AIR²
Access to INFRASTRUCTURES for Radiation protection Research

Special Issue 13
June 2020

Editorial

This Special Issue of AIR² is dedicated to the presentation of the European project HARMONIC, selected during the EURATOM call for projects in 2018. Having obtained the maximum and extremely rare score of 15/15, this 5-year project arouses a lot of expectations. And this is doubly true as far as I am concerned, since I was a participant in the competing project, which was not selected and that also obtained the maximum score (never seen before). HARMONIC deals with a crucial subject, the exposure of children for diagnostic or therapeutic purposes. The importance of the long-term effects of radiation is paramount with the double challenge of optimizing the efficiency of the medical exposure and minimizing the late effects. This subject is one of the top priorities of MELODI, EURAMED, EURADOS and SHARE.

Dr Laure Sabatier, CEA

The floor to...

The use of radiation for medical diagnosis and treatment procedures has had a major impact on the survival of paediatric patients. Although the benefits of these techniques largely outweigh the risks, there is a need to better understand the long-term health effects of such exposures in order to optimise treatment plans and reduce the risk of late toxicities.

HARMONIC — Health effects of cArdiac fluoRoscopy and MOderN radIotherapy in paediatriCs

HARMONIC is a European-funded project that aims at exploring the long-term health effects of radiation treatment in children, specifically cancer patients treated with modern radiotherapy techniques and cardiac patients treated with X-ray guided imaging procedures. We will explore the effect of childhood exposure to a wide range of doses of ionising radiation as a consequence of these treatments. This is true in interventional cardiology, with organ doses varying considerably, depending on procedure complexity. It is also true in radiotherapy when out-of-field organs are considered. Not only will we investigate effects of X-rays but our project will allow evaluation of the impact of direct exposure to protons and secondary neutrons, opening avenues of research on the underlying biological mechanisms of second cancers and vascular diseases.

By building two European cohorts for long-term follow up of paediatric patients, we aim to:

- Investigate the late health effects of ionising radiation in children.
- Provide the medical and radiation protection communities with tools for long-term follow-up of children exposed to medical radiation.
- Improve estimates of radiation doses to specific organs.
- Investigate possible biological mechanisms leading to the development of late adverse health effects.
- Establish recommendations to optimise radiotherapy and cardiac fluoroscopy treatments and further reduce radiation doses.

HARMONIC, a consortium of 24 European partners is based on a close relationship with clinicians, sociologists and patients. It is expected to provide much needed information on the effects of low to moderate doses of radiation on humans, help optimise treatment plans in young patients to reduce the risk of late toxicities and contribute to improving patient care and quality of life.

HARMONIC Coordinator
Isabelle Thierry-Chef,
Head of Medical Radiation Group,
ISGlobal

Project Manager
Rodney Ortiz

Photo: M. Martínez-Campos/PRBB

CONCERT CORNER

Future events:

ERPW 2020
Postponed to 2021. More information to be announced soon.

WP 6 News:

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Harmonic
Health effects of cardiac fluoroscopy and modern radiotherapy in paediatrics

EUROPEAN JOINT PROGRAMME FOR THE INTEGRATION OF RADIATION PROTECTION RESEARCH CONCERT

HORIZON 2020

HARMONIC has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 847707
CONCERT has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 662287

Project coordination

HARMONIC (Health effects of cArdiac fluoRoscopy and MOderN radIotherapy in paediatriCs) is multi-disciplinary by nature, aiming to answer some of the outstanding questions on the health impact of exposure to medical ionising radiation early in life.

It will improve knowledge in the fields of radiation biology/mechanisms, epidemiology and dosimetry and contribute to inform medical care. The project uses an integrated approach of conventional epidemiology complemented by non-invasive imaging and molecular epidemiology to assess cancer and non-cancer outcomes (including neurovascular, cardiovascular, endocrine system effects) in two important, distinct and complementary populations:

- Paediatric patients undergoing modern radiotherapy (including proton therapy)
- Paediatric patients undergoing cardiac catheterization.

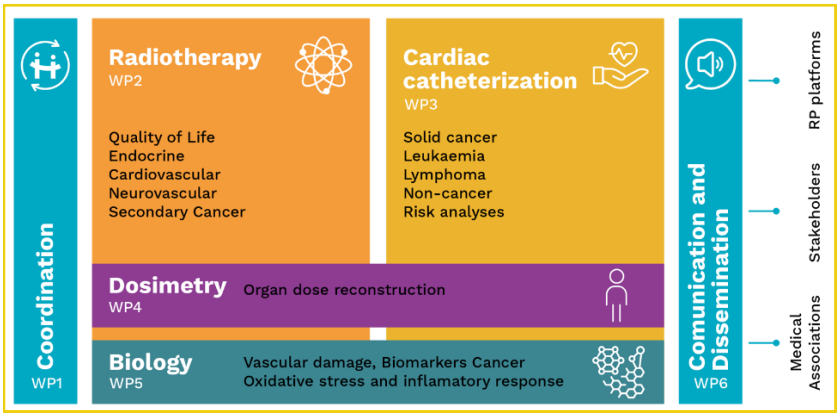

Photo: ISGlobal

Organisation of the Project

HARMONIC involves clinicians and researchers from 24 European Institutions to provide the basis for sustained research collaborations within an international network across Europe and beyond. The project emphases collaboration between clinicians (radiation and medical oncologists, cardiologists, radiologists, medical physicists, endocrinologists, nurses, and psychologists) involved in paediatric care, and RP research scientists (epidemiologists, nuclear physicists, dosimetrists, biologists, sociologists, and radiation protection experts).

