

# **IAEA comprehensive clinical audits for radiation oncology, nuclear medicine and diagnostic radiology**

Contributors: Paez D., Zubizarreta E., Van Der Merwe D., Mikhail M., Tsapaki V., Estrada Lobato E., Kazantsev P., Navarro-Marulanda M., Pynda Y., Pellet O., Akbarov K.

Division of Human Health, Department of Nuclear Sciences and Applications, International Atomic Energy Agency, Vienna, Austria

## **Introduction**

An independent external audit (peer review) framed within comprehensive Quality Management is an outstanding tool to ensure high-quality provision of procedures in radiotherapy, nuclear medicine, and radiology departments. Different kinds and complexities of *quality audits* may be selected and conducted, contingent upon the centre and desired scope: ranging from partial audits focused upon critical elements of quality processes to comprehensive audits providing assessment of quality management of the entire treatment or diagnostic process.

## **Background**

The International Atomic Energy Agency (IAEA) in collaboration with the World Health Organization (WHO) has an established history of providing dosimetry audits to radiotherapy centres and secondary standard dosimetry laboratories in low- and middle-income countries. The IAEA/WHO postal audit programme dates back over 50 years (since 1969) and focuses on the central element of the radiotherapy dose delivery, reference beam output.

For some time, the IAEA has been receiving numerous requests from Member States to perform comprehensive audits of therapeutic and diagnostic programmes involving the use of radiation; to assess the whole process, starting from organization, infrastructure and professional competencies, and extending to clinical and medical physics components. In response to those requests, the IAEA developed and published a series of methodologies for comprehensive hospital audits for three clinical disciplines: radiotherapy (QUATRO), nuclear medicine (QUANUM) and diagnostic radiology (QUAADRIL).

## **Description of activity and work performed**

QUATRO, QUANUM and QUAADRIL methodologies utilize a similar approach for conducting the audits. In all cases, the team of auditors include experts in different disciplines covering the whole clinical process. Their work is supported by numerous checklists and the scope of audits includes assessment of human resources, infrastructure, equipment, procedures, services, patient protection and safety, and overall performance of a department. Before the audit takes place, auditors may request some information from the department, and during the on-site visit communication with the local staff is maintained through entrance and exit briefings as well as constant interactions during interviews, process observations and documentation analysis. Where possible and feasible, sample case dose calculations and/or measurements are performed by the auditors using an independent set of equipment to

compare with local ones. The main purpose of all audits is to assess the current situation and to suggest concrete steps towards improvement of the quality of the healthcare services provided based on international and national standards and recommendations. Over the years, QUATRO, QUANUM and QUAADRIL audits have promoted the establishment of quality management systems, the adoption of good quality culture and the implementation of systematic reviews of all processes.

### [QUATRO \(Quality Assurance Team for Radiation Oncology\)](#)

The IAEA methodology on the clinical audit in radiotherapy was published in 2007 in the document “Comprehensive Audits of Radiotherapy Practices: A Tool for Quality Improvement” [1], often referred to as the ‘QUATRO guidelines’. The audit approach itself dates back to 2003 when the first missions took place, and the experience of the auditors provided a basis for the audit methodology development. Keeping up with the advances in radiotherapy dose delivery techniques and equipment, the QUATRO guidelines have been updated and are currently in preparation for publication.

QUATRO audit is performed by a multidisciplinary team comprised by a radiation oncologist, a medical physicist and a radiation therapist (RTT). Through the application of 37 clinical process, related checklists, and 5 questionnaires related to educational components of the practice, the comprehensive audit reviews and evaluates the quality of all elements involved in radiation therapy.

To date, the IAEA has conducted 101 QUATRO audits (14 of which were follow-up audits) in 51 countries worldwide (see Fig. 1). The results of 31 QUATRO missions conducted during the first 10 years in 21 countries in the European region were summarized [2] to identify the common strengths and weaknesses of different RT departments and the key components which correlate with good clinical practices. Importantly, it was found that all the institutions graded, based on the audit results, as “centres of competence” were adequately staffed.

