University Hospitals of Leicester NHS
NHS Trust

Policy for the Use and Management of Diagnostic Display Monitors – Picture Archiving and Communication Systems (PACS)

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Board Director Lead:	Andrew Furlong, Medical Director
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CONTENTS

REVIEW DATES AND DETAILS OF CHANGES MADE DURING THE REVIEW

Replaces policy version 1. The main changes are:

- Policy aims removed in line with new Trust template.
- 2.3: Inserted Imaging IT maintainance of equipment inventory.
- Definitions amended to reflect Trust required format.
- Within Roles and responsibilities:
    - The Director of Safety and Risk's responsibility was amended to act as chair of the Radiation Safety Committee.
    - The Medical Director was made director responsible for this policy.
    - The role of the Radiation Safety Committee was added.
    - Medical Lead of Imaging was amended to cover all CMGs.
    - Removed responsibilities of RPA as not applicable.
    - Redistributed responsibilities between Head of Medical Physics and Leicester Radiation Safety Service (LRSS).
    - Added Northampton Medical Physics responsibilities.
- Section 5 brocken down into applicable sections.
- Throughout Radiation Protection Committee changed to Radiation Safety Committee.

KEY WORDS

PACS monitors

Primary Workstation

Secondary Workstation

Review Workstation

1 INTRODUCTION AND OVERVIEW

This document sets out the University Hospitals of Leicester (UHL) NHS Trusts Policy for the use of Picture Archiving and Communication Systems (PACS) monitors for diagnosis and the review of radiological images.

1.1 UHL uses PACS to store, transfer, archive and display radiological and other images and patient information. A critical element of the PACS system is the image display and the monitor used for this purpose.

1.2 Monitors are split into two categories – Primary (used for diagnosis) and Secondary (used for review and the initial interpretation of images which could support patient management).

1.3 Standards exist around the use of monitors used for primary diagnosis. The Ionising Radiation (Medical Exposure) Regulations 2017 (IRMER 17) also apply to the clinical evaluation of the image involving a written report in the patient's notes. Those that undertake such activities may be seen as IRMER Operators. The Trust's Ionising Radiation (Medical Exposure) Regulations (IRMER) 2017 Policy (B13/2001) describes that those entitled to act as Operators are identified in individual specialty IRMER procedures and Standard Operating Procedures (SOP).

2 POLICY SCOPE –WHO THE POLICY APPLIES TO AND ANY SPECIFIC EXCLUSIONS

2.1 This policy applies to all staff within UHL who report or review radiological images.

2.2 Staff entitled to report radiological images are specified in the IRMER Procedure for Imaging- "Procedure for providing and documenting reports for radiology examinations" (Produced via Imaging Radiation Protection Group and available through the Imaging Radiation Protection Lead) and in the IRMER Procedure for Cardiology "Procedure for Providing and Documenting Reports for Radiology Examinations" (Produced via RRCV CMG Quality and Safety Board and available through the Clinical Director) or other local IRMER procedures.

2.3 This policy applies to all monitors used on or throughout UHL estate (including Alliance) for image diagnosis or review irrespective of software applications. This includes, but is not limited to, non UHL owned display monitors which are used by UHL Staff. Imaging IT maintain a inventory of equipment across the Trust and notify LRSS of any new equipment to be used for primary diagnosis. The QC programme is detailed in 5.10-5.15.

3 DEFINITIONS AND ABBREVIATIONS

A **Primary monitor** is normally used to report diagnostic images except as described in 5.6 below. Every medical exposure from ionising radiation is required to be evaluated as defined in IR(ME)R 17. This is normally demonstrated by a written radiologist report or a report by other clinicians entitled to report images.

Primary monitors are required to be used in areas of low ambient lighting to enable the grey scale display and the psychophysical response of the eye to perform in line with the required standards.

Secondary monitors are used to only review diagnostic images; they may have the same technical specification but do not comply with the required standards due to the way they are used.

