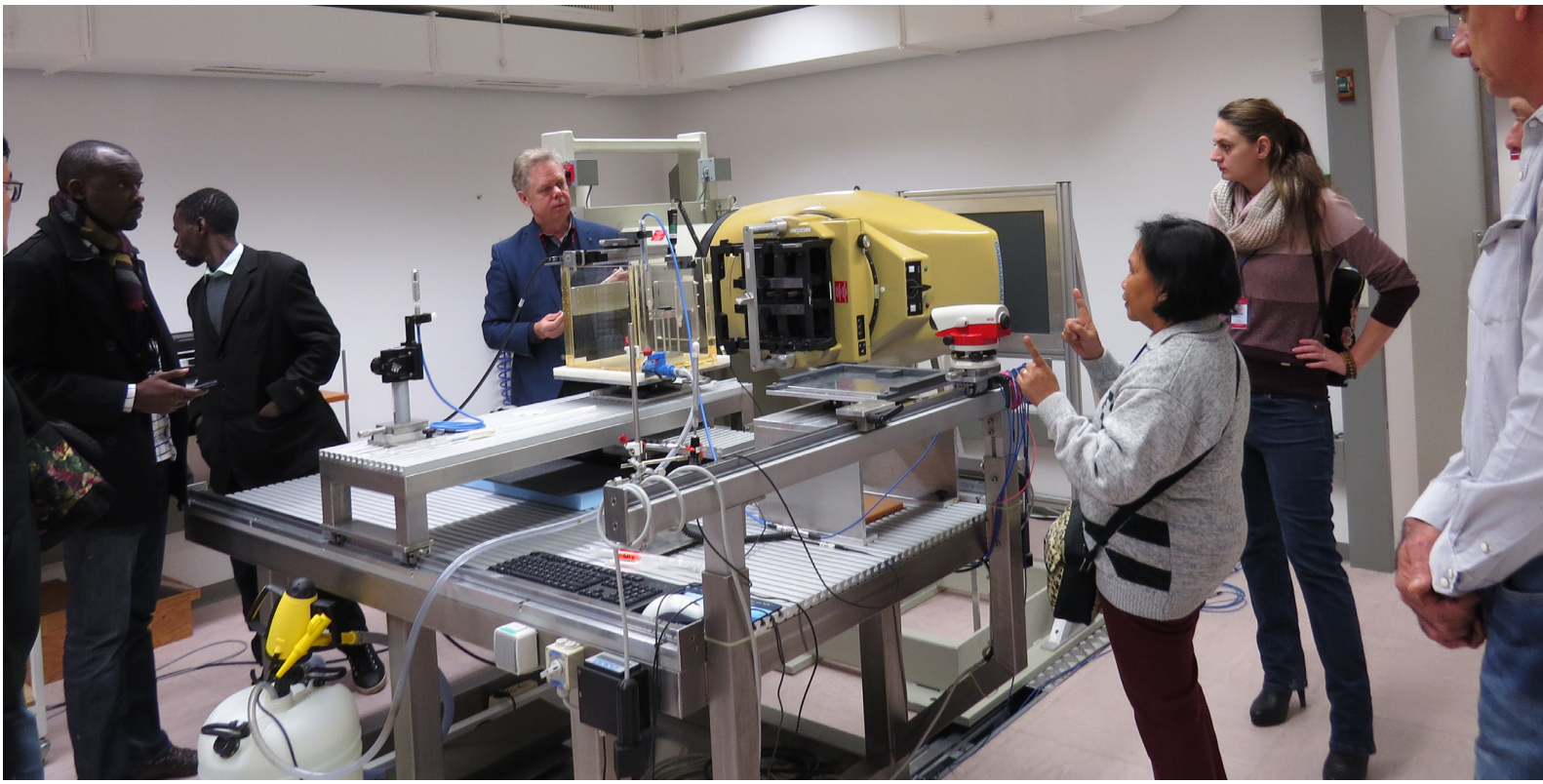
Accurate dosimetry for quality cancer care

