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.

Linkages between Poor Sanitation and Undernutrition

Environmental enteric dysfunction (EED) is strongly associated with stunting and other forms of undernutrition. Stunting is caused by long term poor health and poor nutrition, but unsanitary conditions are considered to be an important part of the problem (Fig. 1). Living in poor sanitary conditions may lead to gut function disorders and chronic inflammation, both of which are evident in EED.

To address this problem, the Agency brought together fifty experts from academia and organizations such as the Bill and Melinda Gates Foundation and the World Bank to participate in a three day meeting at the Agency's Headquarters in October. The experts considered the current knowledge as well as knowledge gaps concerning the definition, biological pathways and consequences of EED. They also considered prevention and treatment options, including areas where the Agency can play an important role by supporting the use of stable isotope techniques.

FIG. 1. Understanding EED can improve nutrition interventions and human health.

The meeting participants concluded that several gaps in knowledge require urgent attention, in particular the need for the classification of EED and a better understanding of its underlying causes. They strongly recommended that practical, simple, affordable tools be developed to diagnose and characterize EED, to allow better targeting of interventions in vulnerable populations. The recommendations from the meeting will be used for planning a coordinated research project in this area.

Global Educational Outreach in Nuclear Medicine and Radiology

Information and communication technologies continued to play a major role in the Agency's growing education, training and outreach activities throughout the year. Such technologies enable the Agency to provide more information to Member States more quickly and more effectively.

In 2015, the Agency broadcast six on-line human health seminars during the year, with an average of 200 participants per seminar. Targeting mainly nuclear medicine physicians, radiologists and medical residents in training, these webinars focused on clinical aspects of nuclear medicine with an emphasis on nuclear cardiology and paediatric nuclear medicine. Other webinars focused on normal anatomy and common pathological findings in a live, interactive, case based format simulating clinical practice.

"the Agency broadcast six on-line human health seminars during the year, with an average of 200 participants per seminar."

The Agency also released new educational materials through the Human Health Campus, including new e-learning modules on quality assurance for single photon emission computed tomography (SPECT) systems. Other topics included energy resolution, uniformity, tomographic sensitivity and measurement of SPECT gamma camera performance. A module entitled 'Atlas of Myocardial Perfusion SPECT Studies' was also released during year, aimed at nuclear medicine physicians practising in the field of nuclear cardiology.

To support Member State efforts to combat cancer, the Agency and the Tata Memorial Centre in Mumbai, India, developed a smart phone application for cancer staging. The app, which was launched during the 59th regular session of the Agency's General Conference, can be used by the global medical community for rapid, accurate and standardized staging of cancer. Based on this classification, physicians can decide on the most appropriate treatment for each cancer patient.

In October, the Agency hosted the International Conference on Clinical PET–CT and Molecular Imaging (IPET-2015): PET–CT in the Era of Multimodality Imaging and Image Guided Therapy. The conference, held in Vienna and attended by more than 500 professionals from over 90 Member States, emphasized important clinical aspects and appropriate use of hybrid imaging (e.g. single photon emission computed tomography–computed tomography (SPECT–CT), positron emission tomography–computed tomography (PET–CT)) for the entire spectrum of cancer management. For the first time, the conference sessions were streamed live over the Internet to reach a broader audience of medical experts around the world. After fulfilling the rigorous requirements of the European Accreditation Council for Continuing Medical Education, IPET-2015 was granted 27 European Continuing Medical Education credits by the European Accreditation Council for Continuing Medical Education.

The Agency issued a number of publications on nuclear medicine and diagnostic imaging in 2015. Three books were published in the IAEA Human Health Series: *Radiolabelled Autologous Cells: Methods and Standardization for Clinical Use* (IAEA Human Health Series No. 5); *Clinical PET/CT Atlas: A Casebook of Imaging in Oncology* (IAEA Human Health Series No. 32); and *Quality Management Audits in Nuclear Medicine Practices: Second Edition* (IAEA Human Health Series No. 33). The Agency also published seven articles in peer-reviewed journals, including an article in the *European Heart Journal* entitled

"Current Worldwide Nuclear Cardiology Practices and Radiation Exposure: Results from the 65 Country IAEA Nuclear Cardiology Protocols Cross-Sectional Study (INCAPS)".

Radiation Oncology and Biology

Contouring of tumours and normal structures as part of the radiotherapy treatment planning process is an important aspect of effective radiotherapy. Such contouring is challenging to teach because it requires guided, hands-on practice in addition to anatomical knowledge. To assist Member States in filling this crucial training need, the Agency organized a contouring workshop in Vienna in June, attended by 21 delegates and five trainers from 24 Member States. The workshop included an introduction to radiotherapy planning, followed by segments focusing on five common cancers: head and neck, lung, breast, prostate and rectal cancer.

