

Hybrid OR imaging solutions

Ready for minimally invasive surgery
with procedural intelligence

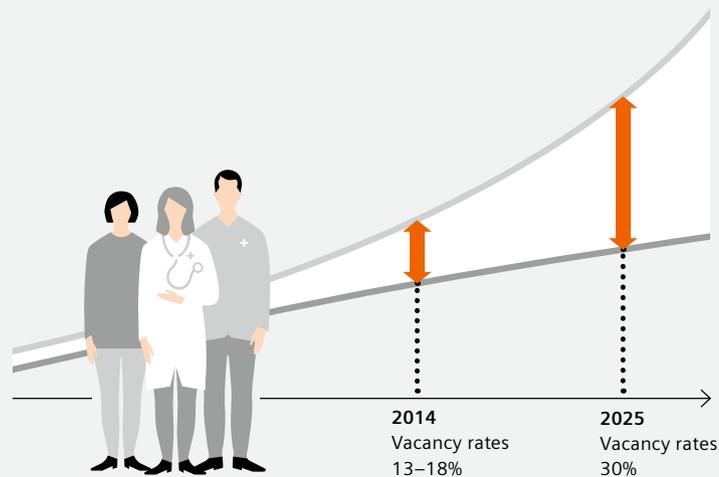
[siemens-healthineers.com/hybrid-or](https://www.siemens-healthineers.com/hybrid-or)



Demand exceeds supply: a growing dilemma for hospitals

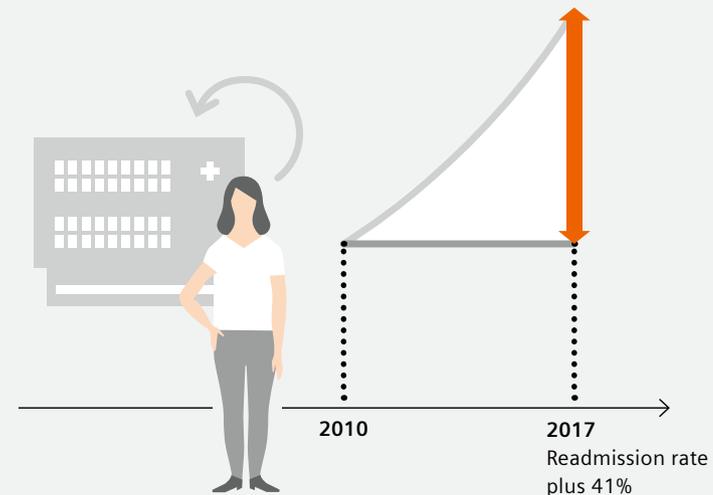
Many hospitals today face staff shortages, limiting their ability to provide optimal treatment in every situation. Innovative solutions that reduce the workload per patient can help alleviate this problem.

Not enough new staff available for vacancies



In 2014, the U.S. healthcare system already faced a vacancy rate of 13-18%¹ – and this number is expected to double by 2025.²

Understaffing may affect patient outcomes



From 2010 to 2017, the number of UK patients who were readmitted to the hospital for potentially preventable conditions rose by 41%.³ Inadequate quality of care due to workforce limitations may help explain this sudden increase.

Hybrid OR imaging solutions

Ready for minimally invasive surgery
with procedural intelligence

Offering standardized minimally invasive treatment for any patient is crucial for healthcare institutions. However, time-consuming manual workflows, unwanted variations in procedural outcomes, and staff training needs stand in the way. To overcome these barriers, we have equipped our latest generation of fixed C-arms with procedural intelligence: an outstanding combination of imaging and workflow software that can help optimize and automate clinical operations in the Hybrid OR.

Procedural intelligence is designed to eliminate repetitive input steps or manual adjustment of system settings. It enables simplified image-guided surgery and consistent procedural workflows. On top of that procedural intelligence provides intelligent optimization of image quality in support of ALARA dose, and automated C-arm positioning – so that users may focus on the patient rather than on the imaging system.

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Optimize clinical operations with procedural intelligence

Wasteful activities account for up to 47% of U.S. healthcare costs per year.

Healthcare has a technical potential for automation of about 36%.

Fluoroscopy is used for more than 10 million interventional procedures every year.

Wasted OR time and resources

Almost half of U.S. healthcare expenditures every year go toward tasks that are completely unnecessary from a resource management perspective.⁹ A prime example is the multitude of manual steps that medical professionals currently perform as part of surgical imaging workflows.

Limited automation despite massive potential

Lost productivity goes beyond unnecessary manual steps during treatment planning. Approximately 36% of all healthcare activities could be automated,⁴ and this includes complex tasks such as data analyses of pre-procedural CT images that software solutions can complete quickly and efficiently.

