

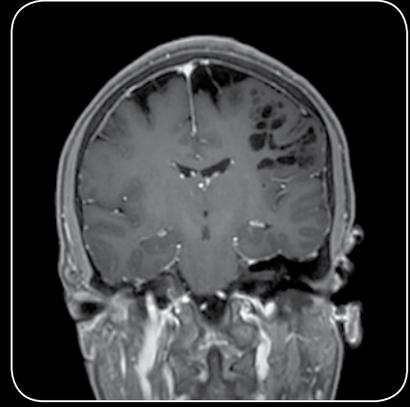
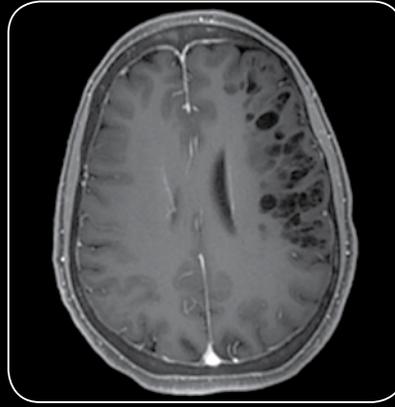
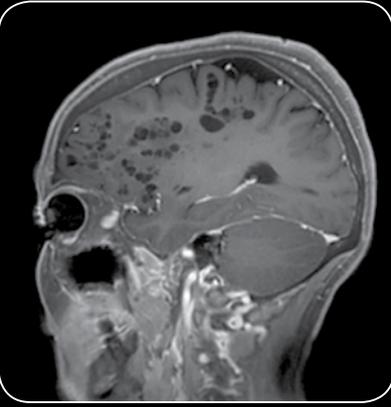
AMIDST THE SILENCE, WE HEARD THE PATIENT.

Can you imagine a mom reading a story to her son during his MR scan? Soon, this scenario could become a reality.

While an abundance of healthcare providers have dedicated themselves to greater compassion in medicine, many radiology practitioners have focused on image quality rather than the human element. Several years ago, GE Healthcare initiated a quest to change that. Like Robert Frost's famous poem which reads, 'Two roads diverged in a wood, and I—I took the one less traveled by, and that has made all the difference,' the company is taking the less-traveled road of Humanizing MR while continuing its tradition of uncompromised image quality.

To truly Humanize MR, Jacques Coumans, PhD and CMO of Global MR at GE Healthcare, explains that patient-centricity must touch everyone in the scanning process and help make their lives better. For example, the patient receives a more comfortable scanning experience; the technologist experiences ease-of-use, speed, and simplicity; the radiologist can count on superb image quality, as well as advanced procedures, exams, and protocols; and the administrator realizes economic sustainability.

† Not CE marked. Cannot be placed on the market or put into service until it has been made to comply with the Medical Device Directive requirements for CE marking.



Post contrast T1w Silent Scan Sagittal acquisition with Axial and Coronal reformats demonstrating dilated Virchow-Robin spaces.

“This caring focus has not taken away our ultimate goal of bringing the best possible diagnostic imaging quality to radiologists,” says Coumans. “At the same time, we are building GE Healthcare into the coolest MR brand on the planet by making patients the measure of our technological choices.”

Silently humanizing MR

To further the Humanizing MR commitment, GE Healthcare has introduced many new technologies including the wide bore w Series—the Discovery* MR750w 3.0T and the Optima* MR450w 1.5T, both with the Geometry Embracing Method (GEM) Suite of coils. “Patients of all ages deserve solutions adapted to their differing bodily habitus and disease symptoms,” comments Coumans.

Using the symbol of Caring Hands as inspiration, the systems are soothing and welcoming for patients; for example, the soft LED accent lights designed to create a rich and warm environment to emphasize patient care. Plus, the lighter, more flexible GEM Suite of coils embrace patients, transforming the environment from cold and clinical to warm and inviting.

In collaboration with PDC Facilities, Inc. (Hartland, Wisc), GE Healthcare launched the comforting and personalized Caring MR Suite. Using the w Series as its foundation, the suite provides lighting, scenery, and music that can be customized by patients using a digital tablet. It helps patients—in particular, children and adults with claustrophobia—feel more relaxed and in control during their MR scans. For technologists, this equates to higher-quality imaging and shorter exam times.

While these are some of GE Healthcare’s many strides in humanizing MR... there’s still a lot left to do. In particular, the company has been busy listening to patients who complain about loud, anxiety-elevating scanner noise generated during MR exams. As a result of this input, GE Healthcare introduces Silent Scan[†], revolutionary technology designed to address one of the most significant impediments to patient comfort—excessive acoustic noise generated during an MR scan.

