Final publishable summary report:

Realising the European Network in Biodosimetry

Proposal acronym: **RENEB**

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CONTENT

1. EXECUTIVE SUMMARY

A European network of biological and physical-retrospective dosimetry “RENEB” has been set up which has the capacity and capability to significantly contribute to European Radiation Emergency Preparedness and to Radiation Protection Research in Europe. The network is based on three pillars, 1) the OPERATIONAL BASIS which provides capacities in well established and approved methods used in biological dosimetry and physical retrospective dosimetry, 2) a basis for QUALITY ASSURANCE, EDUCATION & TRAINING comprising a programme, which is mandatory for network members and “candidates” and made available for non members and 3) a basis for further DEVELOPMENT by identification, evaluation and potential integration of new biomarkers of exposure and advanced techniques and also of new members. With these activities RENEB has considerably strengthened the ability of many Member States and of the EU as a whole to respond more effectively and rapidly to a major radiological event. RENEB maximizes the effort that can be deployed for early classification of individuals according to the received dose. This clearly helps to identify severely injured and exposed persons but also the so called “worried well”, people showing radiation symptoms due to mental stress and fear but without having received a relevant dose. Even in small accident situations it is necessary to reassure a huge number of people on an individual level to avoid distrust and further socioeconomic harm for a country and RENEB is able to provide the necessary infrastructure for this task. To enhance the effectiveness, RENEB is linked to global emergency preparedness and response organizations such as IAEA and WHO and cooperates with networks in Latin America, North America, Asia and African Laboratories.

The value of RENEB to support topics also outside emergency preparedness is evident. With the established strategies to guarantee consistent performance between the partner laboratories, the network has the ability and capacity to contribute to large scale research projects. This includes studies on the effects of low doses, group related radiation sensitivity, and epidemiological studies where sampling and handling of biological samples is included. RENEB drives the development and validation of new exposure markers, also with a special view to their applicability for addressing acute or protracted exposures as well as exposures dating back years or decades.

As a consequence, RENEB has established close links to the European radiation protection platforms, and to CONCERT- European Joint Programme. RENEB as analysis platform is of interest for the Emergency Preparedness Platform NERIS by adding preparedness in the field of individual dose estimation. It benefits MELODI and EURADOS by providing capacity for radiation research and specialized biomarker development. Concerning the latter, the radio-ecological Platform ALLIANCE will also profit from the network.

In addition, RENEB contributes to the crosscutting topics “E&T” by providing inter-comparisons, specialized courses and seminars open also to non partners and to “Infrastructure” by acting as analysis platform for radiation emergency preparedness and radiation research.

The success of RENEB so far is mainly due to the highly active participation of all partners, bringing together more than 60 scientists and technicians. To the end of the project the legal structure of the network is based on a Memorandum of Understanding, signed by 25 organisations from 15 EU countries plus Norway. Thus RENEB is a valuable, efficient, communicational and logistical infrastructure capable of coordinating and achieving any scientific programme in the biodosimetry field. According to the opinion of European and international experts from IAEA and WHO in the field of biodosimetry, to this moment the EU is left with the strongest and most versatile regional network in biological dosimetry and physical retrospective dosimetry in the world.

2. SUMMARY DESCRIPTION OF PROJECT CONTEXT AND MAIN OBJECTIVES

PROJECT CONTEXT

The purpose of RENEB is to use the existing knowledge and laboratory capacities, available in European countries to set up a European network of biodosimetry. A total of 23 organisations from 16 countries have joint forces to realize this project, in order to guarantee highest efficiency in processing and scoring of biological and personalised inert samples for fast and reliable results implemented in the EU emergency management. The established network will significantly improve the accident and emergency response capabilities and will contribute to decision making in case of a large-scale radiological emergency.

Over the last few years, the risk of a large scale radiological event has markedly increased, not only due to possible accidents in nuclear facilities but particularly as a result of an enhanced threat of terrorist attacks against key facilities or civil targets in major cities. According to the judgment of national and international security authorities, it is a question of when, not if, terrorist groups will have the know-how to use radiological devices ("dirty bomb" or Radiation Exposure Device (RED) to attack the public. It can be expected that such malevolent attacks will occur without any advance warning and will target as many people as possible in order to cause the maximum damage. Following such a scenario, the classification of persons according to their degree of injury and exposure will be one of the initial steps within the emergency management. While the triage of individuals will be done by physicians as the first step, biodosimetry can assist to subsequent medical treatments by giving an individual dose.

The situation during large scale accidents may differ, as often an advanced warning allows for precise dose surveillance within the disaster area and close monitoring of the distribution of released radionuclides. However, even in such case, the identification and assurance of the huge number of 'worried well' individuals, i.e. persons who are extremely distressed but have not actually received radiation doses likely to cause acute health effects, will be most important in order to prevent the healthcare infrastructure being overwhelmed and to avoid socio-economic harm.

In both contexts, biological dosimetry and retrospective physical dosimetry is an essential tool to estimate an actual absorbed dose without being influenced by temporal or individual variations in blood counts or confounding factors such as chemical agents or psychogenic reactions. Based on the results of biological and personalised physical dose estimation, people needing extensive medical care due to severe irradiation can be distinguish from people with injuries who have not received high doses of ionising radiation.

In such a large-scale radiological accident or terrorist incident the number of people that may need to be screened thus could easily exceed the capacity of a single or even a number of laboratories. As a consequence biodosimetry networking has been recognised as a sensible and important emergency response strategy in several regions of the world.

A network of six laboratories has been set up, under the patronage of IAEA, covering the whole of Latin America. The US Government was promoting a similar initiative in the USA. At national levels networks have been established in

Japan and Canada while in Europe a tri-partite memorandum-of-understanding for mutual assistance has existed since 2004 between France, Germany and the United Kingdom. However, this European agreement affects only serious radiological events in these three countries and only one laboratory per country is involved, so the total capacity is also extremely limited.

Currently, the best methods of biological dosimetry are based on the analysis of chromosomal damage (dicentric chromosomes, micronuclei and translocations) in peripheral blood lymphocytes and electron paramagnetic resonance in bone and tooth enamel (IAEA, 2001, 2002; Fattibene and Wojcik 2009). These methods have been validated in a number of small-scale radiation accidents and have been shown to be reliable tools to detect an absorbed dose of radiation with sufficient precision. A number of new biodosimetric methods have recently been introduced, such as premature chromosome condensation (PCC), fluorescence in situ hybridisation (FISH) and γ-H2AX foci (IRPA, 2008; Fattibene and Wojcik 2009). In addition, the EPR/OSL method on personal objects (portable electronic devices, chip cards), although strictly speaking not a biodosimetric method, has been shown to have the potential to be an excellent supplement especially if irradiation is heterogeneous (Fattibene and Wojcik 2009). As has been shown in the TENEB survey (Wojcik et al. 2010), one or more of these methods are established in many European laboratories, but what was lacking was networking, which would consolidate the standardisation and harmonisation of the assays. The TENEB survey (www.teneb.eu), completed in 2009, had identified and listed all existing European laboratories with considerable experience in biological dosimetry. Many of these have expressed their interest in a long term commitment to contributing to a European biodosimetry network. These laboratories have built the nucleus for the RENEB project.

References

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IAEA, 2001. Cytogenetic analysis for radiation dose assessment. A manual. IAEA Technical Report 405, International Atomic Energy Agency, Vienna, Austria.

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Wojcik A, Lloyd D, Romm H, Roy L. Biological dosimetry for triage of casualties in a large-scale radiological emergency: capacity of the EU member states. Radiation Protection Dosimetry 138:397-401, 2010.

MAIN OBJECTIVES

The aim of the RENEB CSA-CA was to establish a sustainable European network in biological dosimetry that will guarantee maximum efficiency in processing and scoring of biological samples for fast and reliable results and will be integrated into the EU emergency management structures.

The objectives of RENEB will be achieved by realising five key demands, which are fundamental for the network:

- To create an operational basis of the network, based on coordination of existing reliable and proven techniques in biological dosimetry and EPR/OSL dosimetry (Operational Basis of the Network).

- To ensure the network remains up-to-date by providing the basis for implementation of appropriate new molecular biology methods and expanding through integration of new partners (Basis to Develop the Network).
- To assure high quality standards for reliable dose assessment by implementing a framework for education and training activities, intercomparisons and quality assessment and management (Education, Training and Quality).
- To develop an operational infrastructure within the network and outward, a funding strategy and transform RENEB into a legal organisation (Establishing the Organisation Structure).
- To achieve visibility, accountability and sustainability of the established network within the European and global emergency preparedness system through dissemination of knowledge and a strong linkage of the network to national regulatory authorities and international bodies (Dissemination of Knowledge).

Operational Basis of the Network

The objective was to set up the "Operational Basis" of the RENEB network based on 6 biodosimetric tools, the dicentric assay, the FISH assay, the micronucleus assay, the PCC assay, the γ-H2AX assay and electron paramagnetic resonance/optically stimulated luminescence - EPR/OSL. While one or more of these methods were already established and used for dose estimation in many European laboratories, standardisation and harmonisation had to be performed to consolidate the techniques for networking. The work performed had to include inter-comparison exercises and an accident simulation exercise. This had to be done in close cooperation with "Development" and "Education, Training and Quality". It had to be complementary to the MULTIBIODOSE project in that it had to rely on MULTIBIODOSE guidelines as to which biodosimetric tool(s) should be best applied for a specific accident scenario.

Basis to develop the Network

The technological and logistical problems facing a coordinated approach to biological dosimetry in Europe are considerable. The level of expertise and experience is not homogeneous within the Community and harmonization of techniques, already used in biological dosimetry had the highest priority, while the network was established. However, the established network was not designed to be a static or closed consortium, the sustainability will rather depend on openness and the ability to react in a flexible way towards new situations. This implied the awareness of new technological developments as well as dealing with the loss and gain of network members. It was a major goal of the RENEB consortium to actively identify potential new partners ("candidate partners") and promising techniques ("candidate techniques") already during the installation of the network. The aim was to support RENEB by developing a roadmap of how to identify, verify and integrate new technologies and members into the existing network. Specific procedures for attracting new members, had to be developed and active recruitment initiated.

Basis for "Education, Training and Quality"

In the event of an accident involving a large number of potentially irradiated people, the response kinetics of the network depends tightly on the efficiency of

all labs involved in the response, not only individually but also in coordination. The best operational conditions will result directly from the preparedness of the network before the event. Such provisions include homogenisation of procedures within the individual laboratories, maintenance of qualified staff, knowledge of the laboratory capacity in crisis situations and common training through implementation of periodic exercises.

The topic “Education, Training and Quality” was a significant component of the RENEB proposal, and has a large influence on the whole network, especially for the “Operational Basis” dealing with established biodosimetry assays, the “Basis for Development”, providing the basic principles to include new methodologies and new partners but also for the sustainability aspect of the established network. The applied quality standards had to be conform with international standards as ISO 19238 - Radiation Protection— Performance criteria for Service Laboratories performing Biological Dosimetry by Cytogenetics (2004) and ISO 21243 - Radiation protection — Performance criteria for laboratories performing cytogenetic triage for assessment of mass casualties in radiological or nuclear emergencies — General principles and application to dicentric assay (2008).