Excessive staff radiation exposure

Intraoperative imaging helps improve treatment for many patients groups – but it also leads to health consequences for medical professionals as a result of frequent radiation exposure. Case in point: fluoroscopy is used for more than 10 million interventional procedures every year.⁵

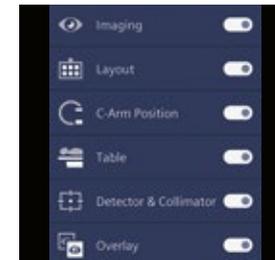
Procedural intelligence helps simplify and standardize your imaging workflows, so that you can provide the best possible treatment for every patient.

Surgical imaging with fewer manual steps

Customize our predefined Case Flows based on your needs to ensure precise intra-operative guidance. The next time you recall the same Case Flow, the system will automatically apply your chosen parameters.



**Up to 83%
less manual interaction¹⁰**



Define optimal parameters and eliminate up to 6 manual system interactions for every Case Flow step.

Intelligent analysis of pre-operative 3D data

Use our dedicated software to guide preparation for surgical procedures. The algorithms will automatically visualize the target along with relevant anatomical landmarks for precise intra-operative guidance.



**Up to 93%
faster data analysis⁸**



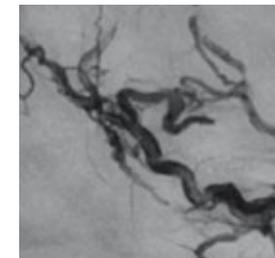
Procedural intelligence reduces preparation time from typically fifteen minutes to just one minute thanks to automated data processing for EVAR procedures.⁸

Standardized image quality in support of ALARA dose

Select your preferred image quality level (CNR) for the anatomy, devices, or materials you need to visualize. Using self-adjusting algorithms, our OPTIQ software will select the right imaging parameters in support of ALARA dose.



**Up to 50% less dose
for DSA and fluoroscopy^{6,7}**



Dose savings of up to 84% in fluoroscopy and up to 86% acquisitions while maintaining the same visibility of tantalum.

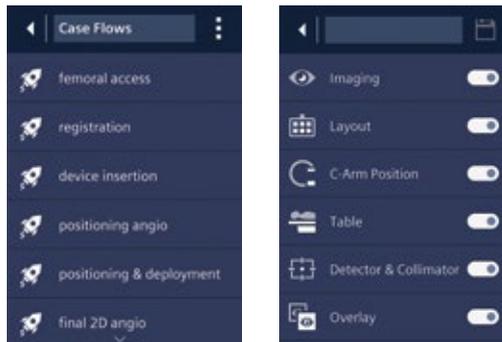


Vascular surgery

Ready for EVAR with procedural intelligence

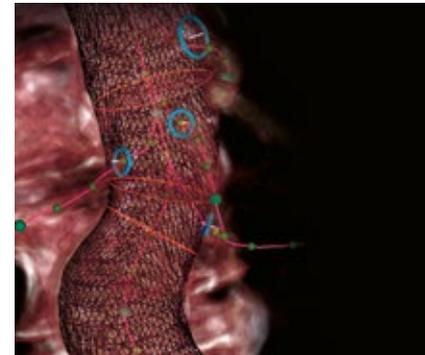
Procedural intelligence helps you speed up your endovascular procedures. With intra-operative software guidance, intelligent optimization of image quality and dose, and automated C-arm positioning, even complex cases are greatly simplified. You can also standardize every workflow step thanks to EVAR Case Flow.

Define optimal parameters for every Case Flow step



Customize parameters for each procedure step and then save all settings to perform future treatments with the identical parameters.

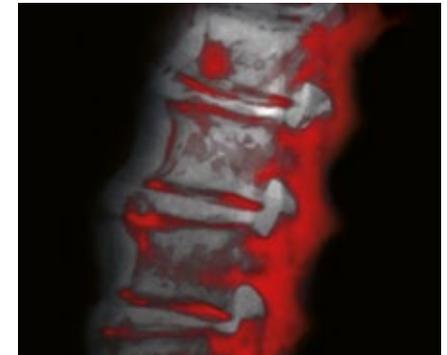
Preparation



Optimal preparation of CT data

Use software for assisted segmentation of important vessels, visualization of centerlines and ostia rings, and identification of landing zones as you get ready for fusion imaging.

Registration



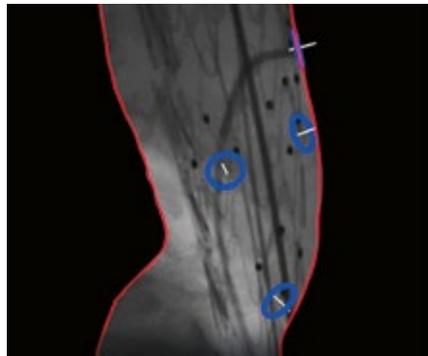
Fast registration for fusion imaging

Quickly align the dataset with your angio system based on anatomical landmarks, using only your tableside controls.

