Key Radiation Projects at the World Health Organization (WHO)

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WHO recognizes the social and economic importance of the exploitation of radiation and nuclear technology and that exposure to radiation is a natural and unavoidable consequence of living in the Earth's environment. However, it is recognized that exposure to radiation, both man-made and natural, is detrimental to health.

Thus, there is a need to balance the benefits of the exploitation of radiation and nuclear technology against the risks of consequential exposure, in order to ensure a net benefit. Furthermore, it is necessary to ensure an equitable distribution of the risks and benefits. These needs can only be met through a sound knowledge of the distribution of exposures and of the effects of radiation exposure on health.

The WHO's Radiation Health Program is mandated by the United Nations to develop and implement evidence-based policies for Member States to reduce risks and protect human health from radiation, to provide intervention support and public health advice in case of accidents or terrorist situations, and to build national capacity and provide information.

While WHO has a mandate to deal with the health consequences of radiation exposures, the acquisition and evaluation of knowledge concerning environmental exposure to radiation is not the direct responsibility of WHO but lies within the UN mandated remit of the International Atomic Energy Agency (IAEA).

It is therefore vital that the two organizations work in close cooperation for WHO to be able to:

1- Evaluate the health impact of exposures; and
2- Where appropriate, advise on the instigation of mechanisms to control exposure through the setting of standards and guidelines for radiological practices and interventions in the case of unplanned or excessive exposures.

Within its Global Strategy for Ionizing Radiation and Public Health, WHO is developing a coherent and scientifically credible program at the international level that will enable it to adopt an independent position, based on technical excellence, from which it can:

1- Assist and advise member states dealing with the health consequences of environmental radiation exposures;
2- Protect the public health from undue risks related to the exploitation of radiation;

and

3- Provide leadership at the international level in developing strategies to protect public health.

With the limited resources available, programs need to be prioritized. RAD's priorities are based on reducing exposures in areas of highest exposure to population groups, responding to WHO's responsibility under UN conventions to provide emergency medical responses in the case of radiation exposures, and providing sound advice on health risks. The key activities at WHO can be summarized as follows:

1- International radon project started in 2005 to raise awareness at the public and political level about the hazards of radon exposure, to determine the extent of health burden from lung cancer caused by indoor radon, and to develop strategies for reducing the health burden. Exposure to radon represents the highest natural radiation exposure that people receive, its can be easily mitigated, and so should be one of the highest priority activities.

2- The Radiation Emergency Medical Preparedness and Assistance Network (REMPAN) is WHO's response to its obligations as a signatory to the UN Notification and Assistance Conventions. These conventions require WHO to provide emergency medical assistance to cases of radiation exposures, when requested by a Member State. This activity is coordinated with the IAEA.

3- Reviews of the health effects of major radiation exposures (e.g. Chernobyl, Tech River, Semipalatinsk). These reviews are conducted with the purpose of identifying areas where further research is needed, developing public health actions, and providing a sound scientific basis for recommendations on radiation health effects to Member States. These reviews are normally conducted in collaboration with UNSCEAR, ICRP and the IAEA. The most recent review on the health effects of the Chernobyl accident was conducted to provide reliable information to people most affected by the accident in Belarus, Ukraine and Russia.

4- Medical applications of ionizing radiation represent the highest man-made source of exposure, and so should be rated as

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a high priority activity. Recent scientific reviews have indicated the possibility of a high cancer detriment coming from the misuse of CT. This seems especially to be the case in Japan and possibly in rapidly developing countries such as China. This issue is currently being investigated jointly with the Essential Health Technologies Department in WHO.

5- Provision of information and advice on various topical radiation issues such as cosmic radiation, depleted uranium, high background area, etc

This presentation will provide further details of current and future activities of the Radiation and Environmental Health Unit. The position of the radiation unit within the overall structure of WHO is in the Sustainable Development and Healthy Environments (SDE) cluster, which is effectively within the Health and Environment cluster of the WHO (Figure 1). The radiation unit has become not only environmental health but a health technology unit including ionizing and non-ionizing radiation teams.

The radiation unit is now ordered based on risk factors. As for ionizing radiation, the most significant risk factor by origin (Table 1) is the natural background radiation, where radon is responsible for the highest level of natural exposure; therefore WHO has developed an international radon project. There are elevated background radiation areas around the world, such as in India, Iran, Brazil, China, etc.

Following meetings on the issue of high background levels, even

![WHO HQ Structure](image)

**Figure 1.** An overview of different clusters of WHO programs and the position of Radiation and Environmental Health Unit in WHO.

