MRTDosimetry collaboration meeting (10 months)

Vienna, 3rd – 4th April 2017

Location

Meeting room, 8th floor

Bundesamt für Eich- und Vermessungswesen
Schiffamtsgasse 1-3
1020 Wien
Austria

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Registered Participants

To register please complete the form at,
https://docs.google.com/spreadsheets/d/1FCmQKNeUvj3EGgUdZ7JbAMTEvB3o44g5UMiZtgXbnuM/

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Meeting Agenda

Overview

Monday 3rd April 2017	
12.30 – 13.00	Registration & Coffee
13.00 – 13.10	Introduction (Andrew Robinson)
13.10 – 15.00	**WP1: Activity standards for QI** ***Chair: Christophe Bobin***
15.00 – 15.30	Coffee break
15.30 – 17.30	**WP4: Accuracy and traceability of dose calculations** ***Chair: Jill Tipping***
Tuesday 4th April 2017	
09.00 – 11.00	**WP2: Imaged-based quantification of 3D activity distributions** ***Chair: Michael Lassmann***
11.00 – 11.30	Coffee break
11.30 – 13.30	**WP3: Computer modelling of time-variable activity distributions in multimodal imaging** ***Chair: Lara Struelens***
13.30 – 14.30	Lunch
14.30 – 16.30	**WP5: Creating impact** ***Chair: Vere Smyth***
16.30 – 17.30	[Breakout session WP3] Discussion of A3.1.5 comparison of simulated and measured images *Chair: Lara Struelens*
Wednesday 5th April 2017	
09.00 – 10.00	Individual WP meetings if required
10.30	Start of workshop

Detailed Agenda

Monday 3rd April 2017		
12.30 – 13.00	Registration & Coffee	
13.00 – 13.10	Introduction (Andrew Robinson)	
13.10 – 15.00	**WP1: Activity standards for QI** ***Chair: Christophe Bobin***	
Currently active tasks and activities (WP1)		
Task 1.1: Decay scheme measurements for QI		
A1.1.1	**CEA**, CMI, ENEA, NPL	Due May 2018
CEA, CMI, ENEA and NPL will independently determine the branching ratio related to the internal pair production of ^{90}Y using nuclear spectrometry.		
A1.1.2	**CEA**, CMI, ENEA, NPL	Due May 2018
CEA, CMI, ENEA and NPL will each produce new primary activity standards of ^{166}Ho and will measure the decay data of their new primary activity standards of ^{166}Ho using nuclear spectrometry.		
Task 1.2: Development of radioactive test sources with known activities		
A1.2.1	**CEA,** CMI, NPL	Due May 2017
CEA, CMI and NPL will develop at least two sealed, long-lived (i.e. useable for more than one year) surrogate radioactive test sources (solid or liquid) containing ^{133}Ba as a surrogate for ^{131}I for SPECT imaging applications. The activity of the reference sources shall be traceable to existing primary activity standards, and the surrogate radioactive test sources should be suitable for QC and commissioning testing in Task 2.2.		
A1.2.3	**CEA,** CMI, NPL	Due Nov 2018
CEA, CMI and NPL will develop at least two sealed, radioactive test sources, (solid or liquid) for ^{90}Y and ^{177}Lu for the improvement of the metrological traceability of QI measurements and for the validation of QI procedures in Task 2.2. This will include an investigation of the stability and homogeneity of the radioactive test sources for ^{90}Y and ^{177}Lu, as well as the definition of typical geometries, which will be done in consultation with the project's external and unfunded clinical partners at the project's kick off meeting (A6.2.1).		
A1.2.4	**CEA,** CMI, NPL	Due Nov 2018
CMI will develop at least two sealed, radioactive test sources of ^{131}I for use in the quasi-realistic anthropomorphic 3D phantom(s) produced in Task 2.3 and in the QI comparison exercise in Task 2.4.		
Task 1.3: Development of a transfer instrument for high-energy beta-emitters		
A1.3.1	**CEA,** ENEA, NPL	Due July 2017
CEA, ENEA and NPL will define the technical specifications for a new transfer instrument for high-energy pure beta-emitters (i.e. MRT agents such as 90Y), which can be used as an alternative to the radionuclide calibrators that are used for the measurement of activity in clinics. The new transfer instrument should reduce the associated uncertainties for high-energy beta-emitters from 15 % to 2 %. It should also be robust enough for use in clinics and radiopharmaceutical companies; being able to handle high levels of activity (i.e. 3 GBq in the case of SIR-Spheres) and compatible with the geometries used in clinics (e.g. vials, syringes). The specification and characteristics of the transfer instrument will be investigated using MC simulations by CEA and ENEA in order to ensure its suitability.		
Future tasks and activities (WP1)		
	Discussion of any upcoming tasks in WP.	
15.00 – 15.30	Coffee break	
15.30 – 17.30	**WP4: Accuracy and traceability of dose calculations** ***Chair: Jill Tipping***	
Currently active tasks and activities (WP4)		

