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The Chernobyl Disaster: Global Impact

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The danger of self-destruction that has accompanied scientific and technical achievements in physics, chemistry, biology and medicine is perhaps the main paradox of the 20th century. While atomic power offers solutions to fields ranging from energy production and medical care, it also produced the disasters at Hiroshima and Nagasaki, and the largest industrial radiation accident in all history -Chernobyl.

The total radioactivity released at Chernobyl is estimated to be around 1.2×10^{17} Bq[1] with Belarus, Ukraine and Russia sharing the major impact from the radiation. In Russia alone, radioactive contamination occurred in a territory inhabited by 30 million citizens. Areas with a contamination density exceeding 1 Ci[2]/km2 of Cesium-137 is over 56,000 km2 are inhabited by some 3 million people.

Over the period from 27 April to mid-August 1986, about 116,000 members of the public were evacuated from their homes in the region around the Chernobyl facility. Increased amounts of radioiodine and radiocesium were registered in milk, meat, vegetables, and other foodstuffs at very large distances from the site. Radioactive material released to the atmosphere was widely dispersed and eventually deposited over a wide area of the surface of the Earth. Measurable levels of activity were found over practically the entire northern hemisphere.

The response to the accident was carried out by some 600,000 - 800,000 emergency workers known by the Russian term ‘‘liquidators.’’ In spite of the protective measures taken, a significant part of them received doses of the order of 250 mSv[3] and higher. Along with the residents of the mostly contaminated areas they form a risk group, where late and long-term health effects are anticipated.

Scientists from the former USSR and their colleagues from the Europe, the United States, and Japan were involved in the studies on the assessment and alleviation of the health consequences of radiation exposure immediately after the accident. It is necessary to develop

[1] A Becquerel (Bq) is a unit of radioactivity. Radioactive materials disintegrate over time. A Bq is a rate of 1 atomic disintegration per second.

[2] A Curie (Ci) is another unit of radioactivity. A Curie is equivalent to 3.7 x 1010 Bq.

[3] A millisievert (mSv) is a unit of radiation dose. It measures the amount of radiation damage that one receives when exposed to radiation. International guidelines limit emergency workers to 250 mSv per year. Members of the public are limited to 1 mSv per year

measures for protection and rehabilitation of the affected population, as well as to develop a possible course of treatment for future generations.

As a specific feature of the Chernobyl accident, the existence of two main radiological factors in affected population should be considered.

First, the radioiodine released delivered radiation doses to the thyroid gland. Iodine was absorbed into the bloodstream, generally by foodstuff ingestion and also by inhalation from the initial radioactive clouds. This material concentrated and accumulated in the thyroid gland resulting in damage to the gland. These absorbed doses were anticipated to be particularly high as compared with those for other organs, especially in children. The thyroid gland appeared to be a so-called "radioindicator of radiation action" in this period.

Second, the chronic intake of radionuclides, primarily cesium, over a period of many years has resulted in the continuous irradiation of internal organs with low doses. While the effects of these chronic exposures had been extensively studied earlier in animal experiments, this is the first time when science has been faced with the effects of such a vast range of low doses from incorporated radionuclides in man.

Medical consequences of the accident may be classified as follows:

1. Acute radiation effects: A total of 237 occupationally exposed individuals (nuclear plant personnel and fire fighters) were suspected to be suffering from clinical syndromes attributable to radiation exposure and were hospitalized. Acute radiation syndrome was diagnosed in 134 cases. Of these 134 patients, 28 died as a consequence of radiation injuries.

2. Longer term radiation effects: These effects include a highly significant increase in the incidence of thyroid cancer among those persons in the affected areas who were children or adolescents in 1986, and thyroid cancer and leukemia in liquidators.
3. Longer term health effects not directly attributable to radiation exposure: There are flare-ups of chronic diseases, various psychosomatic disorders, suicides and other similar complaints among the exposed populations.

The most pressing areas of investigation, posed by Chernobyl to scientists, can be summarized as follows:

1. epidemiological and clinical studies of long term effects induced by low doses of internal exposure;
2. investigations into the toxicology and pharmokinetics of radionuclides and the development of new methods for their elimination;
3. improved clinical diagnosis and treatment of psychological consequences among the exposed population and emergency workers;
4. countermeasures for radiation protection of the population, including a system of regular examination and medical rehabilitation of persons living on the contaminated territories.

In spite of the difficulties of the transitory period in Russia's economics, between 1992 and 1995 the Government delivered the financial support equivalent to $3 billion (US) for measures aimed at alleviating the Chernobyl consequences. The World Health Organization, the European Commission, the International Atomic Energy Agency, UNESCO, the governments of several countries, and international humanitarian foundations all provided scientific, technical and financial help for Russia, Belarus and Ukraine.

Chernobyl is a tragedy for people. At the same time, this tragedy has opened opportunities for more complete studies of the health effects of radiation and to develop techniques of assessment and prognosis that are important for all mankind. A significant portion of the electric power all over the world is producing at nuclear power plants. Large population groups are receiving increased radiation exposure due to the widespread effects of radiation sources in medicine, radiation accidents, and previous nuclear weapon tests. Investigation of the health consequences of Chernobyl has resulted in higher medical preparedness for possible future accidents, as well as in better understanding of the nature of the biological effects of ionizing radiation. These lessons and experience will be used by all mankind.

We are looking for new approaches to medical rehabilitation of persons affected by radiation as a result of the Chernobyl accident. That is why we support scientific research into detoxification in Russia. In addition, we strongly believe that the data obtained by our scientists will be also useful for other problems covered by this Conference.