<table>
<thead>
<tr>
<th>Table 1. Ionizing radiation risk factors by origin</th>
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<tr>
<td>☐ Natural background radiation</td>
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<tr>
<td>• Radon, Highest natural exposure</td>
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<tr>
<td>• Elevated background radiation areas (e.g. India, Iran, Brazil, China, etc)</td>
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<tr>
<td>☐ Medical diagnostic applications</td>
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<tr>
<td>• Diagnostic X-rays (Highest man-made exposure): CT</td>
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<tr>
<td>• Others: Ultrasound, MRI, PET, etc</td>
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<tr>
<td>☐ Radiation emergencies, accidents and contamination</td>
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<tr>
<td>• Emergency responses provided by WHO (REMPAN) and the IAEA</td>
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<tr>
<td>• Chernobyl, Techa River and Mayak, Semipalatinsk, others.</td>
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<tr>
<td>• Depleted uranium</td>
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<tr>
<td>☐ Occupational exposure</td>
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<tr>
<td>• Nuclear workers (IARC study)</td>
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<td>• Cosmic radiation (Air crews)</td>
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up to 5-10 times higher, it was learned that there were not a sufficient number of people living in such areas to make a good statistical study. So now we are more relying on radon levels to gather more information on risk factors and health effects.

The second most important application is medical diagnostic applications, especially diagnostic X-rays responsible for the highest man-made exposure, particularly computed tomography (CT). There are also other diagnostic applications that we are going to study in the future, such as ultrasound, MRI, PET, etc.

The WHO has a UN mandate to participate in radiation emergencies, and response to accidents and radiation contamination problems. The emergency responses are provided by WHO (REMPAN) and the IAEA, such as those which have happened at Chernobyl, Techa River and Mayak, bomb test sites in Semipalatinsk, others.

Depleted uranium is another of these issues which created a lot of media interest. We also look at occupational exposures with our sister organization (IARC); they are working on key groups such as nuclear workers (an IARC study), and we are also interested in the health effects of cosmic radiation, which is important considering the occupational exposure of air crews, and the significance of air travel.

As for the research issues, we want to do a scientific assessment of health risks from radiation exposure. The global burden of radiation related disease is such a study that helps with gathering the information necessary for allocation of health care resources. The depleted uranium monograph and research is an example; after the Gulf war it was suggested by some to be able to lead to leukaemia and other cancers, and also suggestions by then the government of Iraq that the use of depleted uranium was causing birth abnormalities and other diseases.

We have since developed a monograph on the depleted uranium problem which is available on our web site and would like to do more research, though few scientists would volunteer to go to Iraq at this time. There is a key hypothesis that needs to be tested, and it is whether depleted uranium is an environmental risk factor.

We are also involved in other research, one of them being the tissues bank of Chernobyl children with thyroid cancer whose thyroid was subsequently operated and tissue removed and archived for further study. Research can help clarify what chromosomal events started the cancer. The tissues from this bank have been delivered to researchers worldwide for a number of years.

Research on the health effects in Chernobyl populations is another one; we recently had a Chernobyl forum held in Vienna and gained a huge amount of interest. The results show that 23 years after the accident, we still need to do further studies. The Chernobyl Forum however was designed not just to study the health effects but also to synthesize all the research results and make it available to the people most affected in the contaminated areas of Belarus, Russia, and Ukraine. Lots of information have been translated into Russian and provided to the governments along with recommendations on how to improve their health care systems that would lead to a higher level of health care.

The RAD program is now looking into having a Chernobyl Forum type model that could be used in, for example Techa River where there was a large contamination to the peoples drinking water, or the Mayak facility, and similarly at the Semipalatinsk bomb testing facility in the former Soviet Union (currently Kazakhstan) where a lot of people living in the surrounding areas were irradiated by the atomic bomb tests.

We also have a program looking at the health economic consequences of the major reactor accidents in which we are trying to use a model as occurred in Belarus to sum up all the economic and health costs that resulted from that major accident, and hopefully we can set a format to determine what the consequences could be if there were any other accidents. We can see an overview of RAD research issues in Table 2.

Table 2. RAD research issues

<table>
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<th>Scientific assessment of health risks from radiation exposure:</th>
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<tr>
<td>· Global burden of radiation related disease</td>
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<td>· Depleted uranium monograph and research articles</td>
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<td>· Tissues bank of Chernobyl children with thyroid cancer</td>
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<td>· Health effects in Chernobyl populations</td>
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<tr>
<td>· Assessments of other populations exposed to radiation (Maybe use a Chernobyl Forum model on Techa River, Mayak and Semipalatinsk)</td>
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<tr>
<td>· Health economic consequences of major reactor accident</td>
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The WHO’s role and responsibility in the UN Chernobyl Forum was to identify the established health effects and gaps in knowledge, and promote research, as a series of experts meetings on health effects and health care programs, and publication of Forum results. The Forum was mostly formed by three organizations, and WHO published the forum results on the health aspects while IAEA was responsible for environmental aspects and UNDP for the social and economic aspects.

