Welcome to the SINFONIA Newsletter!

Table of contents

- Latest activities and results
- SINFONIA VIDEO
- Training programme
- Annual Consortium Meeting in Vienna
- Staff dosimetry practice in proton radiotherapy centres
- Our Publications

The SINFONIA project aims at developing novel methodologies and tools that will provide a comprehensive risk appraisal for detrimental effects of radiation exposure on patients, workers, carers and comforters, the public and the environment during the management of patients suspected or diagnosed with lymphoma and brain tumours.

Latest activities and results

During the second year of the project, completed in August 2022, one of the main activities has been the organisation of courses which aimed at training young clinicians, medical physicists, radiobiologists and other healthcare professionals as a team, encouraging the exchange of skills and knowledge within Europe.

Regarding the risks associated with radiation exposure of workers, including maintenance and technical personnel, a survey was conducted in 17 proton therapy centres across Europe to evaluate current doses and practices for this type of therapy. Overall, the results obtained confirm that good radiation protection are in place and the risk for staff working in proton therapy does not raise major concerns.

The impact on human and biota from the release of radiopharmaceuticals by hospitals was also assessed, using as case study the river network in Belgium. The results show that both routine and accidental releases under the scenarios considered in the study do not pose risks for humans or the environment.
The data repository of the project has also been released and is currently being tested with real data. The platform is designed in the first instance to facilitate data sharing between partners and in the next stage, selected machine learning algorithms will be implemented for data analyses directly on the platform.

NEW TOOLS FOR MEDICAL RADIATION RISK APPRAISAL

SINFONIA VIDEO
Watch our presentation video to learn how we aim to improve medical radiation protection through our work and results.

Training programme

Under the Education and Training activities of the project we have prepared a 5-course programme aimed to train clinicians, medical physicists, radiobiologists and other healthcare professionals as a team and to stimulate the exchange of skills and knowledge within Europe.

The courses were offered for free and dedicated to Ph.D. students, postdoctoral researchers, seniors, and trainees, and opened to both internal (representatives of the 14 SINFONIA consortium partners) and external participants.

The first 4 courses were held at different project partners’ institutions in the second half of 2022.

**Course 1 - Measuring radiation-induced DNA damage, DNA repair and cell death: radiation biology in lab practice**

The course was organised by Stockholms Universitet (Stockholm University) (SU), between 17 and 21 October 2022, and aimed to acquaint the participants with the state-of-the-art cellular effects of ionising radiation which are relevant for the broader field of radiation research. The course had two parts: theoretical and practical. The theoretical part, designed for non-biologists, focused on SINFONIA-relevant aspects of biological effects of ionising radiation as well as on techniques to
The practical part focused on teaching the classical laboratory techniques used to study cellular effects of radiation in cells: the clonogenic cell survival test, analysing chromosomal aberrations by the Giemsa methods and in-situ hybridization with whole chromosome probes, as well as the gamma H2AX focus assay. Participants learned how the techniques are carried out and how samples are analysed. Every student had a microscope at their disposal to analyse slides for chromosomal aberrations and micronuclei. Painted chromosomes and gammaH2AX foci were analysed on computer images.

The complete programme of the course and information about the instructors is available here.

The course was attended by 5 persons, 3 master students and 2 researchers from Poland (Jan Kochanowski University in Kielce) and Norway (Norwegian University of Life Science in Aas), respectively. Overall, the participants were satisfied with the course, especially with the practical exercises which were rated the highest score in the survey conducted at the end of the training. A participation diploma with 1.5 ECTS credit points (corresponding to one week of education at Stockholm University) was awarded to all participants.

