The Lemmen-Holton Cancer Pavilion at Spectrum Health houses one of the first Biograph mCT systems. Dr. Paul Shreve appreciates its truly integrated system design.

Molecular CT: From Vision to Reality

As the first Siemens Biograph mCTs are coming online in clinics around the world, doctors on three continents spoke with *Medical Solutions* about the impact this revolutionary new system – which is breaking down barriers between radiology and nuclear medicine – could have on their practices and the lives of their patients.

By Ron French

If it's possible to take a picture of the future, the gleaming green-and-white system in the Spectrum Health Lemmen-Holton Cancer Pavilion in Grand Rapids, Michigan, USA, is doing it. It's a future of crisp, state-of-the-art computed tomography (CT) images and of positron emission therapy (PET) images that jump off the computer screen, revealing metastases that may have been missed in the past. It's a future that accommodates larger patients and may ease imaging anxieties where throughput is an asset instead of a headache, and where PET and CT make each modality – and each modality's experts – better and more efficient. It's a future that Paul Shreve, MD, believes will finally bring to fruition the vision of the inventors of the PET/CT. "There's a true integration of the modalities," says Shreve, Medical Director of PET/CT at the Lemmen-Holton Cancer Pavilion. "It's an improvement over anything available right now." Siemens' Biograph® mCT is more revolution than evolution, a game-changer providing clinical and economic efficiencies while breaking down barriers between radiology and nuclear medicine.

One of the first Biograph mCTs was delivered in May 2009 to the sparkling, six-story Lemmen-Holton Cancer Pavilion. Opened in 2008, the facility draws patients from Grand Rapids' Butterworth Hospital and Helen DeVos Children's Hospital, who can travel along underground pathways to the cancer center, and outpatients from a 13-county area of western Michigan. The center treats 40 percent of new cancer patients in the region, offering radiation treatment, medical oncology, chemotherapy, research, cancer multispecialty clinics, a genetic evaluation clinic, and research labs – all under one roof.

A Marriage of Two Disciplines

When it first opened its doors last year, everything about the glass-and-chrome facility was state of the art – even its PET/CT. The center's Siemens Biograph 16 had been the best available on the market when it was purchased five years earlier, a "16-slice CT with the high-resolution LSO crystals," says Shreve. But as good as that technology was, there were times when small metastases couldn't be delineated from normal lumps. There were patients who weighed too much for the PET/CT. The modalities weren't integrated seamlessly. Optimization and integration of PET and CT scans had been an unreached goal since the invention of the PET/CT in 1999. The machine brought together two disciplines, and the marriage was rocky at times.

Even the name of the machine caused disagreement. "The initial debate was over whether to call it PET/CT or CT/PET," says Rodney Hicks, MD, Director of the Centre for Molecular Imaging at the Peter MacCallum Cancer Centre in East Melbourne, Victoria, Australia. "In 2001, at the Academy of Molecular Imaging, you had radiologists saying that most of the

precise localizing information is from the CT. Then the PET people got up on their high horse and said that all the important information is in the PET. Since most of the people who were using PET at the time were from a nuclear medicine background, PET/CT won out."

Ten years after the invention of the PET/CT, there are still turf battles in many institutions between nuclear medicine and radiology, notes Andreas Bockisch, MD, of the Department of Nuclear Medicine, Diagnostic and Interventional Radiology at University Hospital in Essen, Germany. "In many places the collaboration may be improved," says Bockisch.

While disagreeing on which modality was preeminent, experts in both disciplines were aware of "the importance of correlating the molecular images we got from PET and the structural images we got from CT," says Hicks. "We'd put them up on a light box and look at them side-by-side. Putting the two together, and knowing the patient is in the exact same position and there's no opportunity for organs to move, has dramatically improved our ability to differentiate between those areas of potential abnormality on molecular imaging with PET, in order to work out whether it's physiological or pathological. If it is pathological, detailed CT evaluation then helps to refine what differential diagnoses are most likely and can often provide a more definitive diagnosis."

