Quality Audits in Medical Imaging

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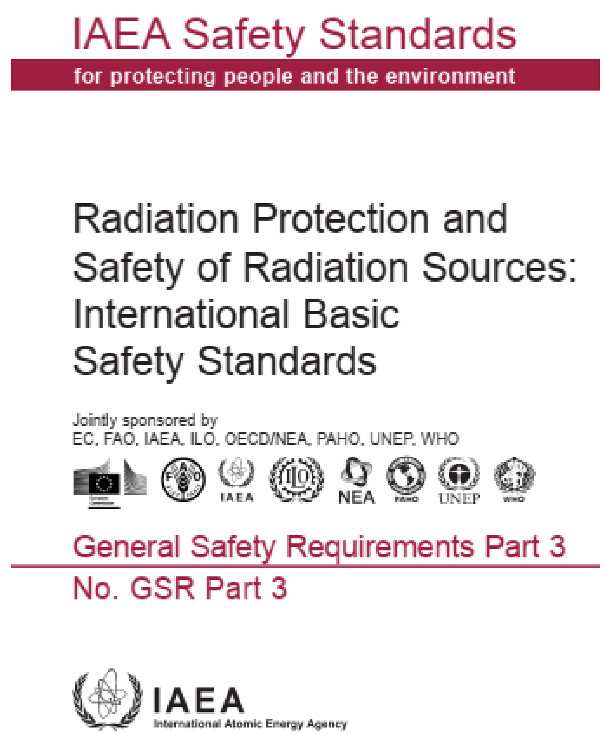
Learning Objectives

- Concept of Quality Audits in Medical Radiological Practices
- Need for Clinical Audits in Diagnostic Radiology
- Role of Comprehensive Clinical Audits in Quality Improvement in Diagnostic Radiology.
- Appropriate QA program for Quality Audits.
  - Medical Physics (Dosimetry) Audit
- Initial experience of Medical Physics Audit in Ghana
- Challenges/Way Forward of Clinical Audit
- Summary
- References

Concept of Quality Audits in Medical Radiological Practices

- The World Health Organization (WHO) has defined Quality Assurance as “an organized effort by the staff operating a facility to ensure that the diagnostic images produced are of sufficiently high quality so that they consistently provide adequate diagnostic information at the lowest possible cost and with the least possible exposure of the patient to radiation” [**WHO, 1982**].

- 3.171. “Registrants and licensees shall ensure that regular and independent audits are made of the programme of quality assurance for medical exposures, and that their frequency is in accordance with the complexity of the radiological procedures being performed and the associated risks” (**IAEA BSS, 2014**).


IAEA Safety Standards
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Radiation Protection and
Safety of Radiation Sources:
International Basic
Safety Standards

Jointly sponsored by
EC, FAO, IAEA, ILO, OECD/NEA, PAHO, UNEP, WHO

General Safety Requirements Part 3
No. GSR Part 3

IAEA
International Atomic Energy Agency

- Clinical Audits "*a systematic examination or review of medical radiological procedures which seeks to improve the quality and outcome of patient care through structured review, whereby medical radiological practices, procedures and results are examined against agreed standards for good medical radiological procedures, with modification of practices, where appropriate, and the application of new standards, if necessary*" [**EU BSS, 2014**].

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II

(Non-legislative acts)

DIRECTIVES

COUNCIL DIRECTIVE 2013/59/EURATOM

of 5 December 2013

laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom

THE COUNCIL OF THE EUROPEAN UNION,

(3) Directive 96/29/Euratom establishes the basic safety stan-

Need for Clinical Audits in Diagnostic Radiology?

- Covered by **Dr. Francis Hasford** (Colleague earlier Speaker)

Role of Comprehensive Clinical Audits in Quality Improvement in Diagnostic Radiology

- **Factors of QA processes and quality improvement in diagnostic radiology**

i. high cost of radiological equipment,

ii. ever increasing complexity of examination equipment and examination procedures due to technical advances,

iii. acknowledgement of the possibility of increasing doses to patients, and

iv. importance of radiological diagnosis to patient management within the health care.