In addition to the Chernobyl Forum, an International Chernobyl Research and Information Network has been specifically set up to provide counselling, advice and information to people affected in the Chernobyl contaminated territories. This is called ICRIN. WHO also provides expertise and representation on key administrative and scientific committees for ICRIN down to the local levels where the information can get to these people.

The Global Burden of Disease (GBD) is the quantification of health impacts caused by specific risk factors at population level, estimated for all regions of the world. Hereby, assessment of many health factors takes place and RAD is currently looking at the Global Burden of Diseases from ultraviolet radiation. Ultraviolet radiation actually produces more skin cancers than the rest of the cancers combined. This is a huge burden of cancer which however is very curable except for melanomas. We want to do a similar study for radon.

We try to estimate the burden of disease in six WHO regions and then sum them up to a Global Burden. This is actually very useful
because the objectives are to draw a picture on the health impacts from the risks associated with environmental and man-made sources of ionizing radiation. This assists countries to draw more precise national pictures of the disease burden caused by the ionizing radiation and thus provides a tool for monitoring progress in the management of the risk. It also allows you to identify where you have to put the available funds to have the greatest impact on reducing that burden. So it is overall a very useful tool.

Therefore the GBD objectives can be summarized as to draw a global picture of health impacts from risks associated with environmental and man-made sources of ionizing radiation (IR), to assist countries in drawing more precise national picture of disease burden caused by IR, to provide a tool for monitoring progress in environmental management, and to provide a tool for identifying intervention measures.

It must be pointed out that it takes a long time to see an impact of the program in environmental diseases. An example is the global warming problem that following the environmental protocols developed in Montreal, Copenhagen and elsewhere, it seems now that the ozone layer is gradually recovering. This recovery also shows the power of international cooperation on addressing a risk problem.

As for radon, we have a big program because the scientific literature is now suggesting that 10% of lung cancers are due to exposure to indoor radon, while people and politicians are not taking enough notice of this problem. There are tens of thousands of people dying every year from exposure to radon. The WHO has acted well at identifying the problem and raising the profile of this risk factor. Fortunately, mitigation is easily achievable but there is a need for creating an international focus to raise awareness on this issue. Therefore the International Radon Project has been developed with the following objectives:

1- To estimate the global health impact of exposure to residential radon
2- To create a global database of residential radon exposure
3- To identify effective measures to reduce radon's health impact
4- To promote sound policy options and mitigation programs to Member States
5- To raise public and political awareness about the consequences of exposure to radon
6- To monitor and periodically review mitigation measures to ensure effectiveness
7- And finally to provide annual reports

Mitigation programs are relatively simple as mentioned before and include the provision of policy options for national authorities, which are generally agreeable and most effective to reduce exposure to radon, the preparation of a draft of international limits on radon concentrations in collaboration with appropriate international and national agencies, and the submission of elements of model legislation that might be necessary, as well as others.

The International Radon Project was established as a 3-year global project with all key international and national partners participating, to identify and promote programs that reduce the health impact of exposure to residential radon. The results of the International Radon Project so far can be summarized as that the working plan of the project has been finalized, working groups have been formed and are working, and a fact sheet from WHO has been published.

Another topic is the medical diagnostic technologies that have been progressing rapidly. There is the possibility that some techniques are being inappropriately used particularly CT, MRI, and Ultrasound. The situation in Japan is worth consideration as a publication in the Lancet suggested that the excessive use of radiation in Japan was responsible for 3% increase in the cancer incidence.

There should be an analysis on the costs and benefits of such diagnostic modalities like CT which produces a large radiation dose. So CT should be appropriately used for clear indications. There is also fetal and paediatric CT where the estimates of the radiation doses are known but the consequences take a lot of time to be known. Therefore we believe WHO and other organizations should work together to develop good use guidelines for CT scanning usage. So the huge benefits of CT should and need to be balanced with the possible detriments. Dr. Shunichi Yamashita has been working with Dr. Ostensen to address the above concerns.

Similarly for magnetic resonance imaging (MRI), the technology has raced away from the science, where there is an understanding of the health effects up to 2 Tesla. Machines are now being presented at a power of 9 Tesla and we know nothing about the consequences of these high intensity magnetic fields, and yet they are being used not only on the patients but also on surgeons working in the magnetic field area. The consequences are profound as we are now having occupational exposure to doses that have not been examined in even short-term studies. We hope the WHO can help in this area because no national authority is taking responsibility on checking the progress and the appropriate use of diagnostic modalities.

Ultrasound is another issue where the technology has been expanding so rapidly that in many countries almost all pregnant women are exposed to ultrasound and an epidemiological analysis is almost impossible. Of course there is a huge benefit from this technology but we need to know what the detriments are likely to be. Nowadays pregnant mothers can go to an ultrasound facility and get what is called keep-sake images to put into their baby’s photo album. In WHO, we believe this is not the appropriate way to use medical technology.