College of Radiology, Academy of Medicine of Malaysia

Recommendations & Guidelines

for

Quality Assurance

in

MAMMOGRAPHY

15 July 2008

Mammogram Working Group

Chairperson
Dr Siti Fathimah Abbas
MD(UKM) M Med (Radiology)(UKM), AM(Mal)
Consultant Radiologist and Head of Department, Melaka Hospital

Members
Prof Dr Humairah Samad-Cheung
MBChB (Edinburgh), MSc CTM (U of London), MSc Hospital & Health
Management (B'ham), FRCR, FAMM
Professor of Radiology, International Islamic University Malaysia; Director, IIUM Breast Centre

Dr Evelyn Ho Lai Ming
MBBS (Mal), M Med (Radiology)(UKM), AM(Mal), FAMS (Hon)
Consultant Clinical Radiologist, Megah Medical Specialists Group Sdn Bhd

Dr Yun Sii Ing
MD (UKM), M. Med Rad (UKM)
Consultant Radiologist and Head of Department, Sungai Buloh Hospital

Assoc Prof Dr Yang Faridah Abdul Aziz
MBBS (Mal), MRad (UM)
Consultant Radiologist, University Malaya Medical Centre.

Dr Shantini Arasaratnam
MBBS (Mangalore), MRad(UM), AM(Mal)
Consultant Radiologist, Kuala Lumpur Hospital

Prof Dr Ng Kwan Hoong
PhD, MIPEM, DABMP, AM(Mal)
Professor, Department of Biomedical Imaging (Radiology), University of Malaya

Dr Pirunthavany Muthuvelu
BSc(Hons) (USM), MSc (Medical Physics) (Leeds) PhD (Biomedical Physics) (Exeter)
Principal Assistant Director, Ministry of Health Malaysia

Ms Ravi Chanthriga Eturajulu
BSc (Hons) in Medical Imaging (UK), Diploma in Radiography (Mal)
Chief Radiographer, University of Malaya Medical Centre

Mrs Hajah Salmah Ahmad
Dip College of Radiographers (UK)
College of Radiographers, Malaysia

CONTENTS

1. INTRODUCTION

A Quality Assurance Programme (QAP) in mammography is vital because mammography is technically one of the most demanding radiological investigations, and consistently high quality mammograms are essential. Poor quality mammograms can lead to misdiagnoses, increased number of inappropriate biopsies, and lower detection rates of breast cancer. It requires a combined effort by all staff involved in mammography, to ensure that every aspect of their work is directed towards the achievement of high quality mammograms every time. It can be described as the maintenance of standards and continual pursuit of excellence, and is required in both screen film mammography (SFM) and full field digital mammography (FFDM) systems.

Mammography QAP involves everyone from radiographer or radiologic technologist to the radiologist. The strength of the QAP is dependent upon the weakest link in any step (or person responsible for the step) in the chain of production of a mammogram including the interpretation of the images by the radiologists. Therefore, the highest standard of care can only be produced by excellent teamwork.

2. DEFINITIONS

Concepts of Quality Assurance (QA) and Quality Improvement in healthcare are detailed below.

- **Quality Assurance (QA)** is a process of assuring quality.
- **Quality Management (QM)** is the overall management function that determines and implements a policy for quality.
- **Quality Control (QC)** is the technical part that deals with techniques and activities required to maintain the quality of the performance.
- **Total Quality Management (TQM)** is a structured, systematic approach in which all employees are utilized as a source of ideas in order to continuously improve processes, services and products. It embraces the concept of improving quality, rather than merely assuring it.

The effectiveness of a QM programme in mammography is reliant on the performance of the correct QC tests, charting and recording of their results and comparison with previous results. Appropriate standards have to be set based on internationally accepted standards. The appropriate corrective measures must be taken whenever quality is found to be suboptimal.

3. GOALS & OBJECTIVES

The main goal of a QM programme is to ensure that the patients, their families and the community obtain maximal achievable benefits from the mammography examination provided by the medical facility, within the available resources.

