Quality Assurance & Quality Control
For Radiotherapy

Definitions
**Definition 1**

*‘Quality assurance in radiotherapy’ is all procedures that ensure consistency of the medical prescription, and safe fulfillment of that prescription, as regards the dose to the target volume, together with minimal dose to normal tissue, minimal exposure of personnel and adequate patient monitoring aimed at determining the end result of the treatment.*

**Definition 2**

*‘Quality control’ is the regulatory process through which the actual quality performance is measured, compared with existing standards, and the actions necessary to keep or regain conformance with the standards.*
Definition 3

‘Quality standards’ is the set of accepted criteria against which the quality of the activity in question can be assessed. Various national or international organizations, such as the World Health Organization (WHO), American Association of Physicists in Medicine (AAPM), European Society for Therapeutic Radiation Oncology (ESTRO), etc. have issued recommendations for standards in radiotherapy.

Need for QA
**Need for QA 1**

- Quality assurance reduces uncertainties and errors in dosimetry, treatment planning, equipment performance, treatment delivery, etc., thereby improving dosimetric and geometric accuracy and the precision of dose delivery.

- Quality assurance not only reduces the likelihood of accidents and errors occurring, it also increases the probability that they will be recognized and rectified sooner if they do occur, thereby reducing their consequences for patient treatment.

**Need for QA 2**

- Quality assurance allows a reliable inter-comparison of results among different radiotherapy centers, ensuring a more uniform and accurate dosimetry and treatment delivery. This is necessary for clinical trials and also for sharing clinical radiotherapy experience and transferring it between centers.

- Improved technology and more complex treatments in modern radiotherapy can only be fully exploited if a high level of accuracy and consistency is achieved.
Sources of RT Errors

- Errors may occur at any stage of the process and be made by every staff group involved. Particularly critical areas are interfaces between staff groups, or between processes, where information is passed across the interface.
- Most of the immediate causes of accidental exposure are also related to a lack of an adequate quality assurance program or a failure in its application.
- General human causes of errors include complacency, inattention, lack of knowledge, overconfidence, pressures on time, lack of resources and failures in communication.

Whose responsibility is it?
Whose responsibility is it?

Radiation Oncologists
- Consultation
- Prescription
- On-Tx evaluation
- Follow-up, etc.

Medical Physicists
- Specification, Acceptance testing, commissioning
- Beam data collection, Calc. procedures and documentation
- Plan and chart review
- Supervision of Therapy equip.
- Maintenance, safety and performance
- Establishment of QA procedures for therapy equip.
- Radiation safety and protection in the department.
Whose responsibility is it?

Radiotherapy technologists (radiation therapists)
- Clinical operation of simulators, CT, Linacs
- Accurate patient set-up and delivery of planned dose

Documentation of treatment and observing patient progress and any signs of complication
Daily QA of the equipment

Whose responsibility is it?

Dosimetrists
- Accurate patient data acquisition
- Radiotherapy treatment planning
- Dose calculation
- Record and Verification Entry

Documentation of treatment plan and dose calculation
Patient measurements
Whose responsibility is it?

Everyone!

Quality Control
QC Program should include:

- Document control.
- Procedures to ensure that the quality system is followed.
- Ensuring that the status of all parts of the service is clear.
- Reporting all non-conforming parts and taking corrective action.
- Recording all quality activities.
- Establishing regular review and audits of both the implementation of the quality system (quality system audit) and its effectiveness (quality audit).

QA & QC of RT Equipment
Elements of Equipment

QA & QC

- Equipment specification
- Acceptance
- Commissioning
- Periodic Quality control
  - Test method
  - Test equipment
  - Parameters to test
  - Frequency of measurement
  - Responsibilities of different group of staff
  - Reference values
  - Tolerances
  - Actions to be taken
  - Rules for documentation

QA / QC of Linacs

- Test Categories
  - Patient - Specific
  - Daily
  - Basic (weekly to monthly)
  - Extended (6 months to 2 years)
QA INSTRUMENTS

- Daily
  - Daily Test Dosimeter
  - Consistency checker
  - Daily test phantom

- Basic (weekly to monthly)
  - Ion chamber
  - Electrometer
  - Basic - test phantom
  - Beam - alignment test frame
  - Film phantom
QA INSTRUMENTS

- **Basic (weekly - monthly)**
  - Ion chamber
  - Electrometer
  - Basic - test phantom
  - Beam - alignment test frame
  - Film phantom

- **Extended**
  - Calibrated ion chamber (ADCL)
  - Electrometer (ADCL)
  - Water phantoms
  - Plastic phantoms
  - Film
  - Alignment tools
  - Scanning water phantom
  - Daily - test tools
  - Basic - test tools
AAPM Report 46
(TG-40)