**Quality Assurance and Quality Control in Mammography**

**What is quality assurance?**

Quality assurance can be defined as all the plans and systemic actions taken to provide satisfied given requirements for quality. It is regarded as an essential part of the Mammographic system. With the passage of Mammography Quality Standards Act (MQSA) by congress and its implementation by the Food and Drug Administration basic quality assurance and quality control are now a matter of law.

**Factors used to assess the quality of a radiograph of mammography**

![Mammographic Image Quality Characteristics](image)

- Keys to obtain high quality images
  - Proper positioning to maximize tissue visualization
  - Image with adequate contrast and resolution
  - Minimum image unsharpness
  - Proper exposure
  - Free of artifacts

**Quality assurance requires an entire system of monitoring**

- Appropriatedesigned and adjusted equipment both in
  - Image obtaining
  - Optimum film Processing
- Development of personal skills and knowledge of technologists and radiologists
- Monitoring of the performance of both radiographers and radiologist
- Analyzing and interpretation
- StandardizedReporting system such as ACR, BIRAD. (that provide an organized structure for reporting)
- Collecting statistical information such as number of biopsies & cancer diagnosed

As well as
• Minimum radiation dose to both patient and the staff.
• Maximize cost containment (by minimizing wastage of time & resources.

**Mammographic Quality system can be performed by two aspects**

1. **Organizational aspects**: Specifies the overall management programme.
2. **Technical aspects**

**Including**:

Assignment and responsibility, Establishment of standards, Staff training, Proper documentation of procedures, Quality control of equipment at the installation and throughout its working life.

**Organizational aspects of Mammographic quality system includes**

1. Quality manager
2. Quality manual
3. BIRADS team
4. Reject analysis

**1. Quality Manager**: A senior member of the staff is appointed as the quality manager

**Responsibilities of quality manager**:

Form a quality assurance/quality control committee, (quality assurance/quality control committee should establish specifications, guidelines and testing procedures), Implementation of quality policy, Production of quality manual, documentation, Monitor and review of the quality control programme, Development, Completion and administration of the quality assurance programme

**2. Quality Manual**

**It should include**:

Names of those responsible for the various aspects of the quality system.
Details of acceptance commissioning and routine test procedures, Equipment maintenance and repair, Should list the limiting values for each test, test frequency and the corrective actions to be taken

**3. BIRADS Team**

**Consist of the**: Radiologist, Technologist, Physicist
All should work closely together to maintain image quality and the delivery of quality service.

Radiologist:
Provide motivation and leadership to the team, Should have firm understanding of the technology and interest and provide technological oversight and continuing education courses for the quality assurance program.

Radiologist Technologist
Should be a certified person, Should have licensure, Must be familiar with correct operation of the mammographic equipment, Must be trained, Must have knowledge of Radiographic techniques, Participate in continuing education courses.

Medical Physicist
Must be certified in radiological physics, Must receive continuing education.

4. Reject analyzing
It is an essential component of quality system.
Provides – performance of the equipment
   Its correct use by the radiographer
All the rejected films should be collected and classified according to the reason of rejection
eg: Over exposed, Under exposed, patient movement, Poor positioning
Result should be analyzed and discussed with a view to improve performance
It helps to determine the reject rate for particular mammographic unit or Individual radiographers. Achievable reject rate is 3%

Technical Aspect (Quality Control)

Technical aspects of mammography quality system includes four steps:

1. Steps specification
2. Acceptance testing
3. Commissioning
4. Routine testing

   1. Steps specification
Choice of mammographic equipment is the extremely important first step
Specification of the equipment should form part of the purchase contract
Once the equipment has been installed it must be tested to ensure that it performs according to its specification.
2. **Acceptance testing**
   Can be done by the medical physicist with the guidance of the radiologist. Should be designed to ensure the Image quality, Patient dose, Radiation Safety to ensure that the equipment meets the manufacturers specifications & the expectations of the user.

3. **Commissioning**
   Comprises the tests that are carried out to ensure that the equipment is ready for clinical use. It includes measurements to provide baseline values, against which routine checks can be compared and optimize the performance of the system. After repair work or service some may need to be reported to establish new baseline values. Once the system is in clinical use its performance must be monitored by a series of routine tests (can be done daily, weekly, six monthly, annually). If the results of the tests are outside from the recommended limits appropriate actions to be taken.