The specific objectives are to:

i.   Achieve consistently high quality mammograms

ii.   Limit radiation dose

iii.   Minimize the number of supplementary and repeat examinations

iv.   Minimize the number of unnecessary invasive procedures

These objectives are achieved by establishing and implementing a QM programme in a planned manner, so that quality is continuously monitored. Shortfalls in quality may then be systematically investigated, and the causes established so that appropriate corrective measures to improve quality are instituted.

4. QUALITY ASSURANCE COMMITTEES

In general, most Radiology (may also be known as Imaging or Biomedical Imaging and Intervention) Departments that offer mammography should have a Departmental QA Committee, chaired by the Head of Department (HOD). A representative from the Mammography Unit should be a member of the Committee, preferably the senior radiographer-in-charge of the mammography service. Problems involving quality in mammography can thus be brought up to the attention of the Departmental QA Committee, and through the Committee to a higher level of hospital administration, if necessary.

Within the Mammography Unit, radiographic quality assurance and quality control is the responsibility of all radiographers performing mammography and is monitored by the senior radiographer in charge of the mammography unit.

5. EQUIPMENT SPECIFICATIONS

The specifications for equipment to be used in mammography are as follows:

- The mammography equipments must have FDA or European standards approval

- Computed Radiography (CR) systems used must have similar approval

- If analog mammography system is used, a dedicated table top processor must be used for printing of the mammogram films

- All equipments must pass the QC tests and possess current certification by an independent H class licensee

The following radiation dose is recommended:

- Mean Glandular Dose (MGD) per single cranio-caudal view should not exceed 3mGy when using grid for a 50% adipose, 50% glandular breast (preferably 2mGy) per exposure

- Where a contact non-grid technique is used, the mean glandular dose should not exceed 1.0 mGy

- The Effective Radiation Dose for a standard 2 view per breast mammogram should be about 0.7mSv

- Digital systems should meet the same dose standard as film screen systems

6. PERSONNEL

6.1. Qualifications

Mammography requires appropriately trained personnel for optimal quality. The mammography team consists of trained radiographers, radiologists and medical physicists.

6.1.1 The Mammographer is a suitably trained female radiographer who has undertaken a formal and recognized training programme in Radiography at an accredited institution, whether in the country or abroad. She must be in possession of a Diploma or Degree in Radiography.

6.1.2 The Radiologist is a suitably trained doctor who has post-graduate qualification in Radiology, and experience and training in Breast Radiology.

For imaging of symptomatic women:

1. Radiologists should be competent in reporting mammograms, performing and interpreting breast ultrasound and in supervising specialised mammography techniques. The radiologist should acquire the skill in performing image-guided biopsy and localization of impalpable breast lesions.

2. Recognized and recommended descriptive terms should be used in the reporting of mammogram and breast ultrasound. Details of site, imaging size and nature of any abnormality should be reported. When available, the present examination should be compared to previous studies and this should be indicated in the report. The overall impression should include the likely diagnoses, the assessment category and recommendations for any further diagnostic procedure or intervention.

3. They should participate in personal breast imaging audits and multidisciplinary breast service audits.

4. They should regularly update their knowledge with at least two Continuous Medical Education/Professional Development (CME/CPD) in the field of breast imaging every 5 years

6.1.3 The services of a Medical Physicist should be available from time to time to assist in the implementation of the QM Programme at every Mammography facility.

6.2. Responsibilities

6.2.1 Radiologists assigned to mammography must

i.   assume the primary responsibility for the quality of mammography and for the implementation of an effective quality assurance program at their mammography facility

ii. review the QA and QC test results and trends periodically and provide advice when problems or sub-standard quality are detected.

iii. select a radiographer to be the quality control radiographer to perform the prescribed QC tests

iv. arrange for the staffing and work scheduling of personnel, so that adequate time is available to carry out quality control tests, record, document and interpret the results

v. provide frequent and consistent feedback to the radiographer about clinical film quality and quality assurance procedures

vi. review the radiographers' performances at least every 3 months

vii. review medical physicists' / independent H class licensee's results annually or more frequently when needed

viii. oversee or designate a qualified individual to oversee the radiation protection programme for employees, patients and others in the Mammography Unit

ix. ensure that records concerning employees' qualifications, mammography techniques and procedures, quality assurance, safety and radiation protection are properly maintained and updated in the procedures manual

x. submit a report on QAP to the head of department at the appropriate intervals determined by the Departmental QA Committee. The report must include QC and Audit activities, Reject Analysis, and Training requirements

