

A man with grey hair is shown from the chest up, looking upwards and to the right. He is holding a large, bright green leaf in his right hand, which is raised towards the top of the frame. The background is a clear blue sky with some light clouds. The overall mood is positive and hopeful.

**SIEMENS**

# CARE Right

Committed to the Right Dose in CT

[siemens.com/care-right](https://www.siemens.com/care-right)

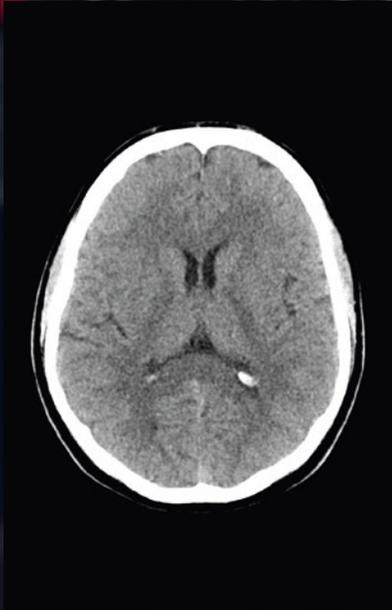
International version. Not for distribution in the US.

# Taking Low Dose to the Next Level

In medical imaging it is essential to provide sound and sustainable clinical results with highest patient safety. When it comes to applying radiation, ALARA - As Low As Reasonably Achievable - is the overarching principle.

For years, Siemens has been at the forefront of radiation reduction. Continuous dedication and unique technological advances have made Siemens CT the low dose leader to catch. Thanks to these efforts, scans at sub-mSv doses have found their way into clinical routine.

However, as such low doses become achievable, one has to verify whether 1 mSv actually is the Right Dose for every patient. Obviously, there isn't one dose level that fits everyone. Every clinical question and every single patient demands an individual and specific dose level. Therefore, while everybody is only talking about low dose, Siemens is convinced that what really matters is the Right Dose.



0.9 mSv

was the right dose in this particular case where iterative reconstruction helped to reduce the radiation below 1 mSv.

Male, 43

Cranial CT to exclude lesion

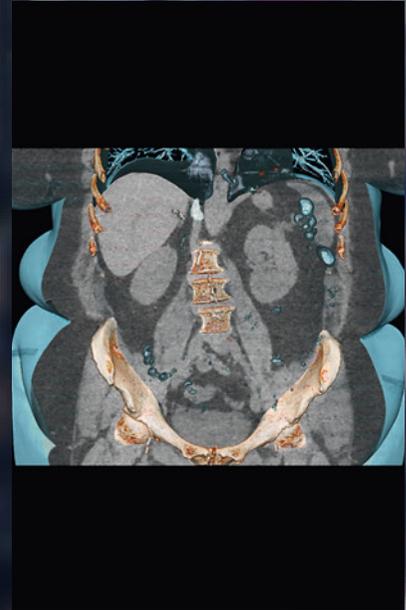


2.4 mSv

was the right dose in this particular case where a dedicated angiography scan protocol was used.

Female, 54

Abdominal CT



7.9 mSv

was the right dose in this case of a bariatric patient after cholecystectomy.

Female, 59

CT scan of whole aorta to detect dissection



# CARE Right. Committed to the Right Dose in CT

The Right Dose is the reasonable balance between applied radiation and image quality. In order to help customers achieve this balance, Siemens is introducing CARE Right.



# Is 1 mSv the right dose for every patient?

Male, 43

Cranial CT to exclude lesion

Female, 54

Abdominal CT

Female, 59

CT scan of whole aorta to detect dissection



Right Dose  
Technology

Right Dose  
Levels

Right Dose  
Management

# CARE Right.

## Committed to the Right Dose in CT

This holistic approach is based on the belief that after the recent innovations in radiation reduction, a singular focus on low dose only is not sufficient anymore. Consequently, efforts must now be targeted towards a comprehensive understanding of the Right Dose. Thus, CARE Right encompasses three key areas:

### Right Dose Technology

### Right Dose Levels

### Right Dose Management

With this, Siemens CT is not only adhering to the ALARA principle, but is inspired by it.