HARMONIC includes six distinct and complementary work packages, including dosimetry (WP4) and biology (WP5), which are fully integrated in the project, with activities contributing to answering the main questions addressed in other workpackages. The epidemiology work packages (WP 2, 3) are co-led by teams of two leaders (clinician & RP scientist) to ensure that the project benefits from all the areas of expertise, technical skills and logistics needed for the planned research activities and its outcomes.

Photo: M. Martínez-Campos/PRBB

Isabelle Thierry-Chef

The overall management of the project, including liaison with the EU and Partners is performed at ISGlobal by the Coordinator (Isabelle Thierry-Chef) and the Project Manager (Rodney Ortiz) with administrative support provided by the institution to ensure follow-up of the work plan, timely provision of results and adherence to European Code of Conduct for Research Integrity; monitoring ethics issues and consortium management issues.

The HARMONIC project aims at complementing recent studies on the effects of paediatric CT examinations by improving the understanding of the health effects of medical ionising radiation exposure of paediatric patients in cardiology and oncology settings. It will provide the medical community with the structure and instruments to evaluate the potential health, QoL and social impacts of medical exposures to ionising radiation in children, with potential for advanced patient-specific dose reconstruction and mechanistic investigations.

Photo: P. Rubio/ISGlobal

HARMONIC Partners - Kick-off meeting, Barcelona, June 2019

ISGlobal Barcelona Institute for Global Health

ID Card:

Keywords:
Project management, monitoring, follow-up, liaison

Work Package leader:
Isabelle Thierry-Chef (ISGlobal)

Duration of the project:
5 years (2019-2024)

Total budget of the project:
Approx. 7 million euros

Open Access of produced data:
Results and data will be openly accessible, when possible, in a format suitable to prevent the disclosure of personal data

Project website:
www.harmonicproject.eu

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Related to:
MELODI
EURADOS
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Radiotherapy

WP2's main objective is to evaluate early-, intermediate- and long-term health and social outcomes of modern external beam radiotherapy techniques (EBRT) using photons or protons in paediatric patients, and more specifically:

- Assess the incidence and severity of health outcomes, primarily endocrine dysfunction, cardiovascular toxicity, neurovascular damage, and second primary cancer, in relation to the dose-volume distribution to normal tissues, radiation delivery technique and beam quality factors, and potential modifying factors that may underlie differences in individual susceptibility for adverse events;
- Assess social aspects of advances in EBRT for paediatric patients, primarily health-related quality of life, multidimensional fatigue and academic achievement.

WP2 is implementing an observational cohort based on an integrated approach of conventional epidemiology complemented by non-invasive imaging (cardiac echography, neurovascular MRI sequences) and molecular epidemiology (using blood and saliva samples). Patients who are treated with EBRT (photons, protons) in five participating European centres in 2008 or thereafter and who are below age of 22 years without prior external or internal irradiation are recruited retrospectively or prospectively. The included individuals are followed actively during 5 to 10 years (depending on inclusion criteria) at the hospital and through patient/guardian's reported questionnaires, and passively through linkage with external morbidity/mortality and healthcare databases to allow implementing a long-term follow-up. Demographic, socioeconomic, clinical, therapeutic, quality of life, imaging and radiation dosimetry data are registered in a centralized database.

The expected number of included individuals is 2700.

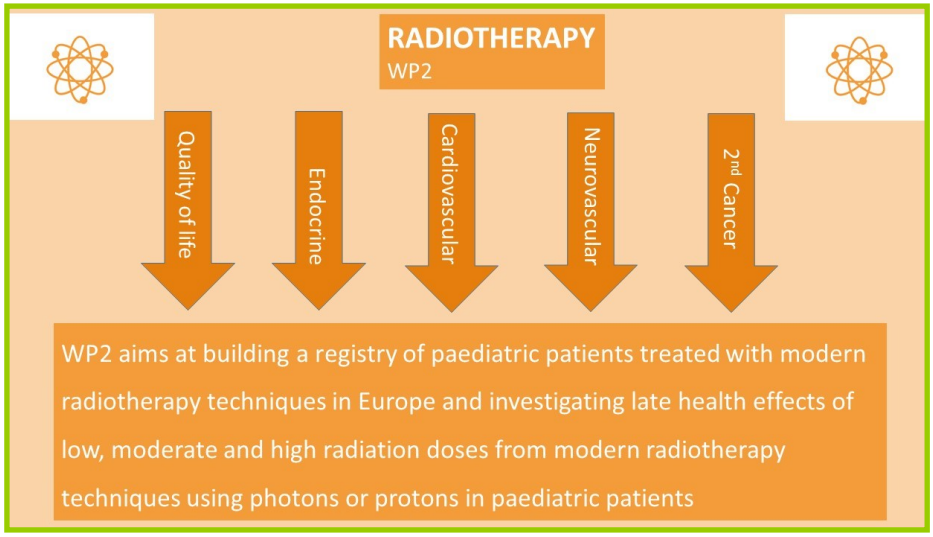
The expected impacts are:

- Enabling evaluations of the effectiveness of technical advances in radiotherapy for paediatric patients;
- Improving the understanding of the determinants of early-, intermediate- and long-term outcomes of modern EBRT techniques;
- Supporting evidence on radiation-induced cellular responses and biological mechanisms related to second primary cancers and cardiac and vascular diseases after radiotherapy, and biomarkers of sensitivity and diseases (WP5);
- Allowing improvements in individual dosimetry to non-targeted organs for different EBRT delivery techniques (WP4)
- Establishing standards for optimized individual treatment planning in paediatric patients to further reduce treatment toxicities.

B. Timmermann N. Journy

The ambition is to serve as a pilot for a future long-term pan-European registry of children and adolescents treated with particle and photon beam therapy, promoting sustained collaborative research activities between medical, biological and technical radiation protection research communities for improvement of patient care, and stimulating future collaborative research projects with existing cohorts or registries in Europe or abroad.

Photo: HARMONIC



Infrastructure of WP2 - Radiotherapy

Universitätsklinikum Essen

Inserm

ID Card:

Keywords:
Radiotherapy, endocrine dysfunction, cardiac and vascular damage, second cancer, quality of life

Work Package leaders:
Beate Timmermann (Essen University Hospital, WPE, University Duisburg)

Neige Journy (INSERM)

Partners:
- Aarhus University Hospital (AUH)
- Aarhus University (AU)
- Katholieke Universiteit Leuven (KUL)
- Centre Régional François Baclesse (CRFB)
- Institute Gustave Roussy (GR)
- The West German Proton Therapy Centre Essen (WPE)
- Princess Maxima Center (PMC)
- University Medical Center Groningen (UMCG)
- Oslo University Hospital (OUS)
- University of Zurich (UZH)

Infrastructures:
Databases: Registry of paediatric patients treated with modern radiotherapy techniques

Sample banks: Blood; saliva; imaging

Cohorts: Individuals treated with external beam radiotherapy (photons, protons) at age ≤22 years in 2008 or thereafter in five European centers

Models and tools: PedsQL™ questionnaires (Quality of life; Multidimensional fatigue); patient/guardian's reported questionnaires; electronic case report form

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Proton therapy for pediatric malignancies: fact, figures and costs. A joint consensus statement from the pediatric subcommittee of PTCOG, PROS and EPTN, Weber D. C., Habrand J. L., Hoppe B. S., Hill Kayser C., Laack N. N., Langendijk J. A., MacDonald S. M., McGovern S. L., Pater L., Perentesis J. P., Thariat J., Timmermann B., Yock T. I., Mahajan A. (2018), Radiother Oncol, 128 (1), 44-55
The evolving role of proton beam therapy for sarcomas, Frisch S., Timmermann B. (2017), Clin Oncol (R Coll Radiol), 29 (8), 500-506

Cardiac catheterization

The overall objective of HARMONIC WP3 is to investigate the association between early-life exposure to ionising radiation and risk of cancer in patients that have undergone cardiac catheterization to diagnose and/or treat cardiac birth defects.

In order to achieve this goal, a large retrospective cohort of paediatric patients exposed to cardiac catheterization is being set-up. This joint cohort will pool data from approximately 100,000 patients, who underwent cardiac catheterization in Belgium, France, Germany, Italy, Norway, Spain and the UK. It is established from electronic and paper records obtained from the main radiology and cardiology departments where paediatric x-ray procedures are performed, in the participating countries. The study is based on a common protocol for data collection, dose reconstruction methodology (from WP4) and risk analysis. Biological samples will be obtained in Italy, prior and after procedure (WP5) in order to explore early molecular mechanisms underlying the association between radiation exposure and cancer risk. Cohort members will be followed-up into adulthood to determine cancer incidence and mortality from cancer.

We aim at quantifying the long-term risk of developing cancer (leukaemia, lymphoma, or solid cancer) in association with radiation exposure. For this, we will associate estimates of radiation dose to individual organs (provided by WP4) with incidence for each type of cancer, based on national cancer registries and will use this information to derive an estimate of cancer risk per Gray (Gy) of organ absorbed dose. Furthermore, we will assess how certain factors, such as age at exposure or other conditions (Down syndrome, transplantation) can modify these associations. Socio-economic status will also be collected, if available.

Photo: IRSN & UNEW

M. O. Bernier & M. Pearce

The results of the analyses performed within this WP will strengthen the bases for assessing radiation risk in paediatric patients, a demographic group for which data are very sparse. The results will also support radioprotection of patients and provide the medical community with new insights on radiation associated risks in childhood.