6.2.2 Radiographers assigned to Mammography have the following responsibilities, to:

i. assist the radiologist in observing the QA Programme

ii. be in-charge of QC activities, film reject analysis, documentation and recording of QA/QC test results

iii. provide feedback on QC activities, film reject analysis and QA/QC test results to the radiologist and the Departmental QA Committee

iv. perform the prescribed tests (listed in this document) with the indicated minimum frequencies

6.3. Training

All members of the Mammography Team must be appropriately trained and continuously updated with the rapid developments in this field. They should maintain the minimum required Continuous Professional Development (CPD) points as required by their Professional bodies.

6.3.1 Radiographers' Basic training in Mammography

This is compulsory for radiographers before practising mammography. It is required to achieve the level of expertise required to produce consistently high quality mammogram

Contents of the training received should include the following:

- Basic mammography equipment

- Mammography techniques and patient positioning

- Mammography Standards guideline

- Quality Assurance and Quality Control Tests

- Practicals on

    o mammography techniques and patient positionining

    o quality control tests

The Society of Radiographers will take up the responsibility of organizing training courses for radiographers practising mammography

6.3.2 Refresher Courses for Radiographers and Radiologists

These are aimed to maintain and develop radiographers' and radiologists' knowledge of mammography and breast imaging.

- Radiographers and radiologists who have attended the basic training and are in active mammography practice must attend at least two refresher courses every 5 years

- Total duration of each training course will be 2 - 3 days

- Contents of training programme/course

    Mammography equipment

    Mammography techniques and patient positioning

    Breast disorders

    Interpretation of mammogram

    QA and QM in Mammography

    QC tests in Mammography

    Safety of Patients and Personnel during Mammography

    Documentation and Communication

7. METHODS OF QUALITY ASSURANCE

7.1. Quality Control Tests (QC Tests)

7.1.1 QC tests that must be performed by the medical physicists include the following:

(unless otherwise specified, the tests apply to both analogue and digital units)

i. Mammography unit assembly evaluation

ii. Collimation assembly test

iii. Focal spot size measurement

iv. kVp accuracy and reproducibility

v. Beam quality assessment

vi. AEC system performance

vii. Uniformity of screen speed (analogue units using film-screen)

viii. Breast entrance exposure and average glandular dose

ix. Image quality evaluation / Phantom Image Evaluation

x. Missed tissue

xi. Artefact Evaluation

xii. Beam Quality Assessment

xiii. Breast Entrance Exposure and Average Glandular Dose

xiv. Ghost Image Evaluation (Digital units only)

7.1.2 QC tests that must be performed by the radiographers.

Analogue Units

i. Darkroom cleanliness

ii. Sensitometry

iii. Screen cleanliness

iv. Darkroom fog

v. Screen-film contact

vi. The fixer retention test

Analogue & Digital Units

i. Compression

ii. Viewbox and viewing conditions

iii. Film / Image reject analysis

iv. Visual checklists

v. Phantom image analysis with RMI 156 Phantom

A tabulated form is in Appendix 1 & 2. Do note that the tests are not limited to but should include those listed. Where applicable, the manufacturer's guidelines should be adhered to for getting the best out of your mammography unit.