The IAEA/WHO Network of Secondary Standards Dosimetry Laboratories

By Aabha Dixit



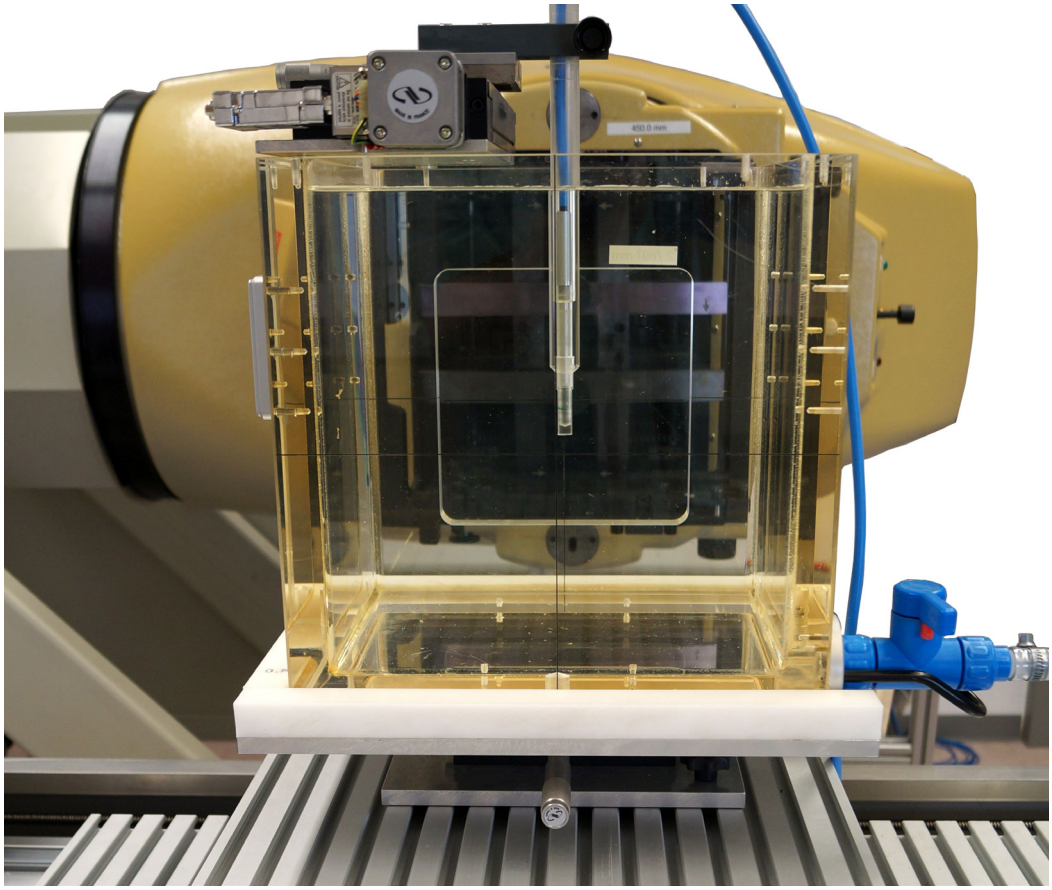
The IAEA Dosimetry Laboratory provides practical training on how to perform accurate calibrations for dosimetry.
(Photo: P. Toroi/IAEA)

More than half of cancer patients require radiation therapy at some point during their treatment. The outcome of treatment can change significantly if the amount of radiation differs by even as little as 5% from the intended radiation dose. To provide patients with highly accurate doses of radiation, it is essential for measurement equipment to be set up and operated properly.

"Accurate dosimetry is a crucial part of radiation therapy," said Zakithi LM Msimang, Director of Ionizing Radiation at the National Metrology Institute of South Africa. "If the radiation dose is too low, the cancer might not be cured, and, on the other hand, if it is too high, it can have harmful side effects."

Radiation doses are measured using specific measuring equipment called dosimeters. These devices play a central role in ensuring accurate dosimetry, which is the science of measuring, calculating and assessing radiation doses. To ensure accurate dosimetry, measuring equipment needs to be calibrated regularly. This is done by crosschecking the devices' performance against national reference standards maintained by national calibration laboratories, such as secondary standards dosimetry laboratories (SSDLs). These reference standards are traceable and linked to the International System of Units (SI).

"We cannot see radiation, so we have to make sure that the measurement equipment is working correctly," said Paula Toroi, Medical Radiation Physicist — SSDL Officer at the IAEA. "Prescribed dose levels in radiation therapy are typically based on international studies and recommendations. To confirm that the doses used in these recommendations and then measured in hospitals are comparable, dosimetry equipment needs to be calibrated, and the measurement methods need to be harmonized. SSDLs provide these calibrations for dosimetry equipment, and they also link



Calibration system set up for a radiation therapy dosimeter.
(Photo: IAEA)

the measurements to the harmonized international dosimetry standards."

The SSDL Network was set up by the IAEA and the World Health Organization (WHO) to help countries to improve accuracy in dosimetry. It comprises 86 SSDLs, located in 73 countries, that provide calibrations for dosimeters. The objective of the IAEA/WHO SSDL Network is to improve accuracy and consistency in radiation dosimetry and to promote cooperation among countries.

"Training and sharing skills are vital for this field, as technology is developing very quickly," Msimang said, adding that "some developing countries are only now establishing their own national calibration laboratories, and the SSDL Network provides the precise support required."

The IAEA's Dosimetry Laboratory in Seibersdorf, Austria, acts as the central laboratory of the SSDL Network. The measurement standards of countries are calibrated, free of charge, at the laboratory, particularly for countries that do not have direct access to primary standards dosimetry laboratories, which are laboratories that establish quantities used for radiation dose measurements.

In June 2019, the IAEA's Dosimetry Laboratory opened a new linear accelerator (linac) facility to further strengthen dosimetry services and radiation safety worldwide, as well as to support research in new codes of dosimetry practices. Linacs are machines that use electricity to create beams of high-energy X-rays or electrons. They are most commonly used for treating cancer.

"With the new linac, the IAEA will be able to meet the increased demand from its Member States, including the direct calibration of SSDL dosimeters," said May Abdel-Wahab, Director of the IAEA's Division of Human Health. "This support will also help enhance audit services for more that 3400 medical linacs in hospitals in low and middle income countries."

In addition to calibration services, the IAEA Dosimetry Laboratory engages in other activities supporting accurate dosimetry worldwide. This includes comparisons and dose audits that allow SSDLs and hospitals to check that they are performing the calibrations and measurements correctly. The laboratory also provides training and conducts research and development in dosimetry and medical radiation physics.

"Training and sharing skills are vital for this field, as technology is developing very quickly. Some developing countries are only now establishing their own national calibration laboratories, and the SSDL Network provides the precise support required."

—Zakithi LM Msimang, Director of Ionizing Radiation, National Metrology Institute, South Africa