Photo: IRSN/ISGlobal

COUNTRY COHORT	PAEDIATRIC COHORT – CARDIAC CATHETERIZATION				
	AGE (years)	START OF ACCRUAL & FOLLOW-UP (year)	END OF FOLLOW-UP (years)	SOURCE OF INFORMATION	EXPECTED COHORT SIZE
BELGIUM	0-18	2004	2020	4 hospitals	6,000
FRANCE	0-16	2000	2017	15 hospitals + Health Care database	19,000
GERMANY	0-18	2004	2020 2018	1 to 2 hospitals + Health Care database	4,000 30,000
ITALY	0-18	2017	2022	2 to 4 hospitals	1,000
NORWAY	0-18	1990	2019	1 hospital	5-8,000
SPAIN	0-21	1995	2020	2 hospitals	5,000
UK	0-22	1991	2020	13 hospitals	30,000
Total EXPECTED					**~100,000**

Characteristics of the cohort

Projected future cancer risks in children treated with fluoroscopy-guided cardiac catheterization procedures, Journy N., Dreuil S., Rage E., De Zordo-Banliat F., Bonnet D., Hascoët S., Malekzadeh-Milani S., Petit J., Laurier D., Bernier M. O., Baysson H. (2018), Circ Cardiovasc Interv, 11 (11):e006765

Cancer incidence among children and young adults who have undergone x-ray guided cardiac catheterization procedures, Harbron R. W., Chapple C. L., O'Sullivan J. J., Lee C., McHugh K., Higueras M., Pearce M. S. (2018), Eur J Epidemiol, 33 (4), 393-401

ID Card:

Keywords:
Epidemiology, interventional cardiology, pediatrics, radiation, stochastic risks

Work Package leaders:
Marie-Odile Bernier (IRSN)

Mark S. Pearce (UNEW)

Partners:
- Barcelona Institute for Global Health (ISGlobal)
- Belgian Nuclear Research Centre (SCK CEN)
- Leibniz-Institute for Prevention Research & Epidemiology (BIPS)
- Institute of Clinical Physiology (IFC-CNR)
- Luxembourg Institute of Science and Technology (LIST)
- Oslo University Hospital (OUS)

Infrastructures:
Databases: Health Insurance databases in France and Germany

Cohorts: Coccinelle study in France, British cohort of interventional cardiology in UK, new cohorts in other countries (Belgium, Germany, Italy, Norway)

Models and tools: Epidemiological analysis

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Dosimetry

The main objective of Work Package 4 (WP4) is to estimate radiation doses delivered to the organs of interest of every patient in the radiotherapy (RT) and interventional cardiology (IC) cohorts, and provide input to WP2 and WP3.

Both for IC and RT, separate approaches are being developed for patient specific dose reconstruction depending on data type and availability, ensuring that organ dose estimates can be provided for every cohort participant.

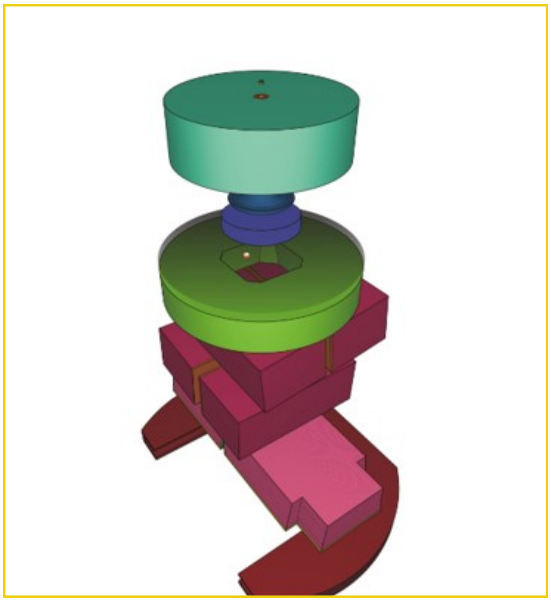


Photo: L. Brualla/West German Proton Therapy Centre Essen

Geometrical description of a Varian Clinac 2300 C/D as coded in the Monte Carlo dose verification system PRIMO

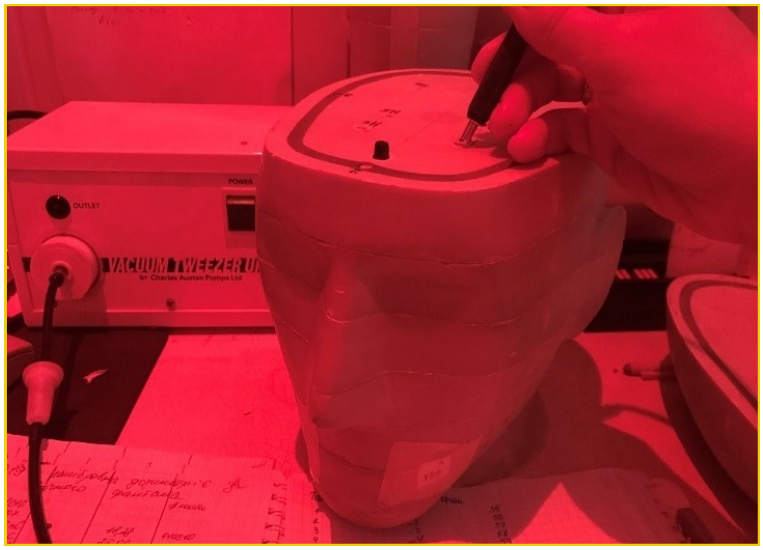
For all RT patients, dose from the different modalities, including therapeutic and imaging exposures, will be reconstructed. While dose volume estimates for organs at risk (OAR) in the target region are available from the Treatment Planning Systems (TPS), out-of-field doses from organ far away from the target and imaging doses are usually ignored. Out-of-field doses will be assessed using a specially developed and validated analytical tool, accounting for contributions from photons, secondary particles and neutrons. Exposure from imaging will be assessed through an existing tool specially tailored to the project. These tools will enable optimisation of the out-of-field dose and dose delivered during imaging procedures. The accuracy of the dose estimates computed by the TPS and modelled analytically will be evaluated for selected patients by means of Monte Carlo simulations.

