Department: Radiology	Section: All	Effective Date: 10/2002
Procedure Number: 2.7		Reviewed: 1/2016

Radiology
Monitor Quality Control Program

Purpose: The intent is to provide consistent, quality controlled displays that meet with accepted standards of care. These requirements pertain to all diagnostic workstations utilized within the department. The monitor quality control (QC) program objectives are to ensure consistent display performance, and identify problems before they become clinically significant.

Introduction: The majority of radiologic image interpretation is performed by a clinician using a medical display (monitor). These monitors must be either calibrated or operation validated in order to provide the clinician with an accurate image. The performance standards of these monitors are defined in part 14 of the DICOM standard and are termed the grey scale standard display function (GSDF). The GSDF ensures that pixel axis ascend linearly and that images on monitors with varying levels of brightness and varying response curves appear the same within the limits of the human eye (Huschorn, 2005).

In the clinical setting, it is important that diagnostic monitors are maintained and ca provide the degree of resolution needed by the clinician. This policy defines the diagnostic monitor QC program that will be used at LSUHSC Shreveport. Although there is flexibility in the implementation, there are certain requirements for proper workstation hardware, environment, and ongoing quality control that must be met. These are based on published literature from the American College of Radiology (ACR) and the American Association of Physicists in Medicine (AAPM) regarding current standards of care. Several of these documents are listed below and can be reviewed for specific information.

ACR:

ACR Technical Standard for Electronic Practice of Medical Imaging (http://www.acr.org/SecondaryMainMenuCategories/quality_safety/guidelines/med_phys/electronic_practice.aspx)
Practice Guideline for Digital Radiography (http://www.acr.org/SecondaryMainMenuCategories/quality_safety/guidelines/dx/digital_radiography.aspx)
Practice Guideline for Determinants of Image Quality in Digital Mammography (http://www.acr.org/SecondaryMainMenuCategories/quality_safety/guidelines/breast/image_quality_digital_mammo.aspx)

AAPM:

Assessment of Display Performance for Medical Imaging Systems (www.aapm.org)

DICOM:

Digital Imaging and Communications in Medicine (http://medical.nema.org), specifically the DICOM Gray Scale Display Function

Program Outline

Evaluation Standards:

1) Cleanliness – Monitor cleanliness is important to ensure that no aspect of the image is obscured. While cleanliness will be checked monthly as part of the program, it is the responsibility of all users. Cleaning agents approved by the vendor will be kept in each physician's reading rooms. Radiology Records will be responsible for monthly visual checks for all equipment. It will be necessary for the records personnel to get with each manager to verify the best time to provide these services. **Verification by serial number to exact location of monitor. Any monitors not found or replaced must be reported to the director's office.** .

2) Quantitative luminance – Luminance refers to the amount of light emitted, transmitted or reflected from a surface (Croth, Bernat, Fetterly, Hargandreasu, 2001). Each monitor has an established range of target values. CRT luminance is determined using a photometer and is further evaluated using the Society of Motion Picture and Television Engineers Test Pattern (SMPTE) (0%, 50%, and 100% luminance). The use of this pattern in luminance evaluation is to ensure visibility of the 5% and 95% SIMPTE patches.

   The measurement obtained by the photometer is compared to the lookup table (calibration data) for the graphics card/monitor being evaluated. If the monitor readings are outside of the defined ranges, adjustments may be performed to correct the problem depending on the device. The subjective analysis of the SMPTE pattern is performed after the monitor calibration has been checked and/or corrected.

3) Image Quality Evaluation – The final evaluation step is to perform a qualitative assessment of the monitor using the SMPTE pattern and a set of clinical images. This assessment is used to assess the following image components; squareness of image geometry, spatial stability of the image, and the presence of visual artifacts.