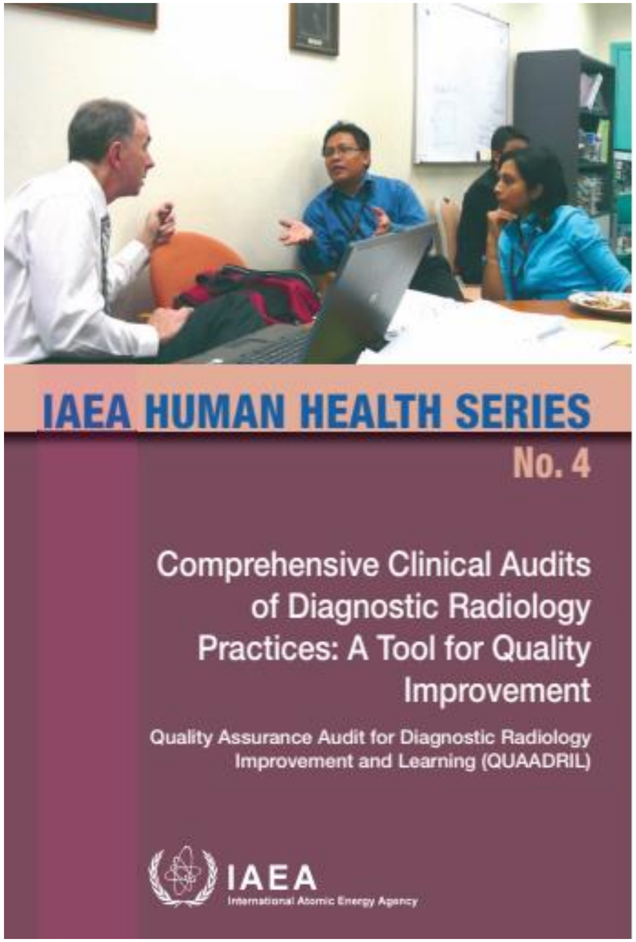
Components of Clinical Audit

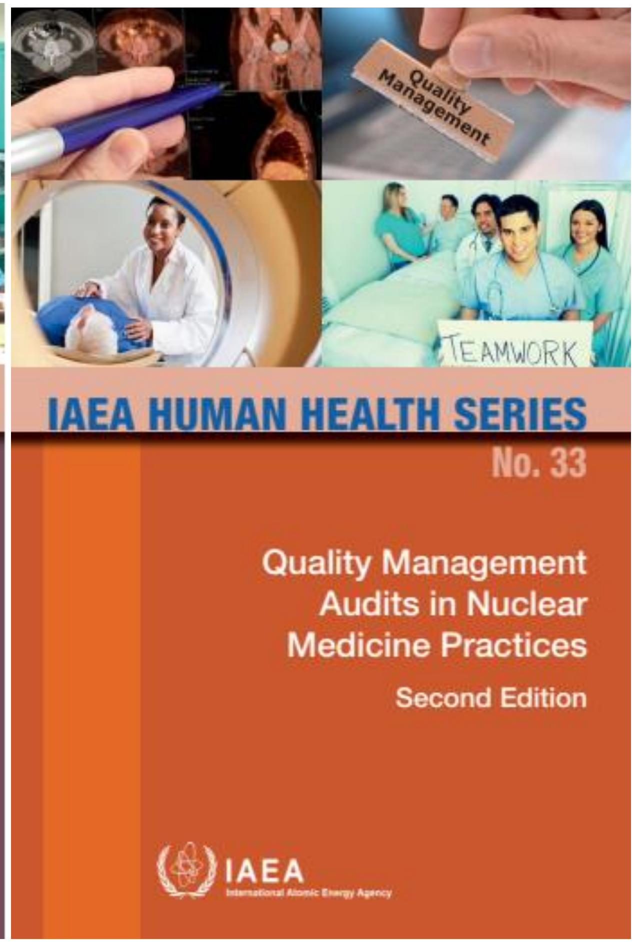
- Clinical audit
  - ✓ evaluation of data, documents and resources to check performance against standards.
  - ✓ essentially a process of fact finding and interpretation and, as such, provides an efficient tool for improvement of quality.

