express the need of additional training and easily accessible and systematic information on the topic.
The results demonstrate the need to promote the medical physicist experts as a competent clinical specialist responsible for risk assessment and optimisation.
Summary: The survey underlined the need for the dissemination of easily accessible, verified and up-to-date guidelines on what algorithm should be followed in such situations. Effective communication in X-ray examinations of pregnant patients is a multidimensional process involving comprehensive consent discussions, defined roles and responsibilities for healthcare professionals, interprofessional collaboration, and ongoing education.

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PP32.04
ESTABLISHMENT OF RECURRENT EXPOSURES REFERENCE LEVELS (RERL) FOR REPEATED COMPUTED TOMOGRAPHY (CT) EXAMINATIONS IN ADULT PATIENTS ON A NATIONWIDE LEVEL IN SLOVAKIA

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Introduction: The study aims were: 1. to assess the incidence in one year ($I_{100;1}$(%)), the cumulative incidence ($I_{100;3}$(%)) and the period prevalence in three years ($P_{100;3}$(%)) of patients fulfilling the condition of acquiring cumulative effective dose (CED) ≥ 100 mSv in the health care centres providing CT examinations in Slovakia. 2. to quantify their variability among different centres 3. to test the feasibility of establishing RERLs on a nationwide level.
Materials & Methods: The data were tracked during three consecutive years using CT dose index and dose-length-product values along with the patient's unique ID. ED was calculated using conversion factors. Hospitals were stratified according to the number of beds in clinics (0), small (<200), medium (201–500) or large (>500) hospitals.
Results: The database included 875,386 patients*year who underwent 1.269.906 CT exams in three years. No significant differences were found in $I_{100;1}$(%), $I_{100;3}$(%) or $P_{100;3}$(%) among different hospital sizes. The $I_{100;1}$(%) ranged from a 0% to 6,2%. The $I_{100;3}$(%) ranged from 0,3% to 23,2% (Fig. 1). The $P_{100;3}$(%) ranged from 0.17% to 13,3%. A strong positive correlation was present between the third quartile values of yearly CED and $I_{100;1}$(%) ($r = 0.84$; $R^2 = 0.70$; $p < 0.0001$). RERL value, set as the 75th percentiles of the distributions of the 3rd quartiles of the yearly CED, amounted to 25.7 mSv in Slovakia.

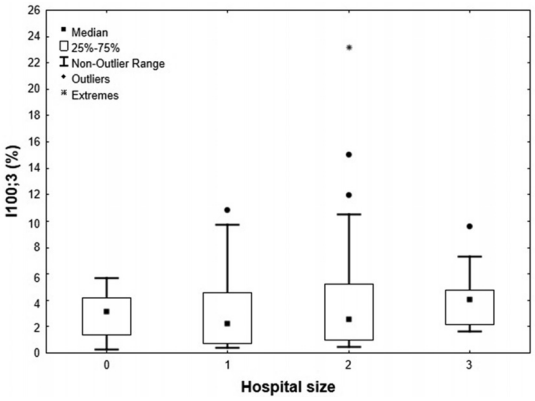

Figure 1 Box-Plot of the three-year period incidence $I_{100;3}$(%) in 2021 among health care centres of different size.

Summary: The management of patients with recurrent CT exposures is highly variable among hospitals and seems quite unrelated with the level of specialization of the institutions. The introduction and use of RERL might reduce such variability.

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PP32.05
SIMULATION OF RADIOACTIVE NANOPARTICLES IN BREAST CANCER USING MCNP

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Introduction: Brachytherapy, a treatment method for breast cancer, involves the implantation of radioactive sources within or near the tumor tissue. By integrating nanotechnology with this approach, there's a potential to enhance treatment efficacy while reducing radiation exposure to healthy tissues. This integration entails utilizing radioactive nanoparticles (RNPs) [1]. This study aims to conduct a dose biodistribution analysis of ^{198}AuRNPs in breast cancer using the Monte Carlo method.
Materials & Methods: To conduct the simulation, we utilized the MCNP code version 6.2. A breast model containing a 2 cm tumor was constructed, adhering to established standards outlined in literature-based semicircular phantoms (Figure 1). The RNPs were strategically distributed within the tumor. We used tallies F6 and F8 within the MCNP to generate the dose biodistribution map.
Results: RNPs have the potential to improve breast cancer treatment due to their ability to interact internally with cancer cells. The concentration of RNPs in the tumor showed efficient delivery of the dose to cancerous tissue and a decrease in the dose received in adjacent tissues. Although preclinical results are promising, further evaluations are needed to determine their optimal dose.