Course 2 - Patient dosimetry and occupational radiation exposure assessment arising from Lu-177, Ga-68, I-131 and Y-90 procedures

The course was organised by Servicio Gallego de Salud (Galician Healthcare Service) (SERGAS) and aimed to provide an overview of several nuclear medicine procedures and their related dosimetry and shielding considerations towards four main isotopes: Lu-177, I-131, Ga-68 and Y-90. The course had two parts: an online pre-session (19-21 September 2022) and on-site course held at the Meixoeiro Hospital in Vigo Spain between 28 and 30 September 2022.
In the online pre-course, the participants learned about the fundamentals of the different radiopharmaceuticals used in nuclear medicine and interventional radiology, the different dosimetry methods and tools available and under research, and the basics of radiation protection when working with these radioisotopes. The on-site part offered both theoretical and practical sessions in which the participants were taught about different medicine planning and dosimetry software as well as about various radiological protection protocols carried out at the Meixoeiro hospital.

The complete programme of the course and information about the instructors is available here.

The course was attended by 29 participants from 6 countries (Belgium, The Netherlands, Poland, Portugal, Spain, Switzerland) with diverse backgrounds – ranging from computational scientists to nuclear medicine technologists and medical physicists – and level of experience (both students and senior professionals).

Course materials and lectures are available online.

Course 3 - Running external beam radiotherapy on the virtual radiation therapy simulator (VERT)

The course was organised by Swietokrzyskie Centrum Onkologii Samodzielny Publiczny Zakład Opieki Drogowej W Kielach (Holy Cross Cancer Centre) (SCO) between 26 and 30 September 2022 in Kielce, Poland, and aimed to introduce external beam radiotherapy. The course had two parts: theoretical, which presented the basis of radiotherapy, and a practical part. The learning outcome was to gain a deeper understanding of the principles of planning and performing radiotherapy, with special focus on dose distribution in organs and tissues and on possible consequences of dosimetric and patient positioning errors.
The practical sessions focused on the techniques employed in planning of therapeutic treatment for prostate and breast cancer patients. The participants created therapeutic plans on individual RayStation planning stations and observed their implementation using the VERT simulator. The effects of an incorrect treatment plan resulting from improper dosimetric control of the system or incorrect positioning of the patient on the therapeutic table were thus observed and discussed.

The complete programme of the course and information about the instructors is available here.

The course was attended by 4 persons, 2 master students, 1 PhD student and 1 postdoctoral researcher from Poland (Warsaw University and Jan Kochanowski University in Kielce), Germany (Rostock University Medical Centre) and Sweden (Stockholm University), respectively. Overall, the participants were satisfied with the course, especially with the practical exercises which were rated the highest score in the survey conducted at the end of the course.

Course 4 - Introduction to Machine Learning / Deep learning

The course was organised by Fundacion Publica Gallega Centro Tecnologico de Supercomputacion de Galicia (Galicia Supercomputer Centre) (CESGA) between 12 and 19 September 2022 in Santiago de Compostela, Spain, and aimed to teach the participants about the basic machine learning (ML) algorithms and
The first four days of the course covered several concepts and techniques of machine learning such as – supervised, unsupervised and reinforcement learning, deep learning (DL) – as well as various algorithms including – classification, regression, support vector machines, decision trees, ensembles, random forest, AdaBoost / XGBoost, naive bayes; in addition, the participants were advised on advanced computational techniques to accelerate the training of models using high performance computing (HPC) solutions and how to optimise the selection of models’ architecture and hyperparameters by means of search algorithms. The last day of the course was dedicated to **practical examples of how machine learning algorithms are used in improving imaging procedures and thus minimise the radiation exposure of patients**. The first example on nuclear medicine was presented by Prof. Habib Zaidi, while Prof. John Damilakis presented examples related to dosimetry for X-ray imaging procedures.

The complete programme of the course and information about the instructors is available [here](#).

The course was **attended by 31 persons from 5 countries** (Belgium, Czech Republic, Germany, Spain and Sweden) representing the SINFONIA project partners, but also external institutions such as University of Santiago de Compostela (Spain), University Hospital of Hamburg (Germany) and University Hospital Olomuc (Czech Republic).

Overall, the participants were satisfied with the course, 23 out of 24 respondents answered that the course met their expectations.

