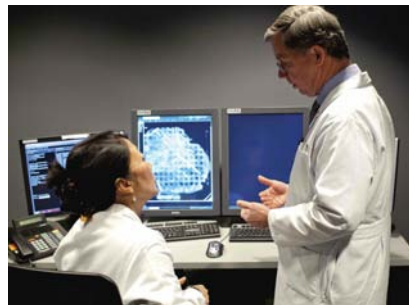
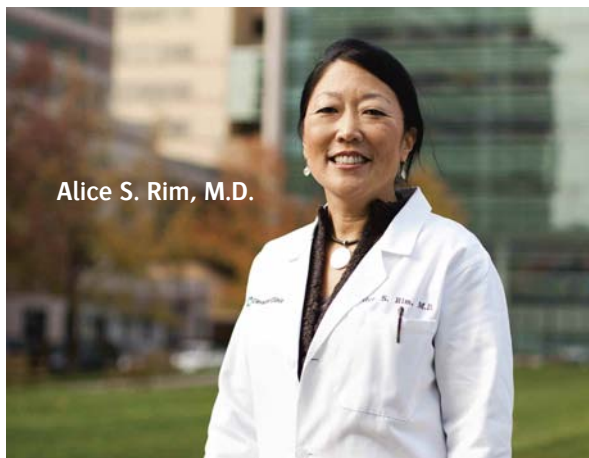


Diagnostic Breast Imaging Solution Eliminates “Digital Islands” and Integrates Workflow



Located in Cleveland, Ohio, Cleveland Clinic is a nonprofit multispecialty academic medical center that integrates clinical and hospital care with research and education. With more than 2,000 salaried physicians and scientists on staff, representing 120 specialties and subspecialties, and a reputation for providing the highest quality healthcare, Cleveland Clinic attracts patients from across the United States and around the world.

The Cleveland Clinic Women's Health Institute is dedicated to women's health and is the home of the Cleveland Clinic Breast Center, which provides services ranging from prevention and detection to surgical and non-surgical breast cancer treatment and reconstruction.



Alice S. Rim, M.D.

Dr. Rim is Vice Chairman of the Imaging Institute of The Cleveland Clinic, Cleveland, OH, and Head of Breast Imaging in the Department of Diagnostic Radiology. Since 1999, when she joined The Cleveland Clinic, Dr. Rim has driven research there to analyze uses of multimodalities in breast imaging and breast biopsies. Dr. Rim is the author of numerous scientific presentations and "hands-on" workshops on topics including invasive sonography and interventional breast imaging. She is a sought-after speaker and advocate for the advancement of diagnostic and screening strategies in breast cancer detection. Dr. Rim received a B.S. from Northwestern University and an M.D. degree from the Medical College of Ohio.

The Breast Center provides a multidisciplinary, team-based approach to breast cancer treatment, prevention, and detection, with surgical oncologists, medical oncologists, radiation oncologists, radiologists and reconstructive surgeons collaborating to provide customized, cutting-edge care. Mammography screenings are available at the main campus and nine suburban family health centers. Diagnostic screenings are available every weekday at the main clinic and at least one day a week at many of the family health centers. In 2009, the main clinic and family health centers conducted nearly 90,000 screening and diagnostic mammography exams.

Imaging Key to Providing "Women-Centered Care"

The Breast Center's goal is to provide the highest-quality "women-centered care." In imaging, the focus is on offering the leading screening and diagnostic techniques, including digital mammography, breast ultrasound, and breast MR.

In the past decade, the Breast Center has invested in a range of technology and facility improvements intended to advance the quality of patient care. The facility began converting all mammography modalities to digital, a process that will be fully complete in 2012. They added breast MR as a diagnostic tool and implemented a CAD solution. They also realized the need for dedicated breast imaging and technical support staff and took steps to facilitate patient diagnosis and treatment.