Summary: MCNP simulations provide a safe environment for conducting dosimetric studies of RNPs, allowing us to describe real-world scenarios and explore treatment options that may be challenging to experimentally test initially. This paves the way for the future clinical application of RNPs in human treatment.
Acknowledgements: Acknowledgment to the agencies FINEP 0941/22, CAPES, CNEN and IAEA BRA6026 for Project funding and scholarship support.
Appendix:

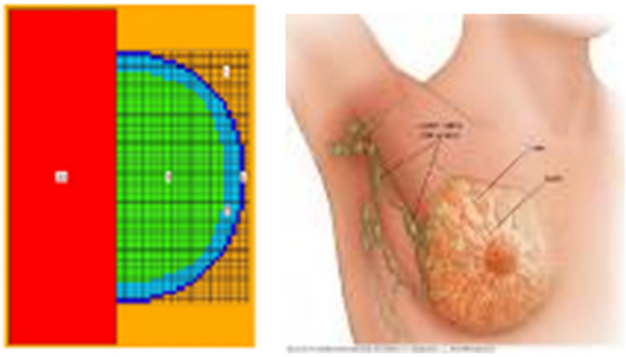

Figure 1: Breast Cancer Phantom and Illustration. Source: IAEA-ENDF, 2023.

Reference:

[1] SOUZA CD, *et al.* Syntesis, in Vitro Testing and Biodistribution of Surfactant-Free Radioactive Nanoparticles for Cancer Treatment. *MBPI: Nanomaterials*. 2022. Doi:10.3390/nano12020187.

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PP32.06
ASSESSMENT OF OCCUPATIONAL EXPOSURE DURING RADIOEMBOLIZATION PROCEDURE WITH Ho-166 MICROSPHERES

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Introduction: Radioembolization is a minimally invasive treatment procedure for treating patients suffering from inoperable liver cancer. The Ho-166 microspheres were injected under interventional angiography procedure. The aim of this study was to evaluate extremity occupational exposure levels during the procedure.
Materials & Methods: The Philips Azurion 7 cath lab angiography system with ClarityIQ technology was used to perform interventional radiology procedures. To assess extremity doses, optically stimulated luminescence (OSL) dosimeters (NaCl) pellets (made at Skane University Hospital, Sweden) were used. NaCl pellets were attached to both hands of the interventional radiologists (15 positions) and the radiology technologists (6 positions). For whole body dose measurements were assessed with the OSL dosimeters and active dosimeters (Mirion DMC3000).
Results: The median Ho-166 administered activity, the average duration of the interventional procedure, average value of kerma-area product for treatment planning and treatment procedures were evaluated for ten cases. For each case, the results of the whole body and extremity radiation exposure doses were evaluated. The comparison of the doses between the NaCl pellets worn on the personnel hands showed that the highest doses were received by the left-hand wrist, palm, index and right-hands middle, ring and wrist positions.
Summary: The encouraging results of the methodology show large dose distributions of the personnel extremity doses (up to a factor of X) that suggest a need for continued studies. Further exposure analysis and optimization is needed for more accurate equivalent dose determinations using NaCl pellets.

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TESTING 3D PRINTING TECHNIQUES FOR REALISTIC IMITATION OF BONES IN ANTHROPOMORPHIC PHANTOMS

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Introduction: This study aims in evaluating the recently presented Interlacing Layers' Method (ILM) for imitation of compact and cancellous bone in 3D-printed phantoms and find possible materials capable to imitate bone attenuation behavior [1].
Materials & Methods: Using multi-material 3D printer (3ntr A2v4, 3ntr, Oleggio, Italy), cylindrical samples with interlacing layers of PLA and PLA reinforced with Iron (PLAFe) were printed with different layer thicknesses and material ratios. All samples were evaluated on Computed Tomography (CT) scanner (GE BrightSpeed 16, GE, Massachusetts, USA) at various slice thicknesses (0.625 mm, 2.5 mm, 5 mm).
Based on a patient CT dataset a femur bone phantom was produced using the appropriate combination of materials, (PLA:PLAFe–50%:50% for compact bone, 85%:15% for cancellous bone, and pure PLA for marrow and soft tissues).
Results: Various HU-values were achieved for different samples, however, a limitation regarding layer creation was observed. The correlation between CT slice thickness and printed layer thickness must be chosen so that both materials are included in each CT slice. Additionally, streak-artefacts and issues with iterative reconstruction were mentioned for samples with high PLAFe fractions.
The femur bone phantom shows a good deal with the patient images. The difference of HUs for compact bone fluctuates in values less than 2%.
Summary: ILM using specific combination of PLA and PLA-Fe in 3D printer can produce realistic CT contrasts for compact and cancellous bone. However, it must be aware of artifacts.

Reference:

[1] Tino R, *et al.* A systematic review on 3D-printed imaging and dosimetry phantoms in radiation therapy. *Technology in Cancer Research Treatment*, 18(1–14), 2019.

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