RADIATION EXPOSURE TO CAREGIVERS AND COMFORTERS

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QUESTION

How much radiation are carers or comforters exposed during radiology or nuclear medicine examinations or therapy?

SEARCH LIMITS

Last 20 years.

SEARCH METHODOLOGY

A systematic search was conducted for literature. Citation searching was also conducted.

DATABASES SEARCHED

- Medline – index of peer reviewed articles across health sciences and medicine.
- Embase – index of biomed and pharmacological peer reviewed journal articles.
- Emcare – index of nursing, allied health, critical-care medicine and more.
- Grey literature – Google, Google Scholar, Trip database, Biomed Central Proceedings.

LITERATURE RESULTS

All articles can be provided in full text - email library@monashhealth.org a list of articles you require.

PEER-REVIEWED LITERATURE - IN REVERSE CHRONOLOGICAL ORDER

Articles are grouped by theme:

- Guidelines
- Nuclear Medicine
- PET CT
- PRRT
- Radionuclides
- Shields

Each article summary contains excerpts from the abstract and an online link.

GUIDELINES

Loose, et al. (2020). The new radiation protection framework since 2019 - Implementation in Germany and comparison of some aspects in seven European countries. RoFo Fortschritte auf dem Gebiet der Rontgenstrahlen und der Bildgebenden Verfahren, 192(11), 1036-1045.

The provisions of the Rontgenverordnung (RoV) and the old Strahlenschutzverordnung (StrlSchV alt), which were valid until 2018, are compared with the new legislation of StrlSchG and StrlSchV for changes in radiation protection for patients, the population and occupational radiation protection of staff members.

(2019). Code for Radiation Protection in Medical Exposure, Radiation Protection Series C-5. Cited 2 times. ARPANSA, Yallambie

This Code for Radiation Protection in Medical Exposure (2019) (RPS C-5) sets out the requirements in Australia for the protection of patients, their carers and comforters, and volunteers in biomedical research projects, in relation to their exposure to ionising radiation.

Jansen, et al. (2006). Dose constraints and guidance for exposure of individuals knowingly and willingly helping in the support and comfort of individuals undergoing medical exposure. Radiation protection dosimetry, 118(3), 315-24.

The council of the European Union (EU) has adopted directive 97/43/EURATOM that states that Member States shall ensure that dose constraints are established for exposure of those individuals (voluntary helpers) knowingly and willingly helping patients undergoing medical diagnosis or treatment. This study investigates for which medical diagnoses and treatments voluntary helpers are active. It provides a rough estimation of the effective dose to the voluntary helper for various applications. It summarises the dose constraints established in various EU Member States.

(2008) Safety Guide for Radiation Protection in Diagnostic and Interventional Radiology, Radiation Protection Series No. 14.1, ARPANSA, Yallambie

The Responsible Person should be able to demonstrate that the effective dose received by a carer, who voluntarily helps in the care, support or comfort of patients undergoing diagnostic or interventional radiology examinations, is unlikely to exceed 5 mSv per year (IAEA 1996)

(2007) The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103

These recommendations maintain the International Commission on Radiological Protection's three fundamental principles of radiological protection, namely justification, optimisation, and the application of dose limits, clarifying how they apply to radiation sources delivering exposure and to individuals receiving exposure.

Singleton, et al. (2003) Dose constraints for comforters and carers. London, UK: Health and Safety Executive; Research Report 155.

This report has been prepared to enable guidance to be developed for employers, to assist them in meeting relevant legislative requirements for the exposure of persons who offer support and care to patients undergoing procedures involving ionising radiation where this would not be considered part of their occupation. The report identifies relevant legislation and guidance, discusses its interpretation, identifies circumstances in which these persons are exposed and presents information relating to the extent of these exposures, including results of dose measurements.