“ARTIS pheno with syngo EVAR Guidance enables us to treat our patients with less radiation exposure, faster and more efficiently. Especially complex procedures like fenestrated stent grafts or TEVAR procedures are extremely simplified.”

Frank Marquardt, MD | Rotes Kreuz Krankenhaus, Bremen, Germany

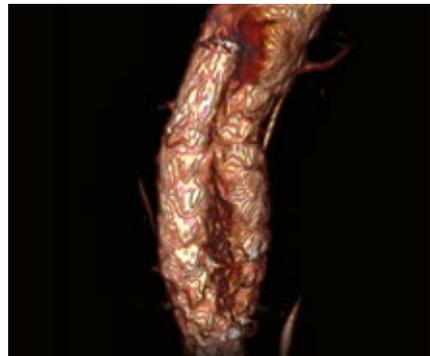
Deployment



Precise guidance during stent deployment

Rely on intra-operative fusion imaging to guide your procedure – and let the C-arm move automatically to the optimal angulations for each vessel.

Assessment



Immediate assessment of treatment results

Verification of correct stent positioning using high-quality 3D imaging can help reduce re-interventions.

Review the clinical evidence

EVAR treatment in itself can lower complication rates^{11,13} and even reduce the risk of mortality compared to open surgery.¹² Using fusion imaging – a core component of procedural intelligence – unlocks additional benefits for you and your patients.



Potentially 30% shorter procedure time¹³

Fusion imaging provides continuous 3D guidance throughout the whole procedure.



57% less iodine contrast media¹³

Fusion imaging provides continuous guidance and reduces the amount of contrast media.

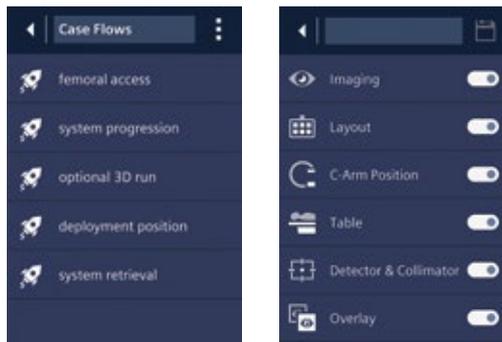


Cardiac surgery

Ready for TAVI/TAVR with procedural intelligence

Procedural intelligence helps you to improve valve positioning. With intra-operative guidance software, intelligent optimization of image quality and dose, and automated C-arm positioning, treatment is greatly simplified. You can also standardize every workflow step thanks to TAVI/TAVR Case Flow.

Define optimal parameters for every Case Flow step



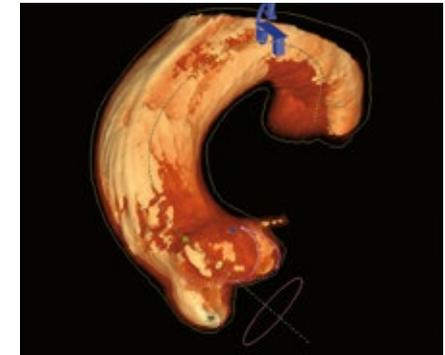
Customize parameters for each procedure step and then save all settings to perform future treatments with the identical parameters.

Acquisition



Intra-operative syngo DynaCT or registration with pre-operative CT
Acquire high quality intra-operative 3D images of the aortic arch in less than five seconds with minimal contrast media with *syngo* DynaCT.

Planning

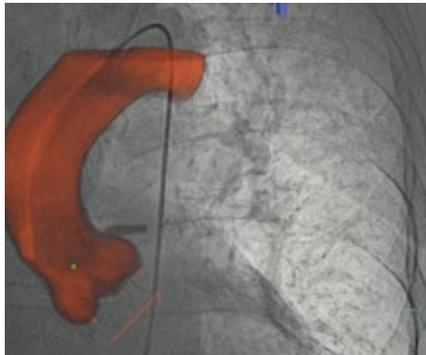


Automatic segmentation and indication of anatomical landmarks
Use automatic segmentation to identify key anatomical landmarks, and move the C-arm into position with a single push of a button.