Basis to “Establish the Organisational Structure”

An important aspect of preparedness for mass casualty radiological/nuclear events at a national or international scale is the need for functional efficiency of the biodosimetry network. To be able to provide mutual assistance between many biodosimetry laboratories, well-established communication channels and logistic procedures to handle hundreds or more samples in an efficient and timely manner had to be assured. Besides the practical arrangements for exchange of information and transport of samples, an appropriate network structure and a legal basis had to be established. A basis was the existing Tripartite network of France, Germany and UK. This arrangement formed a nucleus that was adapted and expanded to an EU-wide networking structure, capable of providing assistance to all EU states, including those without a national capability. Of major concern was the development of strategies to assure a long-term sustainability of the network. This included the identification of funding options and the connection of the network to European radiation programmes.

Basis for “Dissemination of Knowledge”

Information about the RENEB project had to be given to the public and other interested parties. Contact and cooperation with other formal and informal networks and relevant organisations had to be established. Furthermore, dissemination of information about the development of the network through presentations of the RENEB project during the relevant radiation research and emergency preparedness meetings had to be supported.

State-of-the-art web pages by which RENEB can communicate with internal partners, as well as disseminate the activities of the network to the public had to be set up and attended. Also links to radiation protection organisations, national competent authorities in emergency preparedness and response, UN organisations like the IAEA and WHO and other international organisations, non-governmental organisations like EURADOS, and academic institutions had to be initialised. The RENEB web site, which was already set up during the contract period has also to be available after the end of the project.

3. MAIN S&T RESULTS/FOREGROUND

A network of biological and physical-retrospective dosimetry laboratories was established and linked to national and international radiation emergency preparedness networks and to the joint European radiation protection research program.

I. Operational Basis of the Network

In order to establish the operational basis of the RENEB network, 2 intercomparisons, one of them on a global level, and an accident simulation exercise were performed. The results confirmed the good and homogeneous performance of the RENEB laboratories and a most efficient shipment of samples within the EU. A virtual accident simulation exercise was performed over a period of 27 weeks. All partners were continuously trained in activating and responding to an alerting email about a fake radiation emergency and in managing large data sets. The repeated collection of information about the capacity of each lab gave an important insight to the state of preparedness of the network.

The following abbreviations are used: DIC = dicentric assay; FISH = fluorescence in situ hybridisation assay; MN = micronucleus assay; PCC = premature chromosome condensation assay; gH2AX = gamma H2AX assay; EPR = electron paramagnetic resonance assay; OSL = optically stimulated luminescence assay.

The intercomparisons were carried out separately for each tool, whereby one partner could, and in fact most did, participate in several comparisons. Most partners have several biodosimetric tools established in their laboratories, some of them were established thanks to the RENEB network which offered the possibility of learning new methods. A table showing the engagement of partners in the various tools is shown on the right. A number of EURADOS members also participated in the EPR/OSL intercomparisons.

Partner / tool	DIC	FISH	MN	PCC	gH2AX	EPR	OSL
BfS	■	■	■		■		
BIR/UULM	■	■	■				
CEA	■						
ENEA	■		■				
HMGU						■	■
HPA	■	■	■		■		
ICHTJ	■	■	■	■	■		
INSP	■		■				
IRSN	■	■				■	■
ISS						■	■
ITN	■		■		■		
LAFE	■						
LUMC	■	■	■	■			
NCRRP	■	■	■	■	■		
NCSR D	■			■			
NRIRR	■		■				
NRPA							
STUK	■	■		■	■		
SU	■		■				
UAB	■	■		■			
UGent			■		■		
UNITUS	■						
SERMAS	■	■			■		
Total:	19	10	12	6	8	EURADOS partner	

A table showing the biodosimetric tools established in each partner laboratory.

In contrast to the intercomparisons, the accident simulation exercise was not split into tools. On the contrary, each participant had to evaluate the dosimetric readings derived from every tool in an attempt to gain knowledge about the possibilities and limitations of each tool and learn how the results should be interpreted. The main aim of the exercise was however to test the procedure of activating the network and collecting large amount of data following a large-scale accident.

Both intercomparisons and the accident simulation exercise are described in more details below.

Intercomparison 1

The intercomparison was carried out independently for each tool. A table containing the details of each one is shown in the table below.

Biodosimetric tool	Content of the intercomparison
DIC	Part A: Telescoring. Manual scoring of dicentrics from images provided by BfS. Two galleries of images from cells irradiated with 1.3 Gy (Gallery A) and 3.51 Gy (Gallery B). Scored: 50 images per gallery. Reported: dicentric frequencies and doses estimated based on own calibration curve. Part B: Blood irradiated by BfS and sent to all participants of DIC. Doses: 0 Gy, 0.94 Gy, 3.27 Gy and 4.75 Gy mixed 1:1 with control blood (partial body exposure simulation). Reported: dicentric frequencies and doses estimated based on own calibration curve. Only manual scoring. 50 cells scored per dose.
FISH	Blood irradiated by UAB and sent to all participants of FISH. Dose: 2 Gy. Participants used their own FISH cocktails and calculated genomic translocation frequencies. Reported: genomic frequencies of total translocations and doses estimated based on own calibration curves (in some cases for dicentrics).
MN	Blood irradiated by BfS and sent to all participants of MN. Doses: 0 Gy, 0.94 Gy, 3.27 Gy and 4.75 Gy mixed 1:1 with control blood (partial body exposure simulation). Reported: micronucleus frequencies and doses estimated based on own calibration curve. Some partners used manual scoring, other fully automatic or semi-automatic. 500 cells scored per dose.
PCC	Part A: Scoring of PCC from images provided by LUMC. 10 images were scored per dose: 0, 1, 2, 4 and 6 Gy to set up calibration curves. Part B: Blood irradiated at NCSRD (Demokritos) with 0, 0.5, 1, 2, 3, 4, 5 and 6 Gy, PCC slides prepared and sent to partners for analysis of PCC. 100 cells per point were analysed. Part C: Blood irradiated at NCSRD (Demokritos) with 2 and 4 Gy, mixed 1:1 with control blood. PCC slides prepared and sent to partners of PCC for analysis. 100 cells per point were analysed.
gH2AX	Part A: Telescoring. Blood irradiated by PHE with 0, 0.5, 1, 2 and 4 Gy and fixed for foci scoring after 4h or 24h. Images sent to partners of gH2AX who scored them manually or automatically. Part B: Cell scoring. Isolated lymphocyte samples were irradiated by PHE with 0, 1, 2, 3 and 4 Gy incubated for 4h or 24h and sent to partners of gH2AX who detected foci and scored them manually or automatically. Partners with existing calibration curves scored only 2 and 4 Gy samples.
EPR	Part A: Uniform samples. Samples of bulk glass from 3 smartphones of the same model were irradiated by IRSN with 0.8, 2, 4 and 10 Gy for the calibration curve and with 0.9, 1.3 and 3.3 Gy for the blind test. Samples sent to partners of EPR (including selected EURADOS members). Part B: non-uniform samples. Glass from 9 smartphones of the same model were irradiated separately with by IRSN with 0.8, 2, 4 and 10 Gy for the calibration curve and with 0.9, 1.3 and 3.3 Gy for the blind test. Samples sent to partners of EPR (including selected EURADOS members)..
OSL	Smartphones of the same model were irradiated by IRSN by 0.3, 1.7 and 3.3 Gy. Mobile phones sent to partners of EPR (including selected EURADOS members) who performed OSL on resistors in “triage mode” and “full mode”.

The overall results showed that the vast majority of the partners correctly estimated the radiation doses. The first intercomparison was followed by a round of training, where partners could new learn new techniques and train those techniques, which required improvement.

Intercomparison 2

Similarly as the first one, the second intercomparison was also carried out independently for each tool. The content was different, moreover several RENEB candidate partners participated in the DIC and MN comparisons and partners from outside the EU participated in the DIC and MN comparison. These partners were:

RENEB candidate partners (DIC and MN):

Army Medical and Veterinary Research Center, AMVRC, Italy

Central Laboratory for Radiation Protection. CLOR, Poland

University of Sevilla, US, Spain

Laboratori Nazionali di Legnaro, INFN, Italy

External partners from outside the EU (DIC):

iThembaLABS, South Africa (2 laboratories)

Asian Network , coordinated by NIRS, Japan (3 laboratories)

Canadian Network incl. US labs, coordinated by Health Canada, Canada (7 laboratories)

Latin American Network (LBD), coordinated by IIBCE, Uruguay (6 laboartories)
WHO BioDoseNet, coordinated by Health Canada, Canada (5 laboratories)

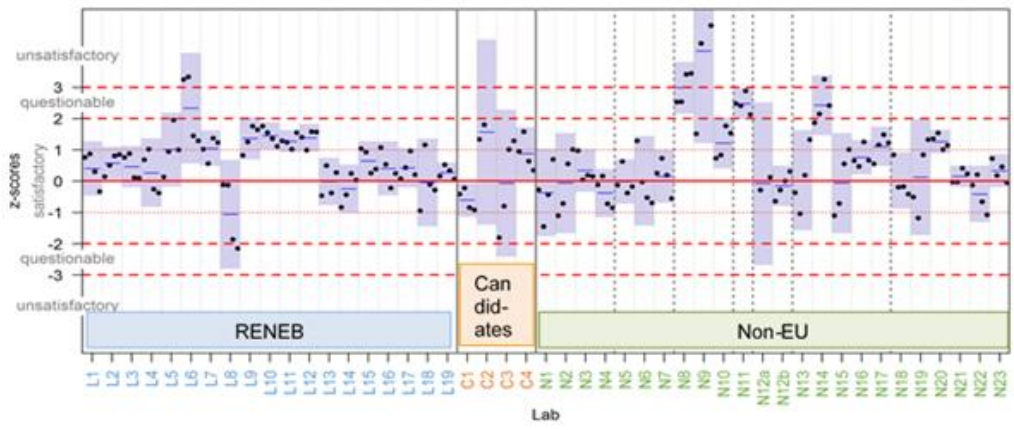
IAEA (RANET): 1 laboratory

A table containing the details of each intercomparison is shown in the table below.