NUCLEAR MEDICINE

Kim, et al. (2021). **Radiation exposure to family caregivers of patients administered radioisotopes for nuclear medicine procedures**. Journal of Nuclear Medicine, 62(SUPPL 1),

Radiation exposure to caregivers is increasing as the use of medical radiation increases. We identified the factors affecting the dose received by a family caregiver who cared for patients who underwent nuclear medicine procedures in order to suggest some considerations for families and nuclear medicine physicians in establishing radiation protection policies for caregivers. This prospective study included 246 cases in two hospitals. The adult family caregivers (1) for patients who underwent F-18 fluorodeoxyglucose (FDG) PET/CT, Tc-99m hydroxymethylene diphosphonate (HDP) bonescans, I-123 scans or Tc-99m dimercaptosuccinic acid (DMSA) scans for diagnosis, (2) for patients who received I-131 radioiodine treatment for therapy, and (3) who agreed to participate in research were included, and theirradiation exposure from patients administered radioisotope was measured. Univariate and multivariate regression analyses were used to determine the factors affecting a caregiver's radiation dose. The patient's gender (P =0.014) and administration of a Tc-99m HDP bone scan (P =0.001) were the independent factors affecting the radiation dose to caregivers who cared for patients administered radioisotopes inthe multivariate analysis. Conclusion(s): A patient's gender and the performance of Tc-99m HDP bone scans should be taken into consideration for establishing a radiation protection policy for caregivers who care for patients administered radioisotope.

Diaz Barreto, et al. (2012). **On the safety of persons accompanying nuclear medicine patients**. Radiation protection dosimetry, 152(4), 313-6.

The aim of this research was to know about the doses received by two significant groups of caretakers: comforters of cancer patients (Group I) and mothers of small children (Group II). The patients were scheduled to undergo two different diagnostic studies: Inmuno-Scintigraphy using a monoclonal antibody bound to (99m)Tc (for adults) and Renal Scintigraphy using (99m)Tc-dimercaptosuccinic acid (for children). The average effective doses were 0.27 and 0.29 mSv for Groups I and II, respectively. Additionally, environmental monitoring was performed in the waiting room for injected patients (Room I) and inside the procedure room (Room II). Equivalent environmental doses of 0.28 and 0.24 mSv for Rooms 1 and II, respectively, were found, which are similar to values reported by other authors.

Henderson and Burkhardt. (2010). **Radiation exposure to a family member in the injection room during dose administration.** Journal of Nuclear Medicine, 51(SUPPL. 2)

Family members often join the patient in the injection room where they are being exposed to radiation. The goal of this study was to determine if the family member would receive significant radiation exposure while being present during the dose administration. Exposure rates were measured with an electronic pocket Geiger Muller dosimeter. The dosimeter was placed one and half meters away from the injection area. Readings from the dosimeter were recorded daily for fifteen days. The procedure, isotope, dose administered, and time in the room were recorded. Background was subtracted out of the daily readings. Out of the fifteen days, only two days went above background level. A one-sided t test statistical analysis was performed to compare measured radiation with the expected background level. On these two days that went above background level I-131 thyroid therapy doses were given. Radiation exposure readings to family members did not exceed background levels unless I-131 therapy was administered.

PET CT

Moroi, et al. (2022). [Development of the Radiation Protective Curtain for the Dose Reduction of Caregivers during Computed Tomography Examinations]. Nihon Hoshasen Gijutsu Gakkai zasshi, 78(2), 140-151. ***Japanese Language***

This study aimed to evaluate the effectiveness of novel radiation protective curtains in reducing radiation exposure to caregivers while assisting patients, especially during CT examinations of the head., METHOD: The absorbed dose in air around the gantry during CT examinations of the head was measured using glass dosimeters. The measurement points from the center of the gantry were 40 to 120 cm in the front, 0 to 100 cm for each side in the right and left, and 60 to 180 cm from the floor. Measurements were performed at each 20-cm interval, and all points were accumulated 10 times. The absorbed dose in air in a CT room was compared with and without the protective curtains. Next, we assumed the height of the caregiver to be 170 cm, and measured the points for the crystalline lens, chest, and abdomen. Also, using the protective glasses and the protective apron, we measured the absorbed dose in air for the caregivers behind the protective curtains., RESULT: The absorbed exposure dose in air toward the crystalline lenses, chest, and abdomen was reduced more than 90% by using the protective curtains and more than 95% by using the protective apron and protective glasses in addition to them., CONCLUSION: This study showed the usefulness of protective curtains in reducing the absorbed exposure dose in air to caregivers.