IMAGE SCORING WITH THE RMI 156 PHANTOM
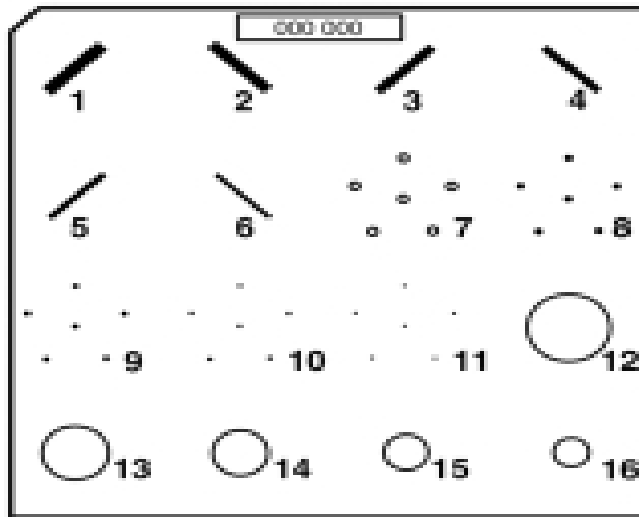
FIBRES			SPECKS			MASSES		
Number	Size	**Points**	Number	Size	**Points**	Number	Size	**Points**
1	1.56	**1**	7	.54	**1**	12	2.0	**1**
2	1.12	**1**	8	.40	**1**	13	1.0	**1**
3	.89	**3**	9	.32	**6**	14	.75	**1**
4	.75	**5**	10.	.24	**7**	15	.50	**7**
5	.54	**9**	11	.16	**10**	16	.25	**10**
6	.40	**10**						

As a minimum, the system must be able to image the following

1)   4 Fibers - (i.e. Fibers 1, 2, 3, 4 in the diagram above – the 4 largest fibres in full length)

2)   3 Specks - (i.e. 7, 8, 9 in the diagram above – the 3 groups of the largest specks and note, not every speck in a group may be visible and this must be taken into account)

3)   3 Masses - (i.e.12, 13, 14 in the diagram above – the 3 largest masses)

The American College of Radiologists (ACR) criteria requires an acceptable minimal score of 10 for fibres, 8 for specks and 3 for masses. This total score of 21 is required of Analogue systems. In practice, it would be 4 fibres, 3 speck groups and 3 masses must be seen. For digital mammography – at least 4 fibers, 3 speck groups and 3 masses must be seen (at least as good as analogue/film-screen mammography). Users are also advised to follow the manufacturer's criteria for digital mammography. Artefacts on the RMI 156 Image quality image must be

looked into, grid lines if any and also completeness of the fibre (length), number of calcifications per group as well as whether the whole margin of the mass is visible.

.

(Note: Other instructions with regards to QC tests as specified by specific vendors according to the model and make of the mammography unit may need to be implemented. See Appendix 1 for an example for a Digital Mammogram Unit)

8. QUALITY AUDITS

Quality audits are an integral part of the QM in Mammography, and should be performed at regular intervals. These audits include Film / Image Reject Analysis and the PGMI categorization of mammogram films.

8.1 Film / Image Reject Analysis (Analogue and Digital units)

The procedure is used for all analogue mammography centres as well as centres using Computed Radiography Mammography (CR) and full field digital units (DR) but are still printing films. In the case of Digital Mammography, if reject images cannot be digitally stored it is recommended that a log be kept for the specific examination reject analysis period. New categories for repeat causes may need to be created for digital mammography e.g. software failures, blank images, non appearance of images on the acquisition work station although an exposure was made and others.

8.1.2 Objective of Film/Image Reject Analysis

The objective of this audit is to determine the number of rejected mammogram films or images, and the reasons for their rejection. The analysis will help identify ways to ultimately achieve the following:

- improve mammogram quality
- reduce radiation exposure to the patients
- reduce cost

8.1.3 Frequency of Film/Image Reject Analysis

The audit is to be done quarterly (every 3 months)

8.1.4 Procedure for Film/Image Reject Analysis

i. Dispose of all existing reject films / images in the department at the start of the audit exercise

ii. Perform an inventory of total films used (or digital images taken) during the period of audit

iii. Collect all rejected mammogram films (or digital images)

iv. Sort and count the rejected films (or digital images) according to categories listed in the data sheet.

v. Determine the percentage of reject films (or reject images) out of the total number of films (total digital images taken) during the audit period, according to the formula

$$\frac{\text{Total rejected mammogram films (or rejected images)}}{\text{Total films used (or images exposed)}} \times 100\%$$

vi. Record the result in the data sheet.

vii. Record reasons for the repeat or reject

8.1.5 The accepted standard for Film/Image Reject Rate

The overall reject rate ideally should be 2% (but less than 3% is probably acceptable).