Photo: SCK CEN

Jérémie Dabin

For IC, two main periods are to be considered. Before the installation of the Picture and Archiving Communication System (PACS), data are scarce and little digital information about the procedure is available; only cumulative dose indicators such as Dose Area Product (DAP) or fluoroscopy time are generally available. After the installation of PACS, more information is available in digital format, ranging from images to radiation dose structured reports (RDSR), which provide detailed information of every x-ray exposure during a procedure, allowing accurate, procedure specific dosimetry. An innovative approach, already proof-tested in studies such as EPI-CT and Euraloc, will combine collected data, literature data and expert knowledge to overcome the data scarcity of the pre- and early-PACS periods. User-friendly tools based on computational phantoms, Monte Carlo simulations and augmented reality will be designed, validated and made available to clinicians and physicists to support dose optimisation. The assessment of the doses from a very large number of centres will improve understanding on the reasons for variability in doses, aiding optimization (reducing doses to as low as reasonably achievable) and help define international reference levels (values of 'typical' doses for a particular procedure type).

Photo: NRCRM



Anthropomorphic phantom

sck cen

ID Card:

Keywords:
Individualized dosimetry, interventional cardiology, radiotherapy, out-of-field dosimetry

Work Package leader:
Jérémie Dabin (SCK CEN)

Task leaders:
Dosimetry in cardiology:
Dr Richard Harbron (UNEW/ ISGlobal)

Dosimetry in radiotherapy:
Dr Lorenzo Brualla (WPE)

Partners:
- Barcelona Institute for Global Health (ISGlobal)
- University of Newcastle upon Tyne (UNEW)
- Institut de Radioprotection et de Sûreté Nucléaire (IRSN)
- Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
- The West German Proton Therapy Centre Essen (WPE)
- Luxembourg Institute of Science and Technology (LIST)
- University of South-Eastern Norway (USN)
- University of Zurich (UZH)
- National Research Center for Radiation Medicine (NRCRM)

Infrastructures:
Exposure platforms:
- Proton therapy facility of Protonentherapiezentrum Essen
- The Laboratory for Nuclear Calibrations (LNK) of SCK CEN

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Radiation doses from fluoroscopically guided cardiac catheterization procedures in children and young adults in the United Kingdom: a multicentre study, Harbron R. W., Pearce M. S., Salotti J. A., McHugh K., McLaren C., Abernethy L., Reed S., O'Sullivan J., Chapple C. L. (2015), Br J Radiol, 88 (1048):20140852

HARMONIC WP5

Biomarkers and studies of molecular mechanisms that can be used for molecular epidemiology for risk evaluation of adverse effects/disorders in radiation exposed pediatric cohorts

The main aims of WP5 are to investigate mechanisms and identify potential biomarkers that can be used a) for molecular epidemiology to refine risk estimates for adverse health effects/disorders of pediatric patients and b) for individualised therapy or providing rational for selection of optimal diagnostic methods for pediatric patients. Blood and saliva from the pediatric cohorts developed in WP2 and WP3 will be used.

Biomarkers will be studied in blood and saliva 1) before start of treatment, 2) immediately after completed exposure or anytime up to 3 months after exposure and 3) one year after the last exposure. The biomarkers will be characterized depending on the dose/radiation quality, stability and relevance for mechanistic understanding of radiation-induced cellular responses. The ambition of WP5 is to develop a framework for future investigations of molecular epidemiology and identification of predictive biomarkers for late health effects.

WP5 focuses on oxidative stress and related pathways, inflammation, telomere shortening, miRNA dysregulation and other pathways that have a strong support in the literature to be involved in the initiation and progression of radiation-induced adverse health effects including vascular diseases and secondary cancer. A special task is devoted to evaluate the use of saliva as non-invasive source of biomarkers.

The specific aims of the WP5 are:

1) To identify new mechanisms and new biomarkers of adverse health effects by the use of plasma as well as saliva protein profiles. This part will also demonstrate the feasibility to use saliva as source of biomarkers by comparing results obtained from blood with results from saliva.

