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Developing a Successful Breast MRI Program

Five Key Points for Consideration

Five Key Points to Consider

1. Potential Market and Revenue
2. Investment
3. Throughput
4. Access to care
5. Patient loyalty

Given the range of advanced technologies and treatments currently available to support breast cancer management, developing the best program for a particular facility or community can be a challenging task. To increase the likelihood for long-term success, medical facilities which are planning to launch, modify, or expand a breast magnetic resonance imaging (MRI) program should evaluate several important factors as part of their decision making process.

In the United States, one in eight women will be diagnosed with breast cancer during her lifetime. According to the American Cancer Society, roughly 178 480 women in the United States were found to have invasive breast cancer in 2007, and there are approximately two and a half million breast cancer survivors. Breast MRI is used increasingly as a high risk screening and diagnostic tool within women's healthcare.

Women are becoming increasingly savvy consumers in terms of their own health care. Through websites such as webmd.com they can easily access information about diseases and treatment options. They can also compare physicians and healthcare organizations using sites such as healthgrades.com and Medicare's hospitalcompare.hhs.gov. Better informed consumers are looking for centers with the best diagnostic capabilities. Imaging departments need to be aware of this trend as they adopt new technology and promote their services.

According to Jae K. Kim, MD, PhD, Radiology Limited, Tuscon, Arizona, "Patients are increasingly aware of various diagnostic and treatment options that may be available to them due to the seach power of the Internet. When evaluating options for breast cancer diagnosis and treatment, multiple factors may influence the decision-making process, including the experienced opinion of the patient's physician, quality and comfort of the imaging and treatment process, accuracy and experience of physician-interpretors, cost, and familiarity with the diagnostic and treatment service. Investment in the very best technology in breast MRI system is a way to achieve and maintain the best care for patients, and to continue to attract increasingly discerning patients."

As part of a comprehensive breast cancer management program, there is a growing awareness that MRI is an important adjunctive imaging tool that can detect lesions not found by either film-screen or digital mammogram. The potential benefit for some patients in terms of earlier detection has been illustrated in multiple clinical studies.

In addition to mammography, the American Cancer Society has recommended annual screening using MRI for women who:

- have a BRCA1 or BRCA2 mutation,
- have a first-degree relative (parent, sibling, child) with a BRCA1 or BRCA2 mutation, even if they have yet to be tested themselves,
- have a lifetime risk of breast cancer scored at 20% or greater, based on one of several accepted risk assessment tools that look at family history and other factors,
- had radiation to the chest between the ages of 10 and 30, and
- have Li-Fraumeni syndrome, Cowden syndrome, or Bannayan-Riley-Ruvalcaba syndrome, or may have one of these syndromes based on a history in a first-degree relative.

The addition of breast MRI services can yield considerable benefits for patients and healthcare providers including:

- earlier detection of disease resulting in decrease of total cost per patient,
- increase in survivability,
- more treatment options,
- access to full spectrum of diagnostic tools for complete care,
- reduced stress for the patient, and
- higher patient retention.

There are five primary factors that should be carefully considered for their impact on the overall quality and financial success of the program. These factors are:

- potential market and revenue,
- investment required,
- throughput,
- access to care, and
- patient loyalty.

Potential Market and Revenue

The market share and revenue in breast MRI procedures has experienced double digit growth over the past five years making it one of the fastest growing MRI procedures. Frost and Sullivan have also noted that the market for breast MRI procedures has continued to gain momentum in recent years. Volume for imaging

has significantly increased, especially with respect to MRI diagnostic and interventional procedures, such as MRI guided breast biopsy.

To meet demand for increased throughput and improved image quality, specialized technologies have emerged such as the Sentinelle Vanguard Breast MRI Coil system and Aegis advanced image analysis and interventional planning software platform. Together, such coil and software products create a complete and integrated set of solutions for breast cancer management.