Task 4.1: Integration of the TAC		
A4.1.1	**UKW**, RSCH, Christie, ASMN, NPL, OUHT	Due May 2017
UKW, RSCH, Christie, ASMN, NPL and OUHT will compare voxel- versus organ-based methods to determine TAC integration and the associated uncertainties. As part of this UKW will collate data sets (timed sequences of patient images) for study and will allocate them to RSCH, Christie, ASMN and OUHT. RSCH, Christie, ASMN and OUHT will analyse the timed sequences of the images using their existing voxel- versus organ-based methods to produce voxel and whole-organ specific data. The data will then be collated and analysed by UKW with input from NPL to determine TAC integration on uncertainty estimates.		
A4.1.2	NPL, UKW, THG, ASMN, BRFAA	Due May 2017
Using input from A4.1.1, NPL, UKW, BRFAA and THG will develop a method for obtaining differences in "quality", as judged by the corresponding uncertainties, between (a) organ-based integration and voxel-wise integration, (b) mono-exponential TACs and more complex functions, and (c) the effects of the uncertainty in patient positioning. To do this UKW and ASMN in agreement with NPL and THG will provide the anonymised clinical patient data sets that are needed.		
Task 4.2: Radionuclide dosimetry with gel and film dosimeters		
A4.2.1	**Christie**	Due May 2017
Christie will optimise the response of MAGIC polymer MR sensitive gels to heterogeneously distributed MRT radionuclides (^{131}I, ^{90}Y, ^{177}Lu). The composition of the gels will be optimised for typical time periods between exposure and measurement of MR sensitivity. From the results Christie will produce a calibration protocol for the use of the MAGIC polymer MR sensitive gel-based dosimetry.		
A4.2.2	**NPL**	Due May 2017
NPL will optimise film based dosimetry for heterogeneously distributed MRT radionuclides (131I, 90Y, 177Lu). NPL will build on the experience they gained from JRP HLT11 MetroMRT to extend existing film based dosimetry measurements to all 3 radionuclides (i.e. 131I, 90Y, 177Lu). NPL will also investigate a reduction of the uncertainties for each radionuclide. From the results NPL will produce a protocol for the use of film-based dosimetry.		
Task 4.3: Continued development of a primary standard of absorbed dose to water from radionuclide solutions		
A4.3.1	**NPL**	**Due Nov 2016**
NPL will review the causes of uncertainty found with their preliminary primary standard of absorbed dose to water from radionuclide solutions (from JRP HLT11 MetroMRT). This will be done by optimising measurements with ^{90}Y in order to optimise the performance of the preliminary primary standard and to minimise the measurement uncertainty.		
A4.3.2	**NPL**	Due May 2017
Using input from A4.3.1, NPL will repeat the measurements using their preliminary primary standard, with a radionuclide solution of ^{90}Y chloride to verify the results achieved in JRP HLT11 MetroMRT and for comparison with the calculated energy deposition from nuclear decay data from published sources. NPL will do this to optimise the performance of the preliminary primary standard and to minimise the uncertainty to better than a combined standard uncertainty of 1.4 %, and agreement with the calculated energy deposition from published nuclear decay data of better than 1.8 %.		
Task 4.4: Dosimetry calculations for a range of commercial and non-commercial platforms		
A4.4.1	**Christie,** UKW, LUND, INSERM, ASMN, NPL, BEV-PTP, CARD, THG, RSCH, OUHT	Due Jan 2018
Christie, UKW, LUND, INSERM, ASMN, NPL, BEV-PTP, CARD, THG, OUHT and RSCH will identify commercial and non-commercial dosimetry calculation platforms for testing in A4.4.3. At least two dosimetry calculation platforms will be chosen and they will be agreed jointly by Christie, UKW, LUND, INSERM, ASMN, NPL, BEV-PTP, CARD, THG OUHT and RSCH. The commercial or non-		