Biodosimetric tool	**Content of the intercomparison**
DIC	Blood irradiated by BfS and sent to all participants of DIC. Doses: 0.85 Gy and 2.7 Gy. Reported: dicentric frequencies and doses estimated based on own calibration curve. Manual scoring and automated scoring. 200 cells scored per dose in total (50 cells per one of four parallel slides).
FISH	Blood irradiated by BfS and sent to all participants of FISH. Doses: 0.85 Gy and 2.7 Gy. Participants used their own FISH cocktails and calculated genomic translocation frequencies. Reported: genomic frequencies of total translocations and doses estimated based on own calibration curves (in some cases for dicentrics).
MN	Blood irradiated by BfS and sent to all participants. Doses: 0.85 Gy and 2.7 Gy. Reported: MN frequencies and doses estimated based on own calibration curve. Manual scoring and automated scoring. Manual scoring: 2000 cells scored per dose (500 slides per parallel slide from two blood culture). Automated scoring: 4000 cells scored per dose (1000 slides per parallel slide from two blood culture).
PCC	Part A: Blood irradiated by BfS and sent to all participants. Doses: 0.85 Gy and 2.7 Gy.40 cells were scored per dose. Part B: Two galleries of PCC images were prepared by NCSRD (Demokritos) and distributed among five additional RENEB participants who did not participate in part A. Also, a calibration curve was distributed and partners were asked to report the doses based on this calibration curve.
gH2AX	Whole blood was irradiated by PHE with 0.5 and 2.5 Gy incubated for 4h or 24h and sent to partners who detected foci and scored them manually or automatically. In parallel to whole blood samples lymphocytes were isolated and shipped together with whole blood.
EPR	A new analysis method of EPR spectra was tested. The method overcomes the problem of confounding influence of sun light on the irradiated glass samples. Spectra generated during the first intercomparison were re-analysed by the two RENEB partners IRSN and ISS without participation of EURADOS.
OSL	OSL was tested in a realistic accident exercise that was carried out within the CATO project. Participants received smartphone components exposed to various doses of radiation. Measurements and dose estimates were carried out analogously as during intercomparison 1.

Similarly as in intercomparison 1, the overall results showed that the vast majority of the partners correctly estimated the radiation doses whereby a slight improvement in dose estimate was observed. This was expected but is important to stress because it shows the value of training.

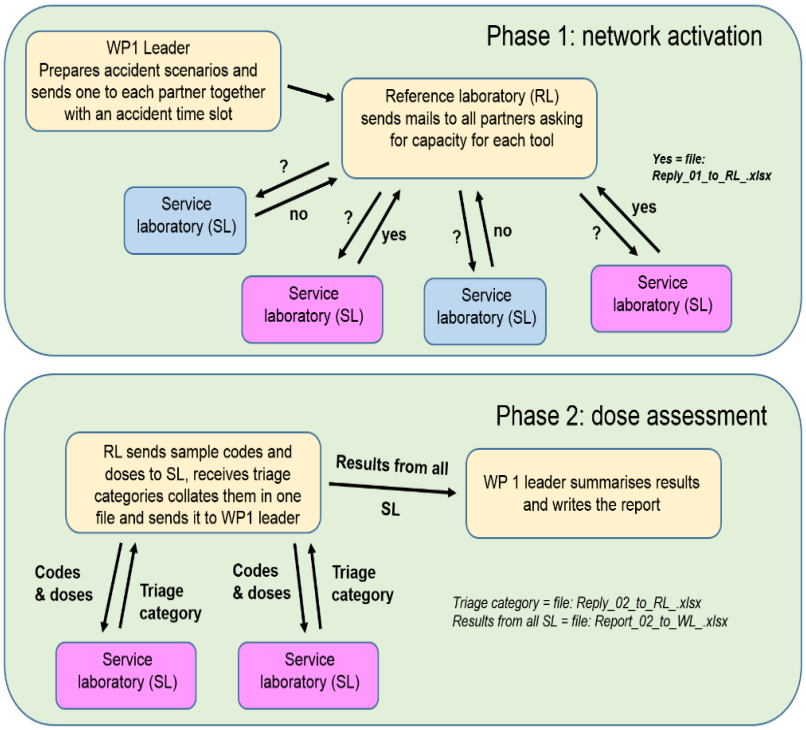
The importance of networking is also demonstrated by a comparative analysis of the performance of RENEB partners, candidate partners and non-EU laboratories. This is shown in the figure below, where the precision of dose estimate by DIC achieved during the second intercomparison is presented in the form of Z-scores. Each point represents the scoring of one microscopic slide and each vertical bar represents one laboratory. The high precision of dose estimate by the RENEB laboratories is clearly seen.



A number of additional analyses were performed within tasks DIC and MN to better understand the variabilities in scoring efficiency and precision of dose estimate between the laboratories. To this end participants were asked to cross-score slides prepared by other partners. Also, slides were analysed by the same image analysis system. The results gave interesting information about the sources of variability that can be utilised in future intercomparisons.

The accident simulation exercise

This subtask was a table top exercise. All assays included in the operational basis of RENEB have been combined to identify different exposure scenarios and perform a triage classification of individuals according to the received dose. The exercise was carried out in order to train the RENEB participants in managing potentially large data sets that will be generated in case of a major radiological event. Each participant received the possibility to activate the network by sending an alerting email about a fake radiation emergency. The same participant had to collect, compile and report the results obtained from all other participants. In this way each participant trained both the role of a reference laboratory (activating the network) and of a service laboratory (responding to an activation). The repeated collection of information regarding the capacity of each lab gives important insight into the state of preparedness of EU biodosimetric laboratories over a period of 27 weeks. A scheme of the exercise is shown in the graph to the right.



Scheme of the accident simulation exercise. File names refer to Excel files distributed among the participants.

The exercise was launched on 18th of May 2015 and ended on 6th of December 2015. There were 28 institutes participating in the exercise: 21 RENEB members, 4 candidates and 4 non-RENEB partners. One exercise was carried out per week. The number of laboratories taking part in each exercise varied, but was never below 64% of the total number.

The exercise was organised for the first time on such scale. Activating the network was based on e-mail exchanges only, because physical analyses of blood samples were done during two previous intercomparisons. Moreover, the aim was to test and train the procedures associated with activating the network in case of an emergency. Two types of laboratories were introduced: RL (Reference Laboratory) and SL (Service laboratory). Each week a RL activated the network by sending e-mails to all SL and asking them for help to analyse blood samples of exposed people. If a SL was

available, the SL team leader sent a response including the capacity of his/her laboratory. Next, the RL sent virtual samples to the available SL. Virtual samples were in fact Excel files with dosimetric information from all RENEB assays per an exposed person. Each file included 54 patient codes with 10 doses estimated by the following assays: DIC (man, auto), FISH, MN (man, auto), H2AX (man, auto), PCC, EPR and OSL. A general scheme of the exercise is shown in the image above.

Generally, the task of a SL was to return the information regarding the capacity of the SL (in terms of blood sample number) and to classify each patient according to given rules. The first rule was to triage the person as green (for doses less than 1 Gy), orange (between 1 and 2 Gy) and red (more than 2 Gy). Additionally, the SL was asked to estimate the exposure scenario. For this purpose 9 scenarios were introduced. The final decision about an exposure scenario was based on combining the information from all assays, even if the assay itself was not performed by the SL.

Capacity of the network.

The first task of a SL was to send the reply (a file called *Reply01_to_RL.xls*) to the RL about the availability to assist the RL with samples analysis. The file sent by a SL included also the information about the lab capacity. This is an interesting information because it reflects the capacity of EU members states to carry out triage Biodosimetry in case of a real emergency. The table below shows the results, stratified according to the tools:

Tool	No. of institutions	Mean no. of samples	Min no. of samples	Total no. of samples
DICs man	21	510 ± 70	353	13,703
DICs auto	8	400 ± 70	235	10,761
FISH	6	100 ± 20	25	2,772
MN man	10	150 ± 40	58	4,155
MN auto	6	240 ± 50	145	6,375
γH2AX man	3	1,600 ± 600	70	44,364
γH2AX auto	5	190 ± 60	90	5,228
PCC	4	50 ± 30	0 (2)	1,299
EPR	3	770 ± 60	700	20,723
OSL	5	500 ± 100	225	12,735
			Sum:	**122,115**

Capacities of the RENEB laboratories to carry out triage biodosimetry by different methods.

The information was collected during the time of the exercise and the variability reflects the actual fluctuations in capacities due to holidays, absence leaves, etc.

In summary, the results of the exercise can be regarded as a success. It was carried out in order to train the RENEB participants in managing potentially large data sets that will be generated in case of a major radiological event. This aim was achieved: each participant trained both the role of a reference laboratory (activating the network) and of a service laboratory (responding to an activation). The repeated collection of information regarding the capacity of each lab gives important insight into the state of preparedness of EU biodosimetric laboratories over a period of 27 weeks.

II. Basis to Develop the Network

In order to further develop the network a strategy was prepared to actively identify, evaluate and if appropriate integrate new partners and new techniques with potential for biodosimetry in RENEB. The recruiting strategy resulted in the application of 8 new laboratories who became RENEB Candidates and several new methods, including –omics technology and molecular-biological approaches, as well as some further developments of established techniques, that became Candidate methods. The spectrum of new techniques and the performance of new partners were evaluated, integration steps of Candidate partners and techniques were developed and implemented in close collaboration with E&T activities.

Principles for the identification, testing and validation of new technologies

Tools to attract and integrate new technologies

A four points strategy was designed and successfully applied to attract new candidate techniques in biodosimetry.

1) Attract new techniques through dissemination of RENEB at scientific meetings (posters, talks)
2) Attract new techniques through the RENEB website including a Reporting sheet for a first contact
3) Direct request to RENEB members to suggest new technologies
4) Literature search for new technologies in biodosimetry twice a year

For the integration of potential new technologies within the network a roadmap was elaborated. The workflow includes the following points (see Figure 1):

1) new methods in biodosimetry were suggested to RENEB through the official reporting sheet (D 2.1).
2) WP2 (in cooperation with WP1, 3 and EB) evaluates suggested methods under consideration of the following criteria (published application in biodosimetry, quality assurance and quality control procedures, assay capacities (samples per week), sample processing time (days to result)
3) candidates are invited to present their institution at a RENEB annual meeting
4) candidates are invited to participate in intercomparisons
5) the EB makes a decision

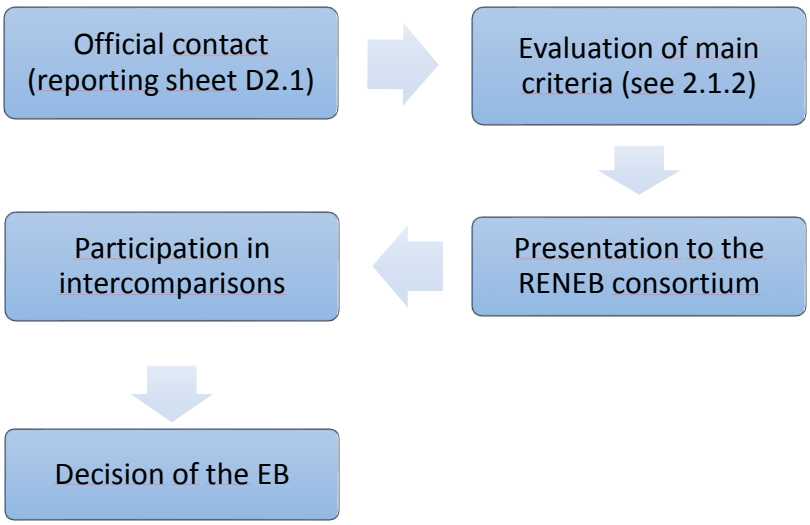


Fig 1: Suggested procedure for the decision making process about the integration of new methods

The developed tools were successfully applied to identify new candidate methods and several candidate methods for the improvement of biodosimetry were suggested to the RENEB consortium. A session at the 4th and 5th annual RENEB meeting was organized by WP2 to introduce these methods to the RENEB consortium (Table 1). Adjacently, two intercomparisons evaluating the capacity of new methods in biodosimetry were coordinated by RENEB (see table 2 and 3). In March 2015 an intercomparison of gene expression methods for biodosimetry was performed. Included institutions and methods are shown in Table 1. The results were already published (M. Abend et al., Examining radiation induced in vivo and in vitro gene expression changes of the peripheral blood in different laboratories for biodosimetry purposes). In December 2015 an intercomparison of new methods for biodosimetry was performed. Included institutions and methods are shown in table 2. In this intercomparison the performance of already in RENEB established assays and candidate methods is directly compared. Moreover methodological developments concerning methods already implemented in RENEB were suggested by RENEB members and presented to the consortium at the 3rd, 4th and 5th annual meeting.