4 ROLES – WHO DOES WHAT

4.1 Responsibilities within the Organisation

a) The **Chief Executive** is ultimately responsible for ensuring that the Trust has in place IRMER procedures for staff to work to, ensuring that if the procedures are followed, liability remains with the Chief Executive rather than individual staff members.

b) The **Chief Information Officer** is responsible for the provision of PACS and for the provision of IT related requirements within the policies.

c) The **Medical Director** is the director responsible for the implementation of this policy.

d) The **Director of Safety and Risk** is the chair of the Radiation Safety Committee.

e) The **Radiation Safety Committee** which is primary the escalation route for all issues with compliance to this policy.

f) The **Medical Leads for CMGs reporting on images** are delegated to ensure that the Trust Policy for PACS is implemented within their CMG.

g) All **Staff** using PACS monitors must complete PACS training (Section 6) and follow this policy and report any faults with PACS monitors to the IM&T Service Desk.

h) **Managers within IM&T and Imaging** are responsible for the delivery of PACS, the audits within this policy and training within the Trust.

i) **Leicester Radiation Safety Service (LRSS)** is a service within Medical Physics in Univeristy Hospitals of Leicester NHS Trust and is responsible for providing advice on the procurement of PACS monitors and assist with the quality control (QC) checks on primary PACS monitors.

j) The **Head of Medical Physics** is responsible for ensuring that there are adequate resources in place to carry out the responsibilities of LRSS.

k) **Northampton Medical Physics:** provide monitor Quality Control (QC) for all primary monitors within mammography.

l) **Individuals providing primary reports**: are responsible for ensuring that they do so from within reporting rooms in adequate conditions and on equipment that is calibrated. They are responsible for undertaking any checks that the system prompts them to carry out as part of the calibration process.

5 POLICY IMPLEMENTATION AND ASSOCIATED DOCUMENTS –WHAT TO DO AND HOW TO DO IT

This section covers the detailed policy requirements and how they will be achieved.

Use of Primary monitors

5.1 Primary diagnosis should only be undertaken on a suitable designated monitor, the minimum recommended standards are outlined by the Royal College of Radiologists.

5.2 Primary monitors are required to be set up in areas where the room illumination can be lowered to enable diagnosis in line with IPEM Report 91(See Section 9).

5.3 As Operators, staff using primary monitors for reporting must do so with the required room illumination, ensure any Quality Control tests are carried out (if requested) and report any damage or faults through the IM&T Service Desk.

5.4 If the Operator has concerns about a monitor and would like to check the performance when not prompted, a test pattern TG18-QC can be displayed on all primary monitors by displaying patient XXTEST,EMRADTWENTYFIVE RWES2917669. (Appendix 2).

5.5 A primary report will be written in line with IRMER procedural requirements using the images displayed on the primary monitor. This report will normally be the radiologist or reporting radiographer report unless there is a separate agreement with Imaging that no radiologist report will be produced, this will be stated as 'auto reported' on the patient's examination on PACS. These agreements cover those areas where high contrast and/or low resolution images exclude the need for the QC requirements and low ambient light level requirements of this policy. Radiologists are available for urgent review when required.

Secondary monitors

5.6 All monitors used for image review, but not reporting, are considered secondary monitors and are not required to be used in areas of low background illumination. Users are required to be trained in the use of PACs monitors and the associated software and to be aware that their use outside areas of low illumination has an impact on specular reflections and thereby the image quality.

5.7 Suitable monitors for image review are supplied by the Trust in consultation with the Medical Director and relevant advice from Imaging, IM&T and LRSS. A 1k test pattern TG18-QC can be displayed on all primary monitors on patient XXTEST,EMRADTWENTYFIVE RWES2917669 (Appendix 2). Monitors which do not display the image correctly should be used with caution. Imaging should always be contacted to review the images if the diagnosis is uncertain.

5.8 Standard desktop PC monitors and tablets can be used for review and initial interpretation of low resolution images such as Nuclear Medicine and CT using appropriate software with an understanding that some features in the image may not be visible because of the limitations of the hardware and or viewing conditions.