4. **Routine testing**

   **4.1 Tests of the X ray set**

   **Safety:** Safety of the equipment to be checked at installation and at regular intervals & thereafter when problem is found for electrical, mechanical, radiation

   **Mechanical Checks:**
   Power assisted system for breast compression, There must be no slackness which could lead to uneven compression, Automatic and emergency release mechanisms, Compression force - Should not exceed 200N

   **Radiation Safety checks:**
   Function and layout of the exposure controls and warning lights, Assessment of X Ray filtration, Estimation of the leakage, Transmission through the Lead protective screen and the tube, Collimation of the beam and alignment

   **Tests of the tube performance**

   Tube Voltage:

   By kV meter specially designed for mammography (6 monthly)

   Focal Spot size (star pattern, slit camera, pinhole), Should be measured at commissioning and annually thereafter, At 28kV and at the most used value of the tube current,

   The Output; To be checked every 6 months, Tests should be made for the tube currents, tube voltages and anode filter combinations

   **Automatic Exposure Control (AEC):**
AEC system (kV and object thickness compensation, OD control, short term reproducibility...) Should be checked for variations with exposure conditions including, with and without grid, standard and magnification geometries, changes in tube current, voltage, target material filtration, varying position of the detector.

4.2 Tests of the screen film system processing and viewing

Cassettes:

Screen-Film contact, Cassette Speed, Light tightness, Inter-cassette sensitivity, Anti Scatter grid (grid system factor)

Grid:

Dose increasing factor, The rate of the incident air Kerma values, determined with and without the grid and should be measured at acceptance, Uniformity of the grid, Poor electrical connection

4.3 Film Processing:

Darkroom (safelights, light leakage, film hopper, cleaning), Most important test of the processor Sensitometry, Helps to assess speed, contrast and base plus fog of the film, And also helps to monitor the processor temperature, replenishment rate, fixer retention, Base line (temperature, processing time, film OD), Film and processor (sensitometry), Helps to assess speed, contrast and base plus fog of the film

4.4 Viewing:

Viewing Boxes:

(brightness, homogeneity), Light output of the viewing boxes should be measured at least annually, Simple visual checks - Carried out every 3 monthly

4.7 Environment (room illumination)

Recommended routine quality control tests should be undertaken for conventional screen film mammography systems by radiographic staff.

<table>
<thead>
<tr>
<th>Test</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Processing quality control (sensitometry &amp; temperature)</td>
<td>Daily before clinical images are processed or whenever processor maintenance is performed</td>
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<tr>
<td>Dark room cleanliness</td>
<td>Daily At least weekly or when artifacts appears</td>
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<tr>
<td>Test</td>
<td>Frequency</td>
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<td>---------------------------------------</td>
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<tr>
<td>Checks on acquisition and reporting monitors</td>
<td>Daily</td>
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<tr>
<td>System check</td>
<td>Daily</td>
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<tr>
<td>Printer checks using test pattern</td>
<td>Daily</td>
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<tr>
<td>Check of contrast-to-noise ratio</td>
<td>Weekly</td>
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<tr>
<td>Image quality tests</td>
<td>Weekly</td>
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<tr>
<td>Artifact and uniformity check</td>
<td>Weekly</td>
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<tr>
<td>AEC thickness check</td>
<td>Monthly</td>
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<tr>
<td>Test of acquisition and reporting monitors</td>
<td>Monthly</td>
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<tr>
<td>Mechanical safety and function checks</td>
<td>Monthly</td>
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<tr>
<td>Detector flat-field calibration</td>
<td>As required</td>
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<tr>
<td>Repeat analysis</td>
<td>As required</td>
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<tr>
<td>Printer checks following software upgrade</td>
<td>As required</td>
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<tr>
<td>Check after mobile unit moves</td>
<td>As required</td>
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<tr>
<td>Check after engineer’s visit</td>
<td>As required</td>
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<tr>
<td>Check after software or any other changes to the imaging chain including rulers/calipers</td>
<td>As required</td>
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</table>

**Recommended Routine quality control tests for full-field digital mammography systems**

Following chart describes the recommended routine QC tests that should be undertaken by radiographic staff. The results of all tests must be recorded on paper, or electronically on spreadsheets to facilitate data analysis and auditing.

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(References: Quality Assurance Guide lines for Mammography including radiography & Routine quality control tests for full field digital mammography system. Quality Control National Quality Assurance co-ordinating Group for Radiography, NHSBSP publication)