

# **HEALTH CONSEQUENCES OF THE CHERNOBYL ACCIDENT**

## **RESULTS OF THE IPHECA PILOT PROJECTS AND RELATED NATIONAL PROGRAMMES**

### **SCIENTIFIC REPORT**

**International Programme on the Health Effects  
of the Chernobyl Accident**

**(IPHECA)**



**World Health Organization**

**Geneva 1996**

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## **EDITORIAL NOTE**

*The Scientific Report of the pilot phase of the International Programme on the Health Effects of the Chernobyl Accident (IPHECA) contains detailed scientific information provided by experts from Belarus, the Russian Federation and Ukraine, which has been reviewed by international experts. It is a text for specialists in radiation medicine, human radiobiology, dosimetry and radiation protection. The major conclusions of this document have been included in the separately published Summary Report which is intended for widespread distribution and is written in a style which can be understood by the informed general public.*

*One hundred authors of the Scientific Report have presented the results of their investigations carried out within the framework of IPHECA. But the huge amount of data related to the problem of the medical consequences of the Chernobyl accident and included in the Scientific Report nevertheless does not mean that this problem is now fully understood. The results obtained in the course of the implementation of the IPHECA pilot projects have improved the scientific knowledge concerning the effects of radiation accident factors on human health and have also provided additional information for the planning and development of further investigations.*

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## List of Abbreviations

|               |  |
|---------------|--|
| <b>AL</b>     | acute leukaemia  |
| <b>AbMc</b>   | antibodies to microsomal fraction of thyrocytes                                |
| <b>AbTg</b>   | antibodies to thyroglobulin  |
| <b>ADPS</b>   | automated data processing system   |
| <b>AED</b>    | annual effective dose  |
| <b>AG</b>     | agranulocytosis  |
| <b>AIT</b>    | autoimmune thyroiditis   |
| <b>AIHB</b>   | all haemoblastosis   |
| <b>ALL</b>    | acute lymphoid leukaemia   |
| <b>AnLL</b>   | acute non-lymphoid leukaemia   |
| <b>ARS</b>    | acute radiation sickness   |
| <b>ARW</b>    | accident recovery workers  |
| <b>AUDR</b>   | All-Union Distributed Registry   |
| <b>BEIR</b>   | biological effects of ionizing radiation                                       |
| <b>BelCMT</b> | Belarus Centre of Medical Technology, Informatics and Economics of Health care |
| <b>Bq</b>     | becquerel  |
| <b>BSSR</b>   | the Belorussian Soviet Socialist Republic                                      |
| <b>CA</b>     | congenital abnormalities   |
| <b>CDR</b>    | central dosimetry registry   |
| <b>CEC</b>    | Committee of European Community  |
| <b>CFE</b>    | (carries, filling, extracted) index  |
| <b>CHQ</b>    | general health questionnaire   |
| <b>CIS</b>    | Commonwealth Independent States  |
| <b>CL</b>     | chronic leukaemia  |
| <b>CLL</b>    | chronic lymphoid leukaemia   |
| <b>CML</b>    | chronic myeloid leukaemia  |
| <b>CRH</b>    | Central Rayon Hospital   |
| <b>CSF</b>    | colony stimulating factor  |
| <b>DAS</b>    | data analysis system   |
| <b>DB</b>     | database   |
| <b>DBQS</b>   | database querying sub-system   |
| <b>DEM</b>    | demineralization of enamel   |
| <b>DRC</b>    | Diagnostic Research Centre   |
| <b>E</b>      | erythraemia  |
| <b>EDR</b>    | exposure dose rate   |
| <b>EES</b>    | entry and editing subsystem  |
| <b>EIA</b>    | enzymimmunoassay   |
| <b>ERC</b>    | Endocrinology Research Centre  |
| <b>ESR</b>    | electron spin resonance  |
| <b>EURO</b>   | European Regional Office   |
| <b>FISH</b>   | fluorescence <i>in-situ</i> hybridization                                      |
| <b>FNAB</b>   | fine needle aspiration biopsy  |
| <b>FT4</b>    | free thyroxin  |
| <b>GSAS</b>   | general statistical analysis sub-system  |
| <b>Gy</b>     | gray   |
| <b>HB</b>     | haemoblastoses   |
| <b>HQ</b>     | headquarters   |
| <b>HRC</b>    | Haematological Research Centre   |
| <b>Hx</b>     | histiocytosis X  |
| <b>IAEA</b>   | International Atomic Energy Agency   |
| <b>IARC</b>   | International Agency for Research on Cancer                                    |
| <b>ICD</b>    | International Classification of Diseases                                       |
| <b>ICMDI</b>  | individual comprehensive medical and dosimetry investigation                   |
| <b>ICPH</b>   | Institute of Chemistry and Physics   |
| <b>ICB</b>    | Institute of Clinical Biology  |
| <b>ICRP</b>   | International Committee on Radiation Protection                                |
| <b>IDS</b>    | information downloading subsystem  |
| <b>IEPRI</b>  | Institute of Epidemiology and Prevention of Radiation Injuries                 |
| <b>IGS</b>    | information generating sub-system  |
| <b>IRS</b>    | information receiving sub-system   |
| <b>ITP</b>    | International Thyroid Project  |
| <b>IU</b>     | international unit   |