### [QUANUM \(Quality Management Audits in Nuclear Medicine\)](#)

The QUANUM programme of patient-oriented, systematic, and outcomes-based audits was developed and introduced by the IAEA in 2007 [3]. The third edition became available in 2019 as a result of continuous improvement of the QUANUM process, aligned with up-to-date knowledge benchmarks and best practices. From 2008 to 2019, 74 QUANUM audits in 36 countries took place (see Fig. 2). 14 teams of auditors comprised by a NM physician, radiopharmacist, medical physicist, and technologist (56 total auditors) were trained and 24 workshops were held with over 540 trainees.

All audited facilities provided relevant documents in advance, including their self-assessment results using the QUANUM checklists. 14 checklists are used to identify non-conformities (NC) categorized as minor, major and critical which may be scored from 0 to 4. Auditors and auditees perform an analysis of the NC detected and possible solutions are evaluated, always considering national and international standards as reference points. At the end of the audit process, an action plan is proposed to address the NC.

In 2017, to evaluate the impact of the external audits conducted by the IAEA and the adoption of the advice provided to address the NC, the results of 42 audits in 39 facilities were compared with up-to-date internal audits. A marked reduction in the NCs was evident, thus proving the relevance of the QUANUM programme. [4,5,6]

### [QUAADRIL \(Quality Assurance Audit for Diagnostic Radiology Improvement and Learning\)](#)

The most recent tool, QUAADRIL was developed in 2010 [7]. As per QUAADRIL, the audit team includes as a minimum: a radiologist, a diagnostic radiology medical physicist and a radiographer. QUAADRIL missions have taken place in 7 institutions located in 7 countries so far: 1 in Latin America (Argentina), 2 in Europe (Bosnia and Herzegovina and Belgium) and 4 in Asia (Israel, Thailand, Malaysia and the United Arab Emirates (UAE)). (See Fig. 3.) Feedback from the hospitals showed that the audit process experience was well-received and very beneficial towards improving practices. Institutions audited thus far were big public hospitals with substantial staff and established QA/QC programs. The IAEA imminently plans to expand the audits to Africa, and more countries in Asia, Europe, and Latin America.

### **Conclusion and recommendations**

Institutions in IAEA Member States may request assistance through audits to improve the quality of their clinical practices of Radiotherapy, Nuclear Medicine, and Radiology. For these disciplines, the respective audit tools developed by the IAEA are QUATRO, QUANUM, and QUAADRIL. One hundred eighty-two (182) audits have been undertaken over the last 17 years in countries all over the world. Follow-up actions by the audited institutions have resulted in measurably higher quality of clinical practices employing ionizing radiation. Time has therefore shown that these constructive reviews of practices and facilities can indeed strengthen Quality Management programmes and ensure that patient safety requirements are met. Audit results can likewise help guide further development of the evaluated facilities.

These audit programs are not designed for regulatory purposes; nor do they incorporate reporting or investigation of adverse medical events, or assessment of potential entry into cooperative clinical research studies. Rather, the audit reports are meant to help institutions identify and constructively focus upon areas for self-improvement, towards measurably enhancing quality clinical practices within their facilities.