commercial dosimetry calculation platforms should cover a range of dosimetry systems to permit at least two calculations for each radionuclide and treatment used with the platforms.		
Future tasks and activities (WP4)		
	Discussion of any upcoming tasks in WP.	
Tuesday 4th April 2017		
09.00 – 11.00	**WP2: Imaged-based quantification of 3D activity distributions** ***Chair: Michael Lassmann***	
Currently active tasks and activities (WP2)		
Task 2.1: Expanded calibration protocol		
A2.1.1	**NPL**, ENEA, BEV-PTP, RSCH, Christie, UKW, ASMN, THG, OUHT	Due Oct 2017
NPL, ENEA, BEV-PTP, RSCH, Christie, UKW, ASMN, THG and OUHT will expand the calibration protocol developed in JRP HLT11 MetroMRT for ^{177}Lu to include the additional MRT radionuclide ^{131}I for use with SPECT systems. To do this UKW, ENEA, BEV-PTP and NPL will review the existing calibration protocol from JRP HLT11 MetroMRT and ASMN, Christie, RSCH and UKW will perform SPECT test measurements with their own existing phantoms using ^{131}I and the calibration protocol from JRP HLT11. The results from the SPECT tests will be discussed amongst NPL, ENEA, BEV-PTP, RSCH, Christie, UKW, ASMN, THG and OUHT and changes will be made by consensus to the calibration protocol from JRP HLT11, as appropriate. NPL and ENEA will include the outcomes of the dead-time measurements from A2.1.3 in the expanded calibration protocol.		
A2.1.2	**NPL**, ENEA, BEV-PTP, RSCH, Christie, UKW, ASMN, THG, OUHT	Due Oct 2017
NPL, ENEA, BEV-PTP, RSCH, Christie, UKW, THG, AOSP and OUHT will expand the calibration protocol developed in JRP HLT11 MetroMRT for ^{177}Lu to include the additional MRT radionuclide ^{90}Y for use with PET-CT systems. To do this Christie, AOSP, RSCH and UKW will perform PET-CT test measurements with their existing phantoms using ^{90}Y. The results from the PET-CT tests will be discussed amongst NPL, ENEA, BEV-PTP, RSCH, Christie, UKW, THG, AOSP and OUHT and changes will be made by consensus to the calibration protocol from JRP HLT11, as appropriate. NPL and ENEA will include the outcomes of the dead-time measurements from A2.1.3 in the expanded calibration protocol.		
A2.1.3	**NPL**, ENEA, RSCH, UKW, THG, ASMN, OUHT	Due Sept 2017
NPL, ENEA, RSCH, UKW, THG, ASMN and OUHT will expand the calibration protocol developed in JRP HLT11 MetroMRT to account for the dead time in the gamma-camera systems for ^{177}Lu and ^{131}I. To do this ASMN, RSCH and UKW will perform dead-time measurements on ^{131}I and they will assess what count rates and activity dead-time corrections for 177Lu need to be implemented in the calibration protocol from JRP HLT11. Correction values that lead to deviations of less than 5% will be considered acceptable. NPL and ENEA will include the outcomes of the dead-time measurements in the expanded calibration protocol developed in A2.1.1 and A2.1.2.		
Task 2.2: A protocol for commissioning and QC for SPECT and PET-CT systems		
A2.2.1	**UKW**, RSCH, Christie, ASMN, NPL, CEA, ENEA, OUHT, THG	Due Nov 2018
To test whether surrogate radioactive test sources can replace liquid sources for commissioning and QC tests, UKW, RSCH, Christie, ASMN, THG and OUHT will carry out SPECT and PET-CT measurements of existing liquid sources (i.e. ^{131}I, ^{90}Y) and the radioactive test sources from A1.2.1-A1.2.3. NPL, CEA and ENEA will review the results and identify any discrepancies, and will decide (in collaboration with UKW, RSCH, Christie, ASMN, OUHT, THG) whether the surrogate radioactive test sources can be used to replace liquid sources for QC for SPECT and PET-CT systems.		
A2.2.2	**UKW**, RSCH, Christie, ASMN, ENEA, THG, OUHT, BRFAA	Due Nov 2018
To develop a protocol for commissioning and QC for SPECT QI for ^{177}Lu and ^{131}I, UKW, RSCH, Christie, ASMN, ENEA, THG, BRFAA and OUHT will devise, test and document a series of procedures, incorporating: • the expanded protocol from A2.1.3 • the recommendations on the use of the radioactive test sources from A2.2.1		