***Editorial Note, List of Abbreviations, Contents***

|                |  |
|----------------|--|
| <b>L</b>       | leukaemia  |
| <b>LDB</b>     | local database   |
| <b>LM</b>      | lymphoma   |
| <b>LUN</b>     | leukaemia of unspecified nature  |
| <b>MAE</b>     | Ministry of Atomic Energy  |
| <b>mBq</b>     | millibecquerel   |
| <b>MC</b>      | Ministry of Communication  |
| <b>MD</b>      | Ministry of Defense  |
| <b>MDS</b>     | myelodysplastic syndrome   |
| <b>MDTG</b>    | mean age doses to thyroid gland  |
| <b>mGy</b>     | milligray  |
| <b>MIA</b>     | Ministry of Internal Affairs   |
| <b>MM</b>      | multiple myeloma   |
| <b>MRRC</b>    | Medical Radiological Research Centre   |
| <b>MRTA</b>    | modelling of radionuclide transfer in the atmosphere                                 |
| <b>NCRP</b>    | National Committee on Radiation Protection   |
| <b>NHL</b>     | non-Hodgkin's lymphoma   |
| <b>NPP</b>     | nuclear power plant  |
| <b>NSHB</b>    | non-specified haemoblastosis   |
| <b>OAL</b>     | other acute leukaemia  |
| <b>OCL</b>     | other chronic leukaemia  |
| <b>OHI</b>     | oral hygiene index   |
| <b>OKSO</b>    | general record chart for examination (abbreviation originated from Russian langvage) |
| <b>ORC</b>     | Oncological Research Centre  |
| <b>PC</b>      | personal computer  |
| <b>PLI</b>     | plaque index   |
| <b>PRG</b>     | primary registration group   |
| <b>RAMS</b>    | Russian Academy of Medical Science   |
| <b>RDAS</b>    | rapid data analysis sub-system   |
| <b>RF</b>      | The Russian Federation   |
| <b>RI</b>      | radioiodine  |
| <b>RIA</b>     | radioimmunoassay   |
| <b>RIHBT</b>   | Research Institute on Haematology and Blood Transfusion                              |
| <b>RN</b>      | radionuclide   |
| <b>RR</b>      | relative risk  |
| <b>RSFSR</b>   | the Russian Soviet Federative Socialist Republic                                     |
| <b>RSMDR</b>   | Russian State Medical and Dosimetry Registry   |
| <b>SACRF</b>   | sub-system for analysis of competing risk factory                                    |
| <b>SCZ</b>     | strictly controlled zone   |
| <b>SDAS</b>    | stratified data analysis sub-system  |
| <b>SES</b>     | sanitary and epidemiological service   |
| <b>SISP</b>    | special IPHECA software package  |
| <b>SLDB</b>    | sub-local data base  |
| <b>SPRRE</b>   | sub-system for prediction of long-term radiation effects                             |
| <b>SRU</b>     | State Registry of the Ukraine  |
| <b>SSR</b>     | Soviet Socialist Republic  |
| <b>TAS</b>     | time trends analysis sub-system  |
| <b>TG</b>      | thyroid gland  |
| <b>TLD</b>     | thermoluminescent dosimetry  |
| <b>TMU</b>     | territorial medical unit   |
| <b>TPI</b>     | Treatment and Prevention Institution   |
| <b>TSH</b>     | thyrostimulating hormone   |
| <b>UCIT</b>    | Ukrainian Centre of Information Technology   |
| <b>UGEC</b>    | Unified General Examination Chart  |
| <b>UN</b>      | United Nations   |
| <b>UNESCO</b>  | United Nations Educational, Scientific and Cultural Organization                     |
| <b>UNSCEAR</b> | United National Scientific Committee on Effects of Atomic Radiations                 |
| <b>USI</b>     | ultrasound investigation   |
| <b>USSR</b>    | the Union of Soviet Socialist Republics  |
| <b>VCS</b>     | verification and correction subsystem  |
| <b>WBC</b>     | whole body counter   |
| <b>WHO</b>     | World Health Organization  |