> "There's a true integration of the modalities."
>
> Paul Shreve, MD, Medical Director of PET/CT, Spectrum Health Lemmen-Holton Cancer Pavilion, Grand Rapids, Michigan, USA

For all the wonders of combining the modalities, physicians trained in one specialty tended to use PET/CTs much the same way they used independent PETs and CTs. "A lot of people who don't have CT training don't use it as a CT scanner," says Shreve. "They use it as a PET scanner and use the CT to localize the PET findings. But you can't really localize things unless you know what you're looking at; if you don't know what you're looking at on the CT, how can you localize?"

The Siemens Healthcare Biograph mCT finally resolves many of the technical limitations of past PET/CT hybrids, with a true integration of modalities that doctors familiar with the machine believe will break down barriers between nuclear medicine and radiology.

Optimal Flexibility and Efficiency

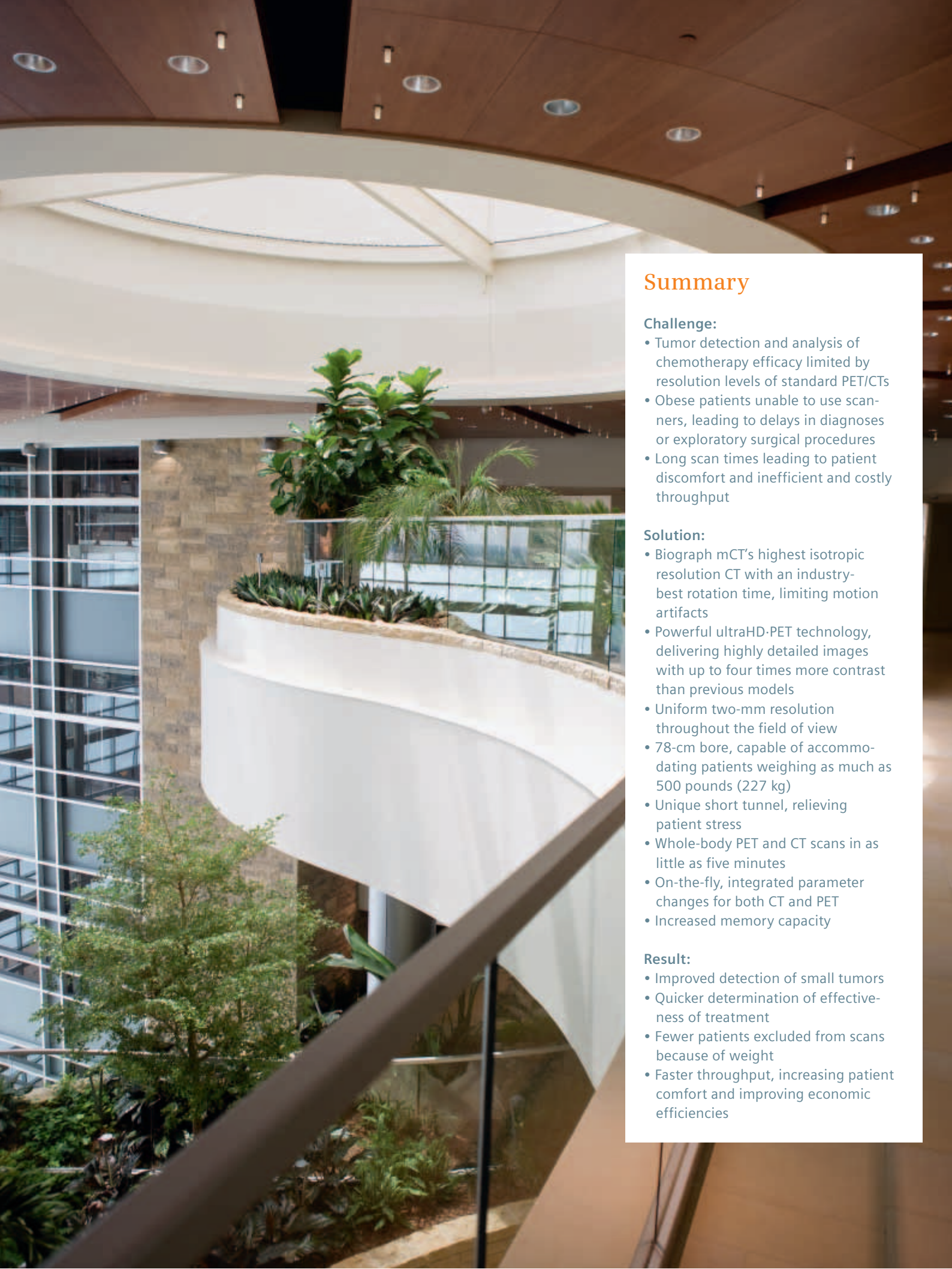
The improvements begin with the introduction of the industry's highest resolution CT and continue with the capability of whole-body PET scanning in just five minutes – a new standard for the industry – while optimizing flexibility and efficiency.

