

# Human Health

## Objective

To enhance capabilities in developing Member States to address needs related to the prevention, diagnosis and treatment of health problems through the development and application of nuclear techniques.

## Nuclear Medicine

Treatment strategies against cardiovascular diseases and cancer, which are two of the major causes of death, are making greater use of nuclear medicine techniques (Fig. 1). Additionally, the management of infectious, metabolic, genetic and degenerative diseases are benefiting from molecular nuclear medicine techniques.

A CRP on myocardial viability detection following myocardial infarction has been researching the risks from operations and predictions of improvement. Results from 252 patients enrolled in the CRP are demonstrating increased sensitivity and accuracy in predicting the functional recovery and the rate of future cardiac events.

Another CRP, completed in 2004, focused on intravascular radionuclide therapy using liquid

rhenum-188 perrhenate at the time of coronary artery revascularization in patients with newly detected lesions in the coronary artery. It was proven that brachytherapy with liquid rhenum-188 filled balloons is a feasible and cost effective technique and prevents restenosis with similar results to those reported in the biomedical scientific literature.

The use of radiopharmaceuticals, in particular rhenum-188 Lipiodol for the treatment of liver cancer, continues to show promise. A CRP is showing an apparent increased rate of survival in patients who are otherwise untreatable.

Two CRPs were started on drug resistance in infectious diseases such as HIV and malaria. The first will focus on the development and quality control of radiopharmaceuticals prepared in hospitals and used for infection imaging in HIV positive patients. The second CRP will study the accuracy of molecular and immunological markers for prediction of the efficacy of antimalarial drugs.

The Agency continued to promote professional training, innovative teaching technologies and the application of information and communication tools through technical cooperation projects on telenuclear medicine and on distance assisted teaching. The