Overhoff, et al. (2020). Radiation dose of chaperones during common pediatric computed tomography examinations. Pediatric radiology, 50(8), 1078-1082.

The aim of this study was to measure the radiation dose of accompanying adults during state-of-the-art pediatric CT protocols. In addition to a 100-kV non-contrast-enhanced chest CT (Protocol 1), we performed a 70-kV contrast-enhanced chest protocol (Protocol 2) using a third-generation dual-source CT. We acquired data on the radiation dose around the scanner using digital dosimetry placed right at the gantry, 1 m away, as well as beside the gantry. We acquired the CT-surrounding radiation dose during scanning of a pediatric phantom as well as 12 pediatric patients. RESULTS: After conducting 10 consecutive phantom scans using Protocol 1, we found the location with the highest cumulative dose acquired was right next to the gantry opening, at 3 muSv. Protocol 2 showed highest cumulative dose of 2 muSv at the same location. For Protocol 1, the location with the highest radiation doses during pediatric scans was right next to the gantry opening, with doses of 0.75+/-0.70 muSv. For Protocol 2, the highest radiation was measured 1 m away at 0.50+/-0.60 muSv. No radiation dose was measured at any time beside the gantry., CONCLUSION: Our results provide proof that chaperones receive low radiation doses during state-of-the-art CT examinations. Given knowledge of these values as well as the optimal spots with the lowest radiation doses, parents as well as patients might be more relaxed during the examination.

Kalogianni, et al. (2019). Radiation exposure to carers and comforters from patients undergoing 18F-FDG-PET/CT. European Journal of Nuclear Medicine and Molecular Imaging, 46(1 Supplement 1), S839.

The aim of this study was to estimate the in-hospital radiation exposure of carers and comforters accompanying patients undergoing PETCT examinations and to establish guidance for radiation safety. Measurements were performed using a Tracerco PED+ Personal Electronic Dosimeter, which records equivalent dose rate and cumulative dose, during the patients resting period and a series 900 Mini-Instruments survey meter. All measurements were corrected for background, measured in the same room without the patient. Result(s): The median injected activity was 342 MBq (224 - 425). The median resting period was 51 min (43 - 61). The median dose rates per unit of injected activity measured at 1m, 0.5 m and 0.1 m were 0.07 muSv/h/MBq (0.04 - 0.09), 0.20 muSv/h/MBq (0.11 - 0.50) and 0.75 muSv/h/MBq (0.40 - 0.89) respectively. The median cumulative dose received during resting period measured at 1m, 0.5 m and 0.1 m was 20 muSv (12-39), 76 muSv (34 - 201) and 234 muSv (167 - 301) respectively. The 95th percentile for these measurements were 33 muSv, 152 muSv and 286 muSv. Conclusion(s): Doses to comforters and carers were within the dose constraint recommended by the International Commission on Radiological Protection (Publication 103) of 5mSv per occurrence. This study confirms that comforter and carer radiation exposure levels from FDG PET-CT examinations practice are acceptably low.