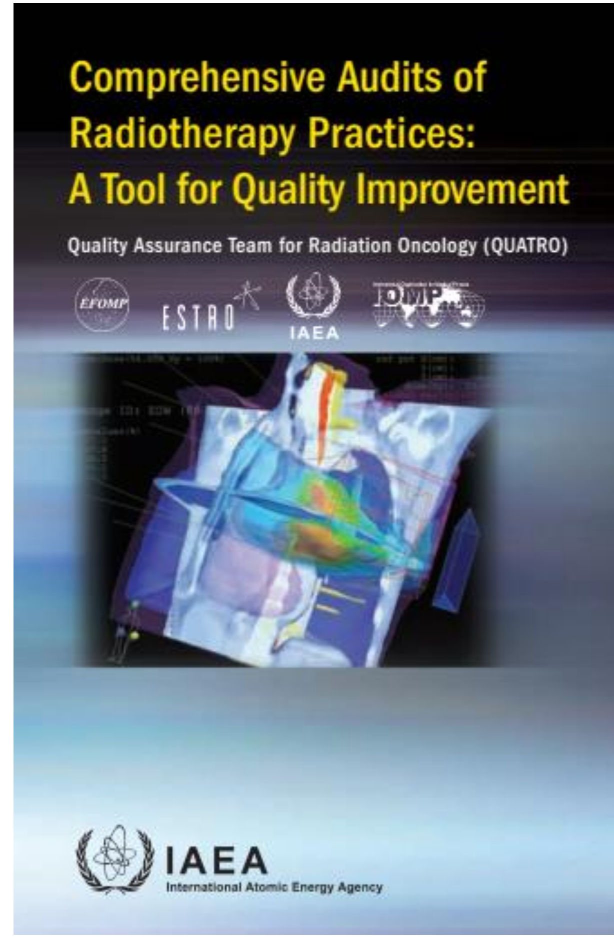
The Priorities of Clinical Audit of Diagnostic Radiology Practices

- **Structure:**
  - ✓ The mission of the unit for diagnostic radiology practices
  - ✓ Lines of authority and radiation safety responsibilities
  - ✓ Staffing levels, competencies and continuous professional development of staff, in particular for radiation protection
  - ✓ Adequacy and quality of premises and equipment
- **Process:**
  - ✓ Justification of referral practices, including referral criteria.
  - ✓ Quality of examination guidelines (protocols, procedures)
  - ✓ Optimization procedures
  - ✓ Patient dose and image quality and comparison of patient dose with nationally accepted reference levels
  - ✓ Quality assurance and quality control programmes
  - ✓ Emergency procedures for incidents which can arise during the use of radiation
  - ✓ Reliability of information transfer system
- **Outcome:**
  - ✓ Methods for the follow-up of examination outcomes