Discover CARE Right. Committed to the Right Dose in CT.

# Right Dose Technology

## Enable the Right Dose with Best-in-Class Technology

In order to reduce radiation to the Right Dose, the first prerequisite still is, of course, the appropriate hardware: healthcare institutions need the right technology. Siemens has a long tradition of being an innovation leader in CT technology. Whether it was the introduction of CARE (Combined Applications to Reduce Exposure) in the 1990s, Dual Source CT in the 2000s, or the Stellar Detector in the 2010s, Siemens has continuously been one step ahead. Therefore, it was a logical consequence that Siemens was named “the low dose leader to catch” when its SOMATOM Definition Flash won the 2011 Best in KLAS award.<sup>1</sup> Overall, this was due to the fact that Siemens offers a comprehensive and innovative portfolio of unique dose reduction features.

## Focus on the Individual Patient and Examination

In order to achieve the Right Dose for a patient, there are three important factors to consider: the size and

stature of the patient, the type of examination, and the applied radiation dose. With Siemens technology, all of these aspects can be addressed:

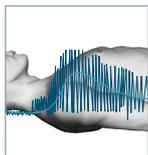
CARE Dose4D, for example, offers real-time anatomic exposure control. This allows adjusting the dose modulation according to the patient’s anatomy and position during the scan.

CARE kV offers an automated dose-optimized selection of the x-ray tube voltage (kV) depending on the selected type of examination. It was industry’s first solution that helped to automatically determine the appropriate kV and scan parameters to optimize contrast-to-noise ratio.

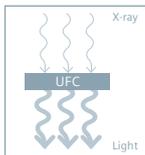
SAFIRE \* (Sinogram Affirmed Iterative Reconstruction) finally made it possible to benefit from iterative reconstruction with a dose reduction potential of up to 60% \* in clinical routine, even in environments where time is crucial, such as acute care.

<sup>1</sup> KLAS “CT 2011: Focused On Dose” report, 11/2011 Best in KLAS and Leader in the CT 64-slice and above category “Best in KLAS Awards Medical Equipment and Infrastructure” report, June 2012 www.KLASresearch.com | © 2011 KLAS Enterprises, LLC. All rights reserved.

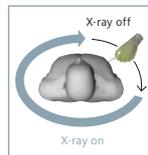
## Proven innovation and Technological Leadership



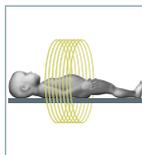
CARE  
Dose4D



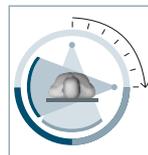
UFC



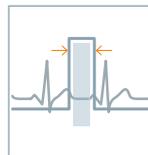
HandCARE



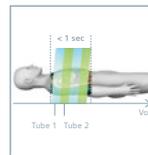
70kV  
Pediatric  
Protocols



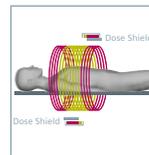
Dual  
Source CT



Adaptive  
Cardio  
Sequence



Flash  
Spiral



Adaptive  
Dose Shield

1990s

2000s

## ADMIRE – Advanced Modeled Iterative Reconstruction

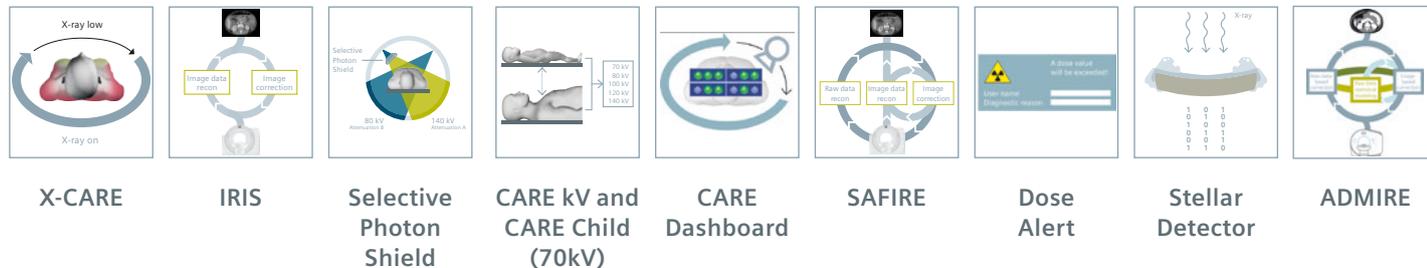
In modern healthcare, patients deserve the lowest possible dose and radiologists desire the best image quality in daily routine. This is known as ALARA – the paradigm to delivery diagnostic image quality at a dose As Low As Reasonably Achievable. The big challenge is to realize this in daily routine, e.g. time-critical settings like acute care, where many institutions step away from iterative reconstruction. For dose reduction, Siemens already overcame this challenge with SAFIRE\*, its raw-data based iterative reconstruction. SAFIRE allows up to 60%\* dose savings at a reconstruction speed so fast, many institutions use it every single examination. Now, with

