Moving from screen-film to digital mammography: Reducing costs, optimizing efficiency and improving outcomes

Success with Merge Mammo™ from Merge Healthcare
Executive Summary
While digital mammography is not a newcomer to the field of breast imaging, it has been gaining increasing popularity, especially based on favorable findings from DMIST (Digital Mammographic Imaging Screening Trial), one of the largest-ever breast cancer screening studies. Breast imaging professionals should understand the benefits of digital mammography and key considerations in adopting this modality. As a new era of digital breast cancer detection emerges, organizations can look forward not only to improved clinical results, but also to enhanced workflow and productivity. Digital mammography will be a mainstay in the full spectrum of breast imaging services across organizations of all sizes.

Digital Mammography: An Introduction
While significant advances have been made in the detection and treatment of breast cancer, the battle against this disease continues. In the 1960s, one in 20 women was diagnosed with breast cancer. Today, the rate has jumped to an alarming one in eight.1 In the United States, breast cancer mortality is second only to that of lung cancer.2 Physicians have relied on x-ray as the primary modality for identifying breast cancer since the early 1900s. Conventional screen-film mammography was long the only medium available to detect breast abnormalities. As technology evolves, however, new options offer promise for improving accuracy and efficiency in detecting breast cancer.

Digital mammography is a solid example of a newer breast imaging option. With this approach, the clinician uses technology to create an electronic image of the breast and store it directly in a computer, much like today’s increasingly popular digital photography. Digital mammography differs from traditional film mammography because the recorded digital data can be magnified, enhanced or manipulated for further evaluation.

A relative newcomer to radiology, digital mammography has largely developed since the early 1990s, when the first digital systems became available in the United States. Early systems used indirect conversion detectors and later improvements came via direct conversion, whereby x-rays are absorbed and electrical signals are created in a single step.

Amorphous selenium systems represented a further major advance in direct conversion technology for digital mammography.

Today, a variety of digital imaging and related technologies are moving forward. Advanced applications are improving the power of digital mammography. Use of modalities such as ultrasound and MR for breast imaging are increasing. Additionally, computer-aided detection (CAD) offers new opportunities to assist with diagnosis. CAD often serves as a second reader in departments wishing to reduce expenses. The integration of CAD and digital mammography brings powerful new capabilities. Moreover, the first CR for mammography has received FDA clearance. This technology should prove to be a more cost effective equipment purchase for going digital than traditional FFDM modalities.

DMIST: A Digital Mammography Milestone
Researchers have completed a landmark clinical trial — one of the largest breast cancer screening studies ever performed — and results offer opportunity for organizations to provide women with a new alternative for high quality breast imaging. Breast imaging centers have eagerly awaited results of the study focused on digital mammography.

While some organizations have already benefited from digital mammography workflow efficiencies, others have chosen to wait for the study’s conclusion to decide on conversion to digital. The study confirms advantages of digital mammography over traditional screen-film for some women, and is expected to stimulate widespread adoption and use of digital breast imaging equipment. Experts predict that clinicians will embrace digital mammography as a new option for breast imaging, and will quickly demonstrate its quality and cost-effectiveness within their organizations.

WHAT:
The Digital Mammography Imaging Screening Trial (DMIST) sponsored by the National Cancer Institute and coordinated by ACRIN, The American College of Radiology Imaging Network

WHO:
The study covered 49,500 participants imaged at 33

1 National Breast Cancer Foundation
2 American Cancer Society
sites across the United States and Canada who had no signs of breast cancer. Women in the trial were given both digital and film mammograms. Mammograms were interpreted independently by two different radiologists. Breast cancer status of the participants was determined through breast biopsy.

**WHY:**
The study’s primary purpose was to determine whether digital mammography was equal to or better than, conventional screen-film.

**WHEN:**
Results of the four-year trial were released in September 2005, and published in the October 2005 issue of the New England Journal of Medicine

**THE OUTCOME:**
The accuracy of digital mammography was higher than that of film mammography among:
- women under the age of 50 years
- women with heterogeneously dense or extremely dense breasts on mammography
- premenopausal or perimenopausal women

Digital mammography found significantly more cancers (up to 28% more) than screen-film mammography among the three subcategories of women, collectively representing 65% of the study’s population. The study showed no significant difference between digital and standard x-ray mammography in detecting breast cancer for the general population of women.

**Film versus Digital Mammography**
While progress has been made with film mammography, challenges still exist. With screen-film mammography, for example, the quality of the processor used to create a breast image can significantly impact results. Optimal performance requires a dedicated investment of time and expertise. A processor must be set according to the film manufacturer’s recommendations and must be regularly maintained for operational consistency.

Additionally, the processing operation is a dynamic one in which conditions change with every film run through a machine. Impediments can result in poorly produced mammographic images, including artifacts, clouding, motion, poor contrast and lack of detail. Once a film image is created, it cannot be significantly altered to improve overall quality. Alternatively, digital images are far more forgiving. Even after they are processed, images can be corrected for under- or over-exposure, and otherwise enhanced in ways that static images cannot.