   There components are important since each can potentially affect clinical usefulness of the monitor. The following factors and the associated analysis techniques are used to perform the qualitative assessment:

   a) Image geometry – The SMPTE pattern should appear square which indicates that the aspect ratio is correct. In addition, the displayed pattern should be properly centered. Images with geometric distortion appear warped.
   b) Temporal artifacts – Artifacts are commonly caused by image instability which appears as a wavering boundary between areas of low or high brightness. Image flickering is most often visible in the spatial resolution targets with the highest frequency.
   c) Image blur – Blurring of images is assessed by examining the alphanumeric characters in the step wedge of the SMPTE pattern. The alphanumeric characters should be clear and easy to read.

d) Image tearing – Tearing or what is sometimes termed "ghosting" of the image is assessed by examining the horizontally oriented spatial resolution patterns of the SMPTE
image. Tearing creates a blurring or smearing of the resolution targets into neighboring structures.
e) Phosphor burn in – Long term displaying of application dialog or tool boxes can result in a persistent faint image remaining on the screen.

Actions:

A monitor that fails any part of the evaluation standards will require that the problem be reported to the RIS/PACS coordinator. The RIS/PACS coordinator will determine if the monitor can continue to be used or should be taken out of service. If artifacts or instability appear in these test images, then the monitor must be repaired. The course of action for repairing a monitor will depend upon the age and/or any existing service contracts.

Frequency:

1. Cleaning and visual inspection will be performed monthly.
2. Quality control will be performed on each diagnostic monitor on the following schedule.

    a. Upon installation of new or just repaired monitor.
    b. After any major repair such as light source replacement
    c. Annually

Responsible Parties:

The RIS/PACS coordinator will be responsible for oversight of the program. The various aspects of the program will be assigned as shown below:

1. Inventory – The RIS/PACS coordinator shall be responsible for maintaining a accurate inventory of monitors that will be included in this program. New monitors will require that a log be created and testing completed before being place in service.
2. Cleaning/Inspection – Radiology Records shall be responsible for performing the monthly cleaning and inspection. The Records Director will assign staff. Any concerns noted during the inspection shall be documented and reported to the RIS/PACS Coordinator.
3. Quality Control

    a. Monitors with on board QC software – The RIS/PACS Coordinator or designee shall perform the remote testing annually and print the report. The report shall be placed in the logbook.
    b. Monitors without on board QC software will require someone to perform tests at the workstation. These monitors will be assigned to a third party