8.1.6 Definition of the Rejected Mammogram

Exposed mammogram films (or digital images) which have no diagnostic value and have to be discarded are classified as rejected mammograms. Excluded are the following:

- any film / (or image) discarded during a testing procedure or taken for test purposes
- any film / (or image) used for quality control tests that are discarded

8.2 PGMI Categorization

8.2.1 Criteria for Image Assessment (Cranio-Caudal View)

a. All breast tissue imaged

- Nipple in profile
- Nipple in midline of imaged breast

b. Correct film identification clearly shown

- Date of the examination

- Client identification – name / number / date of birth

- Side markers

- Positional markers

- Radiographer identification

c. Correct exposure according to workplace requirements

d. Good compression

e. Absence of movement

f. Correct processing

g. Absence of artifacts

h. No skin folds

i. Symmetrical images

8.2.1.1 Classification of Images

P = Perfect images - both images meet all listed criteria

G = Good images

- All postero-medial tissue visualized (axillary portion of breast not to be included at expense of medial portion)
    - Nipple in profile
    - Nipple in midline of imaged breast
- Both images meet all criteria listed inclusive of b to f as listed above in 8.2.1
- A minor degree of variation in items g to i as listed in 8.2.1 will be accepted for categorization as G

M = Moderate images (acceptable for diagnostic purposes)

- Most breast tissue imaged (however all breast tissue must be imaged on MLO view)
- Nipple not in profile but clearly distinguishable from surrounding breast tissue (however nipple must be in profile on MLO view)
- Nipple not in midline of the imaged breast
- Correct film identification to workplace requirement

- Correct exposure

- Adequate compression

- Absence of movement

- Correct processing

- Artefacts which do not obscure the image

- Skin folds which do not obscure the breast tissue

- Asymmetrical images

I – Inadequate images

- Significant part of the breast tissue not imaged

- Incomplete or incorrect identification

- Incorrect exposure

- Inadequate compression which hinders diagnosis

- Blurred image

- Incorrect processing

- Overlying artifacts

- Skin folds which obscure the image

8.2.2   Criteria for Image Assessment (Medio-Lateral Oblique View)

a.   All breast tissue imaged (fat visualized posterior to glandular tissue)
- Pectoral muscle shadow to nipple level

- Full width of pectoral muscle

- Nipple in profile (retro-areolar tissue well separated)

- Infra-mammary fold well demonstrated

b.   Correct film identification clearly shown
- Date of examination

- Client identification – name / number / date of birth

- Side markers

- Positional markers

- Radiographer identification

c. Correct exposure according to workplace requirements

d. Good compression

e. Absence of movement

f. Correct processing

g. Absence of artifacts

h. No skin folds

i. Symmetrical images

8.2.2.1 Classification of Images

P = Perfect images -both images meet all listed criteria

G = Good images

- All breast tissue imaged
    - o Pectoral muscle well demonstrated
    - o Nipple in profile
    - o Infra-mammary fold well demonstrated
- Both images meet all criteria listed inclusive of b to f as above in 8.2.2
- A minor degree of variation in items g to i as listed above in 8.2.2 will be accepted for categorization as G

M = Moderate images (acceptable for diagnostic purposes)

- All breast tissue imaged
- Pectoral muscle not to nipple level but posterior breast tissue adequately shown
- Nipple not in profile but retro-areolar tissue well demonstrated
- Infra-mammary fold not clearly demonstrated but breast tissue adequately shown
- Correct film identification
- Correct exposure
- Adequate compression
- Absence of movement
- Correct processing
- Artefacts which do not obscure the image
- Skin folds which do not obscure the breast tissue

- Asymmetrical images

I = Inadequate images

- Part of the breast not imaged
- Incomplete or incorrect identification
- Incorrect or inadequate exposure
- Inadequate compression which hinders diagnosis
- Blurred image
- Incorrect processing
- Overlying artifacts
- Skin folds which obscure the image

8.2.3 Quality Standards

- >97% of images to be in P, G or M categories

  overall 75% in the P & G groups is desirable with >3% in the P group
- <3% of images to be classified "Inadequate"

8.2.4 Each mammographer should perform the following:

8.2.4.1 Regular repeat and reject analysis of every mammographer and technical repeats should be <3% of total film used

8.2.4.2 Film Rating of every mammographer

Criteria includes:

- >75% should be in perfect or good group in PGMI rating system.
- >97% should be in P, G, M groups.
- <3% in inadequate group.