Estimating potential revenue includes an examination of the relevant CPT/HCPCS codes for breast MRI, and the average reimbursement rate for these procedures. Third party reimbursement totals and coverage policies for specific procedures will vary by payer and by region. To confirm reimbursement rates for specific CPT codes, please consult with your local Medicare contractor. As an example, average total reimbursement for HCPCS C8908 was \$538.40. Some additional breast MRI CPT codes are summarized in Table 1.

CPT/HCPCS Codes for Breast Magnetic Resonance Imaging	
Code	Description
CPT 77058 Magnetic resonance imaging breast	without and/or with contrast material(s); unilateral
CPT 77059 Magnetic resonance imaging breast	without and/or with contrast material(s); bilateral
HCPCS C8903 Magnetic resonance imaging with contrast	breast; unilateral
HCPCS C8904 Magnetic resonance imaging without contrast	breast; unilateral
HCPCS C8905 Magnetic resonance imaging without contrast followed by with contrast	breast; unilateral
HCPCS C8906 Magnetic resonance imaging with contrast	breast; unilateral
HCPCS C8907 Magnetic resonance imaging without contrast	breast; unilateral
HCPCS C8908 Magnetic resonance imaging without contrast followed by with contrast	breast; unilateral

Table 1 - Breast MRI Codes and Descriptions

To help imaging facilities estimate the return on their technology investment, Sentinelle Medical has developed a unique tool that calculates the cost effectiveness of the investment based on the speed and efficiency of the Sentinelle Vanguard breast coil systems and Aegis software platform. The analysis demonstrates that users can reduce their overall cost per exam, including the costs that may be incurred for additional staffing and MR scanning time.

Investment

While the initial cost of a breast MRI coil system and image analysis software are often the most visible aspects of the decision making process, there are other factors that may be even more crucial to determining the overall cost and long-term value to be derived from a breast MRI program. Depending on the specific brand and

model of breast coil system selected, the initial purchase price may vary significantly. However, the purchase price represents only a small amount of the total potential costs associated with a breast MRI program, especially when considering the average life of a traditional breast coil of three to six years.

One of the most important variables to consider when deciding on a breast MRI program is the total lifetime cost of the technology and the potential return on investment associated with the purchase. It is important to note that the actual operating costs and revenue derived from a breast coil system and software platform will be highly dependent on the choice brand and model. For example, if an imaging center only performs three breast scans per day for five years and is operating 252 days per year, the purchase price of the breast coil system would be allocated across 18 900 breast scans over five years. This means that the cost of the breast coil system would equate to less than \$8 per scan.

Beyond purchase price, some of the critical questions that should be addressed include:

- Is on-site imaging and biopsy training included with the cost of the coil system?
- Will the vendor support your program by suggesting improvements to imaging protocols?
- How much can the coil system's parallel imaging capability reduce scan times?
- Are the technologies under consideration truly comparable in terms of capability, adjustability, access, image quality, and overall patient experience?
- Will the breast coils address the greatest variability in patient weight and breast size accommodating patients that would otherwise be turned away?
- Do the design features improve patient comfort, improving patient experience and loyalty?
- Does the technology incorporate features that will measurably streamline clinical workflow, increasing throughput?
- Does the technology work with your site's existing technology and infrastructure or is a large capital outlay required for a standalone scanner and associated construction costs?
- What are the potential upgrade costs of a standard RF coil design vs. a modular design?

The answers to such questions offer useful guidance for distinguishing between the different breast MRI technologies currently available.



Figure 2 - Sentinelle's Vanguard Table for Breast MRI

Throughput

Workflow efficiency is a vital consideration that is sometimes overlooked when making the decision to introduce new technology into a clinical practice. The hidden cost of delays and inefficiencies, frustrated patients and clinicians can undermine the overall success of the program. It is important to select breast coil systems that have been specifically designed to optimize clinical workflow, maximize tissue access and improve imaging speed. A well considered choice of technology can help to minimize the time spent in the MR suite while not scanning and will reduce the number of scans that need to be redone due to motion artifacts.