Table 1: Presentations about new methods suggested to RENEB (4th annual meeting)

Institution	**Title**
M. Abend (Institute of Radiobiology affiliated to the University of Ulm, Munich, Germany)	Genexpression in biodosimetry – results of a recent intercomparision
Ralf Kriehuber (Forschungszentrum Jülich, Germany) -	Gene expression analysis in low- and high-dose irradiated PBL: Possible applications for radiation biodosimetry
R. Quintens (SCK/CEN, Belgium)	Gene/Exon expression microarrays for biodosimetry

K. Brozoska (Institute of Nuclear Chemistry and Technology/Centre for Radiobiology and Biological Dosimetry, Warswa, Poland) - "	Towards development of transcriptional biodosimetry for identification of irradiated individuals and assessment of absorbed radiation dose"
Fiona Lyng: (Radiation and Environmental Science Centre, Dublin Institute of Technology, Ireland):	Raman spectroscopy for biodosimetry
Christoph Badie (PHE, UK)	Genexpression for biodosimetry at PHE

Table 2: 1st RENEB intercomparision – new methods: assays and institutions

Institution	**Method**
BIR (GER)	qPCR
PHE (UK)	qPCR
FZJ (GER)	array
SCK-CEN (B)	array

Table 3: 2nd RENEB intercomparision – new methods: assays and institutions

Institution	**Method**
PHE (UK), BfS (GER), IRSN (France), IRBA (France), RSC (Lithuania)	dicentrics
PHE (UK)	gamma-H2AX
PHE (UK), BIR (GER), SCK-CEN (B), FZJ (GER)	gene expression
IRSN (F), ISS (I), HMGU (GER), PHE (UK) + 7 EURADOS partners: SURO, Czech Republic; University of Durham, UK; Lund University, Sweden; SCK-CEN, Belgium; University of Milan, Italy; Oklahoma State University, USA; Korean Atomic Energy Research Institute (KAERI), Korea	ESR/OSL
DIT (Ireland)	Raman spectroscopy

Table 4 methodological developments in methods already implemented in RENEB

Presenter	**Title**
Testa A., ENEA	3 x 1 assay: a potential tool for triage?
Sabatier L., CEA	Quantification of unstable chromosome aberrations scoring with Telo-Centro PNA FISH
M´Kacher R., CEA,	Detection and Automated Scoring of Dicentric Chromosomes in Nonstimulated Lymphocyte Prematurely Condensed Chromosomes After Telomere and Centromere Staining

Basis to identify, attract and integrate new network partners

Strategy to attract and to integrate new members to the RENEB consortium

To attract candidate members to RENEB a five point strategy was developed: 1) dissemination of RENEB at scientific meetings (bulletins, posters and presentations at national and international meetings) (e. g. IRPA, ERR, CONRAD) and emergency preparedness meetings (IAEA, WHO) RENEB website including a Reporting sheet (see D 2.1) for a first contact. 3) direct request to RENEB members to suggest new partners. 4) information (letter) of national health authorities from EU countries for contact laboratories involved in biodosimetry – not implemented yet (a prepared draft letter needs the consortium agreement). 5) screening of current publications by the task leader. Next interested candidates contact RENEB with the official reporting sheet (D 2.1) and WP2 (in cooperation with WP1 and 3) invites suitable candidates to participate in an intercomparison. At the same time personal and assay capacities information are collected (D 3.2). If suitable candidates are invited to present their institution at a RENEB annual meeting. Finally the EB makes a decision about the integration based on the criteria mentioned in 2.2.3

Considering the mentioned points the following flow chart was developed to decide about the integration of new members:

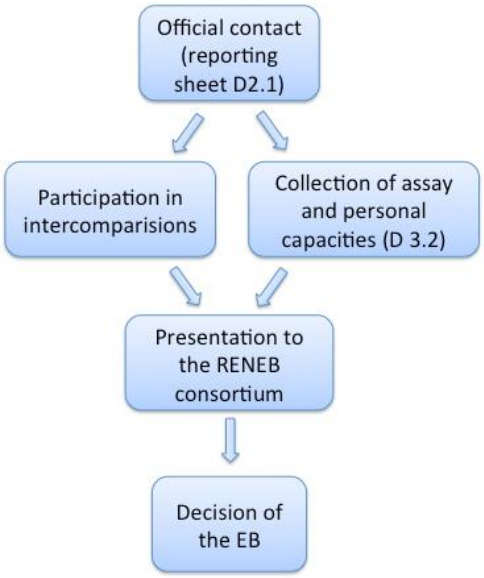


Fig 1: Suggested procedure for the decision making process about the integration of new members

Formal criteria for the integration of new partner in the network

In cooperation with WP3 formal criteria for the integration of new partners were elaborated. Main criteria are: 1) biodosimetric methods used 2) quality assurance and quality control procedures 3) assay capacities (samples per week) 4) sample processing time (days to result) 5) participation and performance in intercomparisons 6) staff status

Eight potential new members for the RENEB consortium were identified (see Table 1) and on the way to be integrated into the RENEB consortium.

Table 1: candidates to become RENEB members

Institution	MoU	Intercomparison	Presentation
BelgianNuclear Research Centre (SCK•CEN) Belgium	✓	✓	✓
LaboratoriNazionali di Legnano (INFN) Italy	✓	✓	✓
Army Medical and Veterinary Research Centre (AMVRC)*Italy	✓	✓	✓
Forschungszentrum Jülich (FZ Jülich) *Germany	✓	✓	✓
University of Sevilla (US) Spain	✓	✓	✓
Dublin Institute of Technology (DIT) Irland	✓	✓	✓
Radiation ProtectionCentre (RPC) *Lithuania	✓	✓	✓
French Army Biomedical Research Institute (IRBA), France		✓	✓

RENEB strengthened its capacities for a large-scale health surveillance by including of institutions outside of Europe into a virtual accident simulation assay (Table 2)

Table 2: institutions and biodosimetry networks outside Europe participating in the virtual accident simulation assay

Institution	Country
Institute of Occupational& Radiological Health,	Serbia
iThemba Labs,	South Africa
IIBCE contact person for the South American Network	Uruguay
Health Canada contact person for the North American Network	Canada
NIRS contact person for the Asian Network	Japan

In summary RENEB proved to be a dynamic and open network. The campaign to scout for new partners was effective with eight laboratories showing an interest to actively participate once the network is established (Table 1). All eight candidates participated in RENEB intercomparisons and presented their institutions to the RENEB consortium at one of the annual meetings. Further on seven candidates signed the memorandum of understanding (MoU) to confirm their interest in a participation in RENEB.

III. Education, Training and Quality

In order to harmonise biodosimetry procedures in RENEB and improve the performance of the partners various training activities were set up, including practical training exchanges. Special emphasis was put on Quality Assurance of the network. Seminars on metrology, statistics and QA&QM were performed, a QA&QM manual for RENEB was developed, and a long-term training programme established. An accident simulation exercise with focus on QA was performed to test and improve the link between national authorities and reference laboratories. A concept to integrate new members was established and applied for candidates. Informal contacts with European training structures/programs with a strong impact in this field were installed.

Education &Training activities

Practical training

Quality and efficiency training exercises were carried out to correct individual shortcomings and problems of networking. According to the needs of each partner, practical training was organised by various institutions. However, during the last project year practical training was also organized for partners, who wished to widen their laboratory assay spectrum by including another assay of the operational basis. The list is provided in the table below.

Assay	Year	Location	Training organized by	Institution trained
H2AX	2014	PHE Chilton UK	PHE	IST NCRRP
Micronuclei Dicentrics	2014	ICHTJ Warsaw, Poland	ICHTJ	INSP
FISH	2014	BFS Oberschleiss-heim, Germany	BfS, UAB and IRSN	BFS, BIR/UULM, ICHTJ, IRSN, LAFE, NCRRP, UAB
PCC	2014	LUMC Leiden, NL	LUMC	ICHTJ, NCRRP; NCSRD; STUK; UAB
Training on new TL (on glass and electronic comp)	2014	ISS, Italy	ISS	IRSN, HMGU
Training on new TL (on glass and electronic comp)	2014	IRSN, France	IRSN	ITN, PHE
FISH	2015	UAB	UAB	IRSN
PCC	2015	NCRSD, Greece	NCRSD	BFSx2, CEAx2, PHE, NRIRR
TL on glasses preparations	2015	HMGU, Germany	HMGU	IRSN, ISSx2, PHE

Seminars

In addition to the practical training courses seminars on statistics, ISO standards and quality assurance and quality management were given.

A collective training course was organised at IRSN (France).19 participants have attended the seminar on statistics, quality and metrology. During the course, theoretical lessons were mixed with applied table exercises. This training course addressed topics related to the use of biological dosimetry in the member laboratories. The content of the course was considering 1) basics statistical aspects related to the establishment of dose-effect calibration curves and to dose estimation, 2) how a quality system is needed and will help in the traceability and management of the activity performance, and 3) particularly the practice and the respect of metrology.

In September 2014 more than 20 participants attended a seminar on QA & QM. During this seminar, a common QA &QM manual was discussed in order to build the specific QA&QM manual for each assay.

Training cooperation with European nuclear safety/radioprotection courses and/or international organisations practicing nuclear safety/radioprotection training

Informal contacts have been taken with some training structures in Europe (e.g. ENSTTI in France) and European programs developing a strong action in this field (e.g. MELODI and OPERRA). Periodic presentations have been done during European platforms meetings. Some representatives of these platforms attended the D-workshop in November in Brussels.