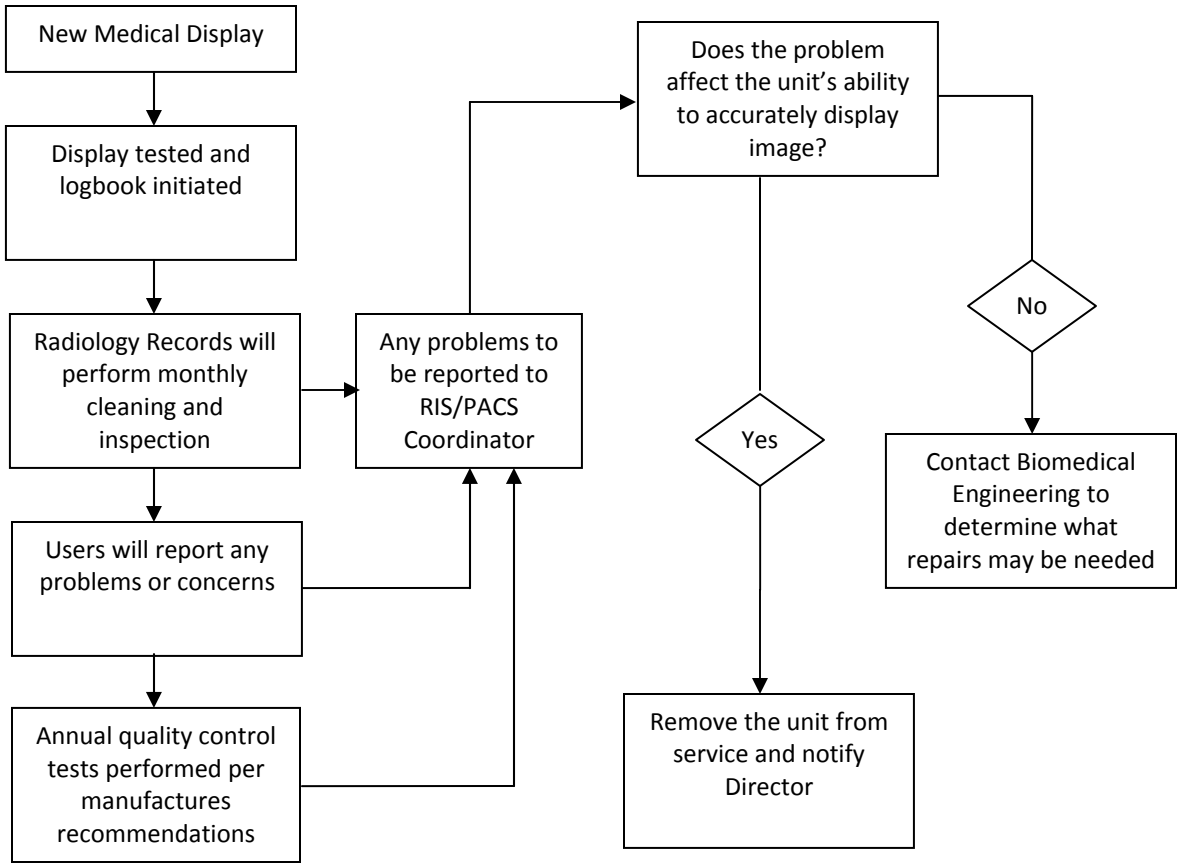
service contract. The vendor must provide a report for each monitor for placement in the logbook.

c. Photometer Checks – Monitors requiring a photometer check will be designated on the inventory sheet. These checks will be performed on the manufactures recommend schedule. The RIS/PACS Coordinator and Department Director will determine the responsible party for performing these checks.

Record Management/Reporting

Each monitor will have a log for recording cleaning, inspections and quality control checks.

Maintenance and Quality Control Cycle:



References

Groth, D.S, Bernatz, S.N, Fetterby, K.S, Hangiandreou, NJ. Calhode Ray tube Quality Control and Acceptance Testing Program: Initial Results for Clinical PACS Displays. Radiographics 2001, 21: 719-732.

Huschorn, D. QC of Medical Image Displays. Decisions in Imaging Economics

Fetterly, L.A., Hangiandreau, N.J., Langer, S.G. Monitor QC. Decisions in Imaging Economics.

A Practical Approach to soft copy display consistency for PC based review workstation. The British Journal of Radiology 2003; 76: 648-652.

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Medical Display Maintenance Log	ɔn: All	Effective Date: 10/2002
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Date Sheet Initiated: _____

Display Information	
Manufacturer	
Model	
SN	
Workstation/Modality Type	
LSU #	

Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Cleaning												
Inspection												
Notes												
Problems Reported To:												
Performed By:												
Comments:												

Annual Quality Control

Method: ☐ Remote Diagnostics ☐ Third Party Vendor ☐ Other

Luminance ☐ Pass ☐ Fail ☐NA Geometry ☐ Pass ☐ Fail ☐NA Artifacts ☐ Pass ☐ Fail ☐NA

Blur ☐ Pass ☐ Fail ☐NA Tearing ☐ Pass ☐ Fail ☐NA

Image Evaluation _____ ☐ Acceptable ☐ Unacceptable ☐NA

Image Evaluation _____ ☐ Acceptable ☐ Unacceptable ☐NA

Status: ☐ No further action needed ☐Monitor OK to use, repair request initiated ☐Taken out of service

Actions Taken/Assessment:

_____

_____

Annual Review Approved By: _____ Date: _____