

**Concept Number:** CRO2014004

**Title:** Upgrading Dose Management and Optimization in Computerized Tomography

**Original Language Title:** ?????

**Project Number:** CRO6015

**Project Type:** National

**Project Class:** Category A

**Submitted By:** Member State and/or Observers With Rights

**Field of Activity:** 29 - Dosimetry and medical physics

**FOA Distribution:**

FoA Code: 29 = 50%

FoA Code: 12 = 50%

**Link to RB Programme:** 2.2 Human Health - 2.2.4 Dosimetry and medical physics for imaging and therapy

**Participating Member State(s):**

Croatia

**Project duration (Total number of years):** 2

**Project duration (Start date):** 2016-01-01

**Gap / Problem / Need Analysis:** Enhancing the public health care system by improving cancer treatment and early diagnosis using modern nuclear methods in Croatia is one of the major priorities indicated in the Country Programme Framework (CPF) for Croatia for the period 2014-2019. Computed tomography (CT) is extremely useful tool in medical practice and consequently the frequency on CT examination is increasing over the world. Also the pattern of use is changed, from discrete slice by slice scanning with inter-slice gap in conventional systems, it is now volume scanning in helical/ spiral CT scanning and multislice CT. The speed and ease with which imaging procedure can be performed has resulted in over-stretching the use of this modality. To minimize this effect referral criteria are given by radiological community. According to UNSCEAR 2010 and EC Dose DataMed II project, CT contributes the majority of the collective dose from diagnostic X ray examinations in the world. The individual patient doses have also been increasing despite technological advances, primarily because of varying patterns of use. There is growing realization that image quality in CT often exceeds the level needed for confident diagnosis and that patient doses are higher than necessary. This is so as increasing exposure factors do not result in blackening of images, rather better quality images are obtained. Radiation dose in CT is of particular importance for children. It is very well known that children are more sensitive and likely to get radiation induced cancer than adults. A multicentre IAEA study in 2012 indicated that exposure factors in CT examination used for children are sometimes similar to adults. There is definite need to attend to patient doses in pediatric CT procedures. With increasing use of CT in children and a lack of use of appropriateness criteria,

there is a strong need to implement guidelines to avoid unnecessary radiation doses to children. During previous involvement in IAEA projects, Croatia recognized most of these problems as own. Afterwards, under the EU IPA program, some steps toward to better optimization and dose management are done in pilot hospitals. The country has been participating in the regional project of the IAEA in the area of Radiation protection of patients and protection in medical exposure (TSA 3). In that project, University hospital of Osijek established the optimization system and radiation dose assessment for patients undergoing mammography and interventional procedures. Some other hospitals were also included, but only by giving data for the surveys. Good progress was done in those areas and we published the results of patient doses and optimization methods and also participated as a partner in multi-centre papers published by the IAEA. CT procedures were not in the focus in the past. In order to help in optimization and building awareness of this problem, establishing of the local dose methodology for recording systems in CT procedures and giving the initial values for diagnostic reference levels in CT procedures in selected hospitals will be of great value. To assure full benefit of dose recording system and DRL optimization we first plan to work on optimization of equipment set up and operation; optimisation of the image quality according to the clinical purpose or diagnostic needs of the examination (i.e. using an acceptable rather than the best achievable image quality); and to improve the education and training of medical personnel involved. During previous surveys dealing mostly with patients dose we also noticed that low awareness of justification problem exists, especially among non-radiological community. There are no national referral guidelines and education of such international guidelines is not included in a radiation safety training of workers.

**Stakeholder analysis and partnerships:** The main counterpart institutions in this project will be Medical faculty Osijek, University Hospital Rijeka and University hospital Osijek, Croatia. The cooperation between regulatory authority (State office for radiological and nuclear safety) and hospitals (University hospital of Osijek, University hospital Sisters of mercy, Zagreb, University hospital Mercur, Zagreb and University hospital of Rijeka) will be utilized and possibly extended to a larger number of hospitals. The end users/beneficiaries will be selected radiology departments in Croatia and population of Croatia undergoing CT examinations.