Conventional MR scanners can generate noise in excess of 110 dBA (decibels) levels, roughly equivalent to rock concerts. GE’s exclusive Silent Scan technology is designed to reduce MR scanner noise to near ambient (background) sound levels, and, thus can improve a patient’s MR exam experience. The popular GE booth at RSNA showcased the Caring MR Suite featuring the Discovery MR750w 3.0T, as well as a demonstration of Silent Scan on the Optima MR450w 1.5T: with a real-time video link to a bay in Waukesha, Wisc. where technologists scanned live to demonstrate the acoustic reduction and image quality. More than 4,000 visitors experienced, and were buzzing about, the Silent Scan difference.

Additionally, this year’s Arab Health—the Middle East’s premier healthcare exhibition and conference—opened with Silent Scan and the real-time video link, and GE Healthcare’s popular booth at the 2013 European Congress of Radiology featured the revolutionary technology.



DIGITAL DIVE

Don’t hear it to believe it (Silent Scan noise comparison video) at tiny.cc/sps131

“What I like about GE’s approach is that it’s a new way to look at MR—breaking down the barriers of pre-conceived notions that noise is part of MR.”

Dr. Mark DeLano

The buzzing, clicking, drumming

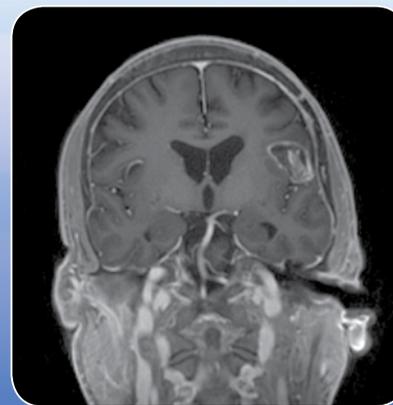
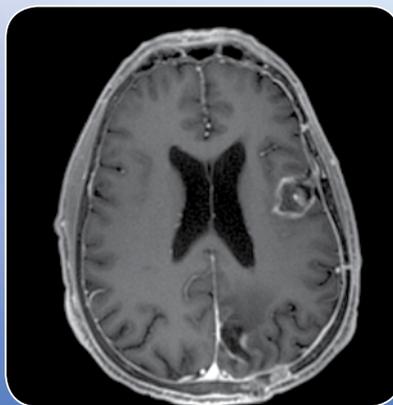
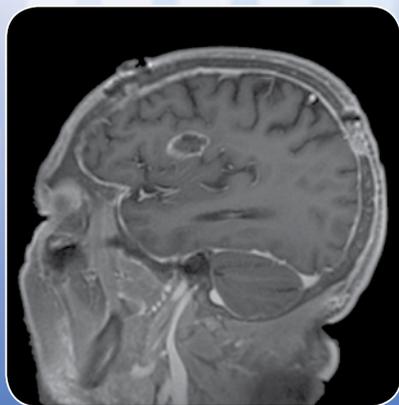
“Many people describe the MR scan noise as buzzing, clicking, or drumming. You do everything possible to provide your patients with a comfortable experience, but realistically, MR exams are loud,” says Bryan Mock, MR Product Manager with GE Healthcare. “The scanner noise can elevate anxiety, especially with geriatric and pediatric patients; damage hearing, if the levels are high enough and the subject does not use hearing protection; and cause a startle response, inducing motion artifacts. An uncomfortable, moving patient can lead to poor image quality and time-consuming re-scans.”

What makes the noise? Picture or “think of” a speaker—inside, there’s a big magnet with a wire around it. An impulse of electric current through the wire in the presence of a magnetic field creates vibration resulting in the generation of noise. It’s the same with

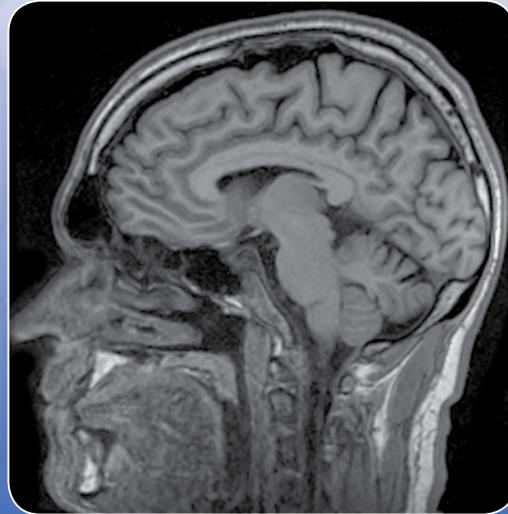
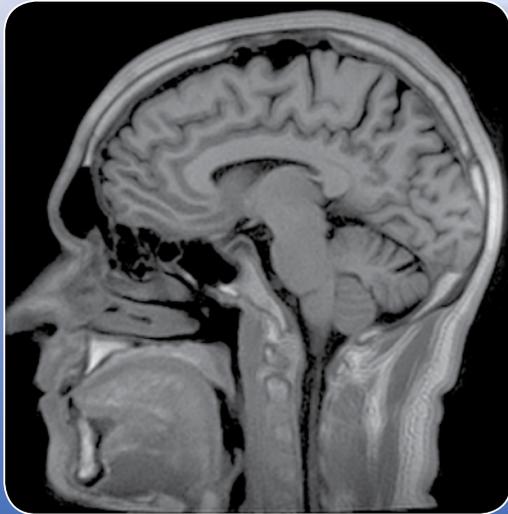
an MR system. The MR imaging gradients are the primary source of noise within the MR suite. Specifically, conventional MR imaging requires that the gradients are rapidly switched on and off to encode the MR spins to produce images with the desired contrast. The imaging gradients are produced by forcing electric current through the gradient coil as it sits inside the main magnet. Current flowing through the wire in a magnetic field creates a Lorentz force that induces motion within the gradient coil.