One of the most important operating costs for an imaging is scan time. Over the years, a significant amount of research has been done to reduce the scan time across MRI procedures. Not all time spent in the MR suite, however, is time spent in the actual scanning process. Depending upon the coil system and the patient, a significant amount of time can be spent in coil system setup, placing the patient in the proper position and inserting an intravenous line. If these activities are carried out within the MR suite, the site is inefficiently allocating its time while the scanner is sitting idle.

If the non-imaging time is minimized, more scans can be completed in a day. This not only increases revenue due to the reimbursement for the extra scans, but also spreads the large fixed costs of the MR suite over a greater number of procedures, thus reducing the per procedure costs.

In the case of a GE MRI system, the detachable tables can speed workflow by multiplexing the patient preparation and patient imaging portions of the exam. Experience with Sentinelle's Vanguard table, Figure 2, for breast MRI at hundreds of centers has shown an efficiency increase (time savings) of 10-25 minutes per patient.

Sentinelle Medical also offers breast coil systems specifically developed for Siemens and Toshiba MRI equipment. The uniquely unrestricted breast access available with Sentinelle coil systems for Siemens, Toshiba, and GE scanners enables the healthcare provider to accommodate larger patients. A challenge which is unique to breast MRI is the variation in breast sizes which works against "one size fits all" breast coils. Sentinelle's Variable Coil Geometry (VCG) adjusts to fit each patient, ensuring optimal coverage and image quality. The coil technology must be able to accommodate a patient with larger breasts and deliver the optimal image quality to patients with smaller breasts as well. This ability to provide the best image quality regardless of patient habitus has an important impact on several fronts:

- diagnostic imaging quality across patient sizes,
- biopsy access to all areas of the breast,
- reduced patient setup times, and
- higher throughput and ROI due to fewer patients being turned away.

There are two clear ways to increase efficiency and lower per procedure costs. The first is to reduce the scan time for a procedure and the second is to minimize the amount of patient preparation inside the MR suite. Breast coils that produce higher SNR can make use of parallel imaging techniques which reduce the amount of time required to scan. SNR and imaging field coverage are more important parameters when comparing breast coils than the number of channels. In breast MRI, a higher channel count does not always give rise to higher quality images.

In Figure 3 to Figure 8, parallel imaging was performed without a contrast agent using a Siemens Avanto 1.5T scanner. The same protocols were used on a Sentinelle coil system and a leading competitor, and the resultant images compared for various acceleration factors. An acceleration factor of 2 means the scan duration is halved, and an acceleration factor of 4 means one quarter of the scan time.

Protocol details are as follows:

- TR/TE = 3.43/1.21 ms
- Bandwidth = 146.72 kHz or 655 Hz/pixel
- Flip angle = 6 degrees (due to the short TR)
- Slice thickness = 1 mm
- FOV = 28 cm
- Number Slices = 176
- Matrix = 448 x 358
- Resolution = 0.6 x 0.8 x 1 mm³
- IPAT = 2 / 3 / 4
- Scan Time = 2:04 / 1:27 / 1:09

