

Human Health

Objective

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

Nuclear Techniques to Monitor Nutrition during Early Life

The rapid increase in the prevalence of non-communicable diseases represents a major global health challenge. The impact of nutrition during early life and its role in the development of disease later in life have been emphasized by the association between small size at birth and rapid growth rate during infancy with higher rates of coronary heart disease and type 2 diabetes mellitus. In 2009, the Agency focused on defining 'quality of growth' by assessing body composition during infancy, i.e. body fat versus muscle mass, to better understand its association with health status later in life (Fig. 1).

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The technically challenging aspects of capturing the dynamic nature of growth during early life and its associated rapid changes in body composition and, in particular, the usefulness of nuclear techniques to assess body composition during infancy were highlighted during a technical meeting held at Headquarters, as well as during the 19th International Congress of Nutrition held in October in Bangkok.

In collaboration with WHO, the Agency launched a new AFRA regional project in Africa on improving infant and young child nutrition and health. Exclusive breastfeeding for six months, followed by the introduction of appropriate complementary foods and continued breastfeeding, as recommended by WHO and UNICEF, are cornerstones of infant nutrition. However, only limited information is available on the quantities of

human milk consumed and the time of introduction of other foods into an infant's diet, partly due to the difficulties involved in measuring the intake of human milk (Fig. 2).

The new regional project will use stable isotope techniques to provide data in 13 countries on the intake of human milk, as well as the time of introduction of complementary foods, in a large group of infants from 3 to 12 months of age. The first coordination meeting was held in Kampala, Uganda, in May, and a training course was organized in Dar es Salaam, United Republic of Tanzania, in August, to develop standardized protocols for use in this project.

Educational Resources in Nuclear Medicine and Diagnostic Radiology

A priority of the Agency is the provision of guidance and educational resources to Member States. One medium is a dedicated human health web site (<http://nucleus.iaea.org/apps/HHW/root/content/MedicalPhysics>), while another is publications on various aspects of clinical practice in nuclear medicine. The Agency is also implementing a programme on Quality Management Audits in Nuclear Medicine Practices (QUANUM).

To support the Agency's training activities, the Research Institute for Asia and the Pacific (RIAP)

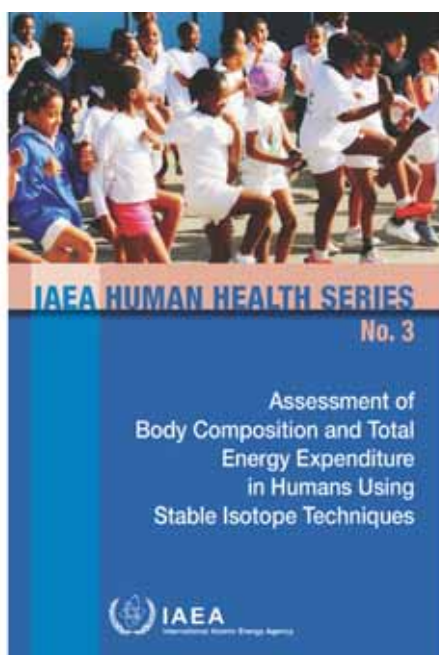


FIG. 1. In 2009, the Agency published its first report on the use of stable isotope techniques in assessing body composition and energy expenditure.



FIG. 2. Mothers and infants participating in an Agency supported project on breastfeeding in Burkina Faso. (Photograph courtesy of N. Mokhtar.)

at the University of Sydney, Australia, coordinated a Distance Assisted Training (DAT) programme for nuclear medicine technologists. Initially developed to cover conventional nuclear medicine applications, DAT material was expanded in 2009 to include single photon emission computed tomography (SPECT/CT) and positron emission tomography (PET/CT), and adapted for on-line delivery through a new web site (DATOL) (<http://nucleus.iaea.org/apps/HHW/root/content/Technologists/NuclearMedicine/Educationalresources/DistanceAssistedTrainingforNuclearMedicineTechnologists>).

Following up on previous work, auditing missions were carried out within the framework of the QUANUM programme. The objective of these missions was to conduct a quality assessment of nuclear medicine services in accordance with Agency guidelines. A quality management self-assessment questionnaire was completed by institutes and submitted before the visit of an external audit team with reference to these guidelines, Agency technical publications or other external standard setting bodies. Typically, the audit missions produce a series of recommendations, corrective measures and action plans for the audited facilities. Follow-up missions check the implementation of the plans.