Audits in Radiation Medicine





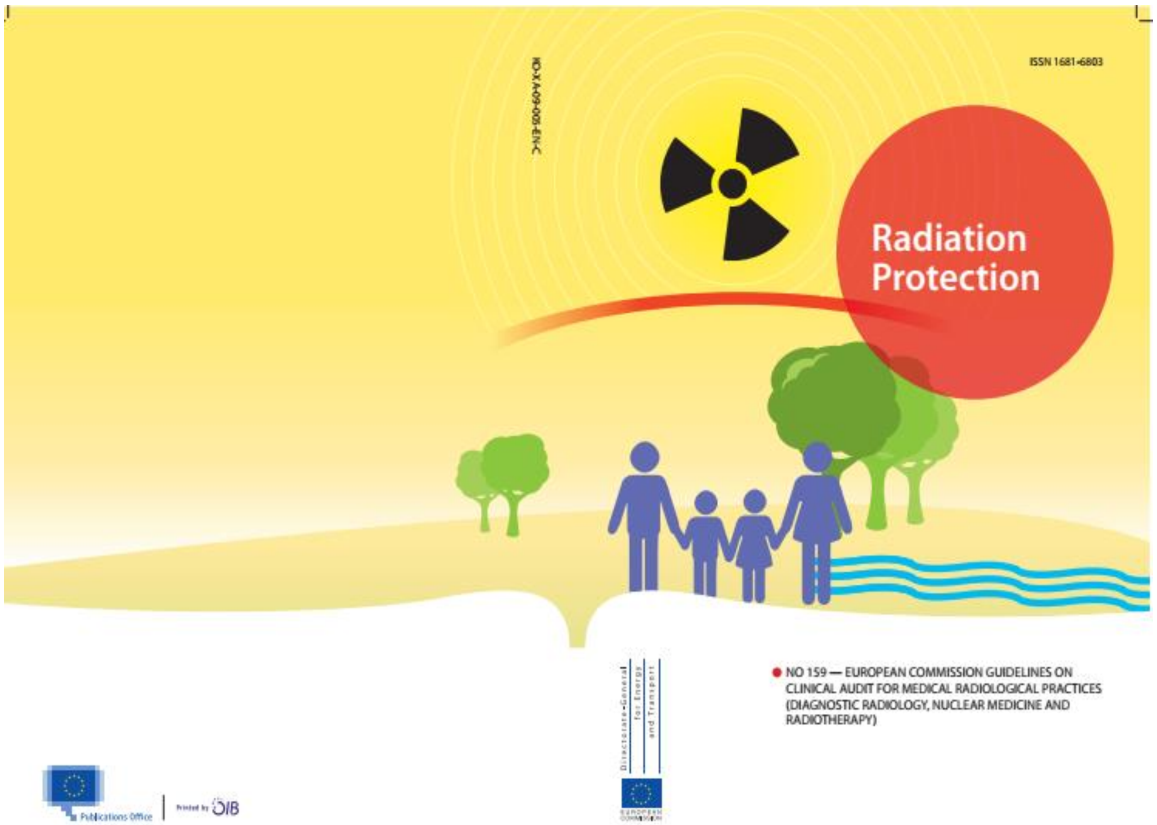


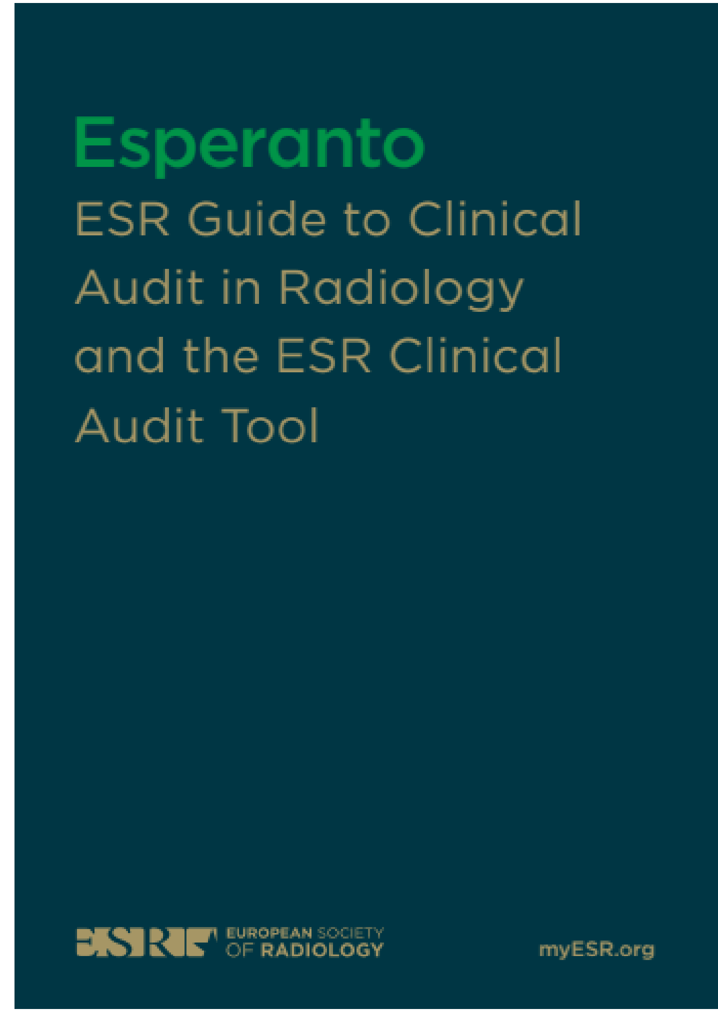
QUAADRIL

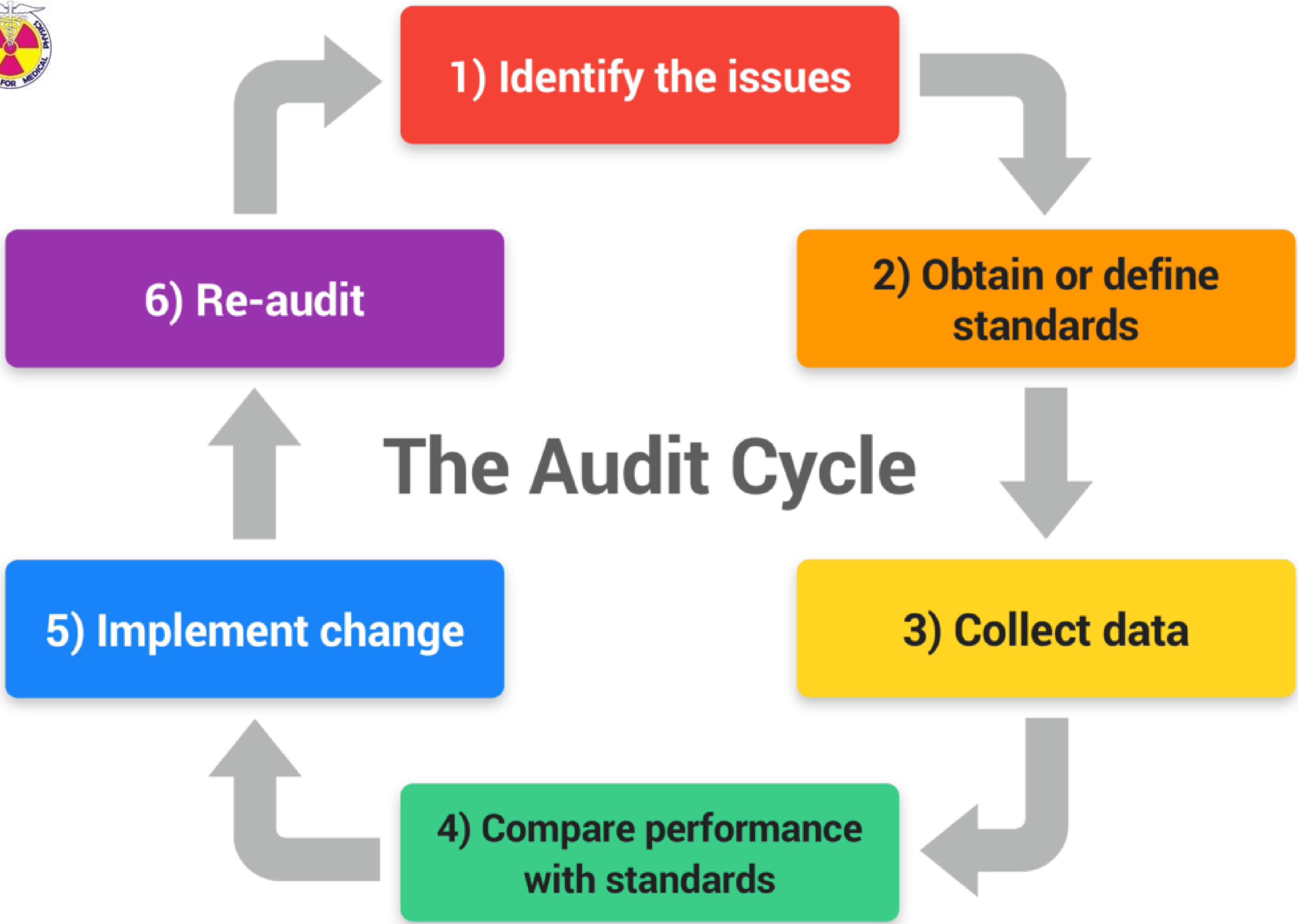
QUANUM

QUATRO

Audits in Radiation Medicine






1) Identify the issues
2) Obtain or define standards
3) Collect data
4) Compare performance with standards
5) Implement change
6) Re-audit
The Audit Cycle