Since the gradient coil is fixed within the system, these forces cause mechanical vibrations that generate noise within the exam room and surrounding structures. Each imaging sequence generates a unique noise profile since the gradients employed change depending on the desired image contrast (e.g, Diffusion Weighted EPI “sounds different” compared to Fast-Spin Echo sequences).

Mark DeLano, MD, Advanced Radiology in Grand Rapids, Mich. and Director of the Division of Radiology at Michigan State University, has Silent Scan installed on a GE Healthcare wide bore scanner as part of the GE-sponsored research protocol. At his facility, the biggest impediments to patients’ acceptance of MRI are claustrophobia and the noise. “So often we hear people complaining that it’s like a jackhammer, but it’s more than just an annoyance—there’s a negative health impact on people from noise beyond potential hearing impairment, such as cardiovascular disease and sleep disturbances,” he comments. “So having healthcare as a source of noise doesn’t make much sense. This is important to our MR workers, as well as patients. The impact on both is something we shouldn’t ignore, especially when we can achieve high-quality images without the noise.”



Post contrast T1w Silent Scan Sagittal acquisition with Axial and Coronal reformats demonstrating enhancing lesion in the left frontal lobe.



Comparison of Sagittal Silent Scan (left) and BRAVO (right) demonstrating similarities in the grey-white contrast.

Reducing acoustic levels

With the advent of stronger and faster gradients over the last two decades, acoustic noise levels have increased and have required new engineering solutions to achieve acceptable levels. Some MR sequences exceed 110 dB(A), which can induce hearing damage if experienced for more than 30 minutes, according to the Occupational Safety & Health Administration.¹ MR examinations dictate the use of hearing protection, such as foam earplugs, to reduce the noise to safe levels—below 99 dB(A)—for patients.

Historically, reducing the noise generated by an MR scanner has been achieved by adding insulation to the MR system to minimize vibration and muffle acoustic noise; modifying internal structural supports to change the natural mechanical frequency of the MR system; or reducing the gradient slew-rate (or how quickly the gradients are allowed to change) to reduce the induced mechanical force/vibration—the latter, however, results in longer scan times.

“We wouldn’t intentionally put ourselves into a situation where we are going to be constantly bombarded with noise, right? Yet until now, we all accepted noise as a necessary part of MR. What I like about GE’s approach is that it’s a new way to look at MR—breaking down the barriers of pre-conceived notions that noise is part of MR,” notes Dr. DeLano.

Novel approach

GE Healthcare has taken a novel approach to minimizing acoustic noise levels by attacking the problem at the source of the noise... the rapidly switching gradients—dramatically reducing the acoustic noise of the MR exam. “Silent Scan eliminates the noise by modifying how the MR data is acquired rather than simply derating the traditional imaging sequence or muffling the sound already produced. It’s truly an industry-changing advancement toward humanizing MR,” says Mock.

The secret behind Silent Scan technology is in the novel combination of a new 3D acquisition and reconstruction technology,

highly stable system power electronics (gradients and RF) and fast RF switching within the RF coil architecture. These new acquisitions slowly step the gradients while maximizing the amount of time for data collection during a 3D acquisition. The data acquired is isotropic and different contrasts can be achieved with novel preparation sequences. The technology requires extremely stable gradients and fast switching RF coils to avert image artifacts and maximize signal-to-noise ratio. It has shown promise at generating the necessary clinical contrast while reducing the scanner noise to near ambient (< 3dB(A) above ambient) levels.

Dr. DeLano and his team have investigated the use of Silent Scan on pre-operative and post-operative patients for brain tumors and epilepsy, and for providing a 3D volumetric, T1-weighted image that is excellent for looking at the hippocampi. Also, when they’re doing epilepsy workups, the technology has compared favorably to other 3D, T1-weighted images for volumetric imaging.