Two publications on quality assurance (QA) were published in 2009: *Quality Assurance for PET*

and PET/CT Systems (IAEA Human Health Series No. 1) and *Quality Assurance for SPECT Systems* (IAEA Human Health Series No. 6). These reports provide guidelines for the implementation of quality control programmes related to the combined medical diagnostic modality, using PET and CT technologies. The use of these independent, but complementary, imaging techniques is growing within the fields of diagnostic imaging, oncology, cardiology and neurology, where they allow physicians to locate and diagnose diseases accurately. A third publication, *Clinical Translation of Radiolabelled Monoclonal Antibodies and Peptides* (IAEA Human Health Series No. 8), provides guidance on planning the investigations needed for radiolabelled biological products to be brought

into routine use. Within the context of the Agency's nuclear medicine activities, a variety of strategies have evolved for radiolabelling biological products with a view to enhancing diagnosis,

palliation and therapy. Currently, more than 350 products aimed at treating over 200 diseases are being tested, including a range of monoclonal antibodies (MAbs) and peptides. However, since very few radiolabelled MAbs or peptide products have reached clinical use, the Agency is conducting two CRPs to test some of these products for clinical implementation.

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Radiation Oncology

At an Agency conference on 'Advances in Radiation Oncology' (ICARO), held in April in Vienna, discussion focused on developments in radiation oncology and on needs with respect to education and training. The participants concluded that the demand for training and equipment will increase dramatically in the future. Furthermore, they agreed that finding the right balance between providing services that cover Member State needs and pursuing advanced technologies is a challenge. A side event was organized to encourage 19 companies to make diagnostic and radiotherapy equipment more affordable and technically suitable for developing countries.

Two new CRPs were initiated to contribute to capacity building and the improvement of cancer management in Member States. A CRP on paediatric radiation oncology was started to improve the quality of radiotherapy given to children with cancer in low and middle income countries.

In 2009, the focus on train the trainer activities was strengthened. In addition, distance learning tools were further developed and training materials were provided through the Agency's human health programme web site (<http://www-naweb.iaea/nahu/default.asp>). The distance learning tool in applied sciences of oncology (ASO) for radiation oncologists, radiation therapy technologists

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(RTTs) and other professionals in radiation medicine is being prepared for release on the Agency's public web site. A pilot course on training RTT trainers was held to test the methodology.

In 2009, the Agency implemented over 120 technical cooperation projects related to radiotherapy capacity building and equipment, and establishing or upgrading radiotherapy centres. In addition, it conducted a number of regional and national training courses. The Agency also carried out audits within the framework of its Quality Assurance Team for Radiation Oncology (QUATRO) service (Fig. 3).

Quality Assurance and Metrology in Radiation Medicine

To support the use of harmonized QA procedures for imaging modalities, the Agency published *Quality Assurance Programme for Screen Film Mammography* (IAEA Human Health Series No. 2); this was in addition to the two QA titles

mentioned on page 43. Quality assurance procedures for digital mammography and CT were also developed. The Agency continued its efforts to raise awareness of the need for proper administration of

QA procedures as a member of the 'Image Gently Alliance', an initiative of the Alliance for Radiation Safety in Pediatric Imaging, which has the goal of changing medical practices to lower the radiation dose in the imaging of children.



FIG. 3. QUATRO audit in Poznan, Poland.

A CRP on accurate radioactivity measurements in nuclear medicine was completed. One of the achievements of this project was a radioactivity measurement comparison for iodine-131, which is widely used in nuclear medicine practice. The results of the comparison have allowed participating Member States to establish traceability to international standards for this radionuclide.

The IAEA/WHO dosimetry services focus on Member States requiring assistance, through the Agency or WHO, in calibrating their national measurement standards and in verifying the calibration of their radiotherapy beams used to treat cancer patients. During 2009, the Agency calibrated 47 national standards from 21 Member States, 70% of which were for radiotherapy dosimetry. The remaining calibrations concerned radiation protection dosimetry. Ten Member States participated in an Agency organized comparison for radiotherapy dosimetry and all of the results were found to be within the acceptance limits. A similar result was also achieved in a comparison of radiation protection dosimetry involving 25 Member States. This demonstrates the competence of calibration laboratories in Member States to provide quality calibration services.