Appropriate QA program for Quality Audits

- Medical Physics (Dosimetry) Audit-Radiology

✓ available facility infrastructure,

✓ radiation protection and safety,

✓ imaging equipment QA processes,

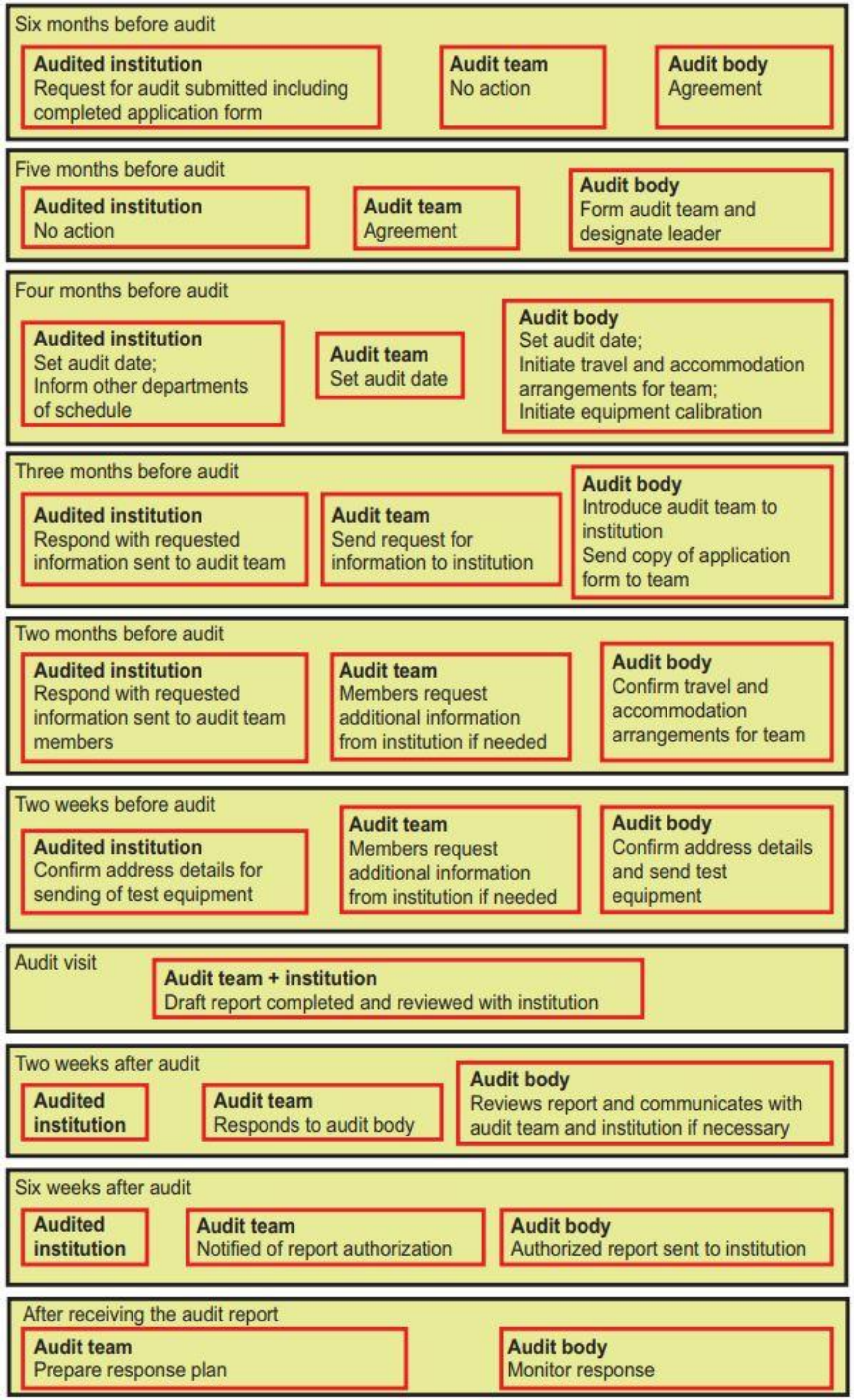
✓ optimization in clinical practice,

✓ dosimetry, and

✓ instrumentation and calibration

QUAADRIL Clinical Audit Process

Fig. 1: Proposed time-line of QUAADRIL clinical audit process.



QUAADRIL Clinical Audit Process

Fig. 2: Programme for a typical clinical audit visit

Day 1

Entrance briefing:

Introductions
Orientation presentations

Commence review:

Tour of facilities
Interviews

Days 2-3

Radiologist:

Review of policy and procedures

Review of procedures

Audit of practice and images

Physicist:

Review of policy and procedures

Review of QC and acceptance testing protocols

Practical measurements

Radiographer:

Review of policy and procedures

Review of radiographic procedures

Review of radiographic QC

Day 4

Meet with staff to complete information collection (including measurements if required) and clarify any issues:

Audit team complete drafting of audit report as a group

Day 5

Exit briefing:

Audit team finalize draft report, and hand report and copies of relevant worksheets to institution

Initial experience of Medical Physics Audit in Ghana

- **Dosimetry Audit of Selected Medical Diagnostic X-ray Installations in Ghana**

- **Objective**

✓ medical physicists of the Ghana Atomic Energy Commission undertook dosimetry audit of selected diagnostic X-ray installations in Ghana, as part of a national need to ensure safe use of radiation in healthcare.