Quality assurance of the network

RENEB QA & QM Manual

A QA&QM program was jointly developed by the consortium. The purpose of this document is to define the use of the different biological and/or bio-physical assays as elements of the operational basis of the RENEB network. The document describes the performance requirements with reference to international standards. Part of the information in this document is contained in other international guidelines and scientific publications, primarily in the International Atomic Energy Agency's (IAEA) Technical Reports Series on Biological Dosimetry. However, the RENEB document expands and standardizes the quality assurance and quality control procedures, the criteria of recognition and the evaluation of performance, for the full range of assays. As such, the document is of primary importance for sustaining the credibility of the network partners and the readiness of the network to respond to requests from first responders, national and European authorities and R & D agencies.

Common QA&QM program for each method described in the operational basis.

Knowledge about the QA & QM program is also included as an essential part of the Education & Training activities under RENEB. It is expected that each laboratory participating in the network has to establish a QA & QM program relating to the operation of each of the bioassays used in the laboratory. The resulting homogeneity of practices will guarantee that dose estimates produced by network members will be comparable irrespective of the laboratories' organisation and the specific emergency scenario.

The RENEB QA & QM manual addresses:

1) The position of the reference laboratory, the solicitation and the organisation of the network in case of emergency;
2) the confidentiality of personal information, for the customer and the network's laboratories;
3) the laboratory safety requirements;
4) the radiation sources, dose rates and ranges used for establishing the calibration reference dose-effect curves allowing the dose estimation from assays, and the minimum resolvable dose;
5) the performance of sample collection and sample preparation by assay ;
6) the observation criteria;
7) the conversion into an estimate of absorbed dose;
8) the reporting of results;
9) the quality assurance and quality control.

To date, the following assays are used by several partners' laboratories within RENEB:

- Dicentrics
- Micronuclei
- Translocations by FISH technique
- Prematurely condensed chromosomes (PCC)
- γ-H2AX foci
- Electron spin resonance (EPR)
- Optically stimulated luminescence (OSL)

Specific QA&QM manuals of each of these assays are included in the QA&QM manual.

A questionnaire about general and technical organisation of the laboratories was addressed to RENEB members. Questions were focused on:

- ✓ Equipment checking
- ✓ Capacity of the lab
- ✓ Lab organization
- ✓ Qualification of staff to dose estimation (low and high)
- ✓ Sample transport
- ✓ Interpretation of results
- ✓ Periodic audit on the technique
- ✓ Characterization of the radiation source; written report
- ✓ Availability and use of the calibration curve; written report

A total of 17 laboratories have taken part in the query.

In conclusion, most of the RENEB laboratories are ready to manage a high number of biological samples immediately and most of them follow the quality assurance rules.

Despite the general good performance of the partner laboratories, some criteria have been identified, which could be improved.

- There is a deficiency of consumable stock management in some laboratories. It could be a problem in case of a mass casualty accident. This could be resolved by an agreement with the purchaser, if possible.

- There are only few laboratories that score the lymphocytes in total blood. However, this could be necessary in case of lymphopenia in order to put in culture only the lymphocyte after isolation of them by density gradient.
- All laboratories have to determine and write on the report the minimum detectable dose level.

RENEB long-term training programme

A long-term training program was developed to ensure adequate organisation of training for members for dose assessment in large scale accidents and to integrate new partners in a quality assured manner.

To reach and keep this quality standard in the performance of the laboratories several approaches have been applied and will be continued after the end of this project:

- Periodic intercomparisons on several assays (dicentrics, translocations, micronuclei, PCC, H2AX, gene expression, calibration sources, EPR, OSL);
- Training in reference laboratories, this has been done for the labs with a low level of qualification following intercomparison results but also when laboratories wanted to be trained on given techniques to widen the assay spectrum in the lab;
- Harmonisation through the RENEB QA&QM manual applied in all the laboratories within the RENEB network to guaranty a certain level of requirement regarding quality.

Accident simulation exercise with focus on QA&QM

A virtual crises exercise has been programmed. This subtask was planned to be carried out complementary to the accident simulation exercise, performed by the operational basis of the network. Within the accident simulation exercise, a virtual table top exercise has been organized to allow each laboratory to make hypothesis on the accidental overexposure scenario based on the results of the different bioassays. During this exercise the ability of one laboratory to coordinate an accident situation, to respond in emergency but also to activate the different satellite laboratories has been tested.

In the activation process, link between a local authority and each RENEB member has also to be tested.

A request for assistance was send on the 27th of November to the various authorities. Some addresses were detected as not correct. These addresses were updated and the message was sent again to the concerned authorities the following week.

The major conclusions were:

- The delays of response are good
    - 7 countries within the day
    - 3 countries within 2 to 12 days
    - 3 countries did not respond, all of them used a personal address rather than an institutional ones (for them it was not send again) ;
- Some countries did not answer after the first mail but after the second one;
- A new test will be conducted for France with a generic address.

It seems that the authorities have correctly identified the national reference laboratory. Except in one country, the satellite laboratories have not been activated by the national reference laboratory but this was not clearly stated in this exercise.

The capacities range from 5 samples to 200 samples a week, reflecting the heterogeneity between labs. The total capacities are 575 samples in a week. One week is not sufficient to analyse the 1000 potential victims but this should be done within a month.

Not all the laboratories have reported the assay they will perform but this was not explicitly request. One lab has proposed to perform H2AX, which is not so relevant regarding the scenario (2 weeks ahead from exposure). One lab has reported a capacity using electronic devices.

In conclusion, the link between national authorities and reference laboratories has been successfully tested.

Weak points as wrong or personalized addresses have been identified and improved.

One major question is how RENEB partners will be officially activated.

In case, the IAEA will be in charge to handle the accident, the agency will contact the RANET-laboratories. However only 4 biological dosimetry laboratories are registered at IAEA RANET system therefore the majority of the RENEB laboratories could not be activated by this mean.

The RENEB laboratories have been encouraged to be registered at the IAEA RANET by their organization.

In a real case, due to the close contacts established within RENEB partners, the national referent laboratory of the country where an emergency situation has occurred will request directly the RENEB partners for assistance. This is also agreed between the RENEB laboratories and stated in the RENEB QA & QM manual (9.2 Use of the network for large scale exposures).

New member qualification

A decision table for providing information to the network on the competence level of the candidate partners and to inform these potential partners on the minimum requirement to join the network was developed.

A questionnaire was established to evaluate technical and operational capacity of new members wishing to integrate the network. This questionnaire will be used after the end of the project in order to integrate new members.

IV. Establishing the Organisation Structure

An operational communication structure within the network and between the network and emergency units was developed and established.

In order to guarantee a long term sustainability of RENEB joint research interests within the partners and with EU radiation research programs were identified.

A legal structure based on a Memorandum of Understanding (MoU) between the partners was established

Operational communication structure

In order to harmonise the course of action within the network between the partners and outside to national and international emergency units, critical factors with impact on efficient cooperation in emergency situation were identified and optimised. The following issues were addressed and realized:

- The contact data of RENEB organizations and contact persons were collected and are available on the RENEB internet platform.
- The list of national organizations responsible for the radiological emergency plans was completed and is available for each partner.
- The operational structure within the network and between the network and emergency units has been described. An operational communication structure with respect to fast exchange of information with health units is not set up yet, due to the different and complicated situation in different RENEB partners' countries and also because RENEB is not yet a legal network. However the information of healthy units were collated and are available for the RENEB partners. Also information about RENEB is provided to national health units.
- An operational communication structure with respect to fast exchange of information with the public was not established. This is a task for national and international radiation emergency organizations and authorities. The RENEB network will have contact to these organizations and authorities but will have no direct contact to the public.
- A guideline on the operational infrastructure with respect to the fast exchange of biological samples in an emergency situation, including taking and transport of samples has been developed.

Concepts for the sustainability of RENEB

In order to guarantee a long term sustainability of RENEB joint research interests within the partners and with EU radiation research programs were identified. The benefits of RENEB for European radiation research were outlined and links established to EURADOS, MELODI and CONCERT-EJP.

Integration in European Radiation Research Initiatives and beyond

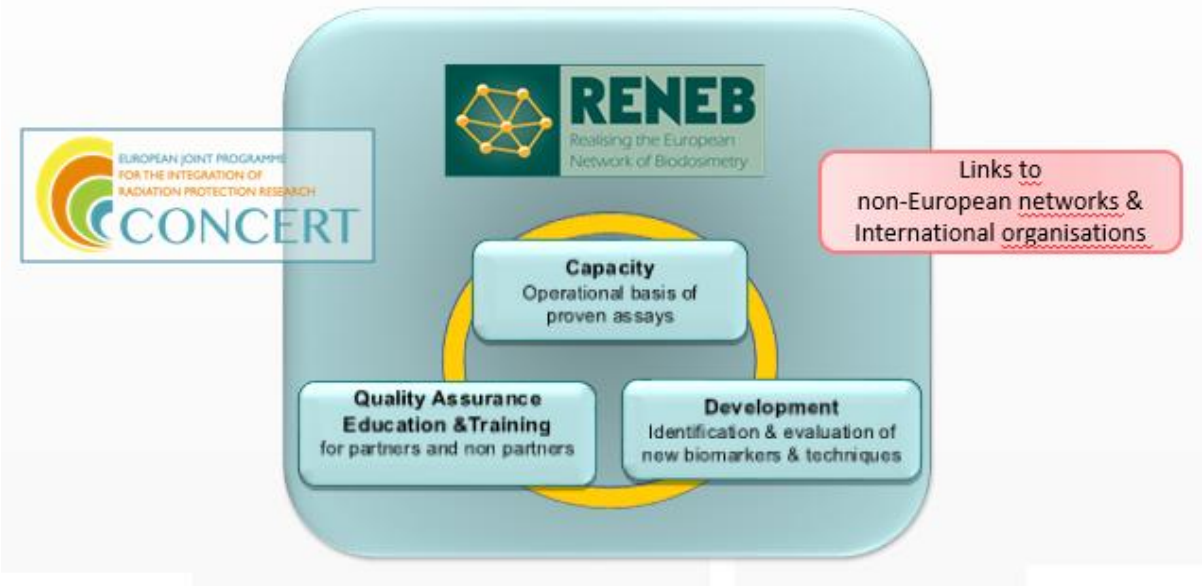
The integration status of the RENEB network in the European Research Area and possible further fields of interest have been surveyed. The capacities of the laboratories of RENEB network, and developments and harmonisation of methodologies in these laboratories can serve as a resource for the large research projects, and especially in existing and emerging European research projects and platforms dealing with effects studies in radiation research.

Now, at the end of the project, the RENEB network is well known by the radiation research community in Europe and beyond. Close links to the European Radiation Protection platforms, especially to EURADOS and MELODI have been developed and the integration status of the RENEB network in the European Radiation Research Area has been shown to be excellent.

The topic “Biodosimetry” is addressed in the strategic research agendas (SRA) of MELODI and EURADOS. Both platforms refer to the RENEB network and have explicitly included the network in their SRAs. . In the MELODI SRA it is stated, that “the use of RENEB for research purposes needs to be actively pursued and supported in future calls where appropriate”. Consequently the enlargement and sustainability of RENEB was included in the priority area for infrastructure. In the EURADOS SRA, RENEB is included as infrastructure for retrospective dose assessment in molecular epidemiological studies and follow up studies and also for dose assessment in emergency situations.