DMIST study senior author, Etta Pisano, MD, of University of North Carolina at Chapel Hill, shared insights in a 2005 Q&A article published by Health Imaging News:
- Over time I expect that most women with dense breasts and younger woman and pre-menopausal women will be receiving digital mammography because of our results.

- Obviously, improved therapies for breast cancer are part of the reason why mortality is starting to fall. …it does worry me a little that if the cost of mammography screening goes up too much some women will be priced out of it. So the cost-effectiveness analysis is very important.

- Mammography is not as effective in terms of mortality for women in their 40s partially because most women in their 40s have dense breasts, but also because breast cancer tends to be more aggressive in younger women. That would argue for doing more screening not less screening for women in their 40s.

- The most important thing is for women who can’t get digital to continue to get screened. We know that digital [systems represent] only 8 percent of the available machines right now. Our study showed that about 65 percent [of women] would benefit from digital, but not all of the 65 percent will be able to get screened with digital, at least in the short run. So, it’s important that women understand that screening mammography is something they should get whether they can get digital or not.
Based on the “finality” of traditional screen-film, technologists have strived to ensure the best possible image by optimizing breast positioning at the time of image capture. Positioning challenges arise, however, and “retakes” often are necessary. This causes strain on resources and frustration among imaging staff, referring physicians and patients. Because digital images can be enhanced at the time of reading, less demand is placed on the technologist to optimize positioning. Thus productivity can be increased, and retakes are rarely necessary.

With screen-film mammography, the sharing of images can be challenging. For years, clinicians have used advancing technology to transfer general radiologic images electronically. Mammography images, however, have not typically been shared in this way — primarily due to large datasets resulting from the high level of detail needed for diagnosis. Digital mammography overcomes some of these limitations, however, offering new opportunities for yielding value from electronic mammographic teleradiology.

**Challenges with Moving to Digital Mammography**

To create and process images, early digital mammography relied on a method called “indirect conversion digital detection.” Similar to the x-ray method for creating screen-film, a scintillator absorbs the x-rays and generates light scintillation. The scintillation is then detected by an array of photo detectors. Unfortunately, this approach has been limited. The image resolution is degraded because light is spread in the scintillator, and because the use of “thin” scintillators yields poor quantum efficiency.4

The development of amorphous selenium detectors has improved digital mammography. These detectors are superior because of their high x-ray absorption efficiency, extremely high intrinsic resolution, low noise, and well-established manufacturing processes. Since their inception, these detectors have brought digital mammography to a level of quality on par with screen-film.

Despite improvements in the quality of digital images, challenges remain. Processes for interpreting digital mammograms, for example, have been somewhat problematic — specifically based on the length of time required for reading digital images.

Mammographers strive to read images quickly. Fast reading translates to higher throughput and maximum revenue. With film mammography, a staff member places images in view boxes for the radiologist to read, thus expediting the interpretation process. With digital mammography, however, the physician spends time using computer technology to magnify, enhance or manipulate the image. Studies have shown the typical reading time for screen-film exams can be less than half the time needed for reading a series of digital mammography images, making digital an unacceptable choice for many.

Additionally, early digital systems could not display images from different vendors nor other modalities. Radiologists would have to literally walk back and forth between workstations to compare current and priors, or view mammography versus ultrasound or MRI images. This causes workflow slow-downs and frustration that hinder easy transition to digital.

Finally, there are currently high-cost challenges to digital mammography. Workflow inefficiency costs money. Having to use multiple workstations is also a high hurdle for many, given the software, workstation hardware and especially high-end monitor requirements of each.

**Today’s Reality: Overcoming Challenges to Create New Opportunity**

Today, approximately 90% of mammography uses traditional film. The movement to digital can be enhanced by several factors. The number of breast imaging clinics has decreased in recent years. Many attribute this shift to low reimbursement rates for mammography reading. Digital mammography has the benefit of higher reimbursement than film. Although the initial investment is high, clinics with a critical volume of mammographies find they better optimize reimbursement through digital.

As today’s breast imaging specialists face increasing pressures, digital mammography offers unique advantages. The recent DMIST study shows promise for digital approaches to improve diagnostic accuracy,
and thus, save lives. Beyond this, digital methods enable organizations to more fully leverage computer and information technologies to improve breast health initiatives and outcomes.

More than ever, radiology workstations are moving toward specialty applications for clinical departments. Whereas workstations have traditionally served most or all imaging modalities, dedicated breast image workstations are becoming increasingly prevalent. With swift development in computer technology, including digital mammography, breast detection services can be more closely tied to a provider’s additional information systems. Workflow processes can be streamlined, departments can be more efficient, and clinicians can use aggregated data to further their knowledge of breast health.