8.3 Breast Cancer Detection Rate (Medical Audit)

A comprehensive QA programme should not only evaluate mammographic equipment, the imaging procedure and processes, but must also include the evaluation of the accuracy of image interpretation and competency in the performance of invasive and interventional procedures. These Medical Audits are useful to virtually everyone involved in the operation of a mammography practice.

Successful auditing with the achievement of optimal results can boost staff morale at the mammography facility. Should an audit uncover an area of deficiency, this indicates the existence of a problem. It may also provide the clues to identifying the source of the problem, and enable the institution of the appropriate corrective measures. Once corrective action has been taken, a repeat audit limited to the area of deficiency can be done to demonstrate improvement.

8.3.1 All mammography facilities should perform medical audit annually.

8.3.2 Each facility must have the following in place:
- a tracking system to collect outcome data
- a tracking system for all positive mammography report
- biopsy results available for all positive cases
- the histological diagnosis of all biopsy / FNAC specimens
- a tracking system to determine the ultimate clinical outcome of all positive cases
- The TNM classifications should be noted and documented for all cases of Breast Cancer.

8.3.3 The following values are derived from the data collected
- True Positive (TP)
- False Positive (FP)
- True Negative (TN)

8.3.3.1 False Negative (FN)

It is important to determine the cause of all known FN interpretations. This should be recorded by retrospective review of images, to determine the reason why a lesion was not detected. Some of the possible reasons include:
   i. poor quality image (over exposure/under exposure and others)
   ii. improper patient positioning
   iii. inaccurate interpretation
   iv. dense breast

8.3.3.2 Sensitivity, Specificity, Positive and Negative Predictive Values

From the TP, TN, FP & FN values the following can be derived.

- Sensitivity = TP/(TP + FN)
- Specificity = TN/(TP + TN)
- Positive Predictive Value (PPV)   = TP/(TP + FP)
- Negative Predictive Value (NPV) = TN/ (TP + FP)

8.3.3.3 Biopsy Rates

Each mammogram facility should record the following information. The optimal results are shown in parenthesis:

- Positive biopsy rate of needle biopsy (> 20%)
- Positive biopsy rate of localization (> 50%)
- Interval cancer rate – only if the Mammography Facility carries out proper population screening at regular intervals. This is not yet feasible in the Malaysian context

The baseline results obtained may be compared with the results of subsequent Audit exercise or be compared with the results published from other Centres or Institutions.

9. DOCUMENTATION

The following must be documented.

i. All results of the QC tests are to be recorded so that proper tracking and trending can be documented.

ii. All results of radiographers' and radiologists' audits must be recorded for proper tracking and trending.

iii. All Training Records of Personnel and Training Courses attended

iv. Policies and procedures for quality improvement

10. COMMUNICATION & PATIENT EDUCATION

It is good practice to have direct communication with the referring doctor with regard results of mammograms, when they fall into the slightly suspicious or highly suspicious categories. In the mammography facilities where patients seek mammograms directly, the patients should be counseled on the results of the mammograms and referred to a breast physician/surgeon/breast

clinic for further evaluation and management.

It is important for patients to understand the usefulness and limitations of the procedure they are undergoing including the fact that there are false negative or false positive findings and the procedures they will need to undergo for the further evaluation of some of the findings in their mammograms. Radiologists should take the lead in this arena whilst well trained mammographers (radiographers/radiologic technologists) would also be able to assist in this as they would have direct contact with the patients. All doctors referring their patients for mammograms should also understand the procedure and process.