5.9 Smartphones and Tablets are **NOT** suitable devices for review of radiological images and must not be used.

Quality Control & Maintenance

5.10 PACS monitors are not subject to routine maintenance and will be subject to maintainance only where internal calibrations/LRSS/Northampton Medical Physics calibration checks fail.

5.11 Imaging and IM&T will be advised by LRSS on the Quality Assurance program for Primary monitors in the Trust, this will ensure that the monitors comply with the performance standards set out in IPEM Report 91. Northampton Medical Physics will provide monitor QC for all primary monitors within mammography and will not be subject to tests detailed in 5.12. Individuals providing a primary report have a responsibility to ensure that they only do so from a calibrated unit in a reporting room. Any new monitors or monitors not owned by the Trust should be reported to Imaging IT to ensure that adequate QC software is installed or that tests are undertaken.

5.12 The performance of primary monitors with auto QC software will be carried out routinely by the Operator, when requested by the system.

5.13 The performance checks of primary monitors without auto QC software will be carried out by LRSS.

5.14 The performance of the primary monitors will be overseen by LRSS, and reported to the Trust Radiation Safety Committee (RPC).

5.15 Any monitor failing to meet the above minimum standard must be decommissioned from primary diagnostic use.

Procurement

5.16 Procurement of primary monitors must be carried out in consultation with Imaging, IM&T and Leicester Radiation Safety Service (LRSS) this is to ensure the devices purchased are fit for their intended use, used in a suitable location and are purchased with the appropriate software (e.g. remote Quality Control software).

5.17 All new equipment must be notified to LRSS by Imaging and tested prior to first use.

Associated Documents – None.

6 EDUCATION AND TRAINING REQUIREMENTS

This policy is designed to raise awareness within the Trust of the standards adopted by the organisation.

6.1 All staff providing primary reports must complete the PACS training (“EMRAD PACs viewer” accessed through HELM) prior to being given a PACs login. Technical specifications of monitors and the capabilities and limitations are discussed Appendix 1 of this policy.

7 PROCESS FOR MONITORING COMPLIANCE

POLICY MONITORING TABLE

Element to be monitored	Lead	Tool	Frequency	Reporting arrangements Who or what committee will the completed report go to.
Primary monitors being used in line with policy	Imaging Service	Audit	Annual	Radiation Safety Committee
Inventory of monitors	IM&T	Report	Annual	Radiation Safety Committee
Assessment of performance of primary monitors	LRSS	Independent audit of a sample calibrations	Annual	Radiation Safety Committee
Training of Staff prior to receiving PACS login	IM&T	Report	Annual	Radiation Safety Committee
Review of primary and secondary monitors with age and location	IM&T	Inventory	Continuous	Imaging Operations

8 EQUALITY IMPACT ASSESSMENT

8.1 The Trust recognises the diversity of the local community it serves. Our aim therefore is to provide a safe environment free from discrimination and treat all individuals fairly with dignity and appropriately according to their needs.

8.2 As part of its development, this policy and its impact on equality have been reviewed and no detriment was identified.

9 SUPPORTING REFERENCES, EVIDENCE BASE AND RELATED POLICIES

This policy is supported by the following procedures and standards found in the associated documents as detailed below in Table 1, which must be used in conjunction with this policy:

Table 1. Procedures and locations

Procedure / Process / Standards	Location
Royal College of Radiologists. BFCR(12)16_PACS_DDD.pdf . The most up to date copy can be downloaded from http://www.rcr.ac.uk/ in the section Clinical Radiology / Publications and professional advice / IT Guidance	https://www.rcr.ac.uk/sites/default/files/docs/radiology/pdf/BFCR(12)16_PACS_DDD.pdf(accessed July 2018)
Royal College of Radiologists. BFCR(12)15_PACS_QA.pdf	https://www.rcr.ac.uk/sites/default/files/docs/radiology/pdf/BFCR(12)15_PACS_QA.pdf(accessed July 2018)
Ionising Radiation Policy	Insite
IRMER Procedure for Imaging- Procedure for providing and documenting reports for radiology examinations	Imaging Radiation Protection Group
IRMER Procedure for Cardiology - Procedure for Providing and Documenting Reports for Radiology Examinations	RRCV CMG Quality and Safety Board
Institute of Physics and Engineering in Medicine (IPEM) 91 – Recommended Standards for the Routine Performance Testing of Diagnostic X-Ray Systems	Hard copy held by LRSS.