“With multi-modal imaging, innovative imaging chains, image fusion and different post-processing technologies in one system, we can manage more complex cases faster and less invasively.”*

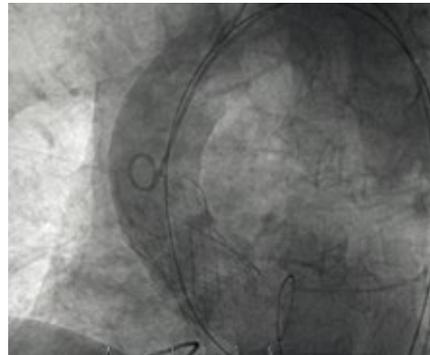
Prof. Bernhard Schieffer, MD | University Hospital Marburg, Germany

Deployment



Superimposition on live fluoro and guidance during valve deployment
Rely on intra-operative fusion imaging to guide you during valve deployment without using additional contrast media.

Verification



Immediate verification of valve positioning
Review the valve deployment right away at the table to prevent paravalvular leaks and early reinterventions.

Review the clinical evidence

TAVI/TAVR procedures allow minimally invasive treatment of patients with severe symptomatic aortic stenosis. Possible benefits you stand to gain by using our imaging systems equipped with procedural intelligence.



Impact on patient

Studies show that the absence of paravalvular leaks are linked to better 3-year survival rates¹⁴. Since our workflow supports optimized valve positioning, it may help to improve outcomes.

ARTIS icono floor

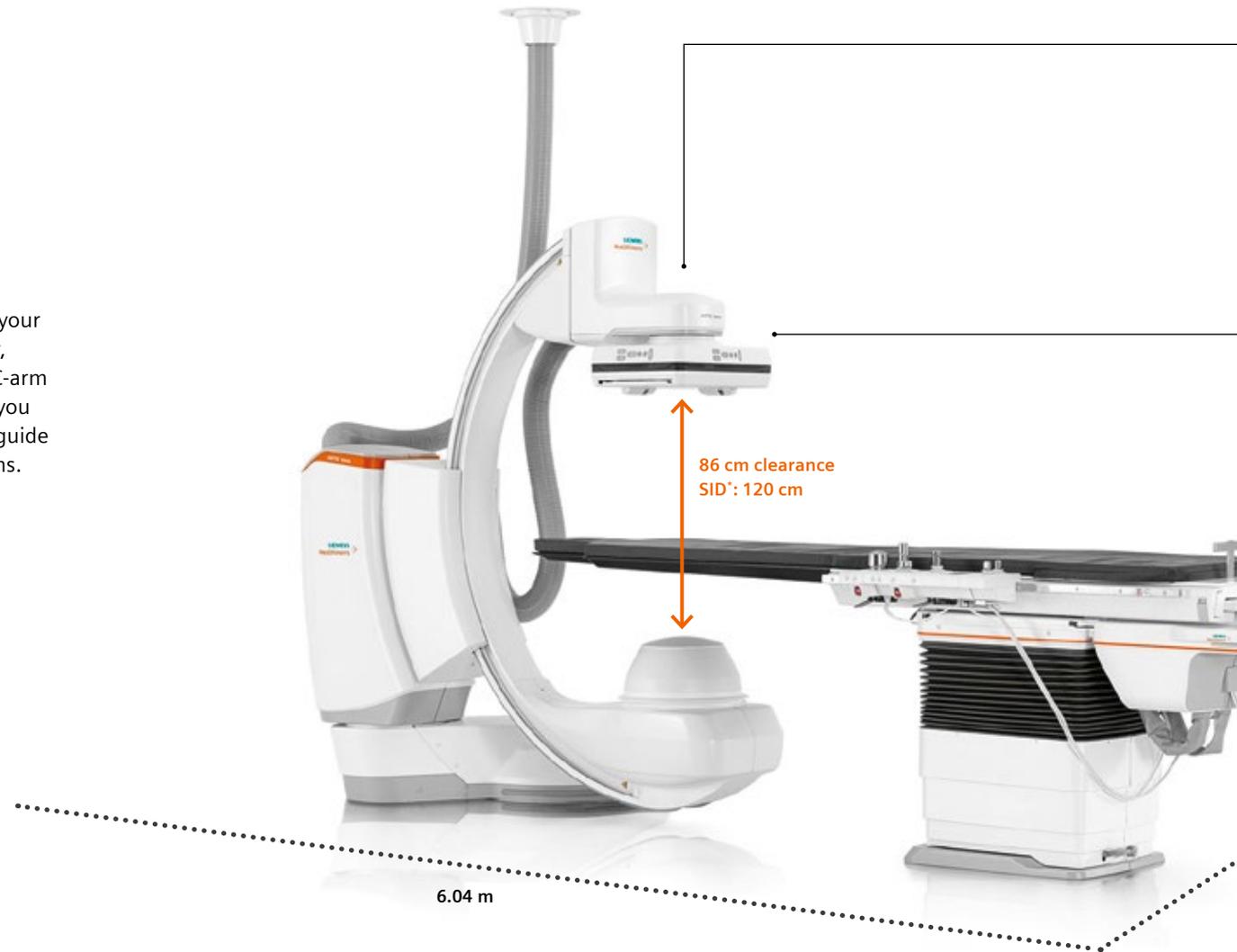
An icon of innovation for cardiovascular procedures

Offering endovascular procedures significantly expands your cardiovascular treatment options. With ARTIS icono floor, this step is easier than ever before. The fully motorized C-arm system is equipped with procedural intelligence to help you standardize workflows for high-volume procedures and guide you through complex cases to optimize clinical operations. Moreover, the small footprint makes ARTIS icono floor a perfect match for every existing OR.