As a consequence RENEB was also included in “CONCERT-EJP”, the joint programming strategy for radiation protection research in Europe. The AIR² - Bulletins, published by CONCERT WP6 on a regular basis with the intention to introduce different types of infrastructures available in Europe, presented the RENEB network as an “analytical platform for emergency and scientific research” in its first issue from October 2015.

RENEB is also accepted as partner by international emergency and preparedness organisations such as WHO (BioDoseNet) and IAEA. Representatives of RENEB were invited to contribute to WHO REMPAN meeting (2014), WHO BioDoseNet Coordination meetings (2013, 2915), to IAEA 1st RCM on Strenghthening of Biological Dosimetry in IAEA Member States (2012) and to a technical regarding the development of a biodosimetry network in Asia, initiated by the IAEA and NIRS (Japan 2015).



RENEB SRA

A draft Strategic Research Agenda (SRA) for RENEB 2016+ was developed and priorities were identified how to proceed after the end of the project. This was a major step to support the long-term sustainability of the network and to facilitate the integration process in the European radiation research community.

Funding strategies

Financial issues and funding mechanisms are of utmost importance for the sustainability of a European network on biodosimetry. In the current European organizational framework, the creation of technology platforms and networks of institutions (laboratories, research centres, universities, national public bodies and in some cases companies) is encouraged by the European Commission and in a first phase, funded to some extend (such as RENEB) in order to develop its structure and to aggregate the relevant institutions and experts. However, in the medium- and long-term, such platforms and networks must be self-sustainable, not depending on funding from the European Commission. However, possible funding resources may come from European Union funded projects in different programmes (EURATOM, SECURITY, etc.). For a future operational + scientific platform there are different options for funding sources (fig. 1) identified but are not yet agreed to:

- Membership fees (500 - 1000 € / institution?) – baseline
- Partner in calls of EJP CONCERT
- Partner in other Horizon 2020 Calls (EURATOM, SECURITY, etc.)
- Intercomparison exercises (participation fee: ~1000-1500 € as is done by EURADOS)
- Workshops & Training Courses (fee to participate for RENEB partners)
- Annual Meetings with a registration fee (typical value 250 €)

Figure 1: Possible funding sources for the RENEB+ platform.

RENEB Memorandum of Understanding

A legal structure based on a Memorandum of Understanding (MoU) between the partners is established.

The objectives of RENEB are to improve the effectiveness of national and local approaches for preparedness concerning nuclear or radiological emergency situations by a sustainable and operational biodosimetry service platform with a high capacity and expertise in biodosimetry. Furthermore the network provides a robust and sustainable service to European authorities and interested stakeholders in terms of research topics in the field of biodosimetry, radiation biology, radiation dosimetry, medical science. It also maintains and improves know-how and technical expertise in biodosimetry for nuclear or radiological emergency response among all interested stakeholders.

In the frame of the project various legal options for the formal structure of the future network have been compiled and the most appropriate and practicable arrangements have been identified.

Overview of possible formal structures and arrangements:

Subject of international law:
An international organization that governs the legal relations between or among states or nations is called subject of international law. This kind of organization has a high political importance because it concerns the relationships between nations. Examples for international organizations / European organizations arranged in this way are IAEA, WHO, UNSCEAR etc.

National Legal entity:
A legal entity is an organization that has the legal capability of entering into a contract with another entity. Essentially, this status makes it possible for a properly incorporated organization to function in the same manner like an individual can, when it comes to enter into binding contracts for all types of services. BfS for example is not a legal entity and is represented by the Federal Republic of Germany therefore it is not possible for the BfS to enter into this kind of association on its one. It would be possible for a representative of a national office or public authority to enter the association as a natural person.
An example of a legal entity is EURADOS entered as an incorporated association into the Register of Associations in Germany and e.V. is annexed to its name (e.V. stands for „eingetragener Verein“)

Organizational form based on “Letter of intent”:
The term “letter of intent” or comparable organizational arrangements (for example memorandum of understanding - MoU, voluntary association) describe a consortium of two or more partners on the basis of mutual interests or common objectives

They are not organized or constituted as a legal entity. In the scientific society there are several examples of already existing networks using this kind of institutionalized form as a start to create a research platform on European or international level. Of course future legally more binding arrangements could be established on this organizational basis. In the following examples of associations are given using this type of arrangements.

Letters of intent	MELODI
Memorandum of Understanding	ERA, Trilateral Network (Cytogenetic Network in Biological Dosimetry)
Voluntary association	HERCA, NERIS, IABERD

The RENEB partners agreed that the most appropriate way to start the transformation of a timely limited project into a formal structure of a sustainable network is to sign a

legally not binding agreement in form of a Memorandum of Understanding (MoU) by as many partners and candidates as possible. This agreement is the fundamental basis to maintain the identity of the network after the end of the project and can be the basis for more binding structures.

A Memorandum of Understanding, adapted to the needs of the RENEB network was send to all RENEB consortium organisations and to new identified RENEB candidates for collecting signatures. Until the end of December 2015 the MoU was signed by 17 RENEB members and 7 RENEB candidates.

To the end of the project, the legal structure of the RENEB network is based on a MoU, signed by 24 organisations from 14 EU countries plus Norway and a further signature will be received in January 2016.

This provides an excellent basis for a further consolidation of RENEB.

Sustainability arrangements for RENEB 2016+

All objectives, included in Annex 1 of RENEB have been achieved within the runtime of the EU project. In 2015 some decisions have been taken about the future of RENEB and additional activities have been initiated which will continue after the end of the project. This was done by purpose to avoid the breakup of the partners after 2015.

1) The acronym RENEB will be maintained with a slight change in the long version:
   old name: Realizing the European Network of Biodosimetry
   new name: Running the European Network of Biological Dosimetry and physical retrospective Dosimetry
2) A special issue “Networking in biological and EPR/OSL dosimetry: the European RENEB platform for emergency preparedness and research” in the International Journal of Radiation Biology is in preparation, and will be published in 2016
3) Activities within CONCERT-EJP:
   - WP7 “E&T”: joint 2 weeks RENEB-EURADOS training course “ADORE” was developed and accepted for funding by CONCERT-EJP
   - WP6 “Infrastructure”: Preparing the STORE repository for RENEB with regard to E&T and QA activities and the management of large data in an emergency
4) A RENEB meeting is scheduled as satellite meeting during the Radiation Protection Week (RPW) in Oxford in September 2015
5) During the Radiation Protection Week a session is dedicated to RENEB and EURADOS
6) The transformation to an association is pushed
7) Contact points for RENEB 2016+
   - Operational Basis: SU
   - E&T and QA&QM: IRSN
   - Development: PHE
   - Coordination: BfS

V. Dissemination of Knowledge

In order to promote RENEB, information was made available on a public web page (www.reneb.eu) and three bulletins. RENEB was presented at national and international meetings focussing on emergency preparedness and on research. A RENEB extranet was created including a collaborative work space for all partners. Interaction with international organisations and national decision-making authorities was initialised and close contact with IAEA and WHO was established and fostered, as well as informal contacts with EC DG Energy. A demonstration meeting was held in Brussels and RENEB was presented to representatives of EU member states, EU radiation protection platforms and to persons, involved in radiation emergency preparedness in Europe.

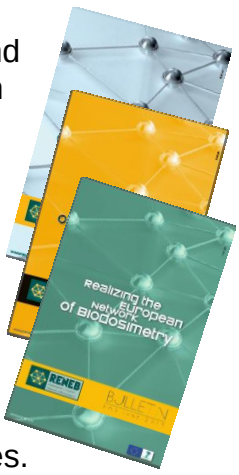
Dissemination activities

Major effort was put in dissemination activities to enhance the visibility of RENEB on a national, a European and global level. The awareness level of the network and broad knowledge about its yctivities and capability is essential for the sustainability of RENEB after the end of the EU funded project.

RENEB web page and Bulletins

In order to promote RENEB, the consortium created a public web page (www.reneb.eu) and published three bulletins.

The RENEB web page: www.reneb.eu was developed and opened on the internet by month 4th of the project, as planned. The web page consists of the open and the consortium part. The open web page was updated and administrated during the whole project period. The same applied to the password protected consortium part of this page. Also a functionality on the consortium part of the webpage was established, where WP leaders or task leaders published WPs related documents. A second password protected this function. Updates of the consortium part of the RENEB web was published when needed until February 2014. After February 2014, the internal communication platform took over the communication within the consortium. In the transition period, between the January 2013 and February 2014, all consortium related information could be find at both places, as the internal platform had been under testing period. The RENEB external web page has a link to internal consortium communication platform ONLY OFFICE.



RENEB published three bulletins that presented the RENEB network and progress of the work. In each of these bulletins there is a chapter with information about project events, publications and presentations of the project on international meetings. The bulletins are available on RENEB external web page under “News” chapter and distributed as paper copies. The bulletins were also available on the international radiation protection and radiation emergency response meetings. First bulletin was published in August 2012. The bulletin presents objectives and description of the organization of the RENEB project as the whole, the individual work packages, and RENEB consortium members. In total 2000 paper copies of the first issue have been published, and distributed among relevant international organizations and authorities.

Consortium members received also paper copies for national distribution. Second bulletin was issued in September 2013. The bulletin presents progress of the work in RENEB work packages with special focus to the results and conclusions from the inter-comparison exercises executed within the operational basis in the period between summer 2012 and 2013. In total 600 paper copies of the second bulletin were published, and distributed. The third bulletin of RENEB, published in the summer 2015, presents achievements of the network since the last bulletin, and summarizes the achievements of the RENEB work during 3.5 years of the project. In this issue, a special focus was put on the sustainability of the network. Moreover the bulletin addresses; results of exercises performed to improve the operational basis of the network, QA and QM, education and training actions, development of new methods and expanding the network in the future by including more European laboratories. In a separate chapter, the bulletin addresses the work done towards application of RENEB methodology in the future European Radiation Research program.

Paper, oral presentations, poster and sessions at international conferences

Up to now, consortium partners published 7 peer-reviewed, scientific papers with reference to the RENEB projects and a report. During the last year, papers were withhold by purpose to enable a joint publishing in a special issue dedicated to RENEB in 2016. Therefore, 18 more peer review papers are in preparation for publication. 16 of these papers will be published in 2016, in the special RENEB issue of International Journal of Radiation Biology. The title of the special issue will be:

Networking in biological and EPR/OSL dosimetry:
the European RENEB platform
for emergency preparedness and research

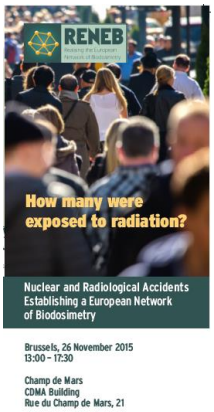
RENEB has been presented at national and international meetings focussing on radiological emergency preparedness, and on research with over 50 talks. On EPRBioDose conferences in 2015, a dedicated RENEB sessions was organized by the hosts.