10 PROCESS FOR VERSION CONTROL, DOCUMENT ARCHIVING AND REVIEW

This policy will be reviewed on a three yearly basis by the Trust's Radiation Safety Committee.

If the policy is updated, the updated version of the Policy will then be uploaded and available through INsite Documents and the Trust's externally-accessible Freedom of Information publication scheme. It will be archived through the Trusts PAGL system.

Appendix 1: Background information regarding the use of Monitors for Reporting and Reviewing Radiological Images

It is possible to view radiological images on a range of devices from high-resolution imaging workstations to a mobile phone using a variety of apps. The quality of the image viewed depends on how the image was acquired, stored and transferred to the device for viewing.

At UHL, plain films are acquired using either CR technology or increasingly DR technology which tends to have better image resolution. Fluoroscopic and fluorographic images are acquired digitally and have lower resolution than plain film images. CT and MR images have even lower resolution than fluoroscopic and fluorographic images.

All images are transferred to PACs without any loss of image information before display. Images viewed over the web are compressed

`Standard` UHL PC resolution varies. It should be noted some run as low as 800 x 600dpi

Impax uses lossless jpeg (approx. 3:1 achieved) for the DICOM archive and a lossless level of wavelet compression on the `Web" archive.

Bit depth of the images varies by modality. Images are stored in their original bit depth. There are recommended standards for the performance of display devices for primary reporting (excluding mammography) as summarised below.

Table 2. Summary of the PACS and Imaging Informatics Group minimum and recommended specification for primary diagnostic display devices used for clinical image interpretation. This guidance applies to all workstations where CR, DR, fluoroscopy, ultrasound, CT, MR, nuclear medicine and PET images are viewed (excluding mammography).

	Minimum[a]	Recommended
Screen resolution[b] (Native pixel array)	≥1280 x 1024 (~1.3 megapixels)	≥1500 x 2000[c] (~3 megapixels)
Screen size (viewable diagonal)	≥42 cm (~17")	≥50 cm (~ 20")
Maximum luminance	170 cd/m2[d]	≥500 cd/m2
Luminance ratio (maximum/minimum)	≥250:1[e]	≥500:1
Greyscale calibration	Within 10% GSDF	Calibrated to GSDF
Greyscale bit depth	8-bit greyscale (24-bit colour)	≥10-bit greyscale
Video display interface	Digital (where possible) Analogue[f]	Digital

Notes

a. The minimum specification for diagnostic display devices is only appropriate if clinical image viewing is performed according to image viewing guidelines, making use of the application software zoom, pan, magnification and windowing tools.
b. LCD devices should be run at their native resolution to ensure there is a 1:1 match between screen pixels and screen resolution, and therefore no loss of image quality due to screen interpolation. CRT displays can be run at a variety of resolutions with no loss of display quality; however, care should be taken that the correct aspect ratio is maintained to avoid distortion of the image.
c. Displays with a variety of aspect ratios are in common usage, in both 'landscape' and 'portrait' orientations. The absolute values of the horizontal and vertical screen matrix dimensions are the limiting factors in the resolution of image display. The total pixel count is therefore of secondary importance.
d. High fidelity displays (≥3 megapixels) are recommended in radiology and other areas where large numbers of images are reported to reduce image interpretation and reporting times, and thereby assist department workflow.
e. AAPM TG18 recommendation.
f. AAPM TG18 & IPEM recommendation.
g. New installations should not be analogue, except where a workstation/display package is provided as a single unit by a medical device manufacturer.