Chun. (2015). **Quantification of radiation exposure to patients and surrounding people after oncologic PET/CT imaging with 18F-FDG**. Journal of Nuclear Medicine, 56(SUPPL. 3),

In the current study, we estimated radiation dose to patients and surrounding people including caregivers and health care providers after F-FDG PET/CT imaging for reassurance of radiation safety and optimized PET/CT imaging protocol. **Methods:** 78 patients diagnosed with various cancers underwent whole-body PET/CT (Discovery 600, GE) imaging after injection of 18F-FDG. **Results:** All patients underwent PET scan about 60 min after injection of 333 +/- 25.9MBq (9.0 +/- 0.7 mCi) of 18F-FDG and helical CT scan (tube voltage = 120 kVp, tube current = auto, noise index = 18). Estimated effective radiation doses (mSv) from PET and CT were 6.4 +/- 0.5 and 8.8 +/- 2.5, respectively. Estimated whole-body radiation dose rates (muSv/min) at 1 m away from the patients (neck, chest, abdomen, and proximal thigh) were 0.34, 0.36, 0.35, and 0.30, respectively. **Conclusions:** Internal and external radiation doses after 18F-FDG PET/CT imaging were quantitatively evaluated. To minimize radiation exposure to caregivers and health care providers as well as patients, further studies would be required on optimized protocol of PET/CT imaging and behavioral guidelines.

Wyszomirska, et al. (2012). **Doses for patient's family members undergoing PET-CT examination**. European Journal of Nuclear Medicine and Molecular Imaging, 39(SUPPL. 2), S506.

The aim of this study was to measure the radiation doses for family members of patients undergoing PET CT examinations using 18F-FDG. Experimental measurements of deep personal dose equivalent Hp (10), which is a conservative approximation of the effective dose to the whole body, were taken by highly sensitive thermoluminescent detectors MCP N (LiF: Mg, Cu, P) in a cassette type dosimeter DI 02. The main measurement concerned the dose which receive persons in the patient's vicinity. The study found that family members of patients undergoing a PET CT using 18F-FDG receive an average dose about of 0.24 mSv. The measurement results confirmed that a patient after PET CT does not pose any severe risk to their vicinity in terms of radiation protection.

Demir, et al. (2010). **Radiation protection for accompanying person and radiation workers in PET/CT**. European Journal of Nuclear Medicine and Molecular Imaging, 37(SUPPL. 2), S342.

The aim of this study is: (1) to quantify the excretion of 18Flor-Florodeoxiglucose in the urine for the patients undergo PET/CT imaging, (2) to measure the total radiation doses for the radiation workers and for the accompanying person to the patients: and (3) guide line for dose minimization to minimize dose for the accompanying person and radiation workers. According to our results, 19.2 % of 18Flor-Florodeoxiglucose was excreted out of the body with urine in 120 min after injection. At 120 min after injection, dose rates at 0,1 m, 0.25 m, 0.50 m, 1.0 m and 2.0 m were determined as 345 mu Sv/h, 220 mu Sv/h, 140 mu Sv/h, 50 mu Sv/h and 15 mu Sv/h, respectively. The whole body total radiation dose after 120 min were measured as 3.92 mSv at 0 m, 2.11 mSv at 0.25 m and 1.08 mSv at 0.5 m. Within the first two hours after injection, (19.3 %) of 18Flor-Florodeoxiglucose radioactivity injected to the body was excretes out of the patients body by way of urinating. The amount of activity retained in the patient's body yield an external dose of about 1,08 mSv within a distance of 0.5 m from the patient's body. Hence, the person living with patients should take necessary precautions from the point of radiation protection within these two hours, and there is no need any protection precautions after that time.

PEPTIDE RECEPTOR RADIONUCLIDE THERAPIES

Ioannidou, et al. (2014). **Radiation exposure of caregivers of patients undergoing prrt with 177Lu-DOTATATE for the treatment of neuroendocrine tumors**. Physica Medica, 30(SUPPL. 1), e96.