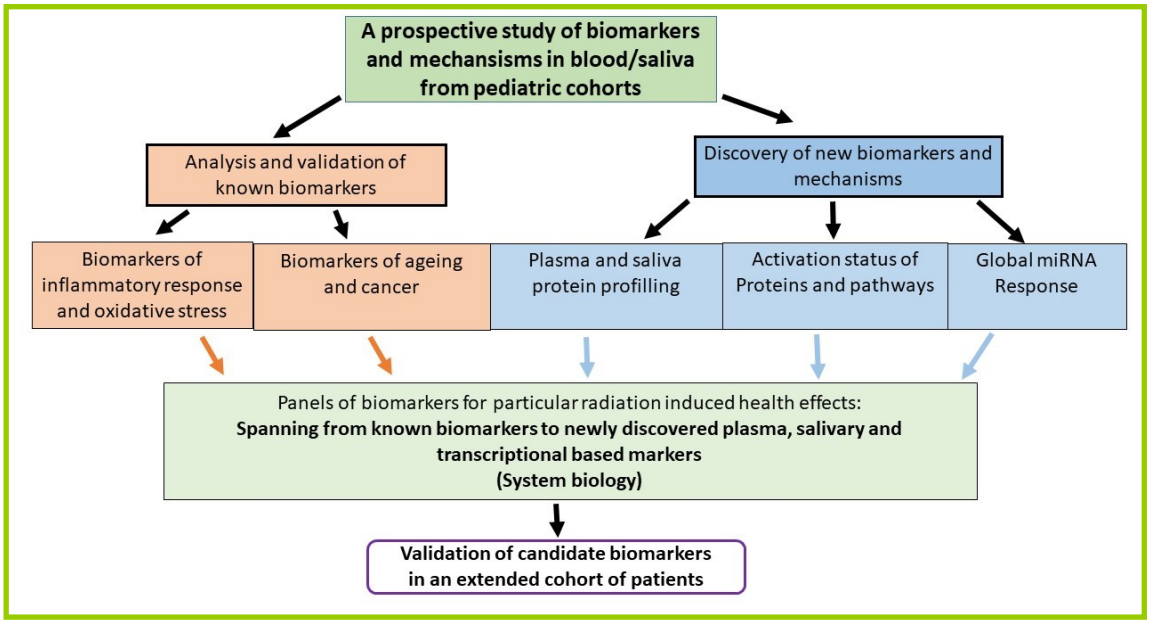
Photo: SU

Siamak Haghdoost

2) To determine the effects at the level of the transcriptome, epigenome and proteome in blood and saliva samples collected at different times after exposure.

3) To develop and implement bioinformatics and computational biology to transform the massive amount of biodata collected into a systems biology approach that can reveal mechanisms behind the onset of radiation induced adverse health in pediatric patients.

Photo: HARMONIC



Experimental design

Ionizing radiation biomarkers in epidemiological studies - An update, Hall J., Jeggo P. A., West C., Gomolka M., Quintens R., Badie C., Laurent O., Aerts A., Anastasov N., Azimzadeh O., Azizova T., Baatout S., Baselet B., Benotmane M. A., Blanchardon E., Guéguen Y. et al. (2017), Mutat Res, 771, 59-84

Establishing mechanisms affecting the individual response to ionizing radiation, Averbeck D., Candéias S., Chandna S., Foray N., Friedl A. A., Haghdoost S., Jeggo P. A., Lumniczky K., Paris F., Quintens R., Sabatier L. (2020), Int J Radiat Biol, 96 (3), 297-323

ID Card:

Keywords:
Plasma biomarkers, saliva biomarkers, cardio/vascular diseases, cancer, adverse health effects

Work Package leader:
Siamak Haghdoost (SU, University of Caen Normandy)

Partners:
- Institute of Clinical Physiology (IFC-CNR)
- Institute Gustave Roussy (GR)

Infrastructures:
Exposure platforms: Organization for the selection of patients, logistic for blood and saliva sampling and handling, transport and analysis of biosamples

Analytical platforms: SciLife Laboratory, proteomic platform in Stockholm

Models and tools: Blood and saliva from pediatric patients

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Communication and Dissemination

The overall goal of HARMONIC WP6 is to maximise the impact of the HARMONIC project, during and beyond its lifespan. It will do so by developing tools and materials adapted to different target audiences to: communicate the what, why and how of HARMONIC; disseminate HARMONIC's progress and results; and engage relevant stakeholders to ensure that the findings contribute to evidence-based recommendations on radioprotection.

Photo: ISGlobal

HARMONIC Mission

The Communication Plan defines HARMONIC's communication objectives, messages, key target audiences, and appropriate tools and channels adapted to each type of audience. Relevant stakeholders are identified at the national, regional and international level with the aim of informing- and when possible engaging- them in the project. Clinicians involved in photon and proton radiotherapy or in interventional cardiology are stakeholders of particular relevance to this project.

One of our goals is to work with them to increase awareness on doses and their potential consequences on health, quality of life and well-being of surviving patients, as well as of the importance of dose optimization. If possible, we will organize a side event at one of the key radioprotection conferences to present the key findings of HARMONIC.