Secondary workstations

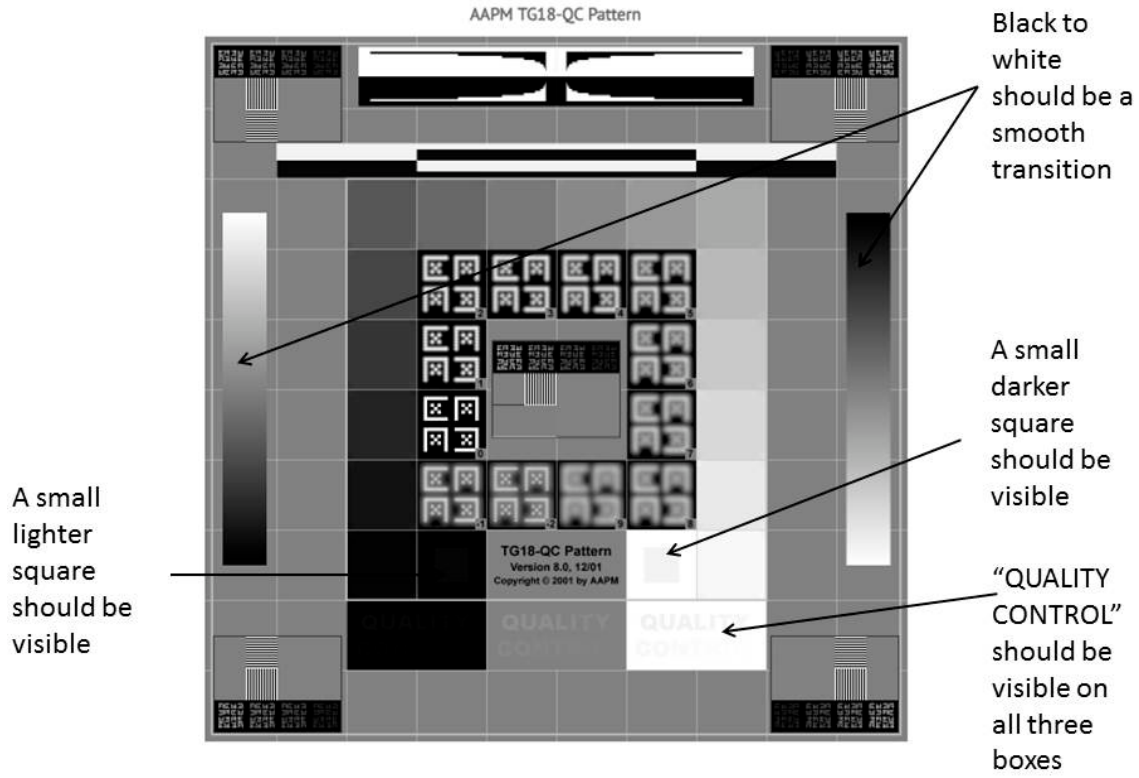
Some secondary workstations do not meet the recommended screen resolution or pixel matrix detailed above. Users need to be aware that viewing high-resolution or plain film images on lower resolution monitors will result in a loss of information

Most workstations are used in areas where the background illumination is relatively high. Users also need to be aware that specular reflections can impact on image perception.

There is freely available software to display images on portable devices. Users need to contact IM & T before installing and need to be aware of the limitations of the software although it is recognised that studies show equivalence between iPads loaded with appropriate apps and standard LCD computer screens. There is an obligation on users to keep their screens clean and scratch free. However, they must not be used for reporting and should be used with caution for image review only.

Clinicians are required to be aware that the limitations may mean some anatomical features are not visible. If there is any doubt a radiologist or reporting radiographer should be contacted.

Appendix 2: Assessing the AAPM TG-18 QC Test Image.



Samei E, Badano A, Chakraborty D, Compton K, Cornelius C, Corrigan K, Flynn MJ, Hemminger B, Hangiandreou N, Johnson J, Moxley M, Pavlicek W, Roehrig H, Rutz L, Shepard J, Uzenoff R, Wang J, Willis C. Assessment of Display Performance for Medical Imaging Systems, Report of the American Association of Physicists in Medicine (AAPM) Task Group 18, *Medical Physics Publishing*, Madison, WI, AAPM On-Line Report No. 03, April 2005.