The potential radiation hazards of caregivers of patients undergoing Radionuclide Therapies (RNTs) has been investigated in several clinical trials. However, the respective literature regarding measurements in Peptide Receptor Radionuclide Therapies (PRRTs) is scarce. We sought to assess the radiation exposure of caregivers of patients undergoing PRRTs with 177Lu-DOTATATE for the treatment of Neuroendocrine Tumors (NETs), as well as to compare theoretically calculated and real recorded doses. The mean total recorded dose of caregivers was 0.1 mSv (range: 0.00-0.29 mSv); around 70% of which was recorded at the first 3 days after treatment. The mean expected dose was 0.78 mSv (range: 0.16-1.59 mSv). The mean daily consumption of liquids by the patients at the same time interval was 2.1 lt (range: 1.0-3.5 lt). The mean Teff was 19 h (range: 9-30 h). The recorded doses to caregivers were considerably lower than the established dose constraints for people assisting patients, when radiation protection instructions are followed by both patients and their caregivers. The theoretically calculated doses were found to be slightly higher than the recorded, but still at very low levels. A 3 or 4-day period of implementation of radiation protection instructions appears sufficient to ensure low radiation exposure to the caregivers. In addition, daily consumption of 2 liters of liquids was associated with the observed very low radiation exposure of caregivers. Effective half life time varies among patients, indicating the necessity for individualized radiation protection instructions. Further studies with larger samples are warranted to confirm our results.

RADIONUCLIDES

Chuamsaamarkkee, et al. (2017). **Area monitoring in radionuclide treatment ward, surrounding areas, and radiation exposure to family caregiver in paediatric patient receiving high Dose131Iodine-MIBG**. European Journal of Nuclear Medicine and Molecular Imaging, 44(2 Supplement 1), S449-S450.

This study aims to measure the radiation exposure to the family caregiver in paediatric patients receiving high dose131I- MIBG. Also, this study intends to measure the radiation exposure in radionuclide isolated treatment room within general paediatric ward and surrounding areas by using OSL (optically stimulated luminescence) to ensure that it is safe to other paediatric patients and their relatives. The radiation monitoring data in the results provides important information to manage radiation protection and aware of radiation exposure in an adjacent room to minimize the exposure dose for the members of public and medical staffs in the paediatric ward. The radiation exposure to caregivers were associated with the patient age; hence, caregiver exposure for younger paediatric patient tends to receive higher as the patient may require more cares and supports.

Tonnonchiang, et al (2016). **Radiation exposure to relatives of patients treated with iodine-131 for thyroid cancer at Siriraj hospital**. Journal of the Medical Association of Thailand, 99(2), 220-224.

Thyroid cancer patients treated with I-131 are potential source of radiation exposure to relatives who are knowingly and willingly exposed to ionizing radiation as a result of providing comfort to patients undergoing I-131 therapy. This study aims to determine radiation dose received by relatives who care for non self-supporting I-131 patients at Siriraj Hospital. Radiation dose to caregivers of a non self-supporting hospitalized patient undergoing I-131 therapy were well below the limits recommended by the ICRP. The patients can be comforted with confidence that dose to caregivers will be less than the limit. This study provides guidance for medical practitioners to obtain practical radiation safety concerns associated with hospitalized patients receiving I-131 therapy especially when patient needs assistance.

Gains, et al. (2015). **Radiation exposure to comforters and carers during paediatric molecular radiotherapy**. Pediatric blood & cancer, 62(2), 235-239.

To show whether the incidental radiation exposure received by comforters and carers of children undergoing molecular radiotherapy was kept as low as reasonably achievable and was within English national dose constraints. The radiation exposure of adult comforters and carers was routinely monitored with a whole body personal dose meter while the child was in hospital. Data were collected on iodine-131 meta-iodobenzylguanidine (131 I-mob), lutetium-177 DOTATATE (177 Lu-DOTATATE), and iodine-131 sodium iodide (131 I-NaI) treatments. Doses to comforters and carers were in all but one case within the dose constraint nationally recommended by the Health Protection Agency, now part of Public Health England. New evidence is presented which show that comforter and carer radiation exposure levels from paediatric molecular radiotherapy in routine clinical practice are acceptably low.

Lee, et al. (2015). **An engagement factor for caregiver radiation dose assessment with radioiodine treatment.** Radiation Protection Dosimetry, 163 (4), pp. 499-508.

