Softcopy QA is the process of controlling and checking medical diagnostic and review displays with respect to medical standards. The introduction of a Picture Archiving and Communication System (PACS) is a major step forward for every medical facility. However, softcopy images, quality assurance (QA), generally perceived as a complex and technical subject, is frequently forgotten in this process. There are many preconceptions about softcopy QA. This article highlights and clarifies these assumptions and suggests ways on how to implement softcopy QA.

Danny Deroo

The amount of image display systems (MDs) for medical diagnosis or review is increasing at a very rapid pace. Some studies estimate that the current use of MDs will be doubled over the next five years. The softcopy process does not escape the all-pervasive concern about quality, and the subject is raising a growing interest among all those involved with digital imaging.

Let us imagine a situation where the following discussion takes place in the corridor of a medical facility.

- “We should replace all those old cathode ray tube displays with new flat panels so we can get rid of the calls from users who complain about poor image focus and spots of poor uniformity,” says the IT administrator.
- “This QA process is not something I should be bothered with; somebody else should check the displays,” replies a radiologist.
- “We are doing it already; we calibrate our displays every six months,” says the QA technologist.
- “The documentation of the display says it is DICOM GSDF compliant, so there is no problem here,” states the medical physicist in order to justify their current QA process.

Based on the above assertions, which are all partly right and partly wrong, life-critical decisions about medical displays are made in a matter of seconds.

Calibration is not softcopy QA?

Calibration is only the initial step of controlling the displays. Images are generated at the acquisition site, run through a central processing cycle and are finally shown on a medical display. However, in this image chain, the data are vulnerable to a series of process deficiencies, such as look-up tables, corrections, etc. For every image coming from a different imaging modality, the same level of detail should be clearly visible. To achieve this, there is only one solution, namely the use of the DICOM GSDF (Digital Imaging and Communications in Medicine Grayscale Standard Display Function). This is a standard contrast curve, according to which display devices (i.e. the combination of a graphic controller and a display) can be calibrated. Using DICOM GSDF, softcopy displays can be calibrated in order to ensure that images look the same when viewed on different workstations and at different times. This, of course, implies that every diagnostic and review display connected to the PACS network is calibrated to this standard contrast curve. This is done by integrating so-called “additional intelligence” into the display to ensure it is ‘DICOM out of the box.’ Simply put, DICOM GSDF is achieved by applying an LUT (Look Up Table) in the image chain of the display system. The LUT can be added either in the graphic controller or in the display itself (Figure 1).

It is obvious that a display retailer needs full control over the internal components of a graphic board, so that eight-, ten- or even twelve-bit accuracy can be achieved. When combining the board with the display, every system should be thoroughly tested.

The significance of softcopy QA

Within today’s hospital environment, many engineers use a calibration tool to reset display systems to the DICOM GSDF curve. This process takes place, for example, twice a year following the display manufacturer’s recommendation. Engineers can thus be confident that the displays are always DICOM GSDF compliant. In some cases this re-calibration is a corrective action, e.g. because instability was reset or another issue was resolved, but it is also very possible that the re-calibration was not necessary at all. What can be learned from the softcopy QA process is that a display system should only be recalibrated when it is necessary. This can be done by running a softcopy QA check-up twice a year. If the result of this check-up recommends a new calibration, it should be done at that moment. Calibrating only when the softcopy QA process tells you to do so will also result in a lower workload for the QA support staff and a higher uptime of the workstations.

Most guidelines use two categories of medical displays based on the application: displays used for diagnostics and displays used for reviewing only. This is still a very technical, regionalised issue. However, this will change in the future as a new working group has been established to develop an IEC 6223-3-6 standard, which can be applied in 36 countries worldwide. The working group aims to finalise the standard beginning 2007.

Current QA tools mostly support the test patterns and wizards for the DIN6868-5-7 and AAPM TG18 standards. Converting the highly technical tests into an easy to use application or plug-in is a challenge.

Who and how to QA?

The person who installs the workstations is responsible for the initial set-up and calibration of the displays. Once this is done, the real QA work begins. In order to maximise workstation uptime and ensure diagnostic confidence, one person should have the responsibility for organising softcopy QA and should have the appropriate QA tools available to do so. Central management tools, asset management tools and a good notification system are key. With the help of these advanced features, it will be possible to check more displays using the same resources in the future.

In some healthcare facilities, the QA technologist imposes a visual test for each radiologist the first time they log in every day (Figure 2).

A short presentation with clear QA objectives and some practical training adds to the meaningfulness of the test, enhances staff motivation and leads to a better outcome. In such presentations, it may be necessary to address the pre-conception that QA has already been discussed and clarified during the PACS retailer selection. Even though displays claim to be always DICOM GSDF compliant, it is still necessary to check them to verify that they meet the defined quality level.

“Let it be… (intervention) free”

Intervention-free is the only way forward. Implementing QA standards can involve hours of work. It is recommended that the functionality details of the retailer’s QA tools (e.g. a front sensor for real DICOM GSDF compliance) be examined so that automated tests are also reliable. It is easy to check if a backlight is depleted by running automated tests using any kind of built-in sensor.

Such QA tools are often bundled with the hardware and give local control of calibration and some QA tests. Good central management tools are an additional option. They enable extra features like notifications, reports, remote actions, etc.

The main cost driver for softcopy QA is the labour cost.
Investments for central tools can easily be justified if the QA technicians can start to control and check things remotely. In the meantime, workstations can still be used and some tools even allow tests that might influence the reading of a study to be run during the night. Results are logged and accessible through an easy-to-use web interface.

“Don’t worry, be happy”
On average, a study is read in less than a minute. During this time, radiologists should not have to worry about the quality of the images shown. They must be able to rely on the image data chain, the combination of hardware and software and all their configuration settings. Having a softcopy QA programme in place will increase the diagnostic confidence of the radiologists. Missed diagnoses still occur, but if there is one person responsible for QA, able to determine when the last calibration and QA tests were run, by who and with which QA tools, there will be far fewer discussions about image quality in the facility.

Conclusions
It is a fact that LCD displays are still not perfect and that future imaging technologies are likely to have some inherent problems too. Calibration and softcopy QA are two different processes, both of which are necessary to ensure that medical displays continuously meet the required standards. Softcopy QA starts at installation time and never ends. Softcopy QA is not a responsibility to be assigned to a couple of staff members as an ‘extra’ job. It should be part of the medical facility’s strategy to establish budget and training for at least one person, e.g. a medical physicist or a QA technician, who will be responsible for softcopy QA. Even when making the move to PACS or updating workstations, it is important to add softcopy QA requirements to the RFP (request for proposal).

References
1. DICOM Part 3.14, supplement 28: Grayscale Standard Display Function
http://medical.nema.org/dicom/final/sup28_ft.pdf
2. AAPM TG18: American Association of Physicists in Medicine Task Group 18
http://deckard.mc.duke.edu/~samei/tg18
4. EUREF: European Reference Organisation for Quality Assured Breast Screening and Diagnostic Services
http://www.euref.org
5. NEMA: National Electrical Manufacturers Association
http://www.nema.org

Danny Deroo is R&D and Product Manager QA products with Barco n.v.
www.barco.com/medical