# **Generating ROI with Advanced PET** and Diagnostic CT Imaging

Known as the "Bush Capital," Canberra is Australia's largest inland city located 170 miles (280 km) southwest of Sydney. As the nation's capital, it is

home to many national monuments and institutions as well as two large public and several private hospitals.

Canberra Imaging Group (CIG) is one of the oldest established medical imaging practices in Canberra and surrounding New South Wales. With 10 imaging clinics in Canberra, Queanbeyan and Goulburn, the organization delivers a wide array of clinical services with some of the most advanced medical imaging technology available today.

However, one imaging service that CIG did not provide was PET/CT. According to Colin Mercer, BAppSC MRS Nuclear Medicine,



Figure 1. (A) Q.Clear PET 2.5 min; (B) diagnostic CT (c-); (C) Q.Clear PET 2.5 min with diagnostic CT (c-); (D) Q.Clear PET 1.5 min; (E) diagnostic CT (c-); (F) Q.Clear PET 1.5 min with diagnostic CT (c-).

(D-F) Note the similar image quality in a shorter acquisition time.

Department Manager, many patients were travelling three to four hours to Sydney to receive this imaging service or they would wait for availability





TOF + Q.Clear





Figure 2. (A) TOF PET; (B) diagnostic CT; (C) ToF PET with diagnostic CT; (D) Q.Clear PET; (E) diagnostic CT; (F) Q.Clear PET with diagnostic CT.



Figure 3. (A) TOF PET; (B) diagnostic CT; (C) TOF PET with diagnostic CT; (D) Q.Clear PET; (E) diagnostic CT; (F) Q.Clear PET with diagnostic CT.

The addition of the PET and diagnostic CT being acquired and reported together is more than the equal sum of its parts.

at the only other PET/CT in the area located at one of the hospitals.

CIG installed Discovery<sup>™</sup> MI DR in February 2017 at an existing CIG practice, the Brindabella Specialist Centre which is located on the grounds of Canberra Hospital.

### One system, two imaging service lines

A key reason CIG chose Discovery MI DR was the added flexibility of a standalone diagnostic CT. Discovery MI DR includes GE Healthcare's Revolution™ EVO, an advanced 64-slice CT system that delivers high resolution and routine low dose imaging. It combines the Clarity Imaging System with the speed of the Performix™ 40 Plus tube with GE's proprietary HiLight CT detector to deliver up MI DR is Smart MAR, which virtually eliminates streaks and shadows from metal artifacts, saving valuable time previously spent correcting images.

The existing CIG practice at the Brindabella Specialist Centre had a diagnostic CT, which was already providing imaging for oncology patients. An important consideration in the system acquisition was for it to be able to maintain the current diagnostic CT imaging services with the addition of PET.

CIG developed a business case demonstrating that the practice could maintain its CT volume and also add new volume for PET imaging. Additionally, since a diagnostic CT is ordered in conjunction with a PET exam, CIG could perform both on the Discovery MI DR system.

to a 2x increase in spatial resolution when used with ASiR-V<sup>™1</sup>. The innovative ASiR-V iterative reconstruction method is an option that can also reduce CT dose by up to 82 percent at the same image quality in routine imaging across applications.<sup>1,2</sup>

Another key feature of Revolution EVO CT on the Discovery



Figure 4. (A) Q.Clear PET with diagnostic CT; (B-D) Q.Clear PET.

To keep the same CT volume, scanning slots were reduced from 20 minutes to 15 minutes. An extra staff member was hired to support this workflow.

"We knew we had the referrals and volume to support the diagnostic CT capability, so that gave us added confidence to build the PET referrals," Mercer explains.

The PET imaging service runs from 7 am to 1 pm; from 1:30 to 5:30 pm the system is used for diagnostic CT exams. On average, nine PET/CT and 16 diagnostic CT exams are performed daily on the system at CIG. The robust CT performs well at high volumes and has been a reliable addition to CIG's imaging arsenal.

"Nine is a good number for PET/CT, but we have the capacity in our organization to take on more diagnostic CT at other facilities, including our flagship center that is a 5 minute drive," Mercer explains. "That's one goal, to add more PET exams and migrate diagnostic CT exams elsewhere."

### **Clinical benefits**

CIG has received rave reviews from referring physicians regarding the high-quality PET combined with diagnostic CT images. "They love it and we've received very positive feedback, mainly because we are performing the full diagnostic CT with the PET imaging service. They just receive the PET study with attenuation corrected CT from other imaging providers in the area," Mercer explains. CIG routinely provides contrast-enhanced CT imaging along with PET.