Photo: ISGlobal

Adelaida Sarukhan

This WP is responsible for developing and managing the project website, which will be the main tool for communicating the project's aim, relevance and progress to a wide public, including scientific and lay audiences.

It will also develop other communication materials such as a project leaflet, a policy brief and a factsheet or infographic at different times of the project. All material will be shared via social networks. Press releases for mass media will be considered when relevant results become available and justify a wider reach.

A scientific publications policy was prepared in coordination with all project investigators.

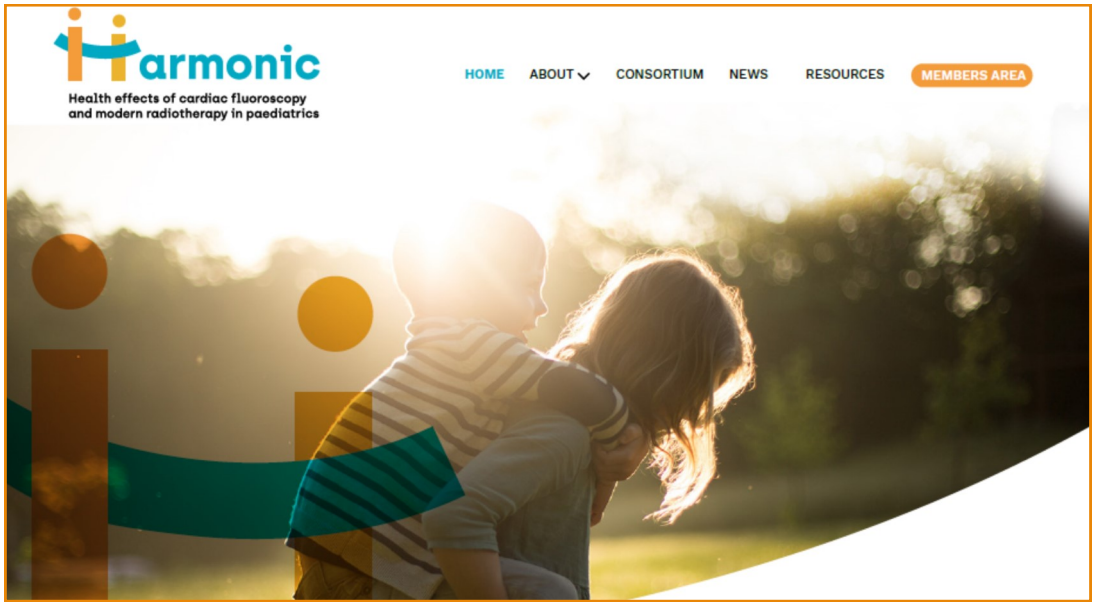

Photo: ISGlobal

Communication and Dissemination (wesbite designer: Maria Beltran)

HARMONIC - brochure, available upon request at ISGlobal and downloadable from the resources section of the project website (harmonicproject.eu)

ISGlobal Barcelona Institute for Global Health

ID Card:

Keywords:
Communication, dissemination, translation

Work Package leader:
Adelaida Sarukhan (ISGlobal)

Partners:
All partners:
- ISGlobal, Spain
- INSERM, France
- UK Essen, Germany
- UNEW, UK
- IRSN, France
- SCK CEN, Belgium
- SU, Sweden
- KUL, Belgium
- AUH, Denmark
- AU, Denmark
- CEA, France
- CRFB, France
- GR, France
- BIPS, Germany
- WPE, Germany
- IFC-CNR, Italy
- LIST, Luxembourg
- PMC, Netherlands
- UMCG, Netherlands
- OUS, Norway
- USN, Norway
- UZH, Switzerland
- NRCRM, Ukraine
- UNICAEN, France