There is a need in hospitals to periodically check the calibration of the treatment machines to ensure safe and high quality treatment. The IAEA/WHO Postal Dose Audit service provides assurance to participating Member States that radiation beams used in clinics for cancer treatment are properly calibrated. The service has checked the calibration of over 7500 radiotherapy beams. As a result, significant improvements in dosimetry practices have been noted worldwide, especially in the last ten years. In 2009, the calibration of 557 hospital beams was checked, and 15 discrepancies in dosimetry were exposed and resolved, directly leading to an improved quality of patient treatment. The number of beam checks in 2009 exceeded what was planned by more than 10%, mostly due to requests from new facilities, which must have their calibrations verified before patient treatments can begin.

Over the past decade, new treatment modalities have been introduced, many of which tend to utilize small and composite radiation fields. In such cases, the determination of radiation dose is more complex, and there is a growing concern about the

lack of standardization in the reference dosimetry used for these new treatment fields. The Agency's response has been to establish a working group, jointly with the American Association of Physicists in Medicine, comprising clinical medical physicists and specialists in dosimetry, to review the current practices and to suggest a harmonized approach.

Programme of Action for Cancer Therapy

The Agency's Programme of Action for Cancer Therapy (PACT) seeks to assist developing countries in integrating radiotherapy into the broader framework of cancer prevention and control. In 2009, the Agency with WHO launched a Joint Programme on Cancer Control to accelerate cancer control programme delivery to Member States. In addition, it signed new partnerships with the Alliance for Cervical Cancer Prevention and with the International Cancer Centre Abuja to fight cancer in Nigeria and neighbouring African countries. In addition to the funds mobilized by the Agency for PACT Model Demonstration Sites (PMDSs), a sum of \$300 000 was raised to support cancer control in Uruguay. Donations to PACT in 2009 reached \$6.2 million.

The PMDSs remain an effective model for interpartner collaboration for cancer control. In 2009, Ghana joined

Albania, Nicaragua, Sri Lanka, the United Republic of Tanzania, Vietnam and Yemen in setting up a PMDS. Through PACT and its partners, the Agency has helped develop national cancer control plans in all seven PMDSs. In Nicaragua, the National Radiotherapy Centre hosted an inauguration ceremony for the launching of the Equinox radiotherapy machine (donated by MDS Nordion/Best Theratronics through the Agency), as well as a treatment planning system and simulator provided through the technical cooperation programme. In Vietnam, following the conclusion of a tripartite agreement in 2008, a Bhabhatron radiotherapy unit donated by India was installed at a regional hospital in Can Tho Province, where patients previously had no access to radiotherapy.

In 2009, the Agency nominated 20 professionals from the PMDSs and other developing countries to attend the US National Cancer Institute (NCI) summer curriculum in cancer prevention. NCI's in-kind contribution to PACT from 2007 to 2009

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was \$800 000. The Agency also supported the participation of 12 cancer professionals from West Africa in a palliative care workshop in Burkina Faso, and of seven PMDS professionals in the 3rd International Cancer Control Congress, held in November in Como, Italy. It also sponsored the participation of five African experts in radiation therapy in the 7th International Cancer Control Congress of the African Organization for Research and Training in Cancer, held in November in Dar es Salaam, United Republic of Tanzania.

By the end of 2009, the Agency had received requests from 72 Member States for 'imPACT' reviews, a cancer control needs assessment and planning process. In 2009, PACT conducted post-imPACT missions to PMDSs in Nicaragua, the United Republic of Tanzania and Vietnam. Pre-imPACT missions were undertaken in Madagascar, Mongolia, the Republic of Moldova and Uganda. A self-assessment questionnaire and an analytical tool were developed to aid government cancer control planning.

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To help meet the global need for qualified cancer care professionals, in 2009 the Agency launched PACT's Regional Cancer Training Networks and Virtual University for Cancer Control. Professionals will be trained in their home countries through linked training centres and regional hubs for education and mentorship. With a \$750 000 donation from the USA, the first network will be established in Africa, with support from a private sector partnership. The network is scheduled to include

newly linked training centres, standardized curricula and a web based portal for low cost content delivery.

As part of its capacity building and awareness initiatives in 2009, the Agency invited 76 policy makers from the African and the Asia-Pacific regions to attend two PACT coordination and planning meetings on cancer control. The Agency also provided the United Nations with information on cancer treatment to assist in its discussions to revise the Millennium Development Goals. In addition, PACT hosted a special seminar entitled 'The Globalization of Cancer'.