**Overall Objective:** To establish policies, mechanisms and methodology for optimization and appropriateness of Computed Tomography (CT) procedures in four selected major regional hospitals.

**Objective Analysis:** See uploaded document

**Role of nuclear technology and IAEA:** Use of ionizing radiation is well established in medicine where benefits are generally higher than risks. There are situations where non-radiation techniques can be used and are employed, but majority of situations require use of ionizing radiation. In this way, radiological techniques complement non-nuclear and non-ionizing radiation techniques.

**Physical infrastructure and human resources:** All involved hospitals are university hospitals having large radiological departments with MSCT. At University hospitals Osijek and Rijeka, medical physicists are available at the departments, but in other two hospitals we will have help from medical physicist from regulatory body (State office for radiological and nuclear safety) and medical physicists from other counterparts to help in optimization and education. Those hospitals are in the process of employing medical physicists also. In every involved hospital there is also radiologist and technologist responsible for the project since optimization in CT is team work of those professions (they were appointed by the department chief and they are involved routinely mostly in CT diagnostic). Also, three senior medical physicists from Medical faculty Osijek, University hospital centre of Osijek and University hospital centre of Rijeka will be engaged into the project. Regulatory body (State office for radiological and nuclear safety) will help with the legislation of the programme and in organizing national courses.

**Safety regulatory infrastructure:** National and institutional safety and regulatory infrastructure seems adequate for implementation of the project in safe manner.

**Other considerations, e.g. environment, gender:** Both genders will attend the project implementation and equally benefit by implementation of this project.

**Implementation strategy:** The teams of medical physicist, radiation technologist and a radiologist will be formed at every involved radiology department. Then the survey of CT protocols, patients dose and image quality will be performed, results analyzed and compared among departments and with published references. Also, awareness and use of referral guidelines will be surveyed within radiologists and referring doctors in the hospitals. Then the methodology for collecting the patients dose indices will be decided and local diagnostic reference levels will be established. The education of all teams in advanced radiology department will be performed in order to learn how to better deal with justification awareness problem and to be able to optimize the used CT protocols in home departments. It will be of great importance to visit the hospital where steps are performed to increase justification awareness and where system for better justification of CT examination (or any radiological examination) exists. Also, following this education, meeting of all participants will be organized to harmonize approach. After the optimization of CT protocols is made, new surveys will be performed in order to compare the patients dose and image quality before and after the optimization. Furthermore, local diagnostic reference levels in terms of CT dose indices will be established again and compared to the first ones. The results will be disseminated through the national conferences of relevant professionals. Also, building awareness of justification problem will be done according to the lessons learned at SV, but at least the international referral guidelines will be included in the regular education of exposed workers. This activity will be performed in cooperation with regulatory body that is responsible for this education. Drawback of this step is that education is dedicated only to exposed workers and general practitioners are not included, so a lecture in organization of a lecture in cooperation with Croatian radiologists society will be organized for broader audience.

**Monitoring and progress reporting:** Six months reporting and the final report from counterparts will be submitted through PCMF.

**Risk management:** The project depends on commitment of the teams from involved hospitals and regulatory body support (the participation and commitment of all involved has been agreed before the project was proposed). In the past we had good cooperation with relevant professional societies and regulatory body in project implementation and sustainability of the results. Nevertheless, there was a risk of low level of support from hospital managements, but this was resolved by having approval to proceed with the project proposal after the design stage. Also, full success of the project depends on acceptance of whole radiological community to work on further upgrading radiation safety of the patients.