“We designed our practice so that imaging is right alongside breast surgeons and medical breast specialists,” said Rosemary Jeric, Clinical Manager of Breast Imaging. *“The majority of patients we see are those who have mammography services scheduled followed by surgical or medical breast specialist appointments on the same day.”*

“We’re very conscious of the needs of the breast imaging patient,” she continued. *“If follow-up images indicate that a patient needs a biopsy, we want to be able to offer same-day biopsy. That’s how breast imaging should be practiced.”*

Workflow Limitations to Achieving the Mission

Yet, as the Breast Center continued to grow and drive towards its mission and goals, its imaging workflow did not keep pace. The Breast Center relied on the digital mammography modality-specific review stations to support the radiologists’ reading workflow. Although these types of review stations are common in many breast imaging departments today, by default they do not support an efficient workflow because they are not truly integrated into the digital PACS environment.

Instead, these modality-specific review stations created an environment of standalone, non-integrated “digital islands” of information. Many of the benefits of digital imaging were lost because of the resulting inefficiencies.

For example, to allow a radiologist to read a set of breast imaging studies at a modality-specific review station, someone must first “push or pull” the current and relevant prior exams to that review station.

This creates additional staffing needs and limits the radiologist as to what can be read from that review station.

These digital islands were inefficient and prevented the Breast Center from experiencing full PACS functionality. *“It was too complicated to access comparison films, which caused both imaging and patient appointments to fall behind,”* said Karli Ziegler, Network Support Specialist. *“Standard screenings were read between 24 and 72 hours after the patient appointment.”*

Another layer of inefficiency was added because the modality-specific review stations did not allow multi-modality review. In addition to mammograms, radiologists should also be able to access breast US and breast MR studies in their diagnostic process. Because this was not possible with the modality-specific review stations, radiologists were forced to access a separate PACS review station to analyze these studies. In many cases these review stations were physically located in different rooms, requiring images to be printed for side-by-side comparison. The inability to view supporting modalities on the same review station as the mammogram resulted in additional cumbersome steps and created a more difficult diagnostic environment.

The impact of the “digital islands” extended to the entire workflow. The dictation system was not integrated into the reading review station and required multiple log-ons and delays in status updates.

Breast MR CAD software was not integrated into the modality-specific review station, creating another island of digital information that needed to be coordinated into the daily workflow.



Digital islands inhibit radiologists' access to necessary studies and supporting information

Primary Workflow Issues

The Breast Center was forced to compensate for the limitations created by the digital mammography modality-specific review stations by adding extra workflow steps to their breast imaging process. This compensation was necessary but created multiple inefficiencies:

- Manual process to allocate studies to digital islands
- Complicated reading process
- Delays in reading standard screening exams
- Heavy dependence on paper and film

Manual process to allocate studies to digital islands.

For the Breast Center, one of the primary problems of the digital island review station environment was the lack of automatic access to relevant priors and newly acquired studies. The manual querying, pulling, and pushing of exams among the hospital PACS, long-term archive, and acquisition modalities to the review stations was an inefficient use of time for radiologists, technologists, and support staff.

Multiple paper trails and special daily procedures were implemented in attempts to ensure the proper studies were present on the correct review station when the radiologist was ready to read. A complicated allocation workflow was designed for the screening studies that required studies to be manually sent to specific review stations in an attempt to balance radiologists' daily workload. Users viewed the review stations as "passive" tools that had to first be prepared by someone before the radiologists could read studies.

The impact of these digital islands was exacerbated by the size of the Cleveland Clinic's network. *"Getting the right studies to the right review station was a challenge,"* said Shelly Weber, Quality Control Lead at the Breast Center. *"It was even more difficult to transfer images between sites."*

Complicated reading process. Radiologists' workflow was driven by stacks of patient jackets and paper logs and their efficiency was limited to reading only cases in their daily stack. There was no easy way to read additional studies because those studies were not available from their review station. The "digital islands" created silos of work instead of allowing the team to function as one.

If a radiologist fell behind due to a difficult case, any unread studies rolled over to the next day, or the radiologist would be required to work longer hours to compensate for the limitations of the review stations. On many occasions the manual process of allocating studies would fail: the current or prior exams did not reach the modality-specific review stations as expected.

The radiologist had no choice but to manually pull the study to his or her review station.

“The radiologists were dependent on the studies arriving at their ‘digital island’ before they could do what they do best: deliver outstanding patient care,” explained Dr. Alice Rim, Section Head of Breast Imaging and Vice Chairman of Cleveland Clinic’s Imaging Institute. *“We felt strongly that the focus of a radiologist should be on the review and diagnosis of the studies presented to him or her, not on searching for and pulling studies from the PACS.”*

The reading process for diagnostic studies was further complicated by the need to log into a PACS review station to view supporting imaging exams, such as breast US or breast MR, or a study that prompted the mammogram, such as a CT exam.