• the test measurements made in non-reference conditions using existing commercially-available phantoms.		
A2.2.3	**UKW**, RSCH, Christie, ENEA, AOSP, THG, OUHT	Due Nov 2018
To develop a protocol for commissioning and QC for PET-CT QI for ^{90}Y, UKW, RSCH, Christie, ENEA, OUHT, AOSP and THG will devise, test and document a series of procedures, incorporating: • the expanded protocol from A2.1.2 • the recommendations on the use of the radioactive test sources from A2.2.1 • the test measurements made in non-reference conditions using existing commercially-available phantoms.		
A2.2.4	**NPL**, UKW, ENEA, ASMN, Christie, THG, OUHT, AOSP, BRFAA, SCH	Due Mar 2019
Using input from A2.2.1-A2.2.3, NPL and UKW will derive a method for assessing the long-term stability of the radioactive test sources over their useful shelf life (typically one half-life or one year, whichever is the shorter), as well as developing criteria for SPECT and PET-CT system acceptance (taking stability issues into consideration) and will suggest maximum acceptable deviations for establishing a QI system. As part of this activity a protocol for the commissioning and QC of SPECT and PET-CT systems used for dosimetry will be produced in agreement between NPL, UKW, ENEA, ASMN, Christie, THG, OUHT, AOSP, BRFAA and RSCH.		
Task 2.3: Quasi-realistic anthropomorphic 3D phantoms		
A2.3.1	Christie, UKW, LUND, RSCH, NPL, ENEA, CMI, THG	**Due Oct 2016**
Christie, UKW, LUND, RSCH, NPL, ENEA, CMI and THG will define and design at least two quasi-realistic anthropomorphic 3D phantoms based on selected diseases and activity distributions that are most relevant to clinical situations (to be decided by Christie in consultation with UKW, LUND, RSCH, NPL, ENEA, CMI and THG). The developed phantoms will be based on digital models and the XCAT & ICRP110 models, a 3D neck phantom for use in thyroid cancer treatment will also be developed.		
A2.3.2	Christie, UKW	**Due Nov 2016**
Using input from A2.3.1, Christie and UKW will determine a method to convert patient or phantom image data into the format required by a 3D printer in order to print a watertight and potentially re-useable phantom.		
A2.3.3	Christie, UKW, RSCH, NPL, CMI	**Due Mar 2017**
Using input from A2.3.1 and A2.3.2, Christie, UKW, RSCH, NPL and CMI will define and test different materials that are compatible with the 3D printers used in A2.3.2, and will select promising candidates for tissue-equivalent material(s) suitable for the production of the quasi-realistic anthropomorphic 3D phantoms. The materials will be chosen by Christie, in consultation with UKW, RSCH, NPL and CMI. The selection of the candidate materials will involve their characterisation and will consist of experimental determination of attenuation coefficients for mono-energetic photons in the energy range of interest for MRT, as well as MC simulations, and the measurement of material characteristics on CT scanners.		
Future tasks and activities (WP2)		
	Discussion of any upcoming tasks in WP.	
11.00 – 11.30	Coffee break	
11.30 – 13.30	**WP3: Computer modelling of time-variable activity distributions in multimodal imaging** ***Chair: Lara Struelens***	
Currently active tasks and activities (WP3)		
Task 3.1: Modelling of SPECT imaging for dosimetry		
A3.1.1	**SCK.CEN**, LUND, INSERM, CARD, UKW, THG, OUHT	**Due Jan 2017**
SCK•CEN will compare Digital Imaging and Communications in Medicine (DICOM) headers for SPECT image files obtained by LUND, INSERM, CARD, THG, OUHT and UKW. A list of DICOM keys will be produced as well as a list of DICOM tags common to vendors of SPECT systems and those		