| Year                              | Human Resource Components (Euros) |                    |             |                   |                  |           | Procurement Components (Euros) |               |           | Total (Euros) |
|-----------------------------------|-----------------------------------|--------------------|-------------|-------------------|------------------|-----------|--------------------------------|---------------|-----------|---------------|
|                                   | Experts                           | Meetings/ Workshop | Fellowships | Scientific Visits | Training Courses | Sub-Total | Equipment                      | Sub-Contracts | Sub-Total |               |
| 2016                              | 3 000                             | 0                  | 0           | 39 000            | 0                | 42 000    | 35 000                         | 0             | 35 000    | 77 000        |
| 2017                              | 3 000                             | 10 000             | 0           | 27 000            | 0                | 40 000    | 30 000                         | 2 000         | 32 000    | 72 000        |
| <b>First Year Approved : 2016</b> |                                   |                    |             |                   |                  |           |                                |               |           |               |
| Year                              | Human Resource Components (Euros) |                    |             |                   |                  |           | Procurement Components (Euros) |               |           | Total (Euros) |

|      | Experts | Meetings/<br>Workshop | Fellow-<br>ships | Scientific<br>Visits | Training<br>Courses | <b>Sub-<br/>Total</b> | Equipmen<br>t | Sub-<br>Contracts | <b>Sub-<br/>Total</b> |               |
|------|---------|-----------------------|------------------|----------------------|---------------------|-----------------------|---------------|-------------------|-----------------------|---------------|
| 2016 | 1 000   | 41 000                | 0                | 0                    | 0                   | <b>42 000</b>         | 0             | 21 000            | <b>21 000</b>         | <b>63 000</b> |
| 2017 | 4 000   | 6 000                 | 0                | 0                    | 0                   | <b>10 000</b>         | 0             | 4 000             | <b>4 000</b>          | <b>14 000</b> |

**First Year Approved : 2016**

## Logical Framework Matrix (LFM)

|                | Design Element  | Indicator   | Means of Verification   | Assumptions  |
|----------------|---|---|---|--|
| <b>Outcome</b> | To raise radiation safety of patients (especially pediatric) undergoing CT examinations in selected hospitals.  | CT procedures (especially pediatric) in four selected major regional hospitals optimized in terms of dose and acceptable image quality according to the clinical purpose. Referral criteria awareness built among radiologists and non-radiologists in four selected hospitals. | Reports from the counterparts. Reports of patients doses and CT protocols before and after implementation of the project. Pediatric CT protocols exists at all selected hospitals. All reports available on the project website and linked from websites of relevant national professional societies and regulatory body. Reports from the counterparts on actions done on building awareness of referral criteria among radiologists and non-radiologists (content and number of lectures given and meetings organized). All actions reported on the project website and linked from websites of relevant national professional societies and regulatory body. | Commitment of management of selected hospitals exists.                   |
| <b>Output</b>  | 1 Project Management Team Operational   |   |   |  |
|                | 2 Dose recording methodology implemented in pilot hospitals and patient doses, protocols, image quality and referral awareness surveyed and LDRLs in terms of CT dose | Dose recording methodology exists in four selected hospitals. Local diagnostic reference levels in terms of CT indices established for  | Report on survey of patients doses, image quality, CT protocols and referral awareness in four selected hospitals.  | Commitment of the selected hospital management and project participants. |

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|  | indices determined and introduced as optimization tool in selected hospitals   | different age and weight groups and in use.  |   |  |
|  | 3 Teams from selected hospitals and regulatory body introduced and trained in optimization process and referral system at hospitals with advanced radiation safety programs at computed tomography facility            | Teams of radiologist, medical physicist and radiation technologist from each and every selected hospital trained at radiology department with advanced radiation safety of patient system. | Counterpart reports.  | Conditions for visits fulfilled.   |
|  | 4 Equipment needed for dosimetry and image quality assessment (to support the objective optimization of clinical protocols) in place and operational   | Equipment needed for optimization of dose and image quality operational and in use.  | Optimized CT protocols in use at four selected hospitals. Project progress report.  | Commitment of the project participants.  |
|  | 5 Harmonization and upgrade of justification awareness process and optimization of practice in selected hospitals  | Lessons learned from SVs and experiences from all selected hospitals agreed. Optimization and justification of CT examinations upgraded in all selected hospitals.                         | Progress report. Upgraded CT protocols exists. Report on content and number of meetings with radiologists and referring clinicians on appropriateness criteria. | Agreement among selected CT facilities and participants according to experience gained during the project.                           |
|  | 6 Survey of referral awareness, patient doses, protocols, image quality and local DRLs done and compared to the one in the beginning of the project and results presented at relevant scientific meeting and published | Survey of referral awareness, patient doses, CT protocols, image quality and DRLs performed and compared to the baseline.  | Report on survey of referral awareness, patient doses, CT protocols, image quality and DRLs presented in front of relevant professionals and published.         | Equipment and forms for dose and image quality survey in place.  |
|  | 7 Experiences and guidelines for the optimization and building justification awareness and the project results publicly available on the project website and linked from relevant professional                         | Experiences and guidelines from all participants of the project agreed and report produced.  | Experiences and guidelines publicly available on the website of the project and linked from relevant professional associations and regular body.                | Agreement between participants according to the experience gained during the project. Agreement with relevant professional societies |