11. RADIATION SAFETY

Radiologists, medical physicists, radiographers/radiologic technologists, and all supervising doctors have a responsibility to minimize radiation dose to individual patients, to staff, and to society as a whole, while maintaining the necessary diagnostic image quality (the concept of ALARA - "As Low As Reasonably Achievable").

Facilities, where possible, in consultation with the medical physicist, should have in place and should adhere to policies and procedures, in accordance with ALARA, to vary examination protocols to take into account patient body habitus and breasts characteristics.

The dose reduction devices that are available on imaging equipment should be active or manual techniques used to moderate the exposure while maintaining the necessary diagnostic image quality. An example would be the imaging of small breasts for which an experienced mammographer would immediately take steps to perform the mammogram using manual selection of exposure factors as the automatic exposure will be unlikely to produce adequate quality images.

Patient radiation doses should be periodically measured by a medical physicist in accordance with the appropriate international standards. An average effective radiation dose of about 0.7mSv for a standard mammogram (2 views per breast) is acceptable.

12. CONCLUSION

The Quality Assurance Program in mammography which is an extension of the already on going quality assurance program in the imaging department will ensure consistently high quality mammograms leading to accurate diagnosis at low cost and minimum radiation to patients. This will contribute towards the country's objective, vision and mission of providing affordable and quality healthcare for all Malaysians.

BIBLIOGRAPHY

1. Adams HG, Arora S. Total Quality in Radiology. A Guide to Implementation. St Lucie Press & the American Healthcare Radiology Administrators Education Foundation; 1997. p. 3-10, 148- 157.

2. American College of Radiology Practice Guidelines for Determinants of Image Quality in Digital Mammography, 2007. Available from: http://www.acr.org/SecondaryMainMenuCategories/quality_safety/guidelines/breast/digital_mammography.aspx.

3. American College of Radiology Practice Guideline for the Performance of Whole Breast Digital Mammography (amended) 2006. Available from: http://www.acr.org/SecondaryMainMenuCategories/quality_safety/guidelines/breast/digital_mammography.aspx.

4. American College of Radiology Recommendations for Full Field Digital Mammography Quality Control, 2006. Available from: http://www.fda.gov/OHRMS/DOCKETS/ac/06/briefing/2006-4236b2-05-**ACR**-Table.pdf.

5. American College of Radiology Mammography Quality Control Manual, 1999. Available from: http://www.acr.org/accreditation/mammography/mammo_faq/mammo_faq_qualcon.aspx.

6. BreastScreen Australia. Available from: http://www.breastscreen.info.au/internet/screening/publishing.nsf/Content/breastscreen-1lp#accreditation.

7. Hong Kong College of Radiologists Mammography Statement, SHKCR 2007. Available from: http://www.hkcr.org/publ/SHKCR_0007_Mammography_Statement.pdf.

8. Ho ELM, Ng KH, Wong JHD & Wang HB. Quality Assurance in Mammography: College of Radiology Survey in Malaysia. Med J Malaysia 2006; 61(2): 207-208.

9. McLean ID, Heggie JC, Herley J, et al. Interim Recommendations for a Digital mammography quality assurance program. Australas Phys Eng Sci Med 2007; 30(2): 65-100.

APPENDIX 1: QUALITY CONTROL for DIGITAL MAMMOGRAPHY

Please note that these steps and the icons on the unit may vary depending on the make (brand) of the digital mammography equipment. The underlying principles should prevail. Please refer to the equipment manual as well as the manufacturer and if necessary, your medical physicist/s to ensure the tests are performed correctly.

A. Weekly

- The first (1st) day in a week

-30 minutes after the last exposure

1. Detector Flat-Field calibration test
2. Artifact evaluation test on AWS (protect)
3. Phantom Image (RMI 156)
4. Artifact evaluation for the printer

B. Biweekly

1. Compression Thickness Indicator test

A. WEEKLY

A1. Detector Flat Field calibration test

a) Make sure your detector is at a stable temperature
b) If you perform this test midday, wait 30 minutes after last exposure to start calibration procedure.
c) Place the provided acrylic phantom on the image receptor, positioning it so that it covers the entire image area
d) No compression paddle should be installed at this time
e) Set the following technique for "Molybdenum tube", Manual mode, MO filter, 25kv 130 mAs, Large focal spot , Grid IN
f) Initiate an exposure
g) Check the image quality. If appropriate, click accept image. Press the accumulate calibration button

h) Change the technique for exposure 2 to use 26kv and 100 mAs

i) Turn the acrylic 180 degrees between exposure

j) Initiate another exposure

k) Check the image quality. If appropriate, click accept image.