Yet, to make digital mammography successful, new solutions must address the reality of today’s mammography workflow pressures. Cost-effectiveness is paramount. To maintain both efficiency and high customer service, mammography depends on quick readings and rapid report turnaround. Additionally, each organization has unique processes. Users must be able to customize a system for current and future needs.

**Merge Healthcare is Transforming the Medical Imaging World**

Merge Healthcare is focused on accelerating productivity for radiology departments and specialty practices, imaging centers and hospitals. By combining sophisticated RIS, PACS, advanced visualization and clinical imaging applications, Merge Healthcare delivers integrated, end-to-end software solutions and professional services that are transforming the way our customers interact with referring physicians, manage their workflow, position their businesses in their markets and deliver imaging and information services to their customers.

We ensure our customers’ success in today’s competitive healthcare environment by streamlining business and clinical workflow with digital image and information solutions and services.

**Digital Imaging and the Merge Mammo Solution**

One of the industry’s first dedicated breast imaging workstations, Merge Mammo™ (formerly known as Cedara I-ReadMammo), is a mammography application that helps organizations reduce costs, optimize efficiency and limit hassles in adopting digital mammography. Launched in 2004, Merge Mammo has evolved to meet numerous needs. Organizations can minimize risk and maximize investment as they use this technology to meet new demands and assume a leadership position in digital mammography.

**Efficiency: Single station, vendor neutral breast imaging**

Merge Mammo supports all modalities including mammography, ultrasound, MRI and nuclear medicine. Studies from several modalities can be simultaneously displayed, manipulated and reviewed from a single workstation. Organizations using Merge Mammo have no need to train staff on multiple workstations from numerous vendors. Physicians don’t experience the frustration associated with toggling between multiple devices. Merge Mammo can be interfaced with any existing DICOM-compliant PACS solution.

**Effectiveness: Intuitive viewing with hardcopy-like tools**

Merge Mammo delivers unique features to streamline image viewing and comparison. This is especially
important as organizations seek to ease the inevitable transition from film to digital mammography. Physicians can quickly compare bilateral structures using Merge Mammo’s pan and zoom functionality and synchronized magnification capabilities.

Merge Mammo tools mimic hardcopy mammography reporting functions, with a cropping tool similar to Dr. Lazo Tabar’s glasses, a bright light feature for spot brightening, and binoculars for focusing on specific regions of interest without disruption. The system delivers intuitive navigation and visualization with cursor-zoom functionality and full size notation. Beyond dedicated breast imaging features, Merge Mammo also includes a full range of standard manipulation and navigation tools.

**Optimization: Customizable workflow for improved productivity**

Merge Mammo is built with the knowledge that each organization and clinician has unique needs. Users can configure image layout, presentation and view order preferences. Images are automatically displayed according to operator preferences. By saving film-hanging time, digital reading can replicate hardcopy throughput speed.

Organizations using Merge Mammo have demonstrated reading times consistently below the rate of hardcopy review. Merge Mammo enables stepping from view to view, improving process and maximizing reading speed. With Smart Load technology clinicians can review multiple mammography examinations quickly, often in less time than required for film alternators. Images can be quickly examined and enhanced using programmable trackball and keypad functions, customizable toolbars, and right mouse button commands.

**Benefits for organizations of all sizes**

Based upon DMIST’s promising conclusions, analysts expect full-field digital mammography to be widely adopted in coming years. Merge Mammo was developed with a growing digital market in mind and with an eye toward bringing the digital world into a competitive stance with screen-film. This system can be readily used by clinicians of all backgrounds, and in breast centers with varying caseloads. At large, busy breast centers, mammographic reading requires a significant time commitment on the part of radiologists. Not only do clinicians and patients benefit from greater anatomic detail, the organization benefits from improved throughput and increased revenues. Smaller centers can reap these rewards as well. With proven, affordable technology, they minimize risk as they move to digital with the most advanced workstation available.

**NEW Features for Merge Mammo v7.2**

- Easy scroll through, arrange, stack and view prior studies - omitting non-screening images - for faster, cleaner reads.
- Efficient Lesion Contouring lets you gain dynamic, quantitative measurements and engaging presentations, simply by clicking and dragging along lesion.
- Cross-Correlation Tool lets you compare a region of interest from the reference image to that of all other MG images in viewport (including prior studies images) quickly and easily.

**The Future of Digital Mammography is Here.... with Merge Healthcare**

With knowledge that detailed images are available via new digital mammography, organizations can usher in a new breast imaging era, while lowering radiation dose rates and improving patient satisfaction. Clinicians rely on Merge Mammo as the most mature digital imaging solution available today. They will benefit from growing with this new technology as it evolves. Dedicated workstations will proliferate, and Merge Mammo will advance -- changing to meet new demands and re-evolving as a second- and third-generation solution. During the coming years, large and small breast imaging centers will adopt one-stop digital solutions such as Merge Mammo. The future holds great promise for improving breast cancer detection -- and for emerging victorious in the battle against this serious disease.

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