SEMINARS IN BREAST DISEASE

Implementation of Full-Field Digital Mammography: A Technologist's Perspective

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Full-field digital mammography (FFDM) is affecting the way breast imaging centers work. The reports of gained efficiencies in workflow by operating in a cassetteless and filmless environment are intriguing and taunt analog users. The gained efficiencies, however, do not come without a price. The price is not only the increased cost of equipment, but also the added stress of the implementation process. Being prepared for the experience is important to avoid unexpected problems and undue stress. The purpose of this article is to help the reader understand what to expect during the implementation of an FFDM unit. The key factors for a smooth transition from analog to digital are preplanning with a team approach, mapping out workflow to completely understand each step in the process, and fully understanding the benefits and limitations of the system.

KEYWORDS digital mammography, workflow, breast imaging, full-field digital mammography

For the purposes of this article, it is assumed that the equipment vendor has been selected, the site visits have been completed, and the equipment order is ready to be placed. A major decision to be made is whether to purchase a single unit or outfit the entire department. Our facility chose to initially add a single unit so that we could experience firsthand what the difference in workflow would be, thus enabling us to adapt and to make changes before adding more units. This approach is supported by Semine[1]: "With these types of transitions there are a lot of kinks, and psychological glitches in the beginning. [*By starting out with a single unit*] we will have worked through most problems by the time we have converted to a completely digital environment." Whichever option you choose, be prepared to be flexible and to make changes as you go. Going from an analog environment to a digital one is not as easy as installing a new machine and gaining efficiencies. A "learning curve" is involved in all aspects of the transition.

Multidisciplinary Team

First, in the installation process, a multidisciplinary team needs to be established. This team should represent a sample of everyone who will be involved with the implementation of the digital system.[2] Your team should include, but not be limited to, a radiologist, medical physicist, mammography supervisor, quality control technologist, information technology (IT) personnel, service engineer, and vendor representative. The radiologist should evaluate the clinical impact and how it may alter workflow; the mammography technologists should compare workflow diagrams between the analog and digital environments, and analyze the different duties that may be expected. The quality control (QC) technologist should assess the differences between analog and digital quality control tests and formulate a plan for implementing the new testing. The medical physicist should evaluate the technical aspects of the digital system and assist with the physical arrangement of the soft-copy image viewers and film viewers. The IT person should assess the connectivity requirements of the system. A service engineer is important during installation planning to explain install information and to understand what is expected from the facility. The vendor should be present to answer questions and to forward unanswered questions to the company.

Space Requirements

After the team has been identified, the planning process can begin. (For assistance with questions and considerations for

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all stages of the planning process, refer to Table 1.) The first item to address is the space requirement. You need to make sure that the equipment fits into the space that has been planned. The physical components of a digital system include the acquisition station, interpretive workstation, archive for digital images, and a high-quality laser printer. In addition, some vendors may require, or suggest as an option, a technologist workstation. Equipment vendors can supply the measurements of these devices to assist with the planning process. The space planned for the workstation will require room for the digital monitors, and a place to display the previous analog images for comparison. Some room-darkening measures may be needed to restrict ambient light and to prevent glare on the digital monitors.[2] You will need to consider where the power outlets are located and whether more will be needed. Federal guidelines require that the facility have the ability to produce a printed original image; therefore, a high-resolution laser printer is needed.

Network connectivity is also an essential component. If the facility is relatively new, the network cabling is most likely in place, but if an older space is being remodeled, network cabling will need to be installed. IT personnel should assist with issues ranging from the physical connections mounted in the wall to the technical issues of Ethernet bandwidth, network addresses, digital imaging and communication in medicine (DICOM) connections and compatibility, and passage to the institution's picture archiving and communications system (PACS). If these topics sound foreign, do not be alarmed; this is the specialty of the IT personnel and is the reason they are part of the team. By working in conjunction with the vendor, service engineer, and medical physicist, IT personnel can determine exactly what is needed and where it is needed. At our institution, the IT team reviews the vendor's DICOM Conformance Statement and asks the vendor to answer a series of additional questions related to connectivity and interoperability with our specific systems before installation planning. The IT personnel, in conjunction with the medical physicist and service engineer, will assist the team in explaining how the images can be moved within the department: from acquisition station to workstation and back, to PACS for archive, and retrieval for use another day. After the necessary infrastructure of data lines has been identified, a work order can be issued so the lines will be in place before the FFDM unit is installed. Two additional items the vendors generally request are a telephone line and a controllable thermostat. The telephone line is needed for remote connection when troubleshooting problems with the acquisition station, and the thermostat is to ensure that room temperature can be kept constant for detector stability. The vendor representative should be able to supply the specifics of this necessary preinstallation information for the purchase selected.

While the necessary remodeling and infrastructure changes are taking place, key members of the team should begin creating a workflow diagram. The best team members to work on this process are the radiologist, mammography supervisor, and QC technologist, because they are involved in the daily workflow. The workflow diagram should demonstrate the current analog process from start to finish. The level of detail should be very specific, starting with the examination order, and continuing through the entire process until the films have been interpreted and filed. Leaving out any step along the way can make preplanning incomplete and compromise the new process. After the analog workflow process has been completed, the team should repeat the process for the anticipated digital workflow, making changes to accommodate the new equipment. When the plan is finished, it should be shared with all the members of the planning team for their input. This will ensure that the necessary infrastructure is in place, and also is a way to verify and validate that all members of the team completely understand the system and workflow that is anticipated.

After the physical space is ready and the equipment has arrived, service engineers begin the installation. If everything that was decided on in preplanning is in place, installation will require 4 or 5 days. After installation and calibration testing have been completed, the medical physicist needs to make an initial assessment for accreditation.[3] Once completed, the physicists' accreditation forms need to be faxed to the accrediting body before patients can be imaged.

Applications training can begin as soon as the accreditation body confirms approval of the medical physicist's forms. Radiologists and technologists who interpret and obtain digital mammograms need to complete 8 hours of initial training before they can work independently.[3] The application specialist who works with the equipment vendor will be able to help you meet these needs. Because the training takes time, it is important for key people to be available for applications. This may mean limiting the patient schedule or having extra personnel available to work so training can be completed.

Workflow

From a technologist's perspective, there are multiple differences between performing digital mammography and analog mammography. Most of these differences make digital mammography easier for the technologist. Instead of typing in the patient's demographics or "flashing" the image, the information is entered into the acquisition station with a bar code or is selected from the radiology information system (RIS) work list. Lead markers, denoting the image view, are no longer needed because each image projection is marked electronically. The previous images can be viewed on a light box if they are analog images, or if the images have been digitized and prefetched, they can be viewed electronically on the acquisition station or technologist workstation. For most of the systems, the technologists will need to relearn how to position the patient. Although the difference in positioning is not major, it requires that the technologist give it some thought when comparing it with a process she has mastered on the analog system. The differences emerge because of the size and shape of the image receptors and the size and location of the compression paddles during positioning of the various