Additional log-ons were also necessary for the dictation and breast MR CAD systems, further stressing the efficiency of the workflow.

Delays in reading standard screening exams. The top priority each day for all breast centers is to read the diagnostic breast imaging cases and complete any additional imaging or exams required for these patients. Cleveland Clinic also offers an extensive same-day screening option that allows patients to have their screening mammogram and visit their primary care or OB/GYN provider on the same day to learn the results. After meeting these critical needs for same-day reading, the remaining standard screening exams were often read on a two or three day delay, as a consequence of the workflow limitations. Although this is not unusual for large breast centers, it was a point of frustration for the Breast Center staff at Cleveland Clinic.

Heavy dependence on paper and film. The Breast Center staff was forced to compensate for the workflow limitations of the digital islands by relying on paper. Driving workflow across a large multi-facility network is a major challenge; to do so with paper logs and patient jackets results in poor usage of staffing and equipment resources. However, in the digital island environment, paper logs are the best way to allocate studies and support the reading workflow.

Because patient history and prior reports were not visible on the modality-specific review stations, a paper history log was attached to each patient jacket, which contained copies of prior reports. It was essential for the radiologist to have every patient jacket for studies he or she was reading. The Breast Center’s ultimate goal was to leverage the digital environment to eventually become paperless, but they were limited by the workflow created by the modality-specific review stations.

In addition to driving workflow with paper logs, the Breast Center was forced to remain dependent on both analog and printed digital films. If the prior analog films were digitized, but had not yet reached the review station due to a delay in the querying/pushing/pulling process, then the radiologist would revert to hanging the analog films on a viewbox.

Identification of Key Criteria for Improved Workflow

Breast Center staff realized that to continue to meet their goal of providing the highest-quality women’s care, they must implement a new imaging workflow.

Dr. Rim became committed to find a diagnostic breast imaging solution that eliminated the digital island caused by the limitations of modality-specific review stations.

Dr. Rim formed a team that included radiologists, technologists, network support specialists, the quality manager, the department manager, the film library, and IT and PACS staff. Their challenge was to find a diagnostic breast imaging solution that fulfilled the key criteria for success:

- Eliminate the “digital islands” by being fully integrated into the PACS environment
- Provide true multi modality capabilities
- Easy integration with third-party solutions such as mammography reporting and tracking and breast MR CAD
- Automated workflow and elimination of the paper trail

The Breast Center’s ultimate goal was to streamline imaging workflow to not only support its mission for “women-centered care,” but to help achieve an even higher level of patient care. At the same time, Cleveland Clinic was in the process of evaluating possible replacements for the PACS used for its entire hospital network. The timing coincided for Dr. Rim and her team to identify a solution to deliver the Breast Center’s key criteria for success while also meeting the needs of the entire hospital.

As part of this effort, the Cleveland Clinic team received a demonstration of Agfa HealthCare’s IMPAX for Breast Imaging, a PACS and diagnostic workstation solution designed for the specific needs of breast imaging departments. For screening and diagnostic exams, radiologists are able to work at a single workstation and



Multi-disciplinary team identifies key criteria for improved workflow.

view all relevant patient images from multiple breast imaging and general imaging modalities, regardless of vendor.

“IMPAX for Breast Imaging met every key criteria for success that we established,” said Dr. Rim. “It’s a proven, well-established solution. Agfa HealthCare had helped other, similar facilities overcome the limitations of modality-specific review stations.”

“The team from Agfa HealthCare was knowledgeable about the ‘pain points’ in our imaging workflow, and they were committed to implementing a solution in a partnership with us,” she continued. “Their dedication to the project weighed in their favor as much as the strength of the IMPAX technology.”

Cleveland Clinic chose Agfa HealthCare’s IMPAX PACS solution to meet the overall imaging needs of the hospital and the Breast Center chose to implement IMPAX for Breast Imaging. As a fully integrated “client” on the PACS, IMPAX for Breast Imaging would enable an integrated imaging workflow to replace the modality specific workstations that functioned as separate “digital islands.”