28 m²
minimum
room size

Procedural intelligence benefits

- ✓ Surgical imaging with fewer manual steps
- ✓ Intelligent analysis of pre-operative 3D data
- ✓ Standardized image quality in support of ALARA dose





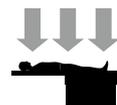
Minimal space requirements

Offering great position flexibility but small enough to fit into a 28 m² room. ARTIS icono floor brings Hybrid OR performance to your existing ORs.



Motorized C-arm movements

The multiaxis floor stand with fully motorized movements provides patient coverage of 2.10 m without the need for repositioning the patient.



Free ceiling above the patient

The system can be installed in most conventional operating rooms, with no special requirements for ceiling and floor. Thanks to the free ceiling above the operating field, sterile airflow during imaging is not interrupted.



Fast 3D scan times from head side

Intraprocedural 3D imaging from head side with short scan times and excellent soft-tissue resolution allow you to perform any cardiovascular procedure.



Maintain infection control

The seamless exterior with smooth surfaces paint acts as a safeguard against spills and permits easy cleaning. These features simplify regular cleaning and disinfection efforts.



4.58 m

Minimum room size

28 m²

Recommended room size

38 m²

Intraprocedural 3D imaging position

Head side

Max. 3D volume size (diameter x height)

23.5 cm x 17.5 cm

Isocenter height

107 cm

ARTIS pheno

Cutting-edge robotic imaging for multiple surgical disciplines

ARTIS pheno offers robotic technology that supports a broad range of procedural needs and patient conditions. Its multidisciplinary surgical capabilities allow minimally invasive treatment across specialties - on one system, in one room. Healthcare institutions can use it for optimizing their case mix, maximum room utilization, and support for upcoming tasks.

100%
room
utilization

Procedural intelligence benefits

- ✓ Surgical imaging with fewer manual steps
- ✓ Intelligent analysis of pre-operative 3D data
- ✓ Standardized image quality in support of ALARA dose





Extended park positions

The robotic C-arm permits fast and easy switching between surgical tasks and imaging and can even be parked with the push of a single button, giving you unmatched positioning flexibility.



Flexible isocenter

The flexible isocenter permits high-quality 2D and 3D imaging regardless of patient positioning. The working height can also be adjusted easily for improved comfort.



Large-volume 3D scanning

syngo DynaCT Large Volume lets you visualize up to ten vertebrae simultaneously and also offers large coverage of the thorax or abdomen with a diameter of 43cm.



Third-party surgical table integration

Multiple surgical disciplines can share a single Hybrid OR suite thanks to complex patient positioning support for any procedure. The robotic C-arm and full integration of third-party surgical tables with segmented tabletops makes it possible.



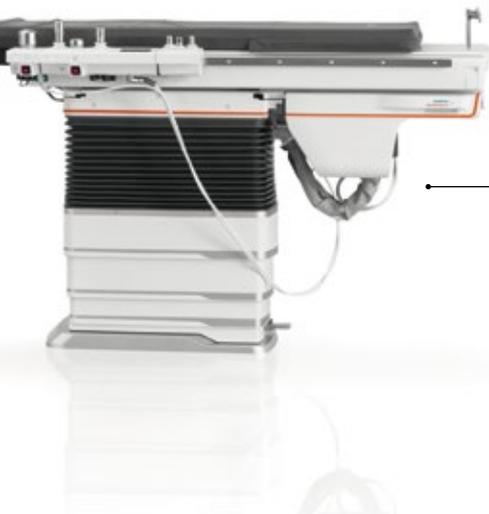
Wide-space C-arm

With its great usable clearance of 95.5 cm, the wide-space C-arm provides ample space around the patient, offering sufficient space to navigate complex setups while working with long devices and instruments and accommodating larger patients.



Maintain infection control

The seamless exterior with smooth surfaces paint acts as a safeguard against spills and permits easy cleaning. These features simplify regular cleaning and disinfection efforts.