At the 3rd European Society for Radiotherapy and Oncology Forum, held in Barcelona in April, a session was dedicated to presenting seven Agency coordinated research projects on radiotherapy. The projects included five trials on treatment of cancers of the head and neck, breast, rectum, bone and lung, and two surveys of capacity in developing countries. The abstracts were published in the journal *Radiotherapy and Oncology* in April.

"The evaluation found QUATRO audits to be a valuable tool for identifying Member State needs in terms of infrastructure, human resources and radiotherapy procedures."

In September, the Agency, in cooperation with the National Institute of Radiological Sciences of Japan, held a Technical Meeting on the Future of Biodosimetry in Asia: Promoting a Regional Network. The meeting was attended by 24 participants from 16 countries, who discussed the future direction of and new developments in biological dosimetry, and the possibility of establishing a research oriented biodosimetric network in the Asia and the Pacific region.

Between 2008 and 2013, the Agency carried out pilot audits of 12 radiotherapy departments in Latin America using the Quality Assurance Team for Radiation Oncology (QUATRO) guidelines. An evaluation of these pilot audits was published in August in an article in the journal *Radiation Oncology* entitled "Quality audits of radiotherapy centres in Latin America: a pilot experience of the International Atomic Energy Agency". The evaluation found QUATRO audits to be a valuable tool for identifying Member State needs in terms of infrastructure, human resources and radiotherapy procedures.

The Agency provided data from its Directory of Radiotherapy Centres for The Lancet Oncology Commission's report entitled "Expanding Global Access to Radiotherapy". The report was published in *The Lancet Oncology* in September and presented at the European Cancer Congress in Vienna later that month.

Quality Assurance and Metrology in Radiation Medicine

Quality control is essential to the safe and effective use of radiation technology in medicine. To support Member State implementation of quality assurance programmes in radiotherapy, the Agency published two new IAEA Human Health Reports in 2015: *The Transition from 2-D Brachytherapy to 3-D High Dose Rate Brachytherapy* (IAEA Human Health Reports No. 12) and *Staffing in Radiotherapy: An Activity Based Approach* (IAEA Human Health Reports No. 13 (CD-ROM)).

In the field of radiology physics, the Agency, in cooperation with the World Health Organization (WHO), published a comprehensive resource guide entitled *Worldwide Implementation of Digital Imaging in Radiology* (IAEA Human Health Series No. 28). The book provides information on developing and implementing a sustainable digital imaging and teleradiology system, and on requirements for the transition from film to digitally based medical imaging. The Agency also published *Nuclear Medicine Physics: A Handbook for Teachers and Students*, the third and final volume in a series of comprehensive handbooks

on medical radiation physics. Endorsed by medical physics associations around the world, including the American Association of Physicists in Medicine, the Asia–Oceania Federation of Organizations for Medical Physics, and the European Federation of Organisations for Medical Physics, the Handbook is expected to become a reference textbook for postgraduate medical physics education programmes.

In June, the Agency held its first train the trainer workshop on medical physics for nuclear or radiological emergencies. Held in Fukushima Prefecture, the workshop was supported by the Fukushima Medical University, the National Institute of Radiological Sciences of Japan and the Japan Society of Medical Physics. It was attended by 21 participants from 17 countries.

To support Member States in strengthening their dosimetry capabilities in radiation medicine, the Agency provides calibration and audit services to secondary standards dosimetry laboratories (SSDLs) and radiotherapy centres. Since 1969, the IAEA–WHO thermoluminescent dosimeter (TLD) postal dose audit service has checked 11 500 radiotherapy beam calibrations in 132 countries. In 2015, over 600 hospital beam audits were conducted, with 21 repeat checks to follow up dosimetry discrepancies. Without such audits, discrepancies might not be discovered, and patients might not receive the correct treatment.

"In 2015, over 600 hospital beam audits were conducted, with 21 repeat checks to follow up dosimetry discrepancies."

During the year, the Agency performed calibrations of national dosimetry standards for 19 SSDLs and conducted ten interlaboratory comparisons for radiotherapy dosimetry. In November, an international workshop to compare the national reference standards for radiation protection dosimetry of six Member States was held at the IAEA's Dosimetry Laboratory (Fig. 2). The results were used to determine the level of equivalence with international standards.

In 2015, the Agency successfully tested a new optically stimulated luminescence dosimetry (OSLD) system for use in radiation protection audits of SSDLs. The new OSLD system replaced the manual TLD system and will be used for future audits in radiation protection dosimetry.

FIG. 2. Participants in an international dosimetry workshop held at the IAEA's Dosimetry Laboratory in November.

As part of the Renovation of the Nuclear Applications Laboratories (ReNuAL) project, in 2015 the Agency acquired a new high dose rate brachytherapy unit through an extrabudgetary contribution from Germany. The unit will be used for dosimetry calibrations for SSDLs, thus contributing to increased consistency in brachytherapy dosimetry around the world.