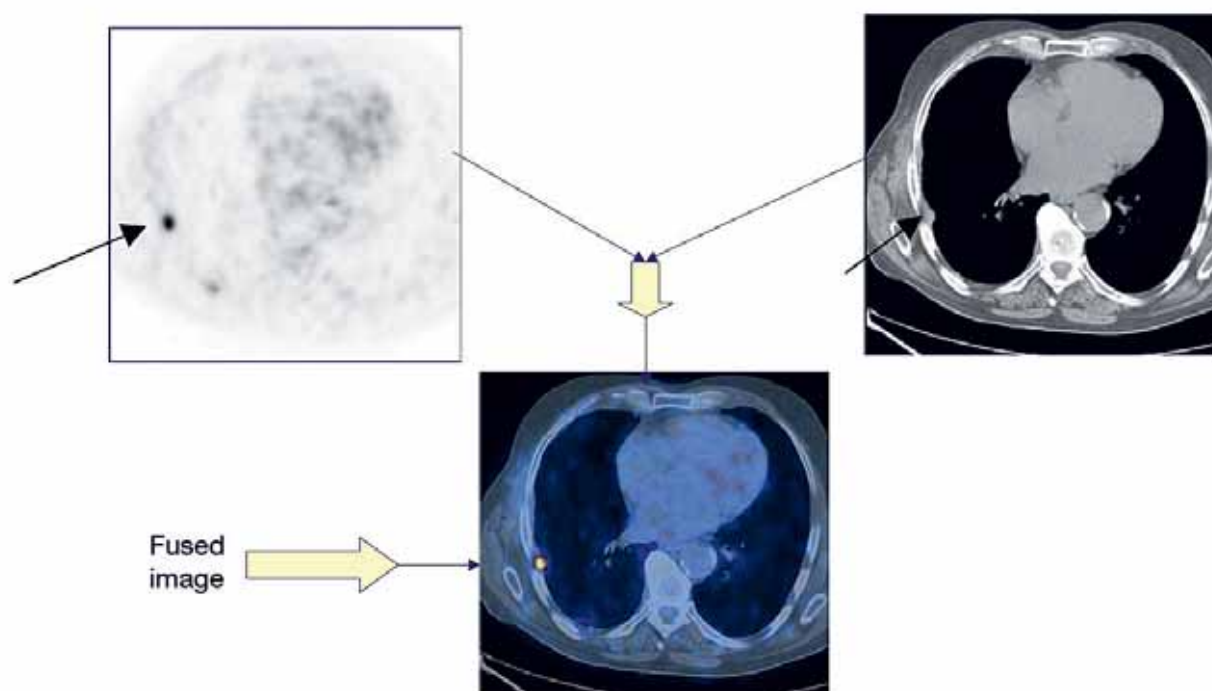


FIG. 1. Improved cancer diagnosis can be achieved by the 'fusion' of positron emission tomography images (left) and computed tomography (right) images. The bottom picture shows the combined image (images courtesy of Dr. S. Fanti, University of Bologna, Italy).

latter is aimed at providing education to nuclear medicine technologists in RCA Member States where formal training is not yet available.

## Applied Radiation Biology and Radiotherapy

Cancer of the cervix is one of the most common cancers worldwide. It is strongly related to infection by the Human Papilloma Virus. A CRP on the response of cervix cancer to radiotherapy was initiated. The clinical component will investigate the most economical method of using high dose rate brachytherapy for the treatment of this cancer. The radiobiology component will study molecular markers of tumour response as well as cell lines with relevant molecular characteristics, in order to better understand the response of these tumours.

A technical meeting was held to discuss normal tissue and tumour banking with respect to predictive testing of response to radiotherapy. Molecular based assays are being used increasingly in the hope of tailoring radiotherapy dosage prescriptions to individuals or groups of patients, thereby improving the overall treatment outcome for cancer patients. Another meeting focused on pathways of tumour radioresistance to radiotherapy, identifying those new molecular targeting agents that may be particularly suitable for study in industrialized or in developing countries to improve the effectiveness of radiotherapy against certain cancers. Future CRPs will be planned on the basis of the knowledge gained from these two meetings.

A review at a Technical Committee Meeting on the long term effects on normal tissues of various agents used in radiotherapy recommended the adoption of the most recent Common Toxicity Criteria, from the US National Cancer Institute. The use of this set of criteria would facilitate: harmonization of the reporting of adverse effects in Agency trials; research into modifying those criteria for improved applicability in resource limited settings; and the use of actuarial methodology for more realistic assessment of late adverse effects.

The Agency's distance learning course, the 'Applied Science of Oncology', is aimed at promoting radiotherapy expertise in developing countries. Currently in the validation stage, the course should reduce substantially the expenses incurred by the Agency and Member States in training physicians and other professionals specializing in radiotherapy.

## Dosimetry and Medical Radiation Physics

Fostering and maintaining a quality assurance culture, leading to accurate dosimetry, dose delivery and patient protection, are of paramount importance in the successful use of nuclear and radiation techniques in diagnosis and treatment. In addition to radiotherapy assistance projects under the Agency's technical cooperation programme, the Directory of Radiotherapy Centres (DIRAC) database was revised, with an Internet based planning tool that can identify gaps in Member State treatment

### *Programme of Action for Cancer Therapy — PACT*

Today there are more new cancer cases every year in developing countries than in industrialized countries. Indeed, by 2020, two thirds of the projected ten million annual cancer deaths will be in developing countries.

Together with other international organizations, the Agency has continued to offer its expertise in radiotherapy to developing countries. Since 1981, it has provided over \$57 million in radiotherapy services. Over 22% of its technical cooperation programme is devoted to human health, and half of that is allocated to providing or improving the delivery of radiotherapy services. In addition, the Agency invests about \$7–8 million annually on technical cooperation projects focusing on radiotherapy.

However, recognizing the magnitude of the impending cancer crisis in many developing countries, the Agency proposed a Programme of Action for Cancer Therapy (PACT) to address the legal, regulatory, technical and human resources requirements involved in establishing, improving and expanding radiotherapy treatment programmes in the context of national cancer control strategies and according to the priorities and needs of the countries and regions concerned. While the Agency's radiotherapy activities will continue, there will be a shift in emphasis to providing support to PACT. The programme of action was endorsed by the Board of Governors in June 2004, with the General Conference passing it as a resolution in September, paving the way for the Agency to seek and direct funds from a wide range of traditional and non-traditional donors to further enhance its delivery of radiotherapy and related diagnostic techniques to Member States.