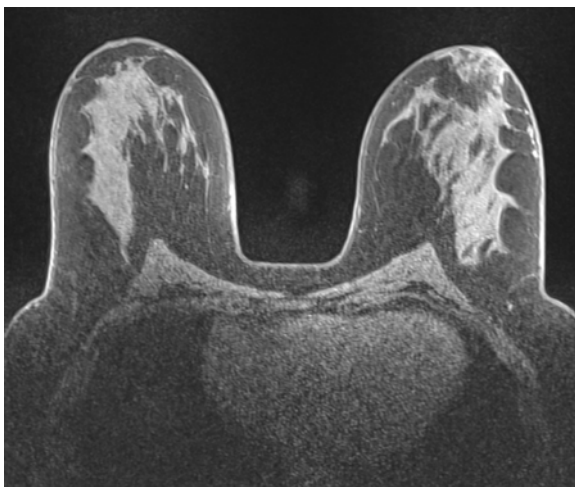


Figure 3 - Acceleration Factor 2, Sentinelle 8-channel

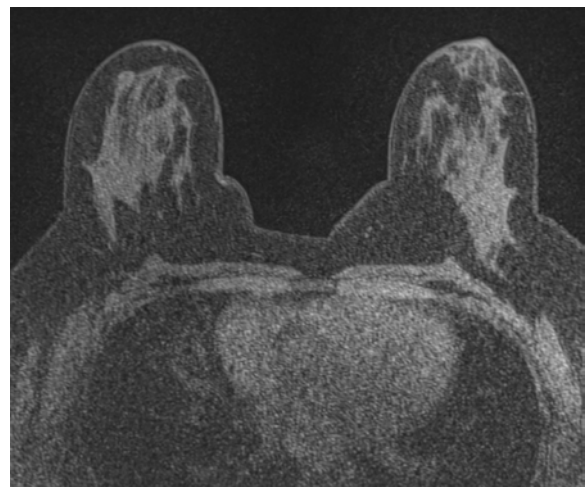


Figure 4 - Acceleration Factor 2, Competitor 7-channel

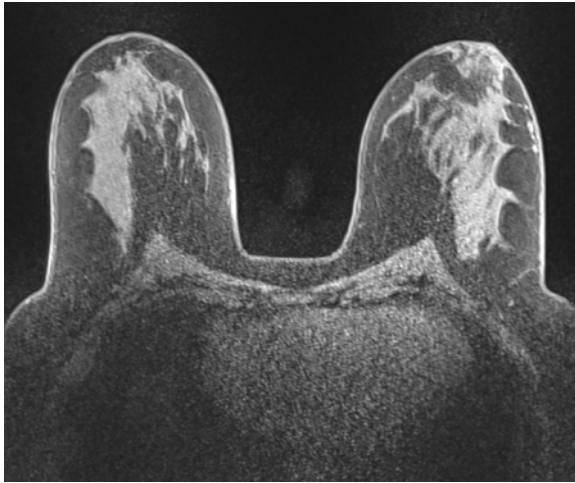


Figure 5 - Acceleration Factor 3, Sentinelle 8-channel



Figure 6 - Acceleration Factor 3, Competitor 7-channel



Figure 7 - Acceleration Factor 4, Sentinelle 8-channel



Figure 8 - Acceleration Factor 4, Competitor 7-channel

Although higher acceleration factors begin to display artifacts, these non-contrast images show the feasibility of performing sub-millimeter isotropic scan volumes in less than 90 seconds with the Sentinelle 1.5T 8-channel coil system. Still better image quality and higher accelerations are possible at 3.0T and using 16-channel Sentinelle coil systems.

Training on optimal use of breast coils and optimal use of protocols varies widely between vendors. Dedicate breast applications training not only optimizes the use of a particular vendor's equipment, but can help even experienced breast MR imagers to trim valuable scan time from their protocols. During a typical training session at a well known US facility, the Sentinelle Medical applications specialist reduced the breast protocol time by ten minutes.

In this example, the site went from three pre-contrast dynamic phases to one (1.5 mins x 2 + 2 mins to reconstruct and assess images = 5 mins). They also replaced their sagittal T2-weighted unilateral right and left scans (aprox 6 min 30 sec) with a single axial T2-weighted scan with an acceleration factor of 2 (aprox 1.5 min), saving an additional five minutes. The applications trainer

was able to show that moving away from sagittal T2-weighted or STIR imaging will yield a reduction in scan time when they switch to imaging axially. This is because the STIR and T2 fat-sat need to be done unilaterally while axials are inherently bilateral. The breast imagers got two scans in the time they used to get one.

