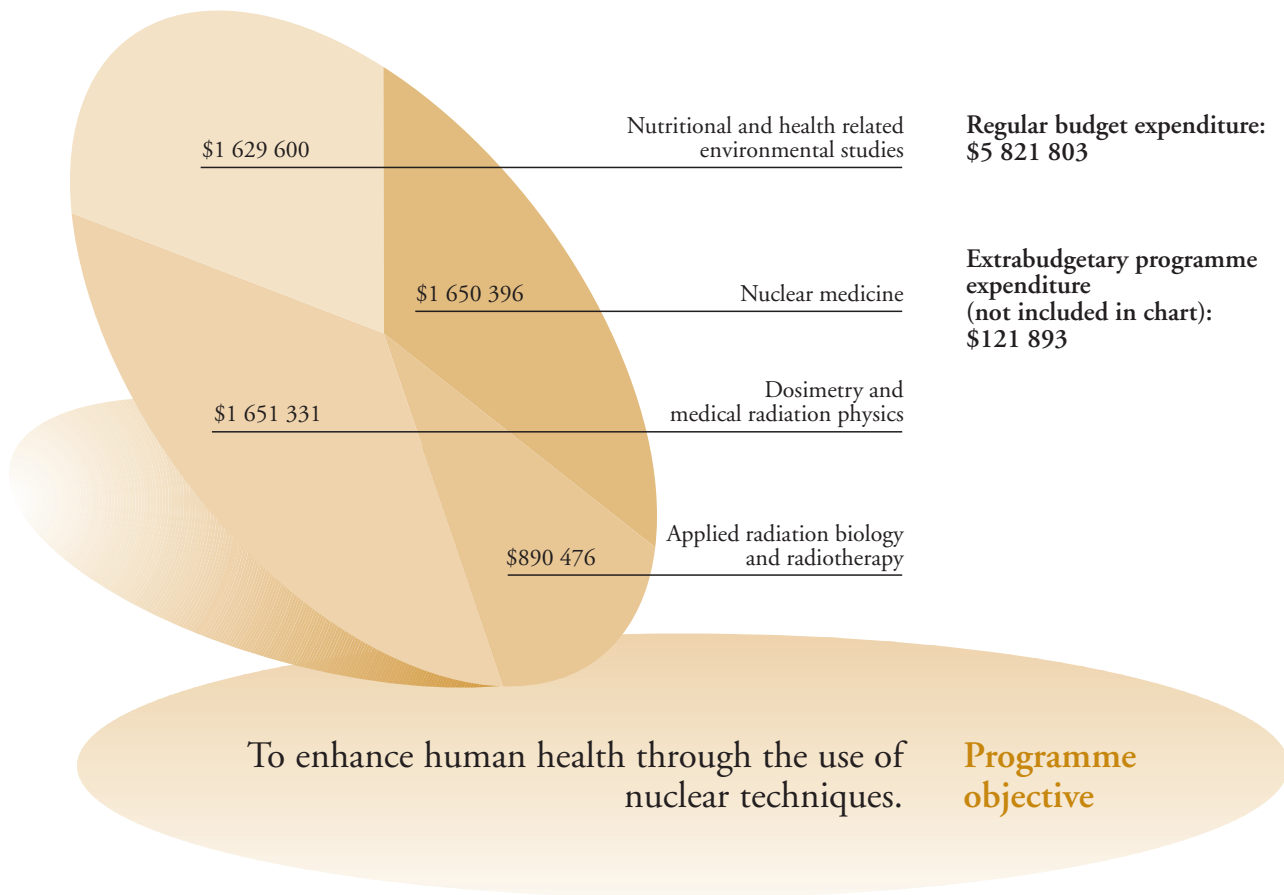


# HUMAN HEALTH



The programme on human health develops, evaluates and disseminates nuclear and related radiation technologies for application in the public health programmes of Member States. In nuclear medicine, activities dealing with infectious diseases were expanded, as were efforts to encourage the use of radioisotopes in molecular biology. New treatment methods in radiation therapy for cancer were also validated. In the field of dosimetry and medical radiation physics, a new project was implemented to disseminate traceable radiation measurement standards at the levels of dose delivered in diagnostic radiology procedures, including mammography. Quality audit postal services to Member States were extended to the verification of national standards used in radiation protection measurements. To take into account the recent development of new standards for radiation measurements, an agreement to develop a new international Code of Practice based on absorbed dose to water was reached with WHO and other international organizations. Work in nutrition and the environment focused on:

applied human nutrition research and assessment of nutritional status; environmental pollution monitoring and research; and radionuclide measurements in the terrestrial environment, water and air. Nutrition intervention programmes in developing Member States were monitored by using nuclear techniques through the Agency's technical co-operation programme. Biomonitoring of the environment using nuclear analytical techniques to measure the accumulation of element in lichens and mosses was another important area of activity.