This study aims to suggest ways to better manage thyroid cancer patients treated with high- and low-activity radioiodine ((131)I) by assessing external radiation doses to family members and caregivers and the level of radiation in the surrounding environment. The radiation doses to caregivers of 33 inpatients (who were quarantined in the hospital for 2-3 d after treatment) and 31 outpatients who received radioiodine treatment after thyroidectomy were measured using passive thermoluminescence dosemeters. This study presents a new engagement factor (K-value) of 0.82 obtained from the radiation doses to caregivers of both in- and out-patients treated with high- and low-activity radioiodine, and based on this new value, this study presented a new predicted dose for caregivers. A patient treated with high-activity radioiodine can be released after 24 h of isolation, whereas outpatients treated with low-activity radioiodine should be isolated for at least 12 h.

Stefanoyiannis, et al. (2015). **Radiation exposure to caregivers from patients undergoing common radionuclide therapies: a review**. Radiation protection dosimetry, 167(4), 542-51.

This work aimed to review the literature regarding measured effective doses to caregivers from such patients. The main selection criterion was the presence of real radiation exposure measurements. The results were categorised according to the treatment protocol and dose parameters. Analysis of the collected data demonstrated that the measured effective dose values were within the dose constraints defined by the International Commission on Radiological Protection, provided that the radiation protection instructions were followed by both patients and caregivers. In conclusion, the radiation risk for caregivers was almost negligible. In this context, treatments could be administered more often on an outpatient basis, once cost-effectiveness criteria were established and radiation protection training and procedures were appropriately applied.

Stefanoyiannis, et al. (2014). **Radionuclide therapies (RNTs): Which is the radiation burden for the caregivers?** Physica Medica, 30(SUPPL. 1), e83.

The aim of this study is to systematically review the literature pertaining to radiation exposure of caregivers of patients undergoing RNTs. Fifteen papers in total were included in the study. It can be concluded that when adequate radiation protection instructions are provided under the supervision and guidance of experts, the dose to the caregivers can be maintained at very low levels. Dose measurements were not differentiated according to the type of dosimeter utilized. Therefore, dosimeter choice depends on protocol structure and availability issues. With regard to specifying the length of hospitalization, it is recommended that new criteria, in addition to accounting for the level of residual activity, should be adopted. For situations where the radiation exposure to caregivers is negligible, outpatient treatments based on specific cost-effectiveness criteria could be established.

ICRP Publication 94. (2004). **Release of patients after therapy with unsealed radionuclides**. Annals of the ICRP, 34(2 SPEC. ISS.), v-vi.

After some therapeutic nuclear medicine procedures with unsealed radionuclides, precautions may be needed to limit doses to other people, but this is rarely the case after diagnostic procedures. Iodine-131 results in the largest dose to medical staff, the public, caregivers, and relatives. Other radionuclides used in therapy are usually simple beta emitters (e.g. phosphorus-32, strontium-89, and yttrium-90) that pose much less risk. Dose limits apply to exposure of the public and medical staff from patients. Previously, the ICRP has recommended that a source-related dose constraint for optimisation of a few mSv/episode applies to relatives, visitors, and caregivers at home, rather than a dose limit. The present report recommends that young children and infants, as well as visitors not engaged in direct care or comforting, should be treated as members of the public (i.e. be subject to the public dose limit).

J. Valentine. (2004). **Radiological protection after nuclear medicine procedures**. Annals of the ICRP, 34(2 SPEC. ISS.), 1-27.

This report covers both diagnostic and therapeutic procedures but focuses on iodine-131, which is the major source of exposure to staff and relatives. The yields and energies of radiations emitted in nuclear transformations of 1252 radionuclides have been assembled for use in calculating nuclide-specific protection and operational quantities.

SHIELDS

Perdomo, et al. (2022). **Do carers and comforters require lead aprons during general radiographic examinations?** Journal of medical imaging and radiation oncology, 66(1), 25-33.

