Introducing Veo* on Discovery* CT750 HD
Great care by design
Introducing Veo – the breakthrough that’s rewriting the rules of CT imaging.
Radiologists and clinicians demand the ultimate levels of clarity and detail in their images.

In making an informed and confident diagnosis, image quality is paramount.

Capturing a clearer image has been a consistent objective for years. Recent advances in reconstruction technology have made great strides in lowering noise while improving low contrast detectability. But radiologists and clinicians continue to demand more.

They also want the lowest dose possible for their patients.

Physicians follow a clear principle around dose management; patients should receive the lowest required dose.

Which makes perfect sense. But as a practical matter, it forces compromise—the lower the dose, the more difficult it is to generate high-quality images.

These have always been the rules of CT imaging.

But what if radiologists and clinicians could have the enhanced image quality at a radiation dose never before thought possible.

Now they can.
Veo is the ultimate advance in CT image reconstruction technology.

Veo is the world’s first model-based iterative reconstruction product. This breakthrough will change the way physicians use CT imaging, delivering a combination of high-quality images and low dose that was previously unthinkable.

GE has solved this challenge in partnership with leading academic partners and hardware manufacturers, combining sophisticated algorithms and advanced computing power. As a result, a CT reconstruction technique that was once only theoretical has now been put into practice.

So radiologists and clinicians can now operate under a new set of rules. Lower noise and higher resolution can be achieved within a single image. At the same time, significant dose reduction capabilities are now available, opening up new possibilities for challenging cases and sensitive patients.

Veo is rewriting the rules of CT imaging.
It’s changing the game in patient care and research.
And only GE Healthcare has it.
The evolution of reconstruction

All CT scans begin with raw data. The method of reconstruction determines the quality of a final image.\(^1\)

**FBP**
- Single reconstruction

**ASiR**
- Iterative reconstruction
- Advanced modeling of system statistics

**Veo**
- Comprehensive iterative reconstruction
- Advanced modeling of system statistics
- Advanced modeling of system optics

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1 The diagram compares three reconstruction methods currently applied by GE Healthcare
2 Image quality/noise as measured as pixel noise standard deviation.
3 In clinical practice the use of ASiR or Veo may reduce patient CT 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.
4 Defined as pixel standard deviation, low contrast detectability and spatial resolution.
New levels of image quality

Veo provides a new benchmark for CT image quality. Its powerful modeling techniques result in better images, delivering previously unattainable levels of combined noise reduction, resolution gain, improved contrast, and artifact suppression. In traditional FBP based approaches, higher spatial resolution is accompanied by higher image noise. But Veo challenges this common trade-off, improving resolution while reducing noise.

The single 0.625 mm Veo image (Figs. b & d) is shown with different window width/window levels to compare against a standard FBP image (Fig. a) and FBP image with Bone Plus kernel (Fig. c). The Veo images show better presentation of soft tissue and edema surrounding the fracture, lower noise, less streak artifact through the shoulder and high resolution bone detail—all in a single image.

FBP Reconstruction (Figure a)

Veo Reconstruction (Figure b)

FBP Reconstruction: Bone Plus kernel (Figure c)

Veo Reconstruction (Figure d)

Scan protocol: 96–144 mAs, 140 kV
Slice thickness: 0.625 mm
Compared to a standard CT image, Veo may:

**Improve resolution**

Compared to a standard CT image, Veo may improve resolution. This can help clinicians obtain diagnostic images with lower mAs.

![FBP Reconstruction](image1.png)  
**FBP Reconstruction (200 mAs)**  
Dose: 100%, Pixel Std. Dev.: 42

![Veo Reconstruction](image2.png)  
**Veo Reconstruction (50 mAs)**  
Dose: 25%, Pixel Std. Dev.: 20

The images compare a single raw CT scan separately reconstructed with FBP and Veo. Scan protocol: 75–200 mAs, 120 kV  
Slice thickness: 0.625 mm

**Help clinicians obtain diagnostic images with lower mAs**

![ASiR Reconstruction](image3.png)  
**ASiR Reconstruction (100 mAs)**  
Dose: 50%, Pixel Std. Dev.: 39

The images represent 3 slices from the same patient performed at 120 kV, 0.5s rotation. The only difference in scan parameters in this IRB approved study was reduction in mA from 200 mAs to 100 mAs to 50 mAs.

![Veo Reconstruction](image4.png)  
**Veo Reconstruction (50 mAs)**  
Dose: 25%, Pixel Std. Dev.: 20

As the relationship between mA and dose is directly proportional, the Veo reconstruction is approximately 25% of the dose of the FBP reconstruction. The Veo image has lower noise (Pixel Std. Dev.) than the FBP image.

**Reduce artifacts that hide underlying structures**

![Veo Reconstruction](image5.png)  
**Veo Reconstruction (50 mAs)**  
Dose: 25%, Pixel Std. Dev.: 20

In clinical practice, the actual level of low signal artifact improvement may vary. Consult with a radiologist and a physicist.