Enjoying the silence

“The new Silent Scan sequences produce image quality that’s every bit as good as the traditional techniques, but in a way that is much more comfortable for patients. We scan many elderly, as well as pediatric patients—two populations vulnerable to hearing damage from noise. Some of the Silent Scan techniques are virtually imperceptible from quiet. As a matter of fact, in our bay, the ambient noise level runs about 70 dB(A), and the sound level when the scanner is on is 70.3 dB(A). There’s only a minor difference from ambient noise,” says Dr. DeLano.

He continues, “Patients who are sensitive to hearing loss or those with anxiety are going to do better when the scan experience is more comfortable. It’s so much quieter, that you almost have to explain to patients that the scanner is still running—in the scanner, patients sometimes get anxious when the machine seems idle, and when there’s no noise, they are prone to feeling forgotten. We need to remind them that we are still there.”

Dr. DeLano says that uniformly, his patients love Silent Scan. But he notes that silent scanning is also critical for techs. At the Spectrum Health Blodgett Campus, they have two MR scanners that work at the same time. When both are running, a number of intrusions can make the environment extra loud, and impact communication with the patient for breath-holding exams and coordination between multiple care team members, such as nurses and anesthesiologists. “Our techs have been uniformly supportive and delighted with the absence of the noise. It’s almost a little bit startling until I went into the scan room, I did not fully appreciate the substantial difference it makes. You don’t hear any noise generated by the system.”

He continues, “When working daily in the MR environment, you’re used to hearing the noise and you use it as an auditory cue as to what’s going on with the scanner. The absence of noise prompts the technologists to pay attention to scanning in a different way because there isn’t the auditory cue that the scan is still running. It’s changing the experience of the technologists in a positive way and it allows them to focus more appropriately on the other aspects of the examination.”

Dr. DeLano says the MR technologists are impressed with how much quieter the console is and see how comfortable the patients are. “The MR experience is very stressful, as it can be blisteringly loud. This can make the experience challenging for the tech, as well as the patient. The combination of the GE wide bore scanner and the virtual silence makes the entire experience much more soothing. There’s really no question about it.”

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DIGITAL DIVE

Silent Scan Deluxe visit tiny.cc/sps138

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The future is silent

Regarding the advancements of Silent Scan, Dr. DeLano feels that we've only begun to scratch the surface. For example, MR angiography (MRA) is something that he'd like to exploit because the blood vessels are inherently very bright on this type of a scan. "It would be wonderful if we could make everything silent. The ability to add other exams such as MR angiography is also of great interest. We receive brain MRA referrals daily, often for patients with headache. It would be a much more positive scan experience without any noise." Dr. DeLano continues, "GE has redefined the MR experience. As creative innovations are introduced we become open to possibilities previously considered impossible."

Another example of where the MR noise gets in the way, according to DeLano, is in MR units in the operating room. "The potential for having Silent Scan in the OR could make a huge difference," offers Dr. DeLano. "The importance of communication in the OR is critical. You want the surgeon concentrating on the complex procedures and the anesthesiologist focusing on your patient, rather than hoping they can tune out the noise."

He continues, "And don't underestimate the importance of the silent scan for the neighboring operating rooms. Sound penetrates all the walls... and while we do our best to dampen the noise, it is distracting for clinicians in the other OR suites."

According to Dr. DeLano, Silent Scan is a revolutionary approach to the way that MR scanning is done—representing a major leap in terms of technology. "For the future, it means there's going to be a stronger focus on patient comfort with respect to sound levels on all exams. I envision this will only be the beginning of a suite of applications, from neuro through body imaging, with substantially lower sound pressure levels and a much higher level of patient comfort." **S**

Reference

1. www.osha.gov

Issue Spotlight



Mark C. DeLano, MD, of Advanced Radiology Services, PC is Associate Professor and Director of the Division of Radiology and Biomedical Imaging at the College of Human Medicine of Michigan State University. He is the Neuroradiology Section Chief and Director of the Advanced Imaging Laboratory of Spectrum Health System. As a Cross-disciplinary basic and clinical investigator, Dr. DeLano has published on MR angiography, neuroradiology, musculoskeletal and cardiovascular MR imaging, and MR imaging techniques, and he has presented nationally and internationally.

Advanced Radiology Services, PC is a team of over 100 Michigan-based radiologists, providing state-of-the-art diagnostic and interventional radiology services and partnering with physicians and healthcare systems across Michigan. Spectrum Health, comprised of nine hospitals and 183 services sites, is a not-for-profit health system in West Michigan offering a full continuum of care. Michigan State University is the nation's pioneer land-grant university and home to nationally ranked and recognized academic and research programs.