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# **FOREWORD**



The Chernobyl accident, the most serious in the history of the nuclear power industry, cost the life and damaged the health of workers at the power plant and created the potential to adversely affect the health of many other people, e.g. accident recovery workers and populations who resided in areas which became contaminated with radioactivity. Apart from any radiation-induced effects, these people have also suffered mental stress and shock with adverse effects on their physical and mental health. Since the accident, massive efforts have been made by the governmental authorities to mitigate the effects, to provide diagnosis, treatment and rehabilitation to those affected and to investigate the effects on health which had occurred. Vast amounts of resources have and continue to be expended in supporting these efforts.

In 1991, WHO officially joined this effort through the establishment by the World Health Assembly of the International Programme on the Health Effects of the Chernobyl Accident (IPHECA). The objectives of this Programme were: to contribute to the efforts to alleviate the health consequences of the accident by assisting health authorities in Belarus, Russian Federation and Ukraine; to consolidate the experience gained from treatment of over-exposure and from various practical interventions and thereby improve medical preparedness for the future; and to acquire data in the fields of radiation epidemiology and medical response to disasters.

Because of constraints of resources and time, IPHECA initially concentrated on five priority areas, and pilot projects were developed for implementation in Belarus, Russian Federation and Ukraine for each: thyroid, haematology, brain damage in-utero, epidemiological registry and oral health (only in Belarus). They were regarded as pilot projects in that they were of limited duration and were designed to help develop and strengthen methods, instrumentation and expertise and thus pave the way for a longer term phase. A major role of the Programme over the last 3 years has been to strengthen the capacity of institutions by providing medical equipment and training staff in diagnosis and treatment.

The pilot phase was essentially completed by the end of 1994 and provides a good opportunity to undertake an assessment of the situation concerning the health consequences of the Chernobyl accident.

This publication is intended to fulfil a number of purposes. It provides an account of what was accomplished during the pilot phase of IPHECA. It discusses the protocols which were developed and used, summarizes the investigations which were carried out and reports on the instrumentation, supplies and training programmes which were provided. The publication also describes and discusses the results which have been obtained to date and identifies the still existing gaps in knowledge. In reporting the results, it is not possible or indeed useful to separate the work carried out within IPHECA and that being conducted by the three countries themselves, either prior to or in parallel with IPHECA in areas addressed by the pilot projects since they are very closely integrated. Throughout, there has been close cooperation with other international organizations engaged in mitigating or studying the health effects of the accident. This publication also gives brief summaries of such activities.