ADMIRE\*\* – Siemens' Advanced Modeled Iterative Reconstruction – clinical images will additionally benefit from higher resolution at organ borders and improved delineation of edges, e.g. to better localize lesions. Moreover, ADMIRE smoothly integrates iterative reconstruction into daily routine. Thick slices are now reconstructed at a more natural image impression, even from ultra-low dose scans. With this, iteratively reconstructed low dose datasets can now easily be stored in PACS or on film. Therefore, ADMIRE sets a new benchmark in iterative reconstruction instead of limiting its potential for clinical routine.

**“Setting new benchmarks” VS. “Limiting clinical routine” Second best is not an option.**

\* In clinical practice, the use of SAFIRE 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. The following test method was used to determine a 54 to 60 % dose reduction when using the SAFIRE reconstruction software: noise, CT numbers, homogeneity, low-contrast resolution, and high contrast resolution were assessed in a Gammex 438 phantom. Low dose data reconstructed with SAFIRE showed the same image quality compared to full dose data based on this test. Data on file.

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2010s

# Right Dose Levels

## Scan at the Right Dose Levels

Next to having access to the Right Dose Technology, it is essential to know the Right Dose Levels to perform an examination according to ALARA (As Low As Reasonably Achievable). The Right Dose Level is the best possible balance between image quality and required amount of radiation. There is an ongoing debate about this balance. Siemens, together with key opinion leaders, founded SIERRA – the Siemens Radiation Reduction Alliance. Feedback from this and other panels of experts provides input for a dedicated development team. This team produces the various Siemens protocols needed to comply with the full range of patient types, disease types, examination procedures, and with the expectations of reading physicians in terms of image quality. The result

is a sophisticated library of scan protocols focused on applying the Right Dose for each examination. In order for users to know whether they apply the Right Dose Levels, absolute dose values are a prerequisite

## Absolute Dose Values – Essential for the Right Dose

A prerequisite for users to know whether they apply the Right Dose Levels is an understanding of absolute dose values. This is why Siemens provides them along with their protocols. Users may then use these values as a reference to compare their current dose level with regional recommendations and guidelines, scientific publications, or the dose levels delivered by Siemens CT standard scan protocols. (see Table)

## Absolute Dose Values in Computed Tomography SOMATOM Definition Flash

Reference values		Switzerland <sup>1</sup>	Germany <sup>2</sup>	European Union <sup>3</sup>	USA <sup>4</sup>
Head Routine	CTDI <sub>vol</sub> [mGy]	65	65	60	75
Thorax Routine	CTDI <sub>vol</sub> [mGy]	15	12	30	n.a.
Abdomen Routine	CTDI <sub>vol</sub> [mGy]	15	20	35	25
Default Siemens Protocol		Standard values *	Standard SAFIRE values **/** ** ** *	Study values **	
Head Routine	CTDI <sub>vol</sub> [mGy]	59	41	45 <sup>5</sup>	
Thorax Routine	CTDI <sub>vol</sub> [mGy]	7.4	4.4	1.5 <sup>6</sup>	
Abdomen Routine	CTDI <sub>vol</sub> [mGy]	14	10	6.5 <sup>7</sup>	