✓ Aim was to analyze data from the audit and assess performance status of the X-ray installations in the sampled diagnostic radiology centres.

Methodology

- **Two fronts**

✓ firstly to compile and analyze equipment [e.g. automatic exposure control (AEC) functionability, etc.] and staffing data (e.g. Radiographers, etc.) and

✓ secondly to assess performance evaluation of the X-ray systems. Tests performed on the systems included:

  ✓ accuracy,

  ✓ reproducibility and linearity of the X-ray tube potential,

  ✓ half value layer, beam alignment and congruence,

  ✓ tube current linearity,

  ✓ tube housing leakage, and

  ✓ assessment of entrance surface doses.

Pubic, Private & Quasi Govt. Hospitals
Private Diagnostic Centres

Preliminary Results

Table 1: Results for kVp reproducibility, HVL, mAs linearity, tube leakage and beam alignment tests

Test	kVp reproducibility	HVL (mmAl)	mAs Linearity (%)	Tube Housing Leakage (mGy)	Beam Alignment (mm)
Tolerance (x)	x < 0.050	x ≥ 2.3	-10 ≤ x ≤ +10	x ≤ 1	x ≤10
No. of X-ray machines	27	27	26	25	27
Minimum	0.001	2.4	0.0	0.1	1
Medium	0.002	4.4	0.6	1.3	4
Maximum	0.707	6.1	1.0	4.7	11
Mean ± SD	0.096±0.180	4.4±1.0	0.5±0.4	1.6±1.2	4.0±2.3

Preliminary Results

Table : Summary of performance status on audited X-ray installations

Test	Number of X-ray installations		
	Within tolerance	Out-of-tolerance	Total
kVp accuracy (at 50 kVp)	22	5	27
kVp reproducibility	21	6	27
Half value layer	27	0	27
mAs linearity	26	0	26
Tube housing leakage	9	16	25
Beam alignment	26	1	27
Congruence	27	0	27

Preliminary Results: Summary

- ✓ 27 X-ray installations were assessed in the audit project
- ✓ half value layer and congruence tests were within tolerances
- ✓ 1 single X-ray system was found to be out-of-tolerance with beam alignment test,
- ✓ 19% of facilities were out-of-tolerances for both kVp accuracy and reproducibility tests.
- ✓ Mean entrance surface doses estimated for selected body regions ranged from 1.1 mGy (cervical spine A/P) to 6.7 mGy (lumbar spine LAT).
- ✓ None of the audited radiology centres was found to engage the services of **Qualified Medical Physicist (not in compliance with IAEA BSS of 2014 requirements).**

Responsibilities in the BSS

IAEA Safety Standards
for protecting people and the environment

Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards

General Safety Requirements Part 3
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3.154. Registrants and licensees shall ensure that:

(a) The radiological medical practitioner performing or overseeing the radiological procedure has assumed responsibility for ensuring overall protection and safety for patients in the planning and delivery of the medical exposure, including the justification of the radiological procedure as required in paras 3.155–3.161 and the optimization of protection and safety, in cooperation with the medical physicist and the medical radiation technologist as required in paras 3.162–3.177;

(b) Radiological medical practitioners, medical physicists, medical radiation technologists and other health professionals with specific duties in relation to protection and safety for patients in a given radiological procedure are specialized in the appropriate area;

(c) Sufficient medical personnel and paramedical personnel are available as specified by the health authority;

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2.41. Other parties shall have specified responsibilities in relation to protection and safety. These other parties include:

(a) Suppliers of sources, providers of equipment and software, and providers of consumer products;
(b) Radiation protection officers;
(c) Referring medical practitioners;
(d) Medical physicists;
(e) Medical radiation technologists;
(f) Qualified experts or any other party to whom a principal party has assigned specific responsibilities;
(g) Workers other than workers listed in (a)–(f) in this paragraph;
(h) Ethics committees.