### **References**

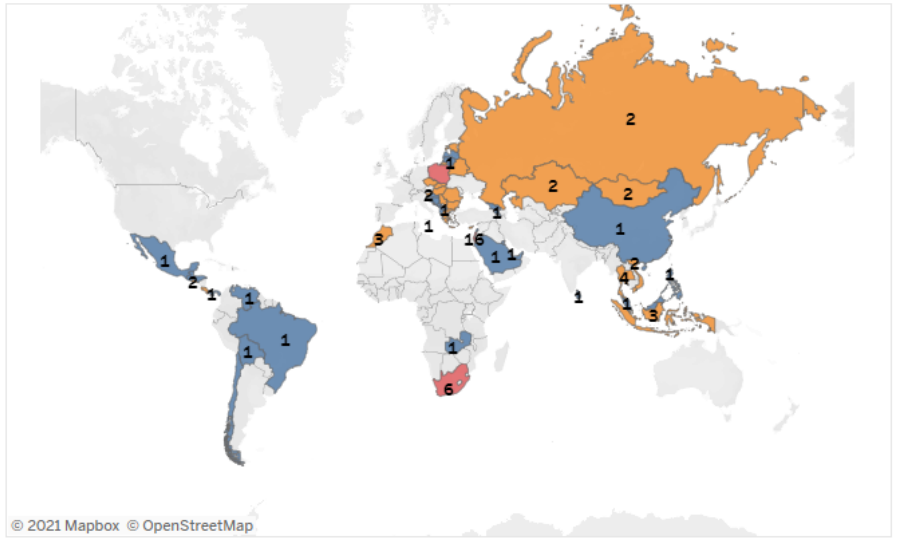
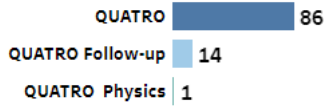
1. INTERNATIONAL ATOMIC ENERGY AGENCY, Comprehensive Audits of Radiotherapy Practices: A Tool for Quality Improvement, IAEA, Vienna (2007).
2. J. Izewska, M. Coffey, P. Scalliet, E. Zubizarreta, T. Santos, I. Vouldis, P. Dunscombe, Improving the quality of radiation oncology: 10years' experience of QUATRO audits in the IAEA Europe Region. *Radioth Oncol*, 2018, 126(2): 183-190
3. INTERNATIONAL ATOMIC ENERGY AGENCY, Quality Management Audits in Nuclear Medicine Practices, Human Health Series No. 33, IAEA, Vienna (2015).
4. Dondi M, Torres L, Marengo M, Massardo T, Mishani E, Van Zyl Ellmann A, Solanki K, Bischof Delaloye A, Lobato EE, Miller RN, Paez D, Pascual T. Comprehensive Auditing in Nuclear Medicine Through the International Atomic Energy Agency Quality

- Management Audits in Nuclear Medicine (QUANUM) Program. Part 1: the QUANUM Program and Methodology. *Semin Nucl Med.* 2017 Nov;47(6):680-686. doi: 10.1053/j.semnuclmed.2017.07.003. Epub 2017 Jul 25. PMID: 28969766.
5. Dondi M, Torres L, Marengo M, Massardo T, Mishani E, Van Zyl Ellmann A, Solanki K, Bischof Delaloye A, Lobato EE, Miller RN, Ordonez FB, Paez D, Pascual T. Comprehensive Auditing in Nuclear Medicine Through the International Atomic Energy Agency Quality Management Audits in Nuclear Medicine Program. Part 2: Analysis of Results. *Semin Nucl Med.* 2017 Nov;47(6):687-693. doi: 10.1053/j.semnuclmed.2017.07.004. Epub 2017 Jul 27. PMID: 28969767.
  6. Dondi M, Paez D, Torres L, Marengo M, Delaloye AB, Solanki K, Van Zyl Ellmann A, Lobato EE, Miller RN, Giammarile F, Pascual T. Implementation of Quality Systems in Nuclear Medicine: Why It Matters. An Outcome Analysis (Quality Management Audits in Nuclear Medicine Part III). *Semin Nucl Med.* 2018 May;48(3):299-306. doi: 10.1053/j.semnuclmed.2017.12.001. Epub 2018 Feb 9. PMID: 29626946.
  7. INTERNATIONAL ATOMIC ENERGY AGENCY, Comprehensive Clinical Audits of Diagnostic Radiology Practices: A Tool for Quality Improvement, Human Health Series No. 4, IAEA, Vienna (2010).

101 86 14 1 84 51 5

Total missions QUATRO QUATRO Follow-up QUATRO Physics Centres Countries Regions

Mission Type



Country

1 mission 2-5 missions >5 missions

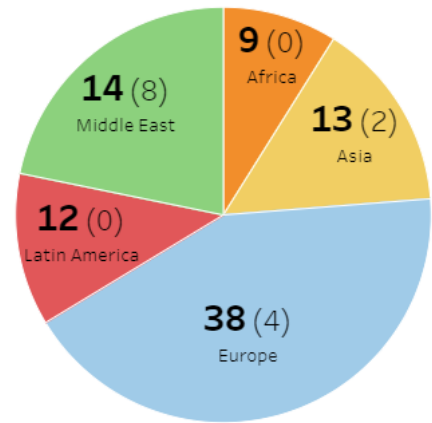
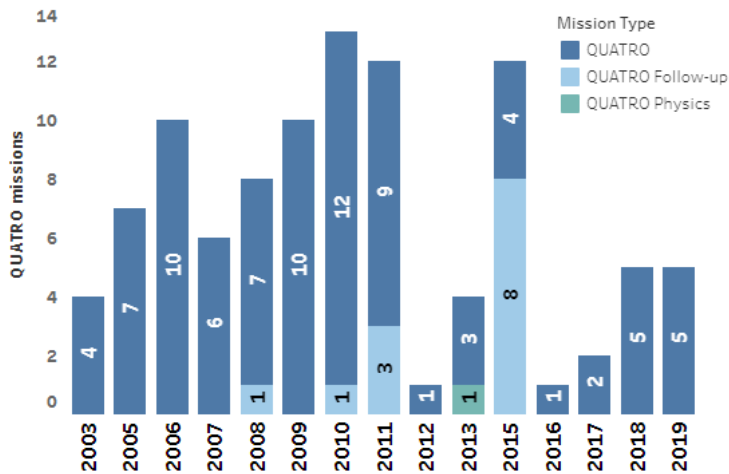