l) Press the accumulate calibration button

m) Repeat steps i through l for exposure 3 using 27 kv and 80 mAs

n) Repeat steps i through l for exposure 4 using 28 kv and 65 mAs

o) Repeat steps i through l for exposure 5 using 29 kv and 50 mAs

p) Repeat steps i through l for exposure 6 using 30 kv and 42.5 mAs

q) Repeat steps i through l for exposure 7 using 31 kv and 35 mAs

r) Repeat steps i through l for exposure 8 using 32 kv and 30 mAs

s) Click the end calibration sequence button to exit

A 2.Artifact evaluation test on AWS (Protect)

a) To confirm there are no artifacts resulting from the Detector

b) Create new patient for weekly QC => Under patient, click new.

> For patient info:
>
> - Last name – WEEKLY QC
>
> - First name – current month
>
> - For ID, DOB & Accession Number – current date, numbers only. If you have more than 1 AWS you should add the rm# to the ID field
>
> - At the procedure description, choose Tech QC procedure; confirm WEEKLY QC is defaulted.
>
> - Click ACCEPT

c) Remove compression paddle, and place acrylic block on receptor.

d) Confirm the flat field icon is highlighted.

e) Using the Auto-Time exposure mode, choose 28 kVp, Mo Filter and Large Focal Spot to make an exposure.

f) After the image comes out, on the right side screen under the tools, adjust the width to approximately 500; change Level to adjust system to a gray color that allows viewing of dead pixels

g) Activate the full zoom/pan (star icon) – to search for artifacts

h) Record any visible artifact.

i) Click ACCEPT

j) Confirm the next Flat Field icon is highlighted, turn acrylic 180 degrees.

k) Using the Auto – Time exposure mode, choose 28 kVp, Rh filter and Large Focal Spot to make an exposure

l) Repeat steps from (f) to (i)

Make sure you PROTECT your Weekly QC at the beginning of each month.

Click ADMIN, Click PROTECT PATIENT, CLOSE.

A 3. Phantom Image (RMI 156)

a) Confirm Phantom icon is highlighted.

b) Center phantom at chest wall of receptor. Make sure disk is properly placed.

c) Install 18 x 24cm compression paddle, compress to 4.5cm.

d) Choose second photocell position.

e) Make an exposure using the clinically used exposure setting, usually AUTO-filter. Auto-Time may be used if unable to compress to 4.5cm.

f)   When image comes up on the screen, check for fibres, calcifications and masses.

g) For adequate digital mammo score – 5 fibers, 4 calcifications and 4 masses must be seen.

A4. Artifact evaluation for the printer

a)   To confirm there are no artifacts resulting from the printing system.

b)   Click on Admin

c)   Click On Test Patterns

d)   At the word Pattern on right side, choose Flat Field from drop down list

e)   Under Output box - At the word Size choose : 18cm x 24cm Paddle 3328 x 2560

f)   Under Devices, choose your printer from the drop down list

g)   Click Print True Size

h)   Click Send

i)   At Image Queued box, click OK

j)   Click Close

k)   View image to confirm there no artifacts.

B. BIWEEKLY

B1. Compression Thickness Indicator Test

a) This is to ensure that the indicated compression thickness is within tolerance

b) Measure your phantom

c) Record this measurement as the Base on your QC chart

d) These two steps are only required the first time you perform this test, unless the phantom is replaced

e) Center the ACR phantom on the image receptor aligning edge to the chest wall

f) Install the 7.5 cm (round) spot compression paddle

g) Apply automatic compression of approximately 30 lbs of force

h) Record the thickness indicated on the compression device

i) Chart results on appropriate form

j) The cm readout should be + 0.5 cm accuracy of the actual phantom thickness