Minimum room size

35 m²

Recommended room size

68 m²

Intraoperative 3D imaging position

Head side and lateral

Max. 3D volume size (diameter x height)

43 cm x 17.5 cm
32 cm x 23.5 cm

Isocenter height

104–150 cm

ARTIS pheno

Advance your case mix – Ready for current and future demands



Endovascular
aortic repair



Transcatheter aortic
valve replacement



Video-assisted
thoroscopic surgery



Spinal
fusion



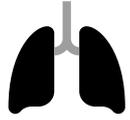
Deep brain
stimulation



Iliosacral joint
fixation

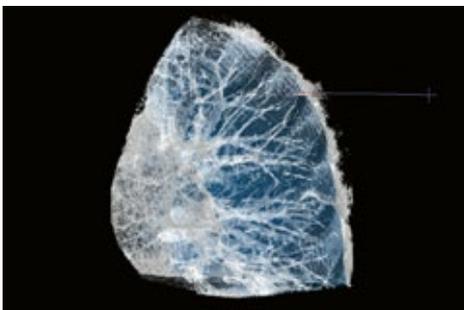


Minimally invasive liver
cancer treatment



Thoracic surgery

Ready for video-assisted thoracoscopic surgery



Images courtesy of Fong et al.,
Chi Mei Medical Center, Tainan, Taiwan

Therapy challenges

Lung cancer screenings enable physicians to discover tumors at an early stage. If the lesions are small and deep, minimally invasive surgery can be challenging. CT-based needle localization in the interventional suite followed by transfer to the OR potentially carries the risk of needle dislocation, hemorrhage, and pneumothorax in an environment that is less safe than the OR.

Our solution: always on target

ARTIS pheno installed in a Hybrid OR offers a one-stop workflow and a set of dedicated features for the resection of small pulmonary nodules to help you master these challenges. The image-guided, video-assisted thoracoscopic surgery (iVATS) workflow combines intra-operative large-volume 3D imaging and laser-guided needle localization, followed by minimally invasive surgery. ARTIS pheno supports thoracic surgeons to optimize clinical operations by reducing the overall procedure time and the time-at-risk for the patient¹⁵.

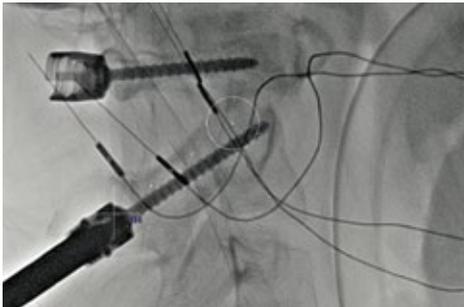
ARTIS pheno highlights

- *syngo* DynaCT Large Volume for visualizing in most cases the whole thorax with a diameter of 43 cm – in 3D, enabling the planning of long transthoracic or endobronchial pathways
- Wide-space C-arm for collision-free rotation – even with large patients in lateral decubitus position – along with comfortable ergonomics for the surgeon
- *syngo* Needle Guidance for planning transthoracic trajectories to multiple lesions



Spine surgery

Ready for spinal fusion surgery



Images courtesy of Ao et al.,
Chi Mei Medical Center, Tainan, Taiwan

Therapy challenges

Reliable technology that makes spine procedures safer, more accurate, and more efficient is crucial for the future of surgery. Precise image guidance and excellent intra-operative 3D imaging help minimize the risk of complications and increase patient safety. However, studies show that, depending on the method of guidance, the misplacement rate for pedicle screws can approach 15%.¹⁶

And, spine revision surgery can be very costly: in some countries, \$ 25,000 is to be expected.

Our solution: speed, precision, less revisions

ARTIS pheno provides individualized pre-operative planning, intraoperative guidance, and immediate post-operative quality control for spinal fusion. *syngo* Needle Guidance supports surgeons can plan and place pedicle screws precisely without the help of a navigation system.

Optical navigation systems are, however, also compatible with ARTIS pheno. A single study has shown that using intra-operative guidance in conjunction with optical navigation can reduce revision rates to about 1%.¹⁷ ARTIS pheno can be used to visualize up to ten vertebrae simultaneously in 3D with *syngo* DynaCT. The wide-space C-arm allows safe and efficient screw insertion using live image guidance and provides ample space for the surgeon.