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|                 | societies and regulatory body  |  |  | and national regulatory body.   |
| <b>Activity</b> | 1.1 Confirming/Setting-up project team (CP, CP team in MS, PMO/TO)   | Team is established.   | Team exists  |   |
|                 | 1.2 Conducting project review meetings   | Meeting was organized and done.  | Meeting report.  |   |
|                 | 1.3 Updating project work plan   | Project work plan agreed and updated.  | Report with updated project work plan. Progress report.  |   |
|                 | 1.4 Preparing and submitting PPARs (every six months)  | PPAR prepared.   | PPAR uploaded at pcmf webpage.   |   |
|                 | 1.5 IAEA Field Monitoring  |  |  |   |
|                 | 2.1 At least one CT room in every selected hospital is selected to participate in project and responsible radiologist, medical physicist and radiation technologist for implementing the project determined  | At least one CT room in every hospital selected and responsible radiologists, medical physicist and radiation technologist for the project determined. | List of CT rooms and responsible persons added to the counterpart report and at project website. | Commitment of management of selected hospitals.                         |
|                 | 2.2 In selected CT rooms patient doses recording methodology established   | Patient dose recording system exists in the selected CT rooms.   | Counterpart report.  | Commitment of the participants from the selected hospitals.             |
|                 | 2.3 Examinations of interest identified. Data forms for collecting number of examinations (and number of examinations rejected due to justification), patient dose indices and procedure protocols determined for different weight and age groups. | Examinations identified. Data forms exists.  | Report of the counterparts.  | Work group to determine the list of examinations and data forms formed. |
|                 | 2.4 Meeting of participant   | Meeting organized  | Report from the counterparts.  | Commitment of the   |

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|  | organized in order to introduce knowledge and literature for optimization of patients dose and image quality according to the clinical purpose of the examination.   | and done. Knowledge of optimization and justification in CT examinations raised among participants of the project. |   | participants and management of the selected hospitals.  |
|  | 2.5 Local diagnostic reference levels in terms of CT dose indices determined and compared to the published ones. DRLs introduced as optimization tool in selected hospitals.   | Local DRLs determined and introduced as optimization tool in CT practice of selected hospitals.                    | DRLs published on the project website. Report of the counterparts.  | Dose recording methodology established.   |
|  | 2.6 Survey of patients doses, protocols, image quality and DRLs prepared and conducted in four selected hospitals  | Survey of the patients doses, CT protocols, image quality and DRLs for selected CT procedures performed.           | Report from the counterpart. Survey of the patients doses, CT protocols, image quality and DRLs for selected CT procedures reported at project website. | Dose recording systems established and working in all selected hospitals. Equipment and forms for dose and image quality survey in place. Commitment of the project participants. |
|  | 3.1 Scientific visits of radiologist, medical physicist and radiation technologist as a team from all selected hospitals to the CT facility with advanced radiation safety program (it should be dpt with working justification system). | SV of radiology team (3 people) from each selected hospital completed.   | Report from the host institute.   | Visitors identified, evaluated and selected. Nominations submitted and visitors accepted.   |
|  | 3.2 Scientific visit of team of national project leaders (national counterparts) and regulatory body representative dedicated to the project implementation to the CT facility with advanced radiation safety programme                  | SV of national counterparts and regulatory body representative completed.  | Certificate of the host institute.  | Visitors identified, evaluated and selected. Nominations submitted and visitors accepted.   |
|  | 3.3 List of references specified, procured and made available to all project participants  | Literature available to all participants of the project.   | Report from the counterpart.  | Publications available.   |