DICOM tags needed, but unavailable from the SPECT systems, will be identified. This information will be used to develop a method to enable the simulated image files developed in A3.1.4 to be read by different software packages.		
A3.1.2	**LUND**, INSERM, RSCH, UKW, NPL,THG	Due May 2017
Using the JRP HLT11 phantom, the response of different types of SPECT cameras: • LUND (GE Discovery 670), • RSCH, NPL and THG (GE Optima 640 and Philips Brightview XCT), • UKW (Siemens T2) to ^{177}Lu will be measured and then modelled with existing dedicated MC software. LUND and INSERM will perform the MC SPECT modelling for ^{177}Lu, using LUND's phantom and SPECT systems. The MC models will be benchmarked against corresponding measurements from JRP HLT11 and a report will be written.		
Task 3.5: Modelling for the determination of optimal scan or measurement times		
A3.5.1	**NPL**, LUND, UKW	Due May 2017
NPL with support from LUND and UKW will perform a review of, and will summarise, previous published work on methods for optimal scan times for radiopharmaceuticals and critical tissues and organs (including kidneys and bone marrow). From the results of this, NPL with support from LUND and UKW will develop a method for determining the optimal times for performing patient scans or whole-body measurements for ^{131}I, ^{90}Y and ^{177}Lu.		
A3.5.3	**NPL**, LUND, UKW	Due May 2017
NPL will collate anonymised patient data records for use in A3.5.4. The patient data records will be provided by LUND and UKW, who will contact hospitals on behalf of NPL and will agree the amount of data required with NPL.		
Task 3.6: Uncertainty propagation for NTCP		
A3.6.1	**NPL**, Lund	Due May 2017
NPL and LUND will investigate models, such as the logistic and the Gaussian distribution function, for representing NTCP curves. To do this, NPL and LUND will perform a literature survey for models used in other radiotherapy modalities, including recommendations on uncertainty levels for NTCP.		
Future tasks and activities (WP3)		
	Discussion of any upcoming tasks in WP.	
13.30 – 14.30	Lunch	
14.30 – 16.30	**WP5: Creating impact** ***Chair: Vere Smyth***	
Currently active tasks and activities (WP5)		
Task 5.1: Knowledge transfer		
A5.1.1	**CMI**, all partners	**Due Nov 2016**
The public project website, hosted by CMI, will give a detailed description of the project and will be regularly updated with progress reports, notices of project workshops, presentations at conferences, and publications. A professional web-design company will be used to design the public project website. The design of the public website will be subcontracted to a professional web-design company, as this is a specialist activity best carried out by software experts to ensure that communications with stakeholders are as effective as possible. On-going maintenance of the website will however be carried out by CMI. Website users will be encouraged to provide feedback, to participate as a collaborator or to join the project's stakeholder committee group (A5.1.6) where appropriate.		
A5.1.2	**NPL**, all partners	**Due Nov 2016**
The private project website will be accessible to all partners and collaborators. It will be hosted by NPL and will be used to store project documents, including presentations and minutes from all project meetings, internal project reports, data sets etc.		