This study quantified a carers exposure to scattered radiation for general radiographic examinations when remaining with a child to assist in positioning or to comfort them. METHODS: Scattered radiation was measured at four common locations where a carer may stand, with a range of tube potentials (40 kVp to 100 kVp) and PMMA thicknesses of 2.5-22.5 cm. This was then matched to our clinical protocols to estimate the radiation dose a carer could be exposed to while assisting a patient during general radiographic examinations., RESULTS: The effective dose received by a carer standing 20 cm from the centre of the patient varies from 11 min of Australian natural BERT for a finger radiograph on a patient <3 kg and up to 62 h for a swimmers view radiograph performed on a patient >70 kg., CONCLUSION: This dosimetric data allowed an evidence-based assessment of radiation protection requirements for the carer using the ALARA principle. At our institution, it was decided that a lead apron is not required if the carer is unlikely to receive more than 2 microSv. A new policy, presented here, was developed to implement this decision.

Goerner, et al. (2015). **Table top fluoroscopy: To shield or not to shield**. Pediatric Radiology, 45(SUPPL. 1), S90-S91.

Young children often require gentle restraint during fluoroscopic imaging procedures. This can lead to additional radiation exposure to the patient, parent, and staff. The purpose of this study was to determine whether placing lead shields on the table above and below the anatomic area of interest decreases this radiation exposure. Results showed that all scatter measurements, except 1, were higher with lead on the table. Average %Diff between measurements with and without lead was below the specified error of the equipment, indicating there is no advantage to having table top lead shielding in place during fluoroscopic procedures. In cases with excessively non-compliant patients where the operator may be forced to perform the procedure with lead partially in the field-of-view, the increase in scatter to both the patient and operator is substantial.

X RAYS

Sulieman, et al. (2011). **Radiation doses to paediatric patients and comforters undergoing chest x rays**. Radiation Protection Dosimetry. Volume 147, Issue 1-2, Pages 171 – 175, September 2011.

Pneumonia is an important cause of hospital admission among children in the developed world and it is estimated to be responsible for 3-18 % of all paediatric admissions. Chest X ray is an important examination for pneumonia diagnosis and for evaluation of complications. This study aims to determine the entrance surface dose (ESD), organ, effective doses and propose a local diagnostic reference level. The study was carried out at the university hospital of Larissa, Greece. Patients were divided into three groups: organ and effective doses were estimated using National Radiological Protection Board software. The ESD was determined by thermoluminescent dosemeters for 132 children and 76 comforters. The average ESD value was 55±8 µGy. The effective dose for patients was 11.2±5 µSv. The mean radiation dose for comforter is 22±3 mGy. The radiation dose to the patients is well within dose constraint, in the light of the current practice.

MEDLINE SEARCH STRATEGY

1 Caregivers/ or Medical Chaperones/ (48332)

2 (comforter* or caregiver* or care?giv* or carer* or parent* or guardian* or support person* or support people* or family member* or (accompany* adj2 adult)).tw. (662624)

3 1 or 2 (670943)

4 Radiation/ or Radiology/ or Radiography/ or Diagnostic Imaging/ or Radionuclide Imaging/ or Molecular Imaging/ or Nuclear Medicine/ (497924)

5 Tomography/ or Positron-Emission Tomography/ or X-Rays/ (104635)

6 ((CT or tomography or MRI or Magnetic resonance imaging or xray* or x-ray* or nuclear medicine or PET or PRRT or positron emission tomography) adj3 (imag* or exam*)).tw. (434602)

7 ((radiology or radiographic) adj3 (imag* or exam*)).tw. (19965)

8 (medical imaging or diagnostic imaging or radiotherapy or ionising radiation*).tw. (225196)

9 4 or 5 or 6 or 7 or 8 (1183882)

10 Radiation Exposure/ or Radiation Protection/ (25552)

11 (radiation adj5 (exposure* or dose* or protect* or safety or risk or amount)).tw. (103071)

12 10 or 11 (117122)

13 3 and 9 and 12 (366)

14 ("25284346" or "10750952" or "34331404").mp. (3)

15 13 or 14 (366)

16 limit 13 to yr="2000 -Current" (305)

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APPENDIX

PRISMA CHART