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| 4.1 List of equipment needed for dosimetry and image quality assesment in all selected facilities identified during the scientific visits and agreed between project participants   | List of equipment identified during the SVs agreed between the participants..   | Report from the counterpart.  | Funds well estimated.  |
| 4.2 Equipment for dosimetry and image quality assesment in selected hospitals procured  | Equipment in place at all selected CT facilities.   | Report from the counterpart   |  |
| 4.3 Low dose protocols adopted according to the indication and body size  | Low dose protocol in use  | Optimized CT protocols in use at all selected hospitals. Project progress report. | Commitment of the participants and workers from the selected hospitals.                |
| 5.1 Lessons learned from scientific visits and own hospital experience exchanged between hospitals in order to upgrade optimization and justification in selected hospitals   | Meeting between participants organized and lessons learned shared in order to harmonize and upgrade optimization of CT practice and upgrade justification process | Report from the counterpart.  | Dose recording system established and optimized CT protocols verified in practice      |
| 5.2 Low dose protocols upgraded according to the clinical indications and body size   | Low dose protocols according to the indication and body size upgraded.  | Report from the counterparts.   | Image quality and patient dose remain adequate.  |
| 5.3 Referral criteria (justification) awareness built among radiologists involved and regulatory body representative. Further steps for accomplished awareness enhancement, especially among referring medical practitioners agreed | Meeting of all participants of the project organized.   | Counterpart report  | Commitment of project participants, selected hospital management and regulatory body.  |
| 5.4 A lecture of referral criteria in cooperation with Croatian radiologists society organized for radiologists and referral doctors.   | Lecture performed.  | Certificates issued for lecture listeners.  | Commitment of Croatian radiologists society was expressed during preparing the project |



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|              | 6.1 Survey of using referrals (and number of examinations rejected due to justification), patients doses, protocols, image quality and DRLs repeated and compared to the first one (baseline)   | Survey of patients doses, CT protocols, image quality and DRLs for selected CT procedures done and compared to the baseline.                     | Report from the counterpart.   | Dose recording in use. Equipment and forms for dose and image quality survey in place.              |
|              | 6.2 Analysis of the survey and preparing the report   |  |  | Feedback from all selected CT facilities. Workgroup to analyse data.                                |
|              | 6.3 According to the report, upgrading the optimization of the CT protocols and implementation in the practice and further steps in building justification awareness decided in cooperation with Croatian radiologists society and regulatory body.     | According to the report CT practice is upgraded in terms of optimization of patients dose and image quality.                                     | Report from the counterpart.   | Optimized CT protocols used in practice and experience gained.                                      |
|              | 6.4 Presenting of the report in front of relevant professionals   | Report presented in front of relevant professionals.   | Report from the counterpart. Published report or report prepared for the publication included in the project report. | Report prepared.  |
|              | 7.1 Preparation of the reports from the project for the website   | All results and reports from the project prepared for publishing at project website.   | Website exists and updated with project results.   | Report exists.  |
|              | 7.2 Preparing the website and sending the link to the relevant associations and organizations (radiation safety regulatory body, Croatian society of radiologists, Croatian society of medical physicists, Croatian society of radiation technologists) | Analyse of data done and report prepared. Website prepared and link sent to the relevant professional associations and national regulatory body. | Report presented at project website. Data from the project accessible.   | Relevant professional organizations and national regulatory body interested in the project results. |
| <b>Input</b> | 1.1.1 EM: The core team for   |  |  |   |