Because of the immediacy of the Breast Center's need to achieve a better workflow, Dr. Rim did not want to wait for the replacement of the PACS at the hospital level. She successfully lobbied to implement the IMPAX PACS for Breast Imaging solution in the Breast Center and the appropriate Family Health Centers first, so that her team would be able to begin reaping the benefits as soon as possible.

Implementing IMPAX for Breast Imaging

The Cleveland Clinic Breast Center staff and Agfa HealthCare Women's Care team agreed on the critical first step to foster a successful implementation: the Agfa HealthCare team would need to have an in-depth understanding of the Breast Center's complicated workflow to design the implementation and deliver improvements in a way that kept the process whole from a patient care perspective.

To develop this understanding, a workflow analysis was conducted by Agfa HealthCare's Women's Care team and supported by the Breast Center. The Agfa HealthCare team shadowed radiologists, technologists, QA/QC personnel, network support specialists, film library staff, and other support staff. A questionnaire was used to make sure that complete information was captured for standard workflows, such as screening and diagnostic mammography studies. In addition, the workflow steps also were captured for special scenarios such as same-day screening exams, patients presenting with outside films, patients needing outside films, etc.

Agfa HealthCare used diagramming software to map the clinic workflow. A constant feedback process with the Breast Center team confirmed that the final map of the

existing workflow was accurate. *"We were in shock when we saw the final workflow maps,"* said Sean Byrne, Workflow Coordinator.

"First of all, it made us realize exactly how complicated our workflow was. Second, it was pretty impressive that the Agfa HealthCare team was able to document it so thoroughly."



Pictured left to right:

Alice S. Rim, M.D.
Vice Chair, Imaging Institute
Head, Section of Breast Imaging
Cleveland Clinic

Ali Esmaili, M.D.
Breast Imaging Fellow
Cleveland Clinic

Laura Shepardson, M.D.
Associate Director,
Breast Imaging
Cleveland Clinic

During this process, a close working partnership developed between the Agfa HealthCare and Cleveland Clinic teams. *"Agfa HealthCare ended up knowing our workflow better than we did,"* said Jeric. *"We had a flawless conversion because they took the time to understand our pain points."*

Agfa HealthCare used the results of the workflow analysis and its knowledge of the Breast Center personnel to design the workflow that would be in place with the IMPAX for Breast Imaging solution.

This design was reviewed with the Breast Center team for buy-in and understanding, and was then used to structure the implementation timeline and staff training needs. Successful training would be critical to success of the overall implementation, so it was carefully planned.

The teams determined that staff training should:

- Be scheduled two weeks prior to the “go-live date” to allow time for users to ask questions and get comfortable with the new system
- Be held away from the reading environment so that trainees were not distracted from the learning process
- Encompass all organizational levels and include an understanding of the workflow with a “client” installation as opposed to the previous “digital islands” model
- Be led by the same team that conducted the workflow analysis, to properly compare the new and old procedures

On the day of go-live for the IMPAX for Breast Imaging solution, members of the Agfa HealthCare team were stationed at all key work areas, including technologist work areas, the film library, and reading rooms, to assist with issues quickly and efficiently. Jeric summarized, *“From the workflow analysis to the training to the conversion itself, it was one of the best installs we’ve ever experienced.”*

Results of the Implementation

Not only was the IMPAX implementation a success, but the improvements to the Breast Center’s workflow were immediate and significant:

- Automated access to any study from any workstation
- Simplified reading process
- Elimination of delay in reading standard screening exams
- Reduction in reliance on paper and film

“Our workflow is much more streamlined since we implemented IMPAX,” said Ziegler. *“This helps us provide a better work environment for staff and a better experience for patients.”*

“With the old workflow model, we were simply focused on getting through the day,” said Dr. Rim. *“Agfa HealthCare was knowledgeable about the endpoint that we would eventually reach and was able to show us the way to cut through our complicated workflow to achieve it.”*

Automated access to any study from any workstation.

The integrated IMPAX environment eliminated the “digital islands” and provided the radiologists with a complete view of all current and prior studies, reports and other important information from any breast imaging workstation at any Cleveland Clinic facility.