## Nuclear medicine

Areas in nuclear medicine which received particular emphasis included development of diagnostic methods and the treatment of disease with open radioactive sources; optimization of the cost effectiveness of health

care; and the transfer of technology for the management of infection.

In the field of radionuclide based diagnostic techniques, a CRP on the diagnosis of genetic disorders using radionuclide based molecular methods was completed, resulting in the establishment of molecular screening techniques for the diagnosis of thalassemia, muscular dystrophy, fragile X syndrome and hereditary ataxia. In addition, prenatal diagnostic programmes were developed in the participating laboratories.

A CRP on the biological discrimination of hormone sensitive and insensitive breast cancer by radio-immunoassay was completed. The main conclusion was that radioreceptor assays for oestrogen, progesterone and epidermal growth factor receptors (a method developed by the Agency) are best carried out in specialized laboratories in developing countries. The immunoradiometric assay for the PS2 protein correlated well with oestrogen and progesterone receptors and is suitable for use in ordinary laboratories.

More than 150 existing analog gamma cameras were upgraded in Member States with the Agency's personal computer based nuclear medicine computer system.

As part of its effort to increase synergy with other international organizations, the Agency organized meetings with WHO during the Congress of the World Federation of Nuclear Medicine and Biology in Berlin in August–September. In addition to enhancing the awareness of the public in general and the medical community in particular, an exhibition was held during the congress highlighting Agency activities in nuclear medicine. The creation of a 'Cochrane Field in Nuclear Medicine' was also announced through which the Agency, the World Federation and The Cochrane Collaboration of the United Kingdom will bring out periodic reviews of major technical advances in nuclear medicine.

## Applied radiation biology and radiotherapy

In work directed at the radiobiological variation of conventional therapy, two new CRPs were initiated. The aim of one CRP is to investigate the use of regional hyperthermia, i.e. the technique of heating a tumour before or after treatment. The other CRP focuses on

studying a new protocol that would increase the number of radiotherapy treatments, or 'fractions', per week. The normal protocol involves one fraction per day, or five fractions per week. The CRP will study the implications of increasing this to six fractions a week. A project on heavy particle radiotherapy was discontinued and attention focused on the clinical problem of dose reporting for hadron (proton, neutron, boron neutron capture and heavy ion) therapy (jointly with the International Commission on Radiation Units and Measurements).

A CRP on radiation responsiveness criteria for human tumours as a determinant for therapeutic modality planning was completed. An important finding was that measurement of the lack of oxygen in a tumour can predict its resistance to radiation. Cell culture techniques to measure radiation sensitivity are too difficult to justify in terms of the prediction value.

An Advisory Group meeting which included manufacturers and participants from developing countries was held to develop cost effective devices to keep patients still and comfortable during radiotherapy treatment. This resulted in a practical new design for head and neck immobilization that has been ordered by about 50 institutions in 45 developing Member States through Agency funding, representing a considerable cost saving to the Agency and to end users.

## Dosimetry and medical radiation physics

A new project was implemented to disseminate traceable radiation measurement standards at the levels of dose delivered in diagnostic radiology procedures, including mammography. In addition, quality audit postal services offered to Member States have now been extended to the verification of national standards used in radiation protection measurements. For quality audits in external beam radiation therapy, efforts were made to improve the cost effectiveness of thermoluminescent dosimetry procedures and to resolve discrepancies when results from measurements in hospitals and Secondary Standard Dosimetry Laboratories (SSDLs) are outside acceptance limits.

The IAEA/WHO SSDL network presently includes 69 laboratories and 6 SSDL national organizations in 58 Member States. The network also includes 13 affiliated

members, mainly Primary Standard Dosimetry Laboratories (PSDLs), and 5 collaborating organizations. As a result of stricter demands on active participation by laboratory members, one SSDL was deleted from the network and five were listed as provisional members. Twenty-two national standards and reference ionization chambers were calibrated for Member States.