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| implementing the project will be set   |  |  |  |
| 1.1.2 SC: Preparation of the reports from the project for the website  |  |  |  |
| 1.2.1 EM: To review the project implementation, project will be reviewed by counterparts and all participants in the project. If needed, meeting will be organized with the IEX/IAEA staff             |  |  |  |
| 1.3.1 M: The project plan will be updated according to the project review meeting  |  |  |  |
| 1.4.1 M: The project reports will be prepared every six month  |  |  |  |
| 2.1.1 SC: One room in every selected hospital is selected to participate in project and responsible radiologist, medical physicist and radiation technologist for implementing the project determined. |  |  |  |
| 2.2.1 SC: In selected CT rooms patient doses recording methodology established   |  |  |  |
| 2.3.1 M: Meeting of project participants on identifying CT examinations of interest. Data forms for collecting dose, number of patients and CT procedure protocols will be also determined             |  |  |  |
| 2.4.1 M: Meeting of participant in order to introduce knowledge and literature for optimization of patients dose and image quality according to the  |  |  |  |

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| clinical purpose of the examination.  |  |  |  |
| 2.5.1 SC: Local diagnostic reference levels in terms of CT dose indices determined and compared to the published ones. DRLs introduced as optimization tool in selected hospitals.  |  |  |  |
| 2.6.1 SG: Survey of patients doses, protocols, image quality and DRLs prepared and conducted in four selected hospitals   |  |  |  |
| 3.1.1 SV: Scientific visits to the CT facility with advanced radiation safety program of radiologist, medical physicist and radiation technologist from four selected hospitals   |  |  |  |
| 3.1.2 SV: Scientific visits to the CT facility with advanced radiation safety program of radiologist, medical physicist and radiation technologist from four selected hospitals   |  |  |  |
| 3.2.1 SV: Scientific visit of team of national project leaders (national counterparts) and regulatory body representative dedicated to the project implementation to the CT facility with advanced radiation safety programme (4 people, 1 w) |  |  |  |
| 3.3.1 EQ: Literature as specified by participants according to the knowledge gained during the project implementation and scientific visits   |  |  |  |
| 4.1.1 EM: List of equipment needed for dosimetry and image quality assesment in all   |  |  |  |

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| <p>selected facilities identified during the scientific visits and agreed between project participants</p>   |  |  |  |
| <p>4.2.1 EQ: Equipment for dosimetry and image quality assessment and implementation of the QA/QC program in selected hospitals procured according to the list identified after the scientific visits of participants</p>                        |  |  |  |
| <p>4.2.2 EQ: Equipment for dosimetry and image quality assessment and implementation of the QA/QC program in selected hospitals procured identified as missing during the implementation of the project</p>                                      |  |  |  |
| <p>4.3.1 SC: Low dose protocols adopted according to the indication and body size</p>  |  |  |  |
| <p>5.1.1 M: Meeting on lessons learned from scientific visits and project review in the light of lessons learned</p>   |  |  |  |
| <p>5.2.1 SC: Low dose protocols upgraded according to the clinical indications and body size</p>   |  |  |  |
| <p>5.3.1 M: Meeting on adopting referral criteria and including it in educational material for regular education of exposed workers. Deciding further steps for awareness enhancement, especially among non exposed referring practitioners.</p> |  |  |  |
| <p>5.4.1 EM: A lecture of referral criteria given in front of radiologists and referral doctors. Lecture will be organized in cooperation with</p>   |  |  |  |

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| Croatian radiologists society.   |  |  |  |
| 6.1.1 SC: To survey of using referrals (and number of examinations rejected due to justification), patients doses, protocols, image quality and DRLs repeated and compared to the first one (baseline)   |  |  |  |
| 6.2.1 M: Meeting on analyzing the data from the survey conducted on patients doses, CT protocols and DRLs and preparing report on the difference of data from the beginning of the project (project results)   |  |  |  |
| 6.3.1 SC: According to the report, to upgrade the optimization of the CT protocols and implementation in the practice and further steps in building justification awareness decided in cooperation with Croatian radiologists society and regulatory body. |  |  |  |
| 6.4.1 M: Presenting of the report in front of relevant professionals (conference)  |  |  |  |
| 7.1.1 SC: Preparation of the reports from the project for the website  |  |  |  |
| 7.2.1 SC: Preparing the website with the project results and sending the link to the relevant associations and organizations   |  |  |  |