FIG. 2. Agency medical physicists investigating dosimetry discrepancies at a hospital as part of the QUATRO project.



FIG. 3. Accuracy of radiation dose measurements is vital in radiotherapy. Here, a physicist at the Agency's Laboratories at Seibersdorf calibrates a dosimeter to be used in a Member State.

capabilities and human resources. Other activities in this area included:

- Revision of a technical document outlining the components of a basic cancer treatment facility (IAEA-TECDOC-1040);
- Publication of *Commissioning and Quality Assurance of Computerized Planning Systems for Radiation Treatment of Cancer* (Technical Reports Series No. 430), to help Member States verify the accuracy of their treatment planning systems;
- Initiation of a CRP to identify the most appropriate technology to be used for the verification of patient dose during therapy, known as in vivo dosimetry.

In order to assist Member States in the event of potential radiation misadministration, the Agency expanded its activities directed at resolving dosimetry discrepancies in medical physics. The result was the development of the 'Quality Assurance Team in Radiation Oncology' (QUATRO), a comprehensive clinical auditing approach (Fig. 2). As a follow up, QUATRO's mode of operation was defined, and possible funding mechanisms for team missions were explored.

In response to increased demands for the calibration of detectors used to measure the output and to verify the calibration of radiation beams and sources used in diagnostic radiology, nuclear medicine and radiation oncology, the Agency began expansion in 2004 of the Dosimetry Laboratory. The laboratory's quality management system was reviewed by an external peer review panel to strengthen the link between the international measurement system and the radiation standards of the members of the IAEA/WHO Network of Secondary Standards Dosimetry Laboratories (SSDLs). In related work, the Agency continued to

provide Member States with dosimetry calibration and verification services at a rate comparable to previous years, and also participated in two international comparisons as part of its role as the central laboratory of the IAEA/WHO Network of SSDLs (Fig. 3).

## Nutrition and Effects of Contaminants on Human Health

The United Nations Millennium Development Goals call for a halving by 2015 of the number of people who suffer from hunger. The Agency is assisting Member States in their efforts to achieve these goals by providing technical support to develop and evaluate strategies to combat hunger and malnutrition.

For example, a new CRP was developed jointly with the International Food Policy Research Institute (IFPRI), based in Washington, D.C., and the Consultative Group on International Agricultural Research to evaluate innovative strategies to combat malnutrition by the introduction of nutritionally improved, 'bio-fortified' crop varieties. The usefulness of bio-fortified staple foods will be evaluated as sources of micronutrients (vitamin A, iron and zinc) using stable isotope techniques.

The Agency is also involved in the development and evaluation of more conventional strategies to combat malnutrition, for example, conventional food fortification and dietary modification. A CRP which provides support to local PhD students showed encouraging results in Sri Lanka on different strategies to enhance iron and zinc bioavailability by the addition of the food additive EDTA to fortified rice flour, and in Pakistan from the addition of

vitamin C to improve iron bioavailability from a traditional complementary food.

Well established stable isotope techniques were used as tools in priority areas in nutrition. The intake of human milk in breastfed infants was evaluated using these techniques in Madagascar and Senegal (Fig. 4). In addition, body composition during pregnancy was evaluated as part of a CRP on foetal development. Stable isotope techniques were also used to determine energy expenditure and body composition in the elderly in several Member States, as well as in adults participating in a regional African project to evaluate the impact of food supplementation on nutritional status in people living with HIV/AIDS.

In support of its collaborative work with other intergovernmental and national organizations, and to promote the Agency's activities in human nutrition, a workshop was held during the International Nutrition Anaemia Consultative Group/International Vitamin A Consultative Group Meetings in Lima. In addition, technical meetings were held with WHO, the US Agency for International Development and IFPRI to investigate the use of stable isotopes in human nutrition. ■



*FIG. 4. To monitor milk intake in infants, a (non-radioactive) deuterium dose is administered to the mother, followed by the collection of saliva samples from the baby.*