**Mercedes Riveira-Martin, participant:** I believe that all the requirements for a complete, valid, and interesting course have been met. First, the platform where the course materials were hosted is a good tool that has facilitated the work of the students. The structure of the course has been planned with a lot of sense, covering from more general and basic concepts, such as the definition of a neural network, to more complex models and techniques, such as reinforcement learning. In addition,
useful. The level of mathematics was sufficient to understand the fundamentals of machine learning from a scientific perspective. In addition, the level of knowledge of the teachers in the subject facilitated the explanations, as they knew perfectly well what they were talking about. The room in which the classes were held was comfortable, with enough ventilation, light, and space to be able to stay quietly for five hours. A coffee break with food and drink was also available, which was much appreciated. Finally, the last day’s sessions, given by professors John Damlilakis and Habib Zaidi, were a perfect ending, showing ML applications directly related to the field of medical physics and the SINFONIA project. Overall, it has been an intense, interesting, practical, and useful course for the work applying machine learning techniques.”

Some courses will be held again in 2023.

Follow our website for updates about the SINFONIA courses!

Annual Consortium Meeting in Vienna

The SINFONIA project partners met in Vienna, on 27-28 October for the annual Consortium meeting. The partners presented the work and results achieved in the second year of the project, which included the ongoing development of the tools for estimation of organ doses from radiological and nuclear medicine examinations, for risk estimation and associated uncertainties; interactive presentations of the data repository and of the MOOC were also given; the training courses, including the feedback received from the participants, were analysed and plans for another round were made. Further dissemination and communication activities for the next year have been set up, and project management related aspects were discussed.
Staff dosimetry practice in proton radiotherapy centres

A field survey was conducted within 17 proton therapy (PT) centres in Europe with the aim to collect data on staff to assess their potential exposure due to the creation of high energy neutrons. Moreover, activation of materials in proton therapy makes the technique subjected to fear and doubts related to the risks of staff. It is therefore essential to monitor neutrons on different positions around accelerator and to monitor staff accordingly.

The outcome of the survey confirms good radiation protection practices and low concern for staff working in proton therapy. In fact, the current classification may be too strict, as doses never exceeded 1 mSv/year. This could suggest it is possible to sample staff monitoring, which will require only few people to be monitored. A similar approach is already done in some countries for staff working in External Beam RadioTheray (EBRT), which perhaps could be also applied for personnel working in proton therapy centres. This can be achieved by following a dialogue with the national radiation protection authority, even though it may be a bit controversial as the concern of secondary neutrons and activation during proton therapy treatments will remain triggering attention towards radiation protection of staff and patients.

Further measurements are planned to confirm our findings but also to assess doses during accidental exposures, such as staff present in PT room or irradiations of the unborn child. As the extent of corrections for directional and energy dependencies is not always clear, we would also like to further identify knowledge gaps on detector calibrations and corrections.

Read the full report

Our Publications

- Determining Out-of-Field Doses and Second Cancer Risk from Proton Therapy in Young Patients—An Overview
- Peripheral organ equivalent dose estimation procedure in proton therapy
- Range shifter scattering contribution to the stray radiation field in proton therapy measured with a tissue-equivalent proportional counter
- Occupational radiation exposure assessment during the management of [68Ga]Ga-DOTA-TOC
- Deep Learning-based calculation of patient size and attenuation surrogates from localizer Image: Toward personalized chest CT protocol optimization
The SINFONIA consortium consists of 14 hospitals, universities, R&D centres, and private research companies from 8 European countries, and incorporate multidisciplinary expertise in the fields of clinical dosimetry, radiotherapy, radiation biology, and artificial intelligence.

In the era of personalised medicine, SINFONIA wants to help clinicians to properly balance risks and benefits of ionising radiation procedures, and practitioners and medical physicists to develop dose optimisation strategies. Our tools and methodologies will produce new knowledge on parameters affecting radiation detriment.

Visit the SINFONIA website!
This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945196.

www.sinfonia-appraisal.eu