Scan protocol: 120–226 mA, 120 kV  
Effective dose: 0.5 mSv  
Slice thickness: 0.625 mm

In clinical practice, the actual level of low signal artifact improvement may vary. Consult with a radiologist and a physicist.

Obtained by EUR-16262 EN, using a head factor of 0.0023 * DLP

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1 In clinical practice, the actual level of spatial resolution improvement may vary. Consult with a radiologist and a physicist.

2 In clinical practice, the actual level of low signal artifact improvement may vary. Consult with a radiologist and a physicist.

3 Obtained by EUR-16262 EN, using a head factor of 0.0023 * DLP
New possibilities in dose management

Veo establishes new rules in the relationship between image quality and dose reduction, giving clinicians the diagnostic information they need at a previously unthinkably low dose.

The benefits of this capability are significant, especially for the most radiosensitive patients—including pediatric cases and young women, or those requiring regular follow-up and monitoring.

Veo is the next step in GE’s commitment to lower dose CT. Our ASiR technology, introduced with the launch of the Discovery CT750 HD, offers fast reconstructions for low-dose imaging without compromise—an ideal approach for routine, robust imaging.

By pushing the possibilities even further, Veo represents added capability for the most challenging cases.

By changing the rules, these dose reduction capabilities open up exciting new possibilities in CT.

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Estimated effective dose for diagnostic chest exam (PA + lateral): 0.06 mSv

Scan protocol: 4 mAs, 80 kV
Slice thickness: 0.625 mm
Effective dose: 0.05 mSv

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Estimated effective dose for diagnostic abdomen AP exam: 0.7 mSv

Scan protocol: 100 kV, 25–38 mA
Effective dose: 0.77 mSv

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1 Wall BF, Hart D. Revised radiation doses for typical X-ray examinations. The British Journal of Radiology 70:437-439; 1997 (5,000 patient dose measurements from 375 hospitals)

2 Obtained by EUR 16262 EN, using an adult chest factor of 0.017* DLP

3 Obtained by EUR 16262 EN, using an abdomen factor of 0.015* DLP and a pelvis factor of 0.019* DLP
Imaging under 1 mSv

The benefits of dose reduction are significant, especially for the most radiosensitive patients — including pediatric cases and young women. Veo may also provide the opportunity to dramatically reduce cumulative dose in patients who require regular follow-up exams.

Thoracic

Cystic Fibrosis follow-up exam, effective dose of 0.05 mSv

Veo Reconstruction

Volume rendering with segmentation of the lobes of the lungs and branchi

Scan protocol: 4 mAs, 80 kV
Slice thickness: 0.625 mm
DLP: 3.16 mGy.cm

BMI: 40

CT chest exam obese patient, effective dose of 0.63 mSv

Veo Reconstruction (Lung WW/WL)

Veo Reconstruction (Mediastinum WW/WJ)

Scan protocol: 5–30 mAs, 100 kV
Slice thickness: 0.625 mm
DLP: 37 mGy.cm
BMI: 40

BMI: 25

CT chest exam, effective dose of 0.48 mSv

Veo Reconstruction (Lung WW/WL)

Veo Reconstruction (Mediastinum WW/WJ)

Scan protocol: 5–30 mAs, 100 kV
Slice thickness: 0.625 mm
DLP: 28.5 mGy.cm
BMI: 25

1 In clinical practice, the use of Veo 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.

2 Obtained by EUR16262 EN, using an adult chest factor of 0.017* DLP
Abdomen Pelvis

Abdomen pelvis exam, effective dose of 0.8 mSv

Veo reconstruction demonstrates improved visualization of renal abnormality.

Abdomen pelvis exam, effective dose of 0.61 mSv

Veo reconstruction demonstrates improved visualization of liver metastasis.

Scan protocol: 10 mA, 0.5 sec, 120 kV, 0.625 mm
DLP: 36.02 mGy.cm

Scan protocol: 10 mA, 0.5 sec, 120 kV, 0.625 mm
DLP: 47.6 mGy.cm

1 Obtained by EUR 16262EN, using an abdomen factor of 0.015* DLP and a pelvis factor of 0.019* DLP
**Pediatric**

**Chest/Upper Abdomen exam (2 yrs), effective dose of 0.7 mSv\(^1\)**

Veo reconstruction demonstrates reduced noise and artifact providing better visualization of right lung abnormalities.