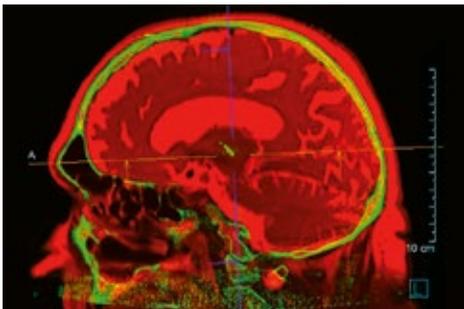
ARTIS pheno highlights

- *syngo* DynaCT Large Volume for visualizing up to ten vertebrae in a single 3D scan
- *syngo* Needle Guidance for planning and guiding multiple pedicle screw paths
- Wide-space C-arm for comfortable screw insertion using live image guidance
- Integration of third-party surgical tables, head clamps, and navigation systems



Neurosurgery

Ready for deep brain stimulation



Images courtesy of Raftopoulos et al.,
Cliniques universitaires St-Luc, Brussels, Belgium

Therapy challenges

Conventional approaches to deep brain stimulation rely on pre-operative 3D images from MR fused with CT which do not offer live image guidance during the actual implantation of the electrodes in the OR. Furthermore, a CT scan is oftentimes performed in the radiology department after the procedure to confirm the placement of the electrodes. This necessitates transporting the anesthetized patient which is challenging for medical staff and may increase patient risk due to longer anesthesia times and repeated repositioning.

Our solution: more information in less time

ARTIS pheno offers intra-operative 3D imaging with *syngo* DynaCT and fusion capabilities with pre-operative MR images for precise trajectory planning. In addition to stereotactic guidance, live 2D imaging helps the surgical team advance the electrodes toward the planned location in the brain. For immediate confirmation of results after the procedure, another *syngo* DynaCT can be performed and fused with pre-operative MR images. Using ARTIS pheno in the Hybrid OR for intra-operative 3D image acquisition for planning and immediate assessment of results, eliminates the need for transporting the patient to the radiology department, saving at least 2 hours of time. As a result, anesthesia time is reduced, additional repositioning is avoided, and the hospital can schedule additional cases to increase OR utilization.¹⁸

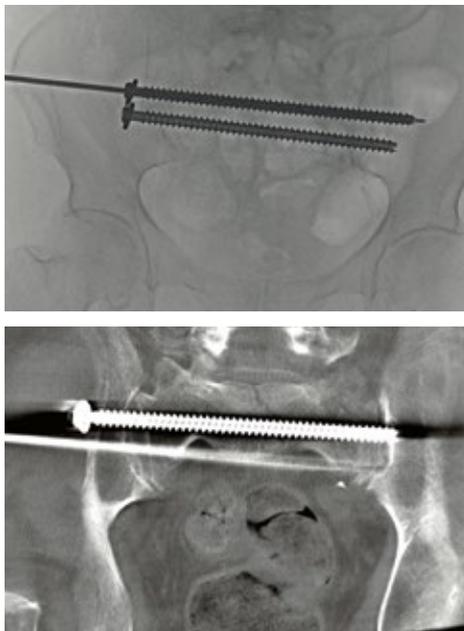
ARTIS pheno highlights

- Fusion imaging with pre-operative MRI and intra-operative *syngo* DynaCT
- *syngo* DynaCT for intra-operative 3D acquisition, used for planning and immediate 3D quality control of electrode placement in the OR
- Wide-space C-arm for comfortable intra-operative imaging, even when using head clamps and stereotactic frames
- Integration with nexaris Therapy Suites for multimodality approaches



Orthopedic and trauma surgery

Ready for iliosacral joint fixation



Images courtesy of Luzerner Kantonspital, Luzern, Switzerland

Therapy challenges

More and more elderly patients – especially those with osteoporosis – are suffering from so-called fragility fractures. A viable minimally invasive alternative to conventional open fixation surgery (which involves large wounds and long hospital stays with complication risks) is percutaneous iliosacral screw insertion. It is challenging, however, to insert a screw using a long corridor – from the skin through the soft tissue and into the correct trajectory in the iliosacral joint, all the way to the contralateral side – without injuring the important nerves and arteries.

Our solution: more precision

ARTIS pheno enables surgeons to perform iliosacral joint fixation. The system permits planning of the screw pathway using intra-operative 3D images and provides live guidance fluoroscopy by way of 2D. The final 3D images for controlling the results with *syngo* DynaCT are acquired in only 4 seconds. In some cases, this minimally invasive approach permits the patients to walk again within one day after surgery.

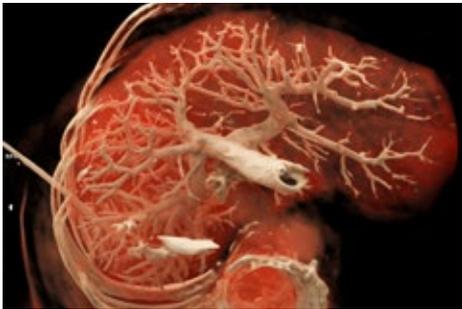
ARTIS pheno highlights

- *syngo* DynaCT Large Volume for visualizing the complete pelvis²⁰ to control symmetry
- *syngo* Needle Guidance with Automatic Path Alignment function for planning and guiding multiple screw insertions
- Integration of surgical tables
- Integration of navigation systems
- Improved clean conditions thanks to significant antimicrobial effects on non-sporulating microorganism
- floor-mounted design that keeps the ceiling free, for maintaining high infection control standards