Biograph mCT's powerful ultraHD·PET technology delivers highly detailed images with up to four times as much contrast as earlier hybrids, offering two-millimeter (mm) uniform resolution throughout the field of view. Shreve describes it as "a special point-spread function reconstruction method plus time of flight, delivering a much better quality with the PET. Big patients have always been a problem with PET because images get degraded very quickly. With time of flight, we're able to solve a lot of the scanner problems."

Those bigger patients can be accommodated with Biograph mCT's unique short tunnel and 78-cm bore, capable of handling patients weighing as much as 500 pounds (227 kilograms), while also alleviating the stress of claustrophobic patients. "It's easier for the patients," says Shreve. "We can accommodate bigger patients because of the gantry size; and there is a lower radiation dose to handle larger patients with no problem."

The Biograph mCT's unmatched isotropic resolution in CT, combined with one of the industry's best rotation times, brings out crisp anatomical details in every scan – routine and advanced – limiting motion artifacts. It is available in detector configurations of 40-, 64-, and 128-slices, a first in integrated scanners.

For Shreve, Biograph mCT was an easy choice. "We're a tertiary care center," says



Summary

Challenge:

- Tumor detection and analysis of chemotherapy efficacy limited by resolution levels of standard PET/CTs
- Obese patients unable to use scanners, leading to delays in diagnoses or exploratory surgical procedures
- Long scan times leading to patient discomfort and inefficient and costly throughput

Solution:

- Biograph mCT's highest isotropic resolution CT with an industry-best rotation time, limiting motion artifacts
- Powerful ultraHD·PET technology, delivering highly detailed images with up to four times more contrast than previous models
- Uniform two-mm resolution throughout the field of view
- 78-cm bore, capable of accommodating patients weighing as much as 500 pounds (227 kg)
- Unique short tunnel, relieving patient stress
- Whole-body PET and CT scans in as little as five minutes
- On-the-fly, integrated parameter changes for both CT and PET
- Increased memory capacity

Result:

- Improved detection of small tumors
- Quicker determination of effectiveness of treatment
- Fewer patients excluded from scans because of weight
- Faster throughput, increasing patient comfort and improving economic efficiencies

Biograph mCT's powerful ultraHD·PET technology and unmatched isotropic CT resolution enable Lemmon-Holten to deliver increased patient care.

Shreve. "We want to offer the highest level of service available." Bockisch, whose University Hospital in Essen, Germany, has a Biograph mCT on order, echoes Shreve's belief in the new technology. "We assume it is the best machine you can buy today," says Bockisch. "We are very much interested in the high resolution of the PET, combined with the large field of view." Earlier PET/CT hybrids took Bockisch an average of 67 minutes per procedure; newer models cut the time to 35 minutes. Biograph mCT will shave more precious time off procedures, increasing throughput and potentially decreasing patient anxiety. "For the patient, the investigation will be faster – we can get better images and save radiation," he says.

Breakthroughs in Ovarian Cancer

The treatment of ovarian cancer highlights the advantages of the Biograph mCT.