A5.1.3	**NPL**, all partners	**Due Nov 2016**
NPL with support from all partners will form an industry interest group with membership from at least 3 camera manufacturers, imaging and dosimetry software developers, and radiopharmaceutical manufacturers. The aim of the group will be to keep the industry informed on developments in the project and to obtain feedback on new developments. Members will be encouraged to enter into formal collaboration with the project in order to facilitate the development of calibration and validation procedures compatible with their products.		
A5.1.4	**NPL**, all partners	**Due Nov 2016**
NPL with support from all partners will contact at least 20 European clinical centres that provide MRT, inviting them to join a mailing list, and to become formal collaborators with the project in order to participate in pilot studies of new methods.		
A5.1.5	**NPL**	Due May 2017
NPL will make contact with national bodies (equivalent to the UK Radiotherapy Clinical Trials QA team) in other EU states that are responsible for overseeing QA in clinical trials involving radiotherapy. The national bodies will be kept informed on the development of new standard calibration and validation procedures, and they will be invited to work with the project to incorporate these in procedures in new clinical trial protocols.		
A5.1.6	**NPL**, all partners	Due May 2019
NPL with support from all partners will create a Stakeholder Committee of at least 5 members from 5 organisations, representing at least 4 European countries. The stakeholders will come from healthcare professionals (clinical centres) and industry (camera manufacturers, software developers, and radiopharmaceutical companies). The aim of the stakeholder committee is to clarify the needs of the various interested parties and to feed these into the project. Interaction of the Stakeholder Committee will be achieved via the public project website (A5.1.1) and ad-hoc meetings will be held at suitable events where the committee are in attendance.		
A5.1.7	**CMI**, all partners	Due May 2019
CMI with support from all partners will give at least 15 oral presentations or posters at major European and national conferences, including the annual EANM Congress 2017, 2018, 2019, International Committee for Radionuclide Metrology (ICRM) biennial meetings 2017 (London, May 25-26th 2017) and 2019, EFOMP (e.g. EFOMP Athens, Sept 2016), and the European Radiation Dosimetry Group (EURADOS). Further relevant conferences may be identified during the project.		
A5.1.8	**CMI**, all partners	Due May 2019
CMI with support from all partners will submit at least 6 papers to peer-reviewed journals during the project, such as Applied Radiation and Isotopes, European Journal of Nuclear medicine and Molecular Imaging, and Radiotherapy and Oncology. The authors of the peer reviewed papers will clearly acknowledge the financial support provided through the EMPIR as required by EURAMET.		
A5.1.9	**CMI**, all partners	Due May 2019
Information on the results of the project will be disseminated to a range of standards bodies and committees and feedback sought (see the table in Section B2.c). The representatives on the corresponding committee or WG from the partners will jointly ask the chairperson to include a point in the agenda to briefly present the outputs of the project related to the WG activities and ask for comments. Where appropriate a written report will be submitted for consideration by the committee or WG.		
Task 5.2: Training		
A5.2.1	**BEV-PTP**, all partners	Due May 2017
BEV-PTP with support from all partners will host a 2-day scientific workshop in 2017 to present the aims and progress of the project to an audience of 50-100 stakeholders from the clinical, scientific, and manufacturing sectors, and other interested parties. Outside experts will also be invited to give presentations, to give their opinions on the project objectives and progress, and to take part in round table discussions. The workshop will be advertised using the mailing list		

compiled and the stakeholders identified in A5.1.3, A5.1.4, A5.1.5 and A5.1.6, and via the public project website (A5.1.1).		
Task 5.3: Uptake and exploitation		
A5.3.1	**NPL,** all partners	Due May 2019
NPL with support from all partners will create an exploitation plan at the beginning of the project and review and update it at least at each project meeting. The main project outputs to be exploited are: • Transfer instrument (Task 1.3) • 3D printed phantom with radioactive test sources (Tasks 1.2 and 2.3) • Protocol for commissioning and QC of QI using SPECT and PET-CT (Task 2.2) • Open-access database containing reference images (Task 3.7) • Protocol for commissioning and QC of MRT dosimetry platforms (Task 4.4)		
A5.3.2	**Christie**, BEV-PTP	Due May 2019
Christie and BEV-PTP will work with national and European medical physics associations to develop guidelines (based on the protocols from Tasks 2.2 and 4.4) for commissioning MRT treatment planning systems based on the validation methodologies developed in the project. This will be a collaborative task involving stakeholders such as medical physicists (A5.1.6) and camera/software manufacturers (A5.1.3).		
A5.3.3	**NPL**	Due May 2019
NPL will work with the IAEA on the translation of the reference database from Task 3.7 to the IAEA web pages (Human Health Campus). The IAEA has agreed in principle to host the open-access database of test images and NPL will engage with the IAEA and will develop suggestions for the promotion, advertisement and adoption of the reference database in the MRT community.		
Currently active tasks and activities (WP5)		
	Discussion of any upcoming tasks in WP.	
16.30 – 17.30	[Breakout session WP3] Discussion of A3.1.5 comparison of simulated and measured images *Chair: Lara Struelens*	
Wednesday 5th April 2017		
09.00 – 10.00	Individual WP meetings if required	
10.30	Start of workshop	