“Before, the radiologists had to wait on us to push studies to them,” said Byrne. *“Now, the studies are right at their fingertips.”*



IMPAX for Breast Imaging eliminates digital islands and allows near-instant access to studies and supporting information from any workstation

As an interim solution until all of the prior studies can be migrated from the pre-existing PACS, a single remaining step will involve having all prior exams be pushed to the IMPAX core in advance of patient imaging so that all studies are immediately available to the radiologists and technologists. Once the migration is complete, IMPAX will automatically retrieve all prior exams, thereby eliminating the need to perform this interim step—a single push from the pre-existing hospital PACS to the IMPAX core (compared to the multiple pushes to multiple review stations previously needed).

This step is invisible to department users, who are able to view any study from any review station without any pushing or pulling of studies. Instead of being on an isolated digital island, users are now completely integrated to the IMPAX core with immediate access to all patient imaging including current and prior mammograms and supporting studies such as breast US, breast MR, and CT. The ability to read any study from any location has significantly improved the workflow efficiency of the radiologists and technologists.

“It’s much easier for the technologists now because there are no post- and pre-filming duties that have to be taken care of when the patient is in the exam room,” said Weber. “The focus is on the patient’s needs.”

Simplified reading process. The integrated workstation environment created by IMPAX for Breast Imaging dramatically improved reading workflow. The elimination of the digital islands was significant, because studies no longer had to be manually “allocated” to specific review stations. Now all studies are available to the radiologist, regardless of location.

IMPAX delivered another key element to simplify and streamline the reading process: the ability to configure worklists that automatically capture studies that meet the worklist criteria. For example, a worklist configured to capture screening studies with a status of “new” and a location of “Main Clinic” will automatically populate during the day with any studies that meet that criteria. The Breast Center designed worklists to capture appropriate studies into manageable groupings and used these worklist groupings to allocate radiologist workload, which eliminated the need for the handwritten patient logs located at each review station.

IMPAX worklists also provide immediate visual feedback on the number of studies in each worklist grouping. This quickly alerts radiologists to any area that needs assistance in keeping up with demand. The artificial walls created by the digital islands were quickly torn down and the radiologists were able to work as a single integrated team to access and read studies in a timely manner.

“Before, everyone was reading within a silo. Now all the cases are in the same bucket,” said Dr. Rim. “It doesn’t matter where the physician is located. No matter which clinic or workstation you’re working from, you can see all the cases.”

Studies from supporting modalities, such as breast US and breast MR, are now accessible from the same review station used to review the mammogram. This eliminates the need for additional PACS review stations and additional log-ons by the radiologists, and greatly improves the quality of the consultation process with breast surgeons. Radiologists can now review each case with surgeons from one workstation without dependence on printed films.



The new workflow also allowed for integration with the Breast Center’s newly installed mammography reporting and tracking solution, PenRad. In addition, the breast MR CAD software can now be accessed from the reading station, completing the concept of a totally integrated workflow for the radiologist.

Elimination of delay in reading standard screening exams. IMPAX-related workflow improvements allowed the Breast Center to continue to provide immediate reading of same-day screening and diagnostic exams while dramatically improving the turnaround time of

standard screening exams. *“I can read a case within minutes of the exam,” said Dr. Rim.*

If their worklists are empty, radiologists assigned to read diagnostic or same-day screening studies can easily open the appropriate standard screening worklist and read standard screening exams. Because physicians are no longer limited to reading the cases assigned to them at a particular workstation, all standard screening exams are normally read by the end of the day. Due to the overall efficiency improvements, in many cases, studies are read before the patient exits the facility.

“With our old system, we might have hundreds of unread standard screenings at the end of the day,” said Dr. Rim. “Now the study appears in the worklist and is available to be read immediately. If patients come in after 5 p.m., they might remain in the worklist and roll over to the next day.”

“We’re now able to mail standard screening results out within 24 hours. It makes a big difference to the patient to receive the results so fast,” said Jeric. “This is the level of care we’ve been striving to provide.”

Reduction in reliance on paper and film. The ability to view any study on any workstation has further reduced the department’s reliance on paperwork.

Besides eliminating handwritten patient logs, a stack of patient jackets at each workstation is no longer necessary. Physicians have access to all images and all patient data via IMPAX.