RENEB partners contributed also to international and national conferences with over 32 posters and 59 oral presentations. In the first year of the project the majority of presentations have been posters. This changed and RENEB presentations were more and more accepted as talks. Remarkably, in the last project year “RENEB” was given the opportunity to have multiple oral presentations and posters during a same conference, to take over the chair of sessions and even to arrange particular RENEB session during the global EPRBioDOSE conference.

There were also numerous, other dissemination activities like organising seminars on statistics and QA and QM and open sessions on the annual RENEB meetings in 2014 in Valencia, including a press conference, and in 2015 in Rome.

Dissemination Event ”Nuclear and Radiological Accidents- Establishing an European Network of Biodosimetry

On 26th November 2015 the Dissemination Event ”Nuclear and Radiological Accidents- Establishing an European Network of Biodosimetry was held at the CDMA building of the EU Commission in Brussel.



The purpose of this meeting was to show the of another terrorist attack in Brussels during the week when the meeting was scheduled. As a consequence less people than announced attended the meeting.

Invited speakers presented talks on the role of biodosimetry in radiological emergency response in Europe and the necessity to maintain national biodosimetry laboratories. Subsequently consortium representatives introduced to biodosimetry and presented the activities of the RENEB laboratories to offer rapid and trustworthy individual dose assessment in a radiological large-scale emergency as well as the impact of the network on the European radiation research. Two feedback sessions, one on emergency preparedness and one for research activities, followed the presentations.

IAEA representative Eduardo Herrera Reyes moderated the session on emergency preparedness, while David Lloyd of WHO BioDoseNet moderated the session of research activities. Both moderators provided the summary reports of the sessions that can be find on the RENEB web page.

RENEB internal communication platform

A RENEB internal communication platform was established and provides a collaborative work space for all partners. The platform is a secure system allowing access through a portal via an https with SSL (Secure Sockets Layer) encryption making it impossible for any third party to enter the session and access private information. The free of charge storage capacity of Only Office is 2GB.

The work of establishing the platform was initiated by the survey of the requirements for the internal web platform. Based on the responses of the RENEB partners to a questionnaire in 2012, the following primary requirements for the website were identified: exchange of confidential consortium information, exchange of images for scoring, archiving RENEB documents, reports and presentations. The important consideration has been at the platform must be inexpensive and possible to use after RENEB project termination.

Several existing web services have been identified. The solution offered by Teamlab (later transformed to Only Office) was considered to be the best adapted to the needs identified by the RENEB members as it offered the required features and the possibility to be used at no cost by non-profit organizations.

The internal password-protected RENEB platform was launched on December 2012, and was presented to the consortium during the 1st annual meeting in February 2013. The platform is accessible only to registered users.

Until February 2014 there was a testing and training period the Consortium members have been encouraged to use the internal platform. In September 2013 the way forward for the transition of the internal section of the RENEB webpage to the OnlyOffice platform was drafted and the functionalities of the internal web platform were discussed. It was decided to reduce the number of functionalities to make the

internal platform more user-friendly. Based on conclusions from this meeting some adjustments were made in order to render the platform easier to use for consortium members.

During the RENEB annual meeting in Valencia in 2014 a training on how to use the platform was organised. The training was successful. The consortium members proved to be both able and motivated to use the software for internal communication. After the training for the use of the internal communication platform by RENEB members the frequentation of the website has increased significantly.

Only office RENEB platform now hosts: temporary galleries for inter-laboratory comparisons, documents (minutes from the meetings, presentations and posters on international meetings, publications, annual meetings materials. and project documents like DOW, Grant agreement, and Deliverables, financial and scientific reporting guidance etc.).

An important element of the future plans for RENEB is the maintenance of a robust internal communication tool. The OnlyOffice platform appears to be suitable for storage and communication of RENEB-related documents. For the storage and exchange of large galleries for inter-laboratory comparisons, large projects and emergencies, the STORE radiobiology database is considered to have advantages especially regarding its long-term sustainability. On the 4th RENEB annual meeting the STORE representatives introduced the database to the RENEB consortium and gave a tutorial on how to upload and retrieve the data.

Interactions with international organisations and national decision-making authorities

Interactions with international organisations and national decision-making authorities were initialised. The project has established close contact with IAEA and WHO as both organisations participate in the External Advisory Board for the project. These two organisations play an important role in international preparedness and response to nuclear and radiological emergencies. Informal contacts have been made with the EC DG Energy and their Radiation protection unit and with DG Humanitarian Aid and Civil Protection, Emergency Response Coordination Centre (ERCC).

The continual contacts with the above mentioned UN and EU organisations, has helped to promote the RENEB project, and to survey the international expectations to the emerging RENEB network.

A list of competent authorities responsible for emergency response or response to overexposures and their contact points was compiled to be at hand when needed in an emergency situation.

The project emphasizes the importance of sustainability of the network. In the process of ensuring sustainability through a national commitment to provide necessary resources over time, the recognition of the individual partner laboratories as national capabilities by competent authorities is important. The IAEA RANET is built upon official national capabilities nominated by the Governments. The project has therefore compiled a list of national contact points, through which the individual laboratories can be nominated as national capabilities to the IAEA RANET. RENEB organized Demonstrations event held in EU Commission premises in Brussel for representatives from the above mentioned national authorities, together with representatives of relevant international organizations. The aim of the event had been to present the

future of the RENEB and to demonstrate the added value, RENEB can bring to the established national and international capabilities in individual dose assessment.

At the end of the project the deliverable «Summary report on established international contacts» has been delivered to the Commission. The report gives description of each contacted organisation and addresses contacts between the given organisation and RENEB. The contacts (both formal and informal) as well as interactions with the following organisations had been described in the report: IAEA incident Emergency Centre and, WHO REMPAN and WHO BioDoseNet (implemented to fulfil requirements of International Health Regulations (IHR 2005), OECD/NEA Nuclear Energy Agency, Research Task Group on Ionizing Radiation Bio-effects and Countermeasures within NATO Science and Technology organisation; HERCA – the association of European radiation protection authorities. Additionally the report describes interaction and collaboration with International Biodosimetry networks, and European research platforms under EURATOM funding mechanism.

Potential impact including socio-economic impact and wider societal implications

RENEB has coordinated the consolidation of European laboratories that are experienced in biological dose estimation with the objective of initiating a European Biodosimetry network. At the end of the project, a biodosimetry network with a legal structure was established. The major socio-economic impact of RENEB is a significant improvement of citizens´ security through an improved emergency preparedness system. RENEB will be activated after a radiological emergency providing a quick and professional support to exposed and potentially exposed people. This activity will reduce the health consequences of a radiation emergency, both regarding the physical and mental aspects. A long-term effect will also be an increased social capital resulting from the feeling of trust towards national institutions that form the RENEB network.

More specifically, the impacts of RENEB can be described as follows:

- Emergency preparedness and management system including socio-economic impact and wider societal implications
- High quality research standards
- Maintenance of infrastructure in the field of research
- Maintenance of knowledge in the field of radiation research
- Development of models for long-term sustainability of biological dosimetry

Impact on emergency preparedness and management through fast and reliable individual dose estimation in case of a large scale radiological incident

The main impact of RENEB is the fast and reliable biological as well as EPR/OSL dose assessment following a radiological accident or terrorist attack involving a potentially large number of affected individuals. With the help of a biodosimetry network, implemented in existing emergency preparedness systems, it will be possible to significantly assist the emergency management by supporting medical decisions, estimating the stochastic radiation damage and also by identifying false positive exposures. It thus will also have a significant socio-economic impact by providing key scientific information about the long term damage caused by radiation and by calming the worried well. This especially will significantly reduce socioeconomic harm, as the fears and anxiety of people are respected and considered on an individual level.

Impact on high quality research standards

A prerequisite of co-operation in biodosimetry is the exceptionally high level of standardisation and harmonisation of the tools to achieve reliable and comparable dose estimates. This demands high level education and training activities as well as accurate and attentive quality assurance and quality management. The high degree of the RENEB quality assurance and quality management will thus improve the research activities of each single laboratory involved in the training programme. It will also be available for interested laboratories outside the network. As the quality standards

include also networking aspects between laboratories, joint research approaches will enormously benefit from RENEB as well.

Maintenance of infrastructure in the field of radiation emergency preparedness and research

The RENEB network was established with the aim to significantly increase dose reconstruction capacities in case of large-scale radiological scenarios by pooling resources and servicing needs. However the value of RENEB to support topics also outside emergency preparedness is evident. With the established strategies to guarantee consistent performance between the partner laboratories, the network has the ability and capacity to contribute to large scale research projects with the analysis of exposure biomarkers. This includes studies on the effects of low doses, group related radiation sensitivity, contribution to non-cancer diseases, and epidemiological studies where sampling and handling of biological samples is included. Accordingly, the RENEB network maintains infrastructure in the form of an analysis platform for emergency preparedness for radiation research.

Moreover, RENEB - in combination with the STORE database - maintains infrastructure for online-training activities such as image–based scoring of aberrations. Additionally, in radiological or nuclear emergencies, it offers secure storing and processing of large data for quality assured dose estimation in radiological incidents.

Maintenance of knowledge in the field of biological and physical retrospective dosimetry

RENEB ensures maintenance of competence of the actual and future network consortium by providing practical training in partner laboratories and giving seminars in quality assurance and management, statistics, dose estimation including uncertainties and other topics according to upcoming needs. While participation in the quality assurance programme of the network is mandatory for its partners, these training is also open to researchers outside the network. This ensures for the long term a maintenance of competence in the field of biological and physical retrospective dosimetry within the network and a quality assured dissemination of knowledge to the wider research community. This will also be the basis for a good integration of new skilled partners. In addition, RENEB in cooperation with EURADOS contributes to E&T activities in CONCERT by providing a basic training course in cytogenetic and EPR/OSL techniques for students and researchers, who are interested in biological dosimetry and physical retrospective dosimetry.

Impact on development of models for long-term sustainability of biological dosimetry

The long term development of the biodosimetry network is assured by implementation of concepts to actively scout for new techniques and integrate verified methods and new members in the network.

Due to the high degree of standardisation and harmonisation between the laboratories the network as a whole will contribute to various research areas, where huge amounts of biological samples have to be processed and analysed, e.g. in the field of low dose radiation effects and molecular-epidemiological studies. Thus, the connection of the biodosimetry network with its analysis platform to European research platforms (e.g. MELODI, EURADOS, NERIS, ALLIANCE) and the use of the RENEB capacity to process and analyse biological samples will be strong factor to assure the long-term

sustainability of the network. During the 3rd project period RENEB is already recognized as a “further to be developed infrastructure” and as such included in the European Joint Programming approach (EJP CONCERT, WP6 “Infrastructure”).

Moreover, a strong link between RENEB participants and national regulatory authorities is given by the nature of several partner institutions as governmental agencies or federal offices. Institutions like these will be able to guarantee the long term sustainability of the project´s product, the European biodosimetry network. Moreover, representatives from international bodies like the IAEA and WHO are included in the Advisory Board of RENEB and strong links to the WHO BioDoseNet, REMPAN and IAEA RANET have been established. This strong connection of RENEB with the national and international regulatory bodies will help to consolidate the sustainability of the network.