The major contributors to this publication are the scientific and medical staff of the institutes concerned with the health consequences of the accident in the three countries. They include the project managers, medical doctors and scientists who worked on the investigation and mitigation of the health consequences on a daily basis, many of them since the first days after the accident. Their firsthand experience and knowledge provides a most valuable contribution. The WHO Secretariat's role has been to structure, compile, review and edit this report, a task which has been assisted by international experts, particularly during the review meeting in Obninsk, Russian Federation, from 13 to 17 March 1995.

It is our hope that this publication will provide a good basis for further extension of our knowledge of the health effects of the Chernobyl accident, that it may assist the development of cooperation in this area between the Member States of WHO, and that in the final analysis it will be of practical use both to those who have suffered as a result of the accident and to those who may still be suffering.

*Dr Hiroshi Nakajima, M.D., Ph. D.  
Director General, World Health Organization*



II

## **STRUCTURE AND SCOPE**



The IPHECA Pilot Phase Report is in two parts: the main report, in which the administration of the programme, pilot phase protocols, data collection and analyses are given in detail in present issue; and a summary of the results in booklet form, published in 1995. Study of the main report will take time and most of it will require the reader to have specialist training, whereas the booklet will provide a rapid overview of the essential results of IPHECA. Moreover, the style of the booklet will make it readily comprehensible to a wide readership.

The results of research in the affected territories, which are given in Sections III-VI of this report, were submitted mostly by specialists from Belarus, Russia and the Ukraine. These results have already been presented in various forms: in monographs; journal articles; and the published proceedings of conferences and meetings, including those organized in the framework of IPHECA; as offprints; and as materials specially compiled for this publication. The WHO Secretariat analyzed the data submitted and published materials that it was able to locate independently, and then put together the separate contributions as a collective review. The Secretariat also undertook the drafting of section IV and VII, editing the Report and the compilation of the references and Annexes.

The original draft of the main report was discussed at a meeting of the national coordinators and leading specialists of the three States in June 1994. The second draft was translated into English, sent to the international experts concerned and discussed in September 1994 at a meeting attended by the principal co-authors of the reports from the three States and by international reviewers. Annexes I, II and III list respectively the main institutions that carried out the work reflected in the report, the co-authors of the report from the three States, and also the compilers, reviewers and editors from WHO and various countries outside the CIS.

Scientific and medical details are given in section V. Detailed consideration is given to the results in those areas of knowledge which were recognized as priorities in the pilot stage of IPHECA, namely the gathering and processing of epidemiological information concerning the accident, malignant diseases of the haematopoietic and lymphatic systems, diseases of the thyroid gland, manifestations of brain damage that could be due to in-utero radiation exposure, some stomatological diseases and physical and biological dosimetry. It should be noted that IPHECA supplements the national efforts and does not exist independently. A lot of attention has been paid to a review of the results of work carried out under the national programmes, both before IPHECA (section III) and after its establishment.

This Report is of necessity so multidisciplinary in nature that the inclusion of all the essential clarifications in the text would overload it with detail. Many such clarifications are therefore given in Annex X which is also of use in establishing equivalents for terms in Russian and English.

IPHECA is a continually developing programme. However, these changes must be checked against the concepts and activities which were originally defined. A description of IPHECA and its pilot projects, its standard protocols and the resolutions and agreements for the project are given as Annexes IV-VII.

Given that this report will be published both in English and in Russian, it is important to ensure that the two texts are as fully reconciled as possible. In particular, it has been deemed appropriate to be consistent in the expression of decimal fractions and large numbers. Thus one-tenth is designated 0.1 and twenty thousand is designated 20,000. Radiation units are given in the SI units. However, old radiation units are also used in a cases of reference to original data. Should any difficulty be experienced in understanding the terms and radiation units, the reader should consult Annex X.