### SIERRA – the Siemens Radiation Reduction Alliance

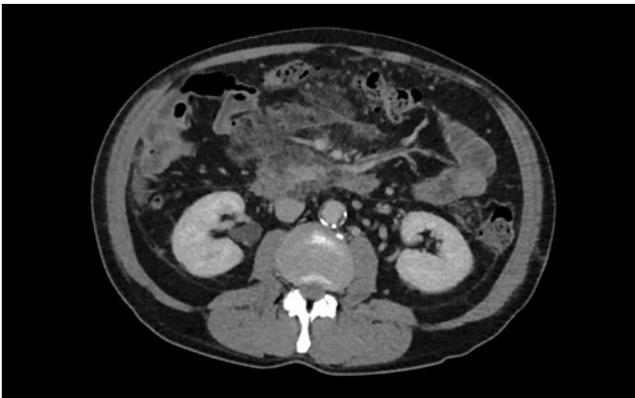
SIERRA was founded by Siemens together with key opinion leaders in radiology. Comprised of 15 international experts, this alliance creates recommendations for clinical practice around the globe. Siemens CT standard scan protocols apply these recommendations to each examination. Along with international guidelines and reference values, Siemens' dedicated protocol development team continuously incorporates the feedback from panels like SIERRA into a sophisticated library of scan protocols.

- 1 Bundesamt für Gesundheit (Merkblatt R-06-06, Diagnostische Referenzwerte in der Computertomographie, 01.04.2010)
  - 2 Bundesamt für Strahlenschutz (Bekanntmachung der aktualisierten diagnostischen Referenzwerte für diagnostische und interventionelle Röntgenuntersuchungen. Vom 22. Juni 2010)
  - 3 European Guidelines on Quality Criteria for Computed Tomography (<http://www.drs.dk/guidelines/ct/quality/htmlindex.htm>)
  - 4 American College of Radiology (CT Accreditation Program Requirements, Clinical Image Quality Guide, 13.04.2012)
  - 5 Becker HC et al. Radiation exposure and image quality of normal computed tomography brain images acquired with automated and organ-based tube current modulation multiband filtering and iterative reconstruction. *Invest Radiol.* 2012 Mar;47(3):202-7.
  - 6 Baumüller S et al. Low-dose CT of the lung: potential value of iterative reconstructions. *Eur Radiol.* 2012 Jun 15. [Epub ahead of print] CTDIvol for the protocol using 100 kV.
  - 7 May MS et al. Dose reduction in abdominal computed tomography: intraindividual comparison of image quality of full-dose standard and half-dose iterative reconstructions with dual-source computed tomography. *Invest Radiol.* 2011 Jul;46(7):465-70. CTDIvol for abdominal CT calculated according to the conclusion.
- \* Values are based on the default protocols of the SOMATOM Definition Flash with syngo CT 2012B and an average sized patient of 1.75 m and 75 kg

\*\* Iterative Reconstruction is used

\*\*\* In clinical practice, the use of SAFIRE 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. The following test method was used to determine a 54 to 60% dose reduction when using the SAFIRE reconstruction software: noise, CT numbers, homogeneity, low-contrast resolution, and high contrast resolution were assessed in a Gammex 438 phantom. Low dose data reconstructed with SAFIRE showed the same image quality compared to full dose data based on this test. Data on file.

### Knowing the clinical targets to scan with the Right Dose



Initial abdomen scan  
@ 120 kV 14 mGy with standard protocol



Follow-up abdomen of the same patient  
@ 100 kV 9.7 mGy using CARE kV

# Right Dose Management

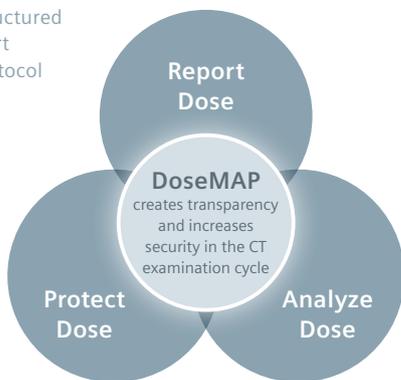
Finally, organizations need to manage dose across their institutions. Regional regulations sometimes require that radiation given to patients is documented. Other CT administrators like to have an overview as a basis for dose optimization. Both cases require structured access to dose data. With DoseMAP® – Siemens' new Dose Management Program – data can be accessed from various sources, such as scanners, PACS, or RIS, and aggregated to the type of report required. With EduCARE, Siemens also offers specialized trainings focussing on applications to reduce dose. Furthermore, Siemens has introduced a new consultancy program, called Optimize CARE CT.