IAEA

The role of the Medical Physicist in all specialities

- **Calibration** and **verification** of measurement instruments;
- **Technical supervision** of equipment operation and maintenance;
- **Records** and **documentation**;
- **Clinical computing** and networking;
- **Research** and development;
- **Education** and **training**.

Main Findings

- ✓ Dosimetry audit on selected diagnostic X-installations has presented an overview of the status and functioning of the systems at the surveyed hospitals/facilities.

- ✓ Data provided can serve as benchmark for further dosimetry audit within the country.

- ✓ Corrective actions/Follow Ups are recommended on the installed systems that failed key parameters that have implications for patient dose.

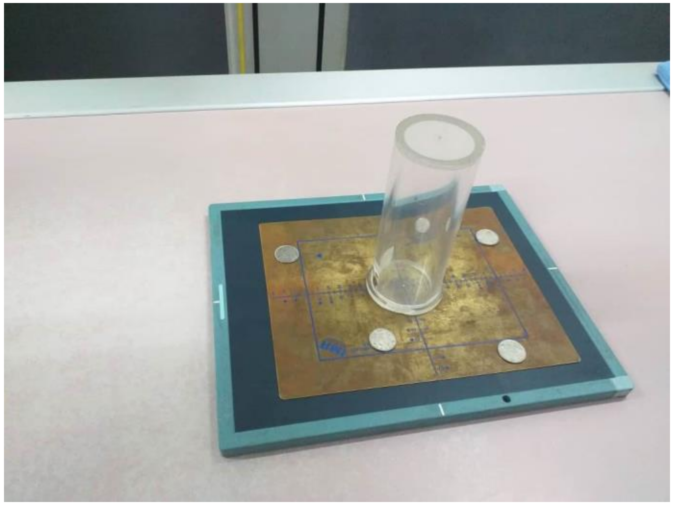
Physics Audits Performed in Ghana

Diagnostic Radiology

Team of MP auditors record tube parameters and dose set up

Physics Audits Performed in Ghana

Diagnostic Radiology



Audit of planar X-ray systems: X-ray field/light alignmen

Challenges of Clinical Audit

- ✓ lack of resources,
- ✓ lack of expertise or advice in project design and analysis,
- ✓ problems between groups and group members,
- ✓ lack of an overall plan for audit,
- ✓ and organisational impediments (e.g. suspicion of managerial interference, etc.)

Way forward

- ✓ Radiologic Team (Radiologists, Radiographers, Medical Physicists, etc.) should embrace Clinical Audits: **"Learning To Work Together "**
- ✓ Hospitals and Facilities are encouraged to carry out their own audits
- ✓ Institutionalisation of Clinical Audits by the Health Service, and especially Professional Bodies
- ✓ Learn From Success Stories (some models)
  - ✓ setting up coordinating functions
  - ✓ clinical audit versus contracting process
  - ✓ forming clinical audit committees

Summary

- **Clinical Audits are:**

✓ intended as an independent assessment of how actual clinical practice compares with the standards of good practice,

✓ how well the systems in place are achieving a set of objective quality standards, with the primary aim of improving patient care,

✓ process of fact finding and interpretation and,

✓ provide an efficient tool for improvement of quality.

References

- World Health Organization. Quality Assurance in Diagnostic Radiology, Geneva, 1982. [http://whqlibdoc.who.int/publications/1982/9241541644.pdf]
- European Parliament and Council. Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom, Luxemburg, 2014. [http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:2014:013:FULL&from=EN]
- European Commission (2009) European Commission guidelines on clinical audit for medical radiological practices (diagnostic radiology, nuclear medicine and radiotherapy). Radiation Protection No 159. [Accessed: 26 August 2020] Available from ec.europa.eu/energy/sites/ener/files/documents/159.pdf
- European Society of Radiology (2016) ESR audit tool. [Accessed: 26 August 2020] Available from myesr.org/sites/ default/files/ESR_2016_Audit-Tool.pdf
- International Atomic Energy Agency (IAEA). Radiation protection and safety of radiation sources: International Basic Safety Standards (BSS). General Safety Requirements, GSR-Part 3. 2014. IAEA, Vienna.


Thank You

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