# The best of both worlds

Scientists and physicians from Siemens Healthineers describe the motivations and innovations behind the development of a PET/CT scanner that combines the best of both worlds: an extended axial field of view (FoV) with industry-leading detector technology.

By Sameh Fahmy | Photography by Hollis Bennett


As the understanding of disease physiology progresses, the tools that help advance this understanding must progress as well. At international conferences, in medical literature, and in meetings with industry leaders, clinicians and researchers have not been silent about their need for technological advancement in molecular imaging. Such advancement, voiced as the need for a PET/CT scanner that enables better care for patients and the expansion of research, has been answered.

To address these needs, Maurizio Conti, PhD, and his colleagues at Siemens Healthineers turned a decade-old idea into reality. Conti, along with Bernard Bendriem, PhD, was part of an initial group that conducted early simulations of extended axial FoV PET/CT scanners in 2010. Building on a decade's worth of information, knowledge, technological advances, and ambition, "we felt the need to answer a call from the scientific and clinical community for a scanner that would capture most of the organs at one time, dramatically increase sensitivity, and use the state-of-the-art detector technology we already had," says Conti, Director of PET Physics and Reconstruction.

Bendriem, Principal R&D Expert at Siemens Healthineers, participated in dozens of meetings with molecular imaging leaders, from both the academic and industry arenas, to assess their needs and expectations as the company designed a new approach to PET/CT technology. "A lot of creativity comes from inside the company to make the dream of the physician a reality," he says with smile.

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Maurizio Conti, PhD, Director of PET Physics and Reconstruction, Siemens Healthineers

**Stimulating research and clinical care**

The reality Bendriem describes is Siemens Healthineers' extended axial FoV PET/CT scanner, Biograph Vision Quadra™.

Conti explains that Biograph Vision Quadra's 106 cm axial FoV is achieved by placing four of Siemens Healthineers' detector-block assemblies in series. Such an arrangement of the assemblies, in which the core detector technology is comprised of silicon photomultipliers (SiPM) coupled with scintillator crystals, improves the system's time of flight and the resulting effective sensitivity. This increase in effective sensitivity—which correlates with the system's image quality—is comprised of two essential design elements. The first is exceptional time of flight, which localizes the photon's origin of emission within the patient's body, leading to exceptional image quality. Second is the system's ability to capture photons emitted from the patient's body, and from a wide range of angles, as allowed by an extended axial FoV. This is the hallmark of Biograph Vision Quadra: a potent increase in effective sensitivity that is achievable with the formidable combination of an extended axial FoV and high-performance SiPM detectors.[a]

Acknowledging the potential progress that can be achieved with such improvements in design, Bendriem states, "we are not only building a machine that is quite useful for clinical needs, but also stimulating the research community to push even more the limits of what can be achieved with PET technology." Bendriem further emphasizes, "with this system, we will be able to bring the best of both worlds, both an extended axial field of view and a time-of-flight performance that is the best that can be achieved by the industry at this time."[a]

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William Curtis Howe, MD, PET Product Manager, Siemens Healthineers

Conti and his colleagues emphasize, however, that the benefits the scanner offers to research and clinical care are more than simply additive.

"The wonderful thing about Biograph Vision Quadra is not necessarily that it does what's achievable today, better; we already have very capable clinical scanners," says William Curtis Howe, MD, PET Product Manager at Siemens Healthineers. "This new scanner actually opens up the possibility of doing things that people really haven't thought of before or worked into their clinical routine, simply because it was not possible for them."

Howe adds that although traditional PET/CT acquisition methods such as step-and-shoot and continuous bed motion can provide information across different regions of the body that are then "summed" together to provide a complete view of the scanned area, an extended axial FoV system eases the acquisition of such dynamic images. The advantage of dynamic imaging lies in its ability to show the behavior of radiotracers over time, and in different areas of interest simultaneously. The difference is analogous to comparing still photos—or a series of still photos taken at intervals—with video.

"If the field of view is sufficiently large to cover all the organs of interest, then you're able to create frames of data without regard for where the bed happens to be at the moment, and that's a huge advantage," Howe says. "It's something that comes naturally with the extended axial field of view.

"I envision this scanner as being one that scans quite a bit of information in dynamic mode," he adds. "I think this is going to be the natural mode of operation for this scanner."

## Points of pride

As with any engineering feat, several of the system's features might not be immediately noticeable, but are points of pride nonetheless. To minimize the need for costly room renovations, Biograph Vision Quadra is designed to occupy the same footprint as a conventional PET/CT. Mechanical enhancements include a new frame design that enables the precise alignment of the detector block assemblies, stable performance, and ease of servicing. In the area of information technology, enhanced computing power, storage, and networking capabilities speed the acquisition, reconstruction, and transfer of data.

Hundreds of global employees, with expertise ranging from physics to engineering, medicine, and information technology, worked to develop Biograph Vision Quadra. Seeing it installed at a customer site marks the end of the initial development process for the team at Siemens Healthineers, but it marks a new beginning for the clinicians and researchers who will use the scanner to advance their work. In his next round of meetings with imaging leaders, Bendriem eagerly anticipates hearing how they are using the benefits of extended axial FoV to advance their research and the care they can provide patients.

"I'm looking forward to learning with them the kind of information we can extract because, at the end of the day, what we are doing is trying to acquire more knowledge about healthcare and trying to help physicians better manage the diseases that affect some of our friends, some of our family, and all of us in the world," he says. "If we can help treat disease better, then we know we have accomplished our mission and will continue to do even more as new challenges occur." ●

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[a] Compared to competitive systems at time of publication. Data on file.

Biograph Vision Quadra is not commercially available in the USA and other countries. Its future availability cannot be guaranteed. Please contact your local Siemens Healthineers organization for further details.