MAIN DISSEMINATION ACTIVITIES

RENEB web page

In order to promote RENEB a public web page (www.reneb.eu) was developed and updated during the whole project period.

RENEB Bulletins

Three bulletins have been published with information about the project.

The first bulletin was published in August 2012 and presents objectives and description of the RENEB project as the whole. A total of 2000 copies have been printed. The second bulletin was issued in September 2013 and presents the progress of work in RENEB work packages with special focus to the results and conclusions from the inter-comparison exercises. A total of 600 copies have been printed, less then the first bulletin as this edition had a smaller circle of readers. The third bulletin was published in the summer 2015. It presents achievements during the 3.5 years of the project, results of exercises, QA & QM and education & training actions, as well as development of new methods and expanding the network in the future by including more European laboratories. The work done towards application of RENEB methodology in the future European Radiation Research program was also shown. This time again 2000 copies have been printed as this bulletin was addressed to a broader audience.
The bulletins were given to RENEB partners to be distributed in their home countries and were spread at conferences, meetings and workshops.

Dissemination event ”Nuclear and Radiological Accidents- Establishing an European Network of Biodosimetry

The Dissemination Event ”Nuclear and Radiological Accidents - Establishing a European Network of Biodosimetry” was held at the CDMA building of the EU Commission in Brussel on 26th November 2015. The meeting showed the benefits and capabilities of the RENEB network for national and international emergency preparedness and response systems as well as for radiation protection research. The RENEB consortium sent invitation letters to representatives from national radiation emergency response and public health organizations in the European Union, from the European Commission in the area of radiation protection and emergency response, and from other international organizations involved in radiation emergency response

and radiation protection. In addition, representatives of the European radiation research platforms, MELODI, EURADOS, ALLIANCE and NERIS and took part in this event. In total, the meeting gathered 45 participants.

Invited speakers presented talks on the role of biodosimetry in radiological emergency response in Europe and the necessity to maintain national biodosimetry laboratories.

Subsequently consortium representatives introduced to biodosimetry and presented the activities of the RENEB laboratories to offer rapid and trustworthy individual dose assessment in a radiological large-scale emergency as well as the impact of the network on the European radiation research area. Two feedback sessions, one on emergency preparedness and one for research activities, followed the presentations.

IAEA representative Eduardo Herrera Reyes moderated the session on emergency preparedness, while David Lloyd of WHO BioDoseNet moderated the session of research activities. Both moderators provided summary reports of the sessions.

Paper, oral presentations, poster and sessions at international conferences

Up to now, consortium partners published 12 articles, thereof 10 peer-reviewed, scientific papers with reference to the RENEB projects and a report. RENEB partners contributed to international and national conferences with 32 posters and 59 oral presentations. Talks have been given at meetings, focussing on Radiation emergency preparedness, or Radiation Protection, or Radiation Research, such as Coordination Meetings of the WHO BioDoseNet, WHO REMPAN meetings, IAEA meetings, NATO Symposium HFM-223 First International Conference on Risk Perception, Communication and Ethics of Exposures to Ionising Radiation (RICOMET 2015), CONRAD meetings (Global Conference on Radiation Topics Preparedness, Response Protection, Research), NCT CBRNe Europe, meetings of the International Radiation Protection Association (IRPA), Meetings of the European Radiation Research Society (ERR), EPRBioDose conferences, meetings of the European Radiation Protection Platforms EURADOS and MELODI and far more.

In the first year of the project the majority of presentations have been posters. This changed and RENEB presentations were more and more accepted as talks. During the last two project years “RENEB” was represented at international key conferences by several partners with numerous talks, posters, and even a particular session, dedicated particularly to the RENEB network.

There were also numerous, other dissemination activities as open RENEB meetings as satellite meetings to conferences or annual RENEB meetings.

Overviews of all oral presentations, poster presentations and other dissemination activities are attached to the report.

EXPLOITATION OF RESULTS

Spreading excellence

RENEB has become key function in fostering collaboration across the wider radiobiological community in Europe and beyond. The training strategy has led to a high level of standardisation and harmonisation in the performance of the RENEB partners. Important factors have been the performance of training courses, such as training exchanges to improve practical lab performance and seminars on quality assurance, quality management and statistics. These activities have clearly enhanced

the quality standards of the RENEB laboratories. Such courses will be continued according to upcoming needs, especially when new staff members of partners or candidate partners have to be integrated in RENEB or when the laboratory has problems to estimate the correct dose in an intercomparison.

During the project, the courses and intercomparisons had been open to some extend also to non RENEB organisations and this will be intensified in the future. There have been several requests from non RENEB laboratories to be included in future intercomparisons and training activities.

RENEB also contributes to Education and Training in the frame of CONCERT-EJP. A joint RENEB/ EURADOS 2 weeks training-course "ADORE" (Application of cytogenetic and EPR/OSL Dosimetry for retrospective dose reconstruction) was developed and accepted for funding. In this course RENEB introduces interested students and researchers to biologically based dosimetry and EURADOS to EPR/OSL dosimetry. This course is complementary to specialised RENEB courses as it gives an introduction to the techniques while specialized RENEB courses impart expert knowledge in these methods.

The RENEB training programs is connected to European nuclear safety/radioprotection courses and/or international organisations practicing nuclear safety/radioprotection training, e.g. by inclusion of laboratories of IAEA RANET and WHO BIODOSE in intercomparisons.

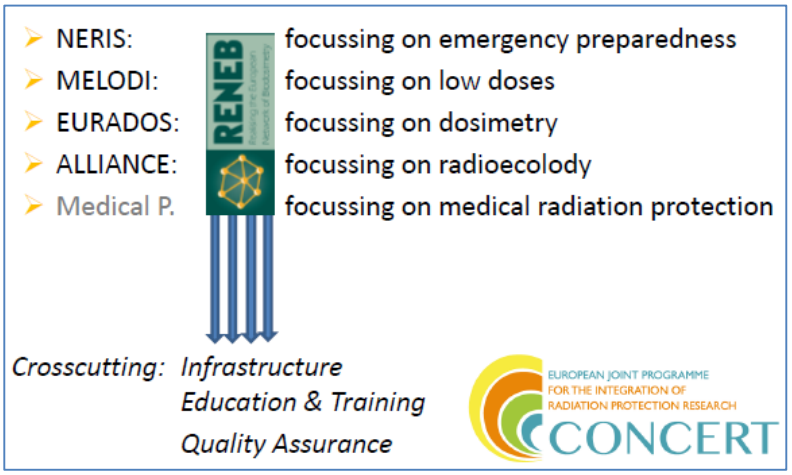
Developments of standards and benchmarks for quality assessment are openly accessible. The knowledge about the standards will be further spread at scientific meetings and through the website and scientists.

<u>Exploitation of results</u>

The results have not been exclusively exploited by RENEB partners but also by the radiobiological community and the emergency preparedness community.

Interaction with the EURATOM Framework Programme within HORIZON 2020

Expert knowledge related to biological dosimetry and physical retrospective dosimetry including awareness of shipment and storage is needed for emergency preparedness and for radiation research. Thus activities and capability of RENEB have been intensively communicated with the European Radiation Protection Platforms MELODI, EURADOS, NERIS and ALLIANCE. As a consequence RENEB was identified as crosscutting infrastructure by CONCERT-EJP and was presented as analysis platform for radiation emergency and research in the AIR² - Bulletin #1 - October 2015- RENEB of CONCERT. In the same manner, RENEB was identified as network with impact on high level Education, Training and Quality Assurance and is integrated in the CONCERT programme of training courses (see figure to the right).



Another activity was initiated together with the STORE database (www.storedb.org). To guarantee an efficient and safe handling of data and images a co-operation between STORE and RENEB has started end of 2015. As part of CONCERT WP6 “Infrastructure”, STORE will be prepared for RENEB 1) E&T and Quality Assurance activities within RENEB and 2) for safe and efficient handling and processing of data in case of large scale accidents/attacks.

Joint RENEB-EURADOS activities with regard to technical improvement especially in EPR/OSL techniques

Some exercises in EPR/OSL dosimetry have been performed in cooperation with EURADOS, e. g to test a new technique in physical retrospective dosimetry. This joint approach was a first test to evaluate if the new technique can become a candidate method in RENEB and, on the long run, can be implemented in the future network.

International Radiation Emergency Preparedness

RENEB accomplishments are of use for activities of International Radiation Emergency Preparedness Organisations as IAEA and WHO BioDoseNet. RENEB was invited to contribute to the “technical meeting about the Future of Biodosimetry in Asia: Promoting a Regional Network” , organised by the National Institute of Radiological Science (NIRS) in collaboration with the International Atomic Energy Agency, held at NIRS, Chiba, Japan in 14-18 September 2015.

Members of the WHO BioDoseNet have made use of the RENEB intercomparison to evaluate their performance in biodosimetry and are highly interested in further joint activities.

Members of the Latin American Network (LBN) received a confirmation about their successful performance in the 2nd RENEB intercomparison. This confirmation is valid for the maintenance of being a qualified laboratory.

Presentations and Publications

Results of RENEB activities have been spread as articles in peer reviewed journals, as poster presentations and oral presentations at national, European and international congresses and workshops.

During 2015, publications have been retained by purpose in order to publish a special issue on RENEB in the International Journal of Radiation Biology. This was agreed with the managing editor of the journal. The title of the special issue is “Networking in biological and EPR/OSL dosimetry: the European RENEB platform for emergency preparedness and research”. The special issue comprises 16 articles including “overview articles”, “results of the intercomparisons”, “lessons learned”, “Wider fields of contribution to emergency preparedness and infrastructure”, and “Conclusions” and will be published in 2016.

Transfer of knowledge to national institutions

Several RENEB partners are employees of national radiation protection authorities. Thus, dissemination of knowledge is transferred to the national authorities via person-to-person meetings. The same is the case for employees of hospitals, who transfer the knowledge about RENEB directly to medical centres.

ATTACHED DOCUMENTS:

- RENEB Final publishable summary report
- List of RENEB Beneficiaries
- Logo
- Bulletin1
- Bulletin2
- Bulletin3
- Demonstration event Flyer
- Demonstration event Programme
- Comments of the Advisory Board 2015
- RENEB MoU & signatures_31-12-2015
- RENEB SRA November 2015
- RENEB QA & QM Manual
- Reporting sheet new member
- Reporting sheet news techniques
- Questionnaire capacity of new members
- RENEB Reporting sheet future laboratory capacity
- RENEB partner LETTER to authorities
- AIR² - Bulletin #1 - October 2015- RENEB
- Dissemination activities: oral presentations
- Dissemination activities: poster presentations
- Dissemination activities: other activities
- Photo: RENEB_WHOBioDose_EPRBIODOSE_4-10-2015
- Photo: RENEB group final meeting December 2015