“We’ve saved the equivalent of one FTE because we eliminated the need to match up jackets to workstations and manage paper patient logs,” said Byrne. “The Cleveland Clinic’s overall goal is to be paperless by the end of 2011, and the IMPAX solution can help our department get there.”

In addition, there are no longer “special” circumstances that require physicians to hang films. For example, any non-digital priors can be sent right away to the film library for digitization and the digital images are immediately available on IMPAX—no pushing, pulling, or waiting.

Critical Success Factors

Cleveland Clinic’s Breast Center staff suggested a few critical success factors to healthcare facilities that are considering steps to eliminate their own digital islands and implement a new breast imaging workflow.

Understand your workflow. A thorough understanding of workflow helps the breast imaging department outline its goals and objectives. *“Seeing our workflow mapped out helped us understand exactly what needed to be fixed,”* said Ziegler.

Don’t forget the reading station. Byrne noted that many breast imaging departments spend the most time and effort on selecting the digital modality equipment. *“People focus on modalities sometimes at the expense of the reading station,”* he said. *“The reading station should be the biggest concern. It’s every bit as important as the imaging equipment.”*

Ease of use. *“Whatever solution you choose should be easy to use,”* said Dr. Rim. *“There are still many people who have more experience with film than digital so it’s important that the system has an intuitive user interface.”*

All staff should have input. Make sure to get feedback from all functional areas, including technologists, radiologists, film library staff, IT staff, and other support staff. *“Every member had valuable input on what it meant to improve efficiency,”* said Weber. *“Everyone had different opinions based on their personal pain points.”*

Multimodality access is a must. For the Breast Center, being able to access ultrasound, mammograms, and breast MR from the same workstation was non-negotiable. *“I want all modalities open with every case,”* Dr. Rim said. *“If you have to run around to different monitors or print things out so you can show the surgeon, you’re just wasting time.”*

Be open-minded. Dr. Rim embraced change and encouraged Breast Center staff to do the same. As Ziegler noted, *“People are resistant to change. You have to be open to everybody’s suggestions, including the vendor. And you have to be willing to step outside of your comfort zone.”*

Choose a customizable system that can be integrated into a single workflow. Make sure that your vendor can create a customized solution. *“It wasn’t a problem to incorporate our CAD and dictation software with IMPAX for Breast Imaging,”* said Dr. Rim. *“We’re able to customize our worklists depending on our reading needs. And radiologists can customize their reading account to meet their personal preferences.”*

Get a commitment for vendor support. Jeric recommended that healthcare facilities get a written commitment for vendor support and hold the vendor accountable to its agreement. *“A lot of product vendors sell you on support, but once the ink has dried on the contract, the service isn’t there,”* she said. *“That was not the case with Agfa HealthCare.”*

See it in action. *“Don’t buy a product sight unseen,”* advised Byrne. *“A vendor that has a tested product will be able to show the solution in action at another breast center. At the very least, see a live in-house demo.”*

Conclusion

By implementing Agfa HealthCare's IMPAX for Breast Imaging, Cleveland Clinic's Breast Center was able to eliminate "digital islands" and create a complete multi-modality imaging environment with automated access to any study from any workstation. The workflow improvements permit any radiologist to read any study, regardless of workstation location, and eliminated time spent by staff pulling and pushing prior and current exams from the PACS and modalities to the review workstations.

"Our recent implementation of the new PACS in the Breast Imaging department has been an incredible workflow achievement," summarized Dr. Rim. "Turnaround time for acquiring, viewing, and reporting of cases has decreased exponentially."

By simplifying the reading process, enabling faster reads of standard screening exams, and reducing reliance on paper and film, IMPAX for Breast Imaging helped the Breast Center streamline the imaging workflow to support its mission of providing "women-centered care." Instead of technology workarounds, staff and radiologists are able to focus on providing breast imaging patients with the very best care.

Summary: IMPAX for Breast Imaging helped Cleveland Clinic's Breast Imaging Center:

- Save the equivalent of one FTE in the imaging library
- Reduce the number of technologist workflow steps by 30 percent or more
- Reduce the number of radiologist workflow steps by 40 percent or more
- Enable same-day reading for standard screening exams, versus a 24 to 72 hour delay
- Eliminate reliance on paper logs and patient jackets and make paperless workflow truly possible

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