The clinicians reading and reporting these studies—many who are trained in radiology and nuclear medicine—are using the PET and diagnostic CT imaging data to guide their diagnosis. Often, the PET images will guide them to an area on the CT and vice versa. It is also common practice for the radiologist to fuse the PET image with the contrast-enhanced diagnostic CT to further examine a particular lesion.

"Clinically in our practice, they are finding that potential false positive lesions they see on the PET can be cleared up with the CT contrast-enhanced images," Mercer explains. "The addition of the PET and diagnostic CT being acquired and reported together is more than the equal sum of its parts." In other words, 1+1=3.

Patients benefit from the new system, as well. Many imaging studies for oncology also require a diagnostic CT. By performing both in one exam, CIG is replacing the need



Figure 5. A) Q.Clear PET 2.5 min; (B) diagnostic CT (c-); (C) Q.Clear PET 2.5 min with diagnostic CT (c-); (D) Q.Clear PET 1.5 min; (E) diagnostic CT (c-); (F) Q.Clear PET 1.5 min with diagnostic CT (c-). (D-F) Note the similar image quality in a shorter acquisition time.

for a separate diagnostic CT, which is more convenient for patients.

And, thanks to the inclusion of ASiR-V, the diagnostic CT performed on Discovery MI DR at CIG delivers a low dose to the patient, similar to advanced CT systems at other imaging centers in the practice. CIG has pre-determined guidelines and protocols for recommended patient dose levels that were utilized on the Discovery MI DR's CT system. In the initial system testing, Mercer discovered that the system was 50% lower than those recommended dose levels.<sup>3</sup> Even when adding in the attenuation correction for the PET and the administration of injected dose, the total patient dose remained under recommended levels.

"That is very important to our practice, we try to keep dose as low as possible following the ALARA principle," Mercer adds.

Smart MAR is another technology that delivers clinical benefits. In many of the practice's pelvic CT cases, patients have hip replacements. CIG routinely uses Smart MAR to minimize the metal artifact and improve image quality.

In PET imaging, Q.Clear enables small lesion detectability and Mercer believes it is an invaluable clinical tool. He performed initial comparisons with and without Q.Clear for evaluation by the radiologists. With Q.Clear, the lesions appeared brighter and were easier to visualize, especially in small lesions.

"We saw a significant improvement in lesion detection, so we use it routinely on every patient," he says. "Q.Clear is now part of our physicians' preferred reconstruction data set and they absolutely love it."

As important, Q.Clear helps reduce noise with the boost in SNR, leading to high image quality. Because of the high SNR and image quality, CIG is able to deliver low injected dose averaging 3 MBq for every 2.2 pounds (1 kilogram) for a typical 30 minute PET exam.

#### **Economic value**

The "DR" in Discovery MI DR means "digital ready." The software and analytics are digital and the system's modular design provides an upgrade path to GE Healthcare's digital detector technology. It's the perfect solution for a practice like CIG to economically fit today's clinical imaging needs yet be easily upgraded to Discovery MI with the LightBurst Digital Detector technology.

"The upgrade path was one of the tipping points why we chose Discovery MI DR over a competitive system," Mercer says. "To initially acquire a fully-digital system was cost prohibitive for us. Yet, we have that opportunity to upgrade later without sacrificing improvements in image quality and sensitivity, so that's a strong positive."

Discovery MI DR provided an entry into PET imaging for CIG while helping maintain existing CT imaging volumes.

"We're providing a new service without a huge financial risk," Mercer adds. He can easily adapt the type of imaging—PET or diagnostic CT—each day based on the schedule. If there is a lower volume of PET exams, then the scanner is used for diagnostic CT and vice versa. This approach keeps the system scanning all day, enhancing CIG's return on investment. PET and CT studies can be performed on the same scanner without the requirement for patient repositioning or separate appointments, resulting in increased clinical efficiencies.

Mercer adds, "The system will pay for itself with the CT exams that were already being referred to us, and now we have the added PET work, which also adds more CT exams."

#### Reference

2. Image quality as defined by low contrast detectability.

3. This represents a single user's experience and may not be representative of other clinical settings and use cases.

In clinical practice, the use of ASiR-V may reduce CT patient dose depending on the clinical task, patient size, anatomical location, and clinical practice. A consultation with a radiologist and a physicist should be made to determine the appropriate dose to obtain diagnostic image quality for the particular clinical task. Low Contrast Detectability (LCD), Image Noise, Spatial Resolution and Artifact were assessed using reference factory protocols comparing ASiR-V and FBP. The LCD measured in 0.625 mm slices and tested for both head and body modes using the MITA CT IQ Phantom (CCT183, The Phantom Laboratory), using model observer method.