Figure 1. Quality Assurance Team for Radiation Oncology (QUATRO) audits conducted by the IAEA.

**74**  
Total missions

**36**  
Countries

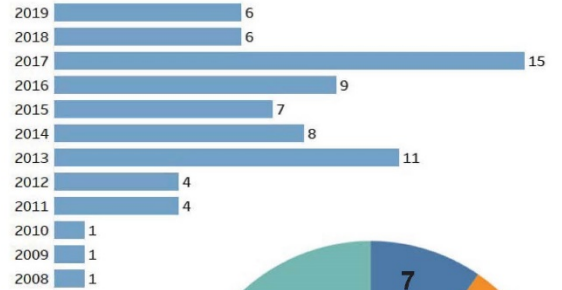
**56**  
Auditors

**540**  
Trainees

### Quality Management Audits in Nuclear Medicine Practices

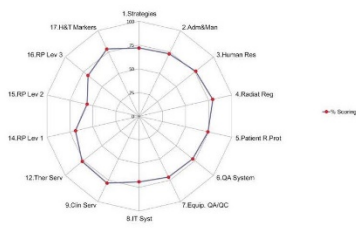


#### QUANUM Audits per year



#### First Audit

##### Summary of General Checklist Radar Plot



#### Follow-up Audit

##### Summary of General Checklist Radar Plot

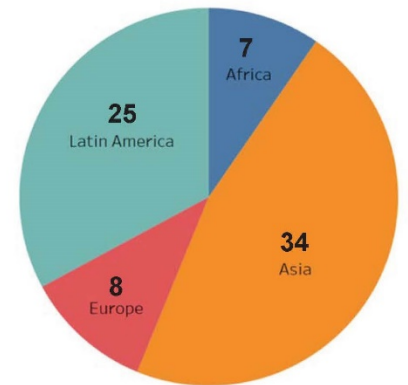
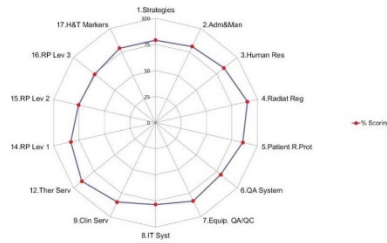


Figure 2. Quality Management Audits in Nuclear Medicine (QUANUM) conducted by the IAEA.

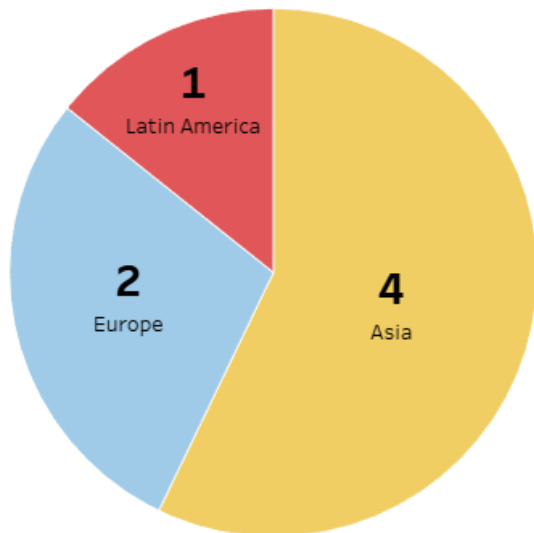


Figure 3. Quality Improvement Quality Assurance Audit for Diagnostic Radiology Improvement and Learning (QUAADRIL) conducted by the IAEA.