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AIR²

Access to INFRASTRUCTURES

Issue	Exposure platforms	Databases, Sample banks, Cohorts	Analytical platforms, Models & Tools
Published to date:			
Oct 2015, #1	FIGARO	FREDERICA	RENEB
Nov 2015, #2	B3, Animal Contamination Facility	The Wismut Cohort and Biobank	The Hungarian Genomics Research Network
Dec 2015, #3	Pulex Cosmic Silence	STORE	METABOHUB
Feb 2016, #4	SNAKE	French Haemangioma Cohort and Biobank	Dose Estimate, CABAS, NETA
Mar 2016, #5	Radon exposure chamber	3-Generations exposure study	PROFI
Apr 2016, #6	Biological Irradiation Facility	Wildlife TransferDatabase	Radiobiology and immunology platform (CTU-FBME)
May2016, #7	CIRIL	Portuguese Tinea Capitis Cohort	LDRadStatsNet
Jun 2016, #8	Mixed alpha and X-ray exposure facility	Elfe Cohort	ERICA Tool
Jul 2016, #9	SCRS-GIG	RES³T	CROM-8
Sep 2016, #10	Facility radionuclides availability, transfer and migration	INWORKS cohort	France Génomique
Oct 2016 #11	LIBIS gamma low dose rate facility ISS	JANUS	Transcriptomics platform SCKCEN
Nov 2016, #12	Microtron laboratory	EPI-CT Scan cohort	CATI
Dec 2016, #13	Nanoparticle Inhalation Facility	UEF Biobanking	The Analytical Platform of the PREPARE project
Feb 2017, #14	Infrastructure for retrospective radon & thoron dosimetry	Chernobyl Tissue Bank	HZDR Radioanalytical Laboratories
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Mar 2017, #15	Alpha Particles Irradiator Calibration Laboratory at KIT		SYMBIOSE
Apr 2017, #16	Changing Dose rate (SU) Low dose rate (SU)		Advanced Technologies Network Center
May 2017, #17	Chernobyl Exclusion Zone	Chernobyl clean-up workers from Latvia	BfS whole and partial body Counting
Jun 2017, #18	MELAF	Belgian Soil Collection	INFRAFONTIER
Jul 2017, #19	MICADO'LAB	Estchern Cohort	ECORITME
Sep 2017, #20	DOS NDS		CERES
Oct 2017, #21	CALLAB Radon Calibration Laboratory		CORIF
Nov 2017, #22	Calibration and Dosimetry Laboratory (INTE-UPC)	German airline crew cohort	Centre for Omic Sciences (COS)
Dec 2017, #23	NMG	Techa River Cohort (TRC)	iGE3
Special Issue 2	MEDIRAD	MEDIRAD	MEDIRAD
Feb 2018, #24	UNIPI-AmBe	Greek interventional cardiologists cohort	SNAP

Future events:

1st ISORED scientific and organisation meeting, Sitges, Spain: Postponed until spring 2021 because of the COVID-19 pandemic. The new dates will be communicated soon.

ERPW2020: European Radiation Protection Week 2020, Estoril, Portugal: Postponed to 2021. More information to be announced soon.

To verify for modifications due to the COVID-19 outbreak!

See also on CONCERT website

Editorial Committee: Maria Panagiotopoulou, Jean-Michel Dolo, Laure Sabatier

Special Issue 13
June 2020

AIR²

Access to INFRASTRUCTURES

Issue	Exposure platforms	Databases, Sample banks, Cohorts	Analytical platforms, Models & Tools
Published to date:			
Special Issue 3	2nd CONCERT Call: LEU-TRACK, PODIUM, SEPARATE, VERIDIC, ENGAGE, SHAMISEN-SINGS	2nd CONCERT Call: LEU-TRACK, PODIUM, SEPARATE, VERIDIC, ENGAGE, SHAMISEN-SINGS	2nd CONCERT Call: LEU-TRACK, PODIUM, SEPARATE, VERIDIC, ENGAGE, SHAMISEN-SINGS
Mar 2018, #25	IRRAD	MARiS	BIANCA
Apr 2018, #26	Forest observatory site in Yamakiya	BBM	OEDIPE
May 2018, #27	Belgian NORM Observatory Site	The German Thorotrast Cohort Study	VIB Proteomics Core
Jun 2018, #28	CERF	Mayak PA worker cohort	Geant4-DNA
Jul 2018, #29	TIFPA	RHRTR	D-DAT
Sep 2018, #30	HIT	The TRACY cohort	COOLER
Oct 2018, #31	PTB Microbeam	The BRIDE platform	BRENDA
Nov 2018, #32	AGOR Facility at KVI-CART LNK		MARS beamline at SOLEIL
Dec 2018, #33	PARISII	The ISIBELa cohort	CIEMAT WBC
Feb 2019, #34	The MIRCOM microbeam	The ISE cohort	EFFTRAN
Special Issue 4	NSRL	LSAH & LSDA	GeneLab
Mar 2019, #35	IRSE Experimental Farm	The MWF database	DSA Environmental Laboratory
Apr 2019, #36	PG stack at Barreiro, Portugal	CONSTANCES	The MCDA Tool
May 2019, #37	LERF	IMMO-LDRT01 cohort	Radiochemical and Radioactive Analysis Laboratory (INTE-UPC)
Jun 2019, #38	FAIR	The BACCARAT study	CIEMAT *In Vitro* Internal Dosimetry Laboratories
Jul 2019, #39	AMBIC	LSS	LRM
Sep 2019, #40	FRM II	REQUITE	TU Dublin Analytical Platform
Special Issue 5	CONFIDENCE	CONFIDENCE	CONFIDENCE
Special Issue 6	PODIUM	PODIUM	PODIUM
Special Issue 7	LDLensRad	LDLensRad	LDLensRad
Special Issue 8	ENGAGE	ENGAGE	ENGAGE
Special Issue 9	LEU-TRACK	LEU-TRACK	LEU-TRACK
Special Issue 10	CIEMAT External Dosimetry Service and Retrospective Luminescence Dosimetry Lab, AIFIRA Microbeam, The Calliope Facility, ZATU	The 'hematopoietic system' database for Mayak nuclear workers chronically exposed to ionizing radiation	
Special Issue 11	TERRITORIES	TERRITORIES	TERRITORIES
Special Issue 12	VERIDIC	VERIDIC	VERIDIC
Special Issue 13	HARMONIC	HARMONIC	HARMONIC

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