With a detachable patient table, as found on the Sentinelle Vanguard for GE, nearly all patient preparation can take place outside of the MR suite. When the patient is properly positioned and comfortable, the stretcher can be moved into the MR suite and docked to the scanner. In this scenario, the scanner can be imaging a patient while the next patient is being prepared elsewhere, leaving very little time between each scan where the scanner is idle.

These factors are also very important for interventional procedures such as MR-guided biopsies. By ensuring these procedures are carried out quickly and efficiently, disruption to the physician's schedule is minimized. With maximized tissue access for both medial and lateral approaches, the entire line of Sentinelle Vanguard breast coil systems help to minimize the effort required for a breast biopsy. When paired with an effective and easy to use breast MRI software solution such as Aegis, the process of planning, preparing, and conducting a breast biopsy becomes streamlined and efficient.

Calculating the possible financial benefits that can be achieved by a typical imaging site may help to clarify the advantages. For example, if an average breast scan requires 30 minutes of imaging time, and an average patient takes 15 minutes to position and prepare, a site operating 12 hours a day could complete 16 breast scans per day. If all patient preparation was done in a separate room and the time spent moving the patient stretcher in and out of the MR suite was three minutes, then the number of breast scans that could be done in a 12-hour day would increase by 36%. Over an entire year (252 operating days) this increase represents the potential for an additional 1460 scans, or approximately \$1.46 million in additional revenue.

This added capacity also allows the facility to provide more timely access to service for a greater number of patients.

Access to Care

MRI is the most spatially restrictive imaging modality. With such a wide variability in patient breast sizes, the choice of a breast coil plays a key role in determining how many patients will be able to access the benefits of breast MRI. According to the Centers for Disease Control, 66% of non-institutionalized adults in America age 20 years and over are overweight or obese, creating special challenges for healthcare providers and the communities they serve. Some women have been turned away from multiple facilities because the equipment would not accommodate larger patients. The Sentinelle Vanguard line of breast coil systems feature greater breast volume than any other system. Imaging a greater volume is helpful up to a point, but only when all tissues are properly visualized and are accessible to the radiologist's interventional devices.



Figure 9 - Sentinelle Vanguard on Toshiba Titan MRI

The Signal to Noise Ratio achieved with an MRI surface coil drops off the farther the tissue is from the coil. Many breast coils have been designed as “one size fits all”, meaning the coil elements are set back from the tissue to accommodate the largest patients. This results in greatly degraded images when small breasted patients are imaged. In some cases, larger breasts will not completely fit into the coil, so it is not possible to image the entire area, especially the tissue closest to the chest wall. Similarly, patients with smaller breasts, or those who have undergone a mastectomy, will not image well on these “one size fits all” breast coils because the tissue will be too far away from the coil elements resulting in poor coil loading, which lowers SNR still further. To resolve this issue and improve image quality over a much greater range of breast sizes, the entire line of Sentinelle Vanguard breast coil systems uses Variable Coil Geometry. This unique technology allows the coils to be adjusted left-right and anterior-posterior in order to properly fit each patient. Using this unique ability to adjust to each patient, some Sentinelle Vanguard breast coil systems have the capacity to accommodate breasts of greater than 6000 cc bi-laterally.

It is easy to see how this can make a difference not only in the timely provision of quality care, but also in terms of potential revenue loss or gain for the imaging center or hospital. When a patient is referred to an imaging site for a breast MRI, the necessary scan time is blocked off in the schedule and reserved for this particular patient. Once the patient arrives, if a determination is made that the patient is too large or heavy for the breast coil, or if their breasts are too large or too small to be effectively imaged, the scan cannot be completed. Unless the scheduled scan time can be immediately filled by another patient, (a highly unlikely scenario) the site will incur administrative costs to process the failed appointment and they will lose the revenue that could have been obtained if the scan had been completed. Even if this happens only a few times each quarter, the financial losses can quickly accumulate. For example, if 15 breast exams were done per week or 3780 breast exams per year, if only 7% of these patients were too large to be imaged with a conventional breast coil, this would result in 264 patients that were turned away from their breast exam, or a loss of \$264 000 per year in revenue.