## DoseMAP® Siemens CT Dose Management Program

DoseMAP® provides functionalities like CARE Analytics to report, document, and analyze dose. It lets the user access dose values per case, per examination type, or per patient. Additionally, access to scan protocols can be restricted to protect the set dose levels and to prevent unauthorized changes to the scan parameters.

## DoseMAP

- DICOM Structured Dose Report
- Patient Protocol



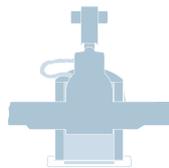
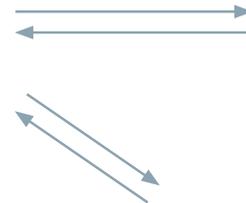
- Scan Protocol Lock
- Dose Notification
- Dose Alert

- CARE Analytics
- CARE Dashboard
- CARE Profile

## Dose Report



Stand-alone PC  
CARE Analytics



Other DICOM node  
(e.g. modality, workstation)



### EduCARE

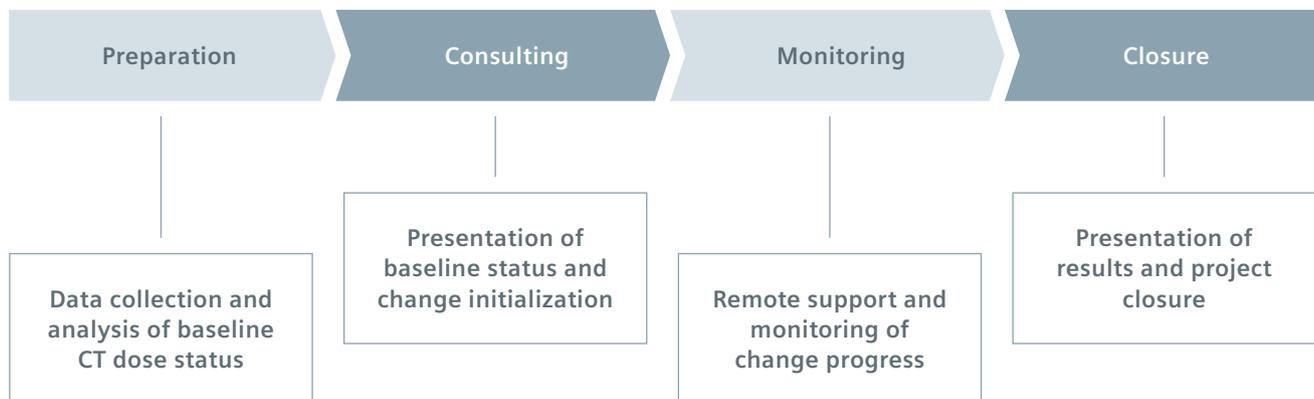
EduCARE bundles dedicated trainings from Siemens that focus on key technologies and their application in clinical practice. Exclusive tutorials, webinars, e-trainings, and brochures cover a wide range of topics related to achieving the Right Dose. CME-accredited tutorials and webinars can be booked by users for specific topics.

### Optimize CARE CT

Optimize CARE CT is a consultancy program offered by Siemens Customer Service. Over the course of the program, Siemens professionals guide users towards optimizing the use of radiation in order to reduce dose. Through onsite and offsite support and trainings, users learn how to use the Right Dose Technology to deliver the Right Dose Levels for every patient.

Siemens professionals work with the customer on site to analyze the current situation, define and implement improvement measures to reasonably reduce radiation, and then monitor the progress with the customer to finally hit the Right Dose.

### Optimize CARE CT consulting project spans up to 10 weeks from start to end



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