**Scan protocol:** 10–15 mA, 80 kV  
**Slice thickness:** 0.625 mm  
**DLP:** 27.7 mGy.cm

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**Pediatric Maxillofacial CT (9 yrs), effective dose of 0.06 mSv\(^2\)**

Veo Reconstruction  
(3D Volume Rendering)  
Veo Reconstruction  
(Sagittal reformat)  
Veo Reconstruction  
(Coronal Reformat)

**Scan protocol:** 14 mAs, 100 kV  
**Slice thickness:** 0.625 mm  
**DLP:** 18.0 mGy.cm

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**Pediatric sinus CT with Veo (9 yrs), effective dose of 0.02 mSv\(^2\)**

Ultra low dose exam for paranasal sinuses

**Scan protocol:** 4 mAs, 80 kV  
**Slice thickness:** 0.625 mm  
**DLP:** 5.0 mGy.cm

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\(^1\) Obtained by ICRP 1 year old chest factor of 0.026 x DLP using a 16 cm phantom. ICRP Publication 102, March 2007

\(^2\) Obtained by ICRP 10 year old head factor of 0.0032 x DLP using a 16 cm phantom. ICRP Publication 102, March 2007
Veo brings clinical benefits to any number of advanced and routine applications, which are illustrated in the following cases.

GE Healthcare would like to acknowledge Rendon C. Nelson, M.D., FACR, Reed and Martha Rice Professor of Radiology, Duke University, for assistance with image review.

Compared to FBP, this Veo reconstruction illustrates:
- Demonstration of more small order arteries
- Sharper depiction of all of the arteries

Scan protocol: 100–192 mAs, 100 kV
Slice thickness: 0.625 mm
Compared to FBP, this Veo reconstruction shows:
- Sharper depiction of the wall of the carotid artery
- Lower noise at the level of the shoulders
- Improved bony detail in the skull base
- Slightly lower artifacts from metallic dental work
Vascular

Scan protocol: 48–340 mAs, 100 kV
Slice thickness: 0.625 mm

Compared to FBP, this Veo reconstruction illustrates:
- Clearer delineation of the neointimal hyperplasia within the stent lumen
- Sharper depiction of metallic components of the stent
- Similar streak artifacts at the ends of the stent

Veo Reconstruction

FBP Reconstruction
Compared to FBP, this Veo image illustrates:

- Significant reduction in image noise
- Increased ability to detect and characterize the hypoenhancing liver lesions
- Clearer depiction of anatomic structures such as the left adrenal gland and left renal artery
Compared to FBP, these Veo images demonstrate:
- Improved contrast to noise ratio to visualize anatomy
- Significant reduction of streak and noise artifacts, especially through pelvis
- Improved visualization of ovarian abscess

Scan protocol: 153–190 mAs, 120 kVp
Scan range: 420 mm
DLP: 400.96 mGy.cm
Slice thickness: 0.625 mm

Masahiro Jinzaki, M.D., PhD
Assistant Professor, Department of Radiology
Keio University School of Medicine
Compared to FBP, these Veo images illustrate:
- Lower image noise, especially through the shoulders
- Improved depiction of small intracranial arteries
- Slightly fewer streak artifacts from dental work on the left

Scan protocol: 52–160 mAs, 100 kV
Slice thickness: 0.625 mm
Compared to FBP, these Veo images illustrate:

- Improved gray-white matter differentiation
- Increased ability to evaluate the cortical surface of the brain, right under the calvarium.
Where Discovery CT750 HD set a new standard for high-resolution CT and low-dose images, Veo is now advancing the benchmark. While the technology behind it is new today, it will establish new standards in CT imaging for years to come.

While Veo represents a dramatic step forward, it’s a natural step in our vision for the future of high-definition CT imaging. Through bold investments and unconventional thinking, GE has achieved image quality improvements on multiple fronts, from equipment to post-processing to reconstruction.

So by finding yet another way to improve image quality—and at the same time, lower dose—GE Healthcare continues to define new rules. In doing so, we are laying the foundation for a promising vision of CT advances to come.

As a result, radiologists and clinicians have another powerful new tool to deliver more informed, confident diagnoses. And above all else, Veo can help achieve what has always been the ultimate goal—the best patient care available.

The rules have changed. But the goal hasn’t.
GE Healthcare provides transformational medical technologies and services that are shaping a new age of patient care. Our broad expertise in medical imaging and information technologies, medical diagnostics, patient monitoring systems, drug discovery, biopharmaceutical manufacturing technologies, performance improvement and performance solutions services help our customers to deliver better care to more people around the world at a lower cost. In addition, we partner with healthcare leaders, striving to leverage the global policy change necessary to implement a successful shift to sustainable healthcare systems.

Our “healthymagination” vision for the future invites the world to join us on our journey as we continuously develop innovations focused on reducing costs, increasing access and improving quality around the world. Headquartered in the United Kingdom, GE Healthcare is a unit of General Electric Company (NYSE: GE). Worldwide, GE Healthcare employees are committed to serving healthcare professionals and their patients in more than 100 countries. For more information about GE Healthcare, visit our website at www.gehealthcare.com.
Veo is only available on the Discovery CT750 HD.

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