEIR VII which considers age and sex differences.
Results: Study population included 3224 patients, 1843 male and 1381 female, with an average age of 67 years. The average CTDIvol, SSDE and DLP, and E103 were 6.8 mGy, 8.7 mGy, 239 mGy·cm and 4.4 mSv respectively. The average LAR of all solid cancers was 2.1 cases per 10,000 patients, while the average LAR of leukemia was 0.2 cases per 10,000 patients. For both male and female the organ with a major cancer risk was lung.
Conclusions: Despite the impressive increment in thoracic CT examinations due to COVID-19 outbreak, the high resolution low dose protocol used in our hospital guaranteed low doses and very low risk estimation in terms of LAR.
Keywords: CT dosimetry, Thorax imaging, COVID-19, Dose tracking, Lifetime attributable risk

OL55
Use of an MRI scan based 3D printed personalized phantom to assess lens dose reduction factors for lead glasses in interventional cardiology

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Purpose: New eye dose limits specified in EU13/59 BSS present a challenge for interventional cardiologists. Collar doses are recognised as a method of estimating eye lens dose when used with a dose reduction factor to take account of lead glasses. A range of dose reduction factors have been published in the literature for different types of glasses and varying geometries. The purpose of this paper is to create a personalised 3D-printed phantom to estimate individualized dose reduction factors from lead glasses.
Materials and Methods: A 3D printed model of the surface of an MPRAGE MRI scan (Siemens Avanto) of the cardiologists head was created on a low cost 3D printer. The head was filled with gelatine to simulate human tissue. This was placed on top of a Rando phantom covered by a lead apron. The Rando phantom was placed to the right of the x-ray tube, in an interventional cath lab (Siemens Artis Zee), with a 20 cm Perspex block used to simulate patient scatter. Placement was of a similar geometry and height to that used by the cardiologist. Dosimeters (Mirion whole body TLD, Landauer Vision TLD) were placed on the phantom including on the collar, the left and right eye lenses and on the arms of the glasses. Overall entrance air kerma to the Perspex was of the order of 8Gy for each set of glasses tested. This resulted in typical Hp(3) doses of 8mSv to the Vision eye badge placed on the collar. The dose reduction factors given below are relative to the Vision eye badge located on the collar of the phantom.
Results: Dose reduction factors (DRF) are given for the left lens (A) and corner of left eye (B) relative to the collar eye badge.
Glasses 1: DRF at position A = 1.5 and position B = 4.0
Glasses 2: DRF at position A = 3.7 and position B = 0.8
Conclusions: Personalized dose reduction factors can be measured for lead glasses as worn by an interventional cardiologist in a simulated clinical setting.
Keywords: Occupational, eye dose, interventional

OL56
Reference dosimetry audits for radiotherapy beams in Italy

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Purpose: Remote dosimetric audits aiming at verifying the photon beam output in reference conditions begun in 2019, organized by the Italian Association of Medical Physics (AIFM) with the support of the Italian National Institute of Ionizing Radiation Metrology (ENEA-INMRI). In the following we report on the audit methodology and results so far.
Materials and Method: The ENEA-INMRI designed and characterized a dosimeter based on thermoluminescent detectors (TLD) for absorbed dose to water (D_w) measurement in megavoltage photon beams in reference conditions. The dosimeter consists of a set of TLD (LiF:Mg,Ti; chips 3.2x3.2x0.89 mm^3) embedded in a PMMA waterproof holder. Up to 20 chips can be hosted into the holder and the average value of the individual TLD readings represents the dosimeter signal. Signal reproducibility, response linearity and stability, energy dependence, and fading effects were investigated and the relevant correction factors assessed.
For the audit, measurement procedures based on the dosimeter calibration at the ^{60}Co beam quality were developed. A technical protocol was established to detail the audit methodology and the operating procedure. In particular, the protocol specifies irradiation set-up, dosimeter positioning, absorbed dose to be delivered, irradiation data to be recorded and the metric adopted for evaluating the audit results. The technical protocol was tested and validated carrying out pilot audits for different types of clinical accelerator photon beams. Then, the protocol has been applied for remote audits provided on request to Italian radiotherapy centres.
Results: Audits have been carried out for photon beams in the range 6-18 MV produced by conventional accelerators and in 6 MV flattening filter free beams including CyberKnife and Tomotherapy beams. Up to now, a total of 34 beams were checked in 16 Italian radiotherapy centres. For each beam the dosimeter irradiation was repeated twice. The combined standard uncertainty of the D_w value obtained by each dosimeter ranged from 1.5% to 2.1%, depending on the number of correction factors applied and the homogeneity of the TLD individual response. Differences between D_w values measured by the TLD dosimeters and those stated by the radiotherapy centres were always within the combined extended uncertainty with coverage factor k=2, except for one beam. Of note, for about 75% of the beams the agreement was within the combined standard uncertainty (k=1).
Conclusions: Reference dosimetry audits for radiotherapy photon beams are currently ongoing in Italy. To date, the audit results have shown good performance of the involved radiotherapy centres.
Keywords: dosimetric audit, TLD, radiotherapy photon beams, reference dosimetry, remote audit

OL57
Irradiation of a pregnant on Leksell Gamma Knife Icon/ Perfexion: radiobiological risk assessment and three clinical cases

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