"We don't have a terribly accurate way of assessing the burden of disease with CT scanning (alone) because the areas of disease can often mimic the loops of bowel," says Hicks. "There are many lumps that can masquerade as disease or be assumed to be normal structure when in fact they are tumors. It's been difficult, short of looking directly into the abdomen and doing an operation, to actually appreciate the difference."

PET/CT hybrids have helped, but the size of visible tumors was limited by the technology. "Ovarian cancer can be difficult because of the nature of the small metastases in the intraperitoneal space in the abdomen and pelvis," explains Shreve. "Having very high sensitivity, high-quality PET images lined up with very high-quality CT images is very important, because you're looking for very small metastatic deposits. Ovarian cancer can have a lower profile on PET, but then you can see it on CT if the CT image quality is very good. It requires optimization of both scans."

Biograph mCT may lower the size of visible tumors – a vast improvement for ovarian cancer identification, says Bockisch. With the improved spatial resolution, follow-up investigations can offer physicians a clear indication of whether patients are responding to chemotherapy.

The increased resolution offered by the Biograph mCT is also a boon for cancer drug development, says Fadlo Khuri, MD, Professor and Chair of the Department of Hematology and Medical Oncology at Emory University in Atlanta, Georgia, USA. "A lot of these agents are unlikely to cause large changes in the contours of the tumor immediately, regardless of which vascular, epithelial, or even epidermal growth factor receptors they are targeting," he notes. "For us, it's very attractive to have PET because it's much more sensitive for studying tumor metabolism than what we've had prior to PET. We've had bone scans, and bone scans were nice in the bone; now we have something that tells us what the drugs are doing – in visceral tumors as well as bone."

The increased sensitivity of scans offered by Biograph mCT will make drug investigations more effective. "We're able to get a simultaneous view of whether the agent is acting metabolically and anatomically," says Khuri. "I think that the future of drug development and response assessment in oncology is tied to the development of these modalities."

Collaboration for Patient Benefit

Biograph mCT provides a big step in the development of both modalities, and a giant leap in the integration of PET and CT – an integration that Bockisch believes will help specialists in nuclear medicine and radiology understand each other. "I think cooperation will develop like that in the future," he says. "If people work together, they start to understand each other better and respect the knowledge of each other more. The setting must be one of collaboration between equals, and of having respect for the modality of the other specialty. Our younger physicians have learned it that way. They don't know the times when CT and PET were separate."

At the Lemmen-Holton Cancer Pavilion, Shreve and his peers have always

Fast scanning times and the 78-centimeter gantry bore make exams easier for patients. So does the bright and friendly examination room.

attempted to integrate the modalities – a practice that the Biograph mCT makes seamless. "It's truly an integration of the modalities," he says. The Biograph mCT is already making a difference in Grand Rapids. Staff members report that the new operating system is faster and has a much higher memory capacity. "There's increased flexibility, allowing us to develop protocols that are more integrated," says Shreve. "In the past, we had to scan the neck and stop and change parameters; now the scan makes adjustments in both the CT and PET, changing parameters on the fly that are appropriate for the neck or chest, which is really nice. Again, it's less time for the scan and a shorter time for the patient – it's just one seamless, integrated process."
The Lemmen-Holton Cancer Pavilion is already planning to expand its hours to handle the increased number of patients referred to the center since the Biograph mCT was installed. "We do ten to 12 a day, and we're booked solid," says Shreve. We have eight uptake rooms for one scanner." Shreve says he doesn't know what the future will hold, but he's sure it will involve the green-and-white machine that is getting so much attention, adding, "We're just now beginning to push it to its full capabilities with different operating parameters."

***Ron French** is an investigative reporter for the* Detroit News *who has written extensively about healthcare and economics. His series, "The General and the Beast," analyzing the devastating impact of healthcare costs on General Motors, won numerous awards. He lives in Okemos, Michigan, USA.*

Further Information

www.siemens.com/mCT