The traceability of SSDLs to the Agency is now verified regularly through quality audits using a transfer ionization chamber: 15 SSDLs participated in this programme. The performance of SSDLs is being monitored through a quality audit system based on mailed thermoluminescent dosimeters (TLDs): 88 radiation beams produced by cobalt-60 therapy units and medical accelerators supervised by SSDLs were checked through this service.

Laboratory procedures were developed for the calibration of ionization chambers at mammography dose levels. Seventeen mammography beam qualities were established for tube voltages between 23 and 40 kV, and a suitable reference ionization chamber has been chosen and is awaiting calibration at a PSDL.

The IAEA/WHO TLD postal dose quality audit service for monitoring the calibration of radiation therapy beams checked a total of 356 beams, of which 211 were cobalt-60 and 145 were high energy X ray beams from clinical accelerators. The scientific and organizational aspects of the service were improved, resulting in a substantial decrease in the total response time to participants, from six months to one to two months. Greater co-operation with WHO led to a significant increase in the return rate of the irradiated dosimeters, from 60% in the past to approximately 90% at present. Follow-up procedures for hospitals with results outside acceptable limits were also strengthened, resulting in a net increase in the percentage of resolved discrepancies.

Forty-seven cobalt-60 beams of industrial facilities and research institutes in Member States were checked through the International Dose Assurance Service (IDAS). A field study was conducted to check the usefulness and suitability of these dosimeters for electrons. The results show that these dosimeters can be used for electron beams of energy of more than 8 MeV and for restricted irradiation geometries.

Since 1959, the Agency has maintained a register of radiotherapy hospitals and clinical institutions having radionuclide and high energy teletherapy machines. This 'Directory of Radiotherapy Centres' (DIRAC) was

available only in printed form and its last edition was published in 1976. An electronic version of this directory has now been developed as a database and includes information not only on teletherapy machines, but also on sources and devices used in brachytherapy, equipment for dosimetry, patient dose calculation and quality assurance, and staff strength at installations. With WHO's recent involvement, this project has now become a common undertaking to provide a single international directory of radiotherapy centres and equipment.

## Nutritional and health related environmental studies

Nuclear and isotopic techniques were used to increase the sensitivity of nutrition monitoring techniques and to identify effective strategies. A draft thematic plan entitled 'Isotopic Evaluations to Add Value to Nutritional Interventions' was developed as a template for regional technical co-operation projects in Latin America and in the East Asia and Pacific region.

Reports by WHO and other international organizations indicate that chronic diseases associated with ageing are becoming a serious problem in many developing countries, especially those undergoing nutritional and demographic change. Accordingly, a CRP was initiated on the application of nuclear techniques in the prevention of degenerative diseases in ageing to study the underlying mechanisms of disease development so as to define better methods of prevention.

As a result of two CRPs in environmental monitoring and several technical co-operation projects, a global network of monitoring stations in more than 40 countries was established using the same sampler design providing information on element content in the (particulate matter)<sup>10</sup> and PM<sub>2.5</sub> fractions of airborne particulate matter. Efforts were also made to identify various plants for monitoring airborne pollution with a view to using them as biomonitors at the regional or global scale.

A radiological study on terrestrial samples collected at Mururoa and Fangataufa Atolls in the South Pacific, where French nuclear weapon testing took place, was completed and the results published. In general, the activity concentrations measured by the international team were consistent with the French data that were

available. In particular, the data for plutonium in surface soil, sand and vegetation samples were completely overlapping at all sampling locations. Differences up to a factor of 10 were observed for plutonium concentrations in coconut samples and for areas on the Colette motu, where plutonium contamination resulting from safety tests was found to be about three times higher than the French average value for this area. The ranges of caesium-137 concentrations observed by the international team overlapped with the French results, but the French data include consistently higher values, except for vegetation samples, where lower values have been reported. The international team concluded that the French data constitute a comprehensive and reliable account of the levels of artificial material in the atolls and that the very low concentration levels found in the accessible terrestrial environment were of no radiological significance.

Two proficiency test materials for measuring gamma emitting radionuclides, strontium-90 and actinides were prepared. They will be used by the Analytical Laboratories for Measuring Environmental Radioactivity (ALMERA) network.