Patient Loyalty

Healthcare executives sometimes make the mistake of viewing qualitative issues such as patient comfort and quality as being disconnected from the quantitative financial management of the organization. In reality, the two are closely related. This is especially true for medical imaging procedures. The comfort of the patient while on the breast coil and during the entire procedure will have a meaningful impact on the financial success of a breast MRI program.



Figure 10 - Sentinelle Vanguard on Siemens Espree MRI

The design elements of the breast coil system must optimize patient comfort. Greater comfort translates to less movement by the patient which translates to fewer artifacts on the image. This ability to remain comfortably still during the procedure reduces unnecessary costs caused by the need to redo scans. *“One of the Sentinelle features that positively impacts image quality is the comfortable padding and design of the coil,”* notes Dr. Linda Frye, Radiologist with Pacific Breast Care in California. *“We’ve found that our patients are less likely to move and shift during the MRI procedure which means decreased motion artifacts.”*

Maximizing comfort during the procedure is in part related to the ability to quickly position a patient on the breast coil system. When the coil system has been designed to be comfortable and adjustable for a wide range of body types, the patient can be easily and quickly placed in a comfortable position.

If the radiologist determines the images are too heavily affected by patient motion, the patient will have to be scheduled for a second scan. The imaging site now must conduct two scans, incur twice the cost, and only receive reimbursement for one scan. Furthermore, since the second scan is now taking the place of a scan for which payment would have been made, another patient misses the opportunity to take this slot, and the imaging site loses the ability to deliver services and earn reimbursement during this timeframe.

According to Dr. Kerri Dias, radiologist with St. John’s Mercy Medical Center in Missouri, the hospital’s breast center is able to offer patients greater comfort with the Vanguard Table for breast MRI from Sentinelle Medical. *“The new table allows for better positioning of the breast for complete coverage during the MRI,”* says Dr. Dias, *“and it cuts the time in half from 45 minutes to 25 minutes. It also improves the image quality for breast MRI, takes less time and improves accuracy of interventional procedures done with MRI on the breast biopsies and breast needle localizations.”*

The level of comfort experienced by the patient during the breast scan also has ramifications for the patient’s compliance with an annual screening regimen. Patients may be more or less willing to recommend a given site to their friends based on the issue of comfort. Given recommendations from the American Cancer Society that high risk patients receive annual breast MRI exams, patient’s annual scanning program can become an important recurring revenue source for an imaging site. However, if the patient experience is not pleasant, she may neglect or delay scheduling her annual scans or she may decide to move her business to another, more advanced, imaging site.

For all of these reasons, the patient experience was thoughtfully incorporated into the design of the Sentinelle Vanguard line of breast coil systems. Patients can be situated with their arms resting by their sides or they can have them raised above their head during

the scan. Since the coils are adjustable, they can be repositioned to accommodate a patient's unique breast shape and size. The padding used on the table is made from soft visco-elastic foam covered in surgical grade material which creates a comfortable support platform for the patient and allows for easy clean up for the technologist. The padding, like the coil elements, is adjustable to fit the shape and preferences of each patient.

Conclusion

Multiple factors must be considered prior to launching, expanding, or modifying a breast cancer management program. As one important component of such a program, breast magnetic resonance imaging technologies can help to improve diagnostic and interventional capabilities while having a positive impact on the financial position of the imaging site or hospital.

While the initial purchase price of the Breast MRI coil system and software is often the most obvious cost of a breast program, it is only one of many factors to consider. After careful analysis it is evident that the most important financial consideration of choosing a breast coil system is its lifetime operating costs; and this cost is significantly different across vendors and models. The factors that contribute to this operating cost include: image quality, clinical workflow, patient range, and patient comfort. Medical facilities can improve their chances for long-term success and accelerate return on investment through careful planning and inclusion of state-of-the-art technologies such as the Sentinelle Vanguard Breast MRI system and Aegis software platform.