Abdominal surgery

Ready for minimally invasive liver cancer treatment



Images courtesy of Prof. Gimenez, IHU Strasbourg, France, CardioVascular and Interventional Radiology

Therapy challenges

Image guidance in abdominal surgery is a relatively new field, but it creates new opportunities for curative treatment of patients with liver cancer. One of the most promising approaches available today is thermal ablation. Because ablation of tumors larger than 3 cm requires multiple precisely positioned needles, additional guidance equipment is indispensable.

Our solution: better guidance

ARTIS pheno provides integrated 3D planning and navigation tools for visualizing needle progression and achieving precise placement of multiple needles¹⁹. CT or MRI datasets can be fused with intra-operative fluoroscopy to provide additional information about sensitive structures during the procedure. Choosing minimally invasive approaches for liver cancer treatment may reduce the length of patients' hospital stays and lower complication rates compared to open surgery as source.

ARTIS pheno highlights

- *syngo* DynaCT Large Volume for 3D visualization of large organs in the abdomen based on the actual situation in the OR
- *syngo* Needle Guidance for guiding ablation systems precisely to the target
- *syngo* Embolization Guidance for selectively embolizing structures
- Fusion imaging with MRI and CT for visualizing important anatomical landmarks
- Integration with nexaris Therapy Suites for multimodality approaches

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The statements with footnotes in this document are based on a result of the quoted clinical study that evaluates the procedure. The results are not generated with the actual product version. It is expected, that the actual product version has similar or improved functionality to support the evaluated procedure.

- ¹ Susan Salka, "Healthcare Staff Shortages?" AMN Healthcare, accessed January 29, 2019, <http://www.amnhealthcare.com/industry-research/2147484673/1033>.
- ² Matthew Stevenson, "Demand for Healthcare Workers Will Outpace Supply by 2025: An Analysis of the US Healthcare Labor Market," Mercer Health Provider Advisory, <https://www.mercer.com/content/dam/mercer/attachments/private/gi-career-2018-demand-for-healthcare-workers-will-outpace-supply-by-2025-analysis-healthcare-labor-market-mercer.pdf>.
- ³ "Emergency Readmissions to Hospital for Potentially Preventable Conditions on the Rise, New Research Shows," Nuffield Trust, June 2018, <https://www.nuffieldtrust.org.uk/news-item/emergency-readmissions-to-hospital-for-potentially-preventable-conditions-on-the-rise-new-research-shows-1>.

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- ⁹ Donald M. Berwick and Andrew D. Hackbarth, "Eliminating Waste in US Health Care," JAMA 307, no. 14 (2012): 1513–6, <http://doi.org/10.1001/jama.2012.362>.
- ⁴ Michael Chui, James Manyika, and Mehdi Miremadi, "Where Machines Could Replace Humans – and Where They Can't (Yet)," McKinsey Quarterly, July 2016, <http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/where-machines-could-replace-humans-and-where-they-cant-yet>.
- ⁵ Homepage of the Organization for Occupational Radiation Safety in Interventional Fluoroscopy, accessed March 29, 2019, <http://orsif.org>.
- ¹⁰ E.g., in Case Flow "Device insertions" - comparing to manual system settings.
- ⁸ Manual preparation of CT dataset with segmentation and marking of aorta typically takes 20 minutes with syngo EVAR Guidance software. The segmentation and marking of branched vessels can be performed typically in one minute.
- ⁶ Advanced Robotic Angiography Systems for image guidance during conventional transarterial chemoembolization impact on radiation dose and image quality, Vogl, Thomas J., MD; Alizadeh, Leona S., MD; Maeder, Richard, MS; Naguib, Nagy N., MD; Herrmann, Eva, PhD; Bickford, Matthew W., BS ; Burck, Iris, MD; Albrecht, Moritz H., MD Investigative Radiology: March 2019 - Volume 54 - Issue 3 - p 153–159.
- ⁷ Compared to Artis zeego
- ¹¹ Shorter anesthesia time and less risk of necrotic tissue due to unperfused areas (A), reduced risk for patients with renal insufficiencies (B), fewer early reinterventions (C) lead to lower complication rates overall.
- ¹² Muhammad S. Sajid et al., "Endovascular Aortic Aneurysm Repair (EVAR) Has Significantly Lower Perioperative Mortality in Comparison to Open Repair: A Systematic Review," Asian Journal of Surgery 31, no. 3 (2008): 119–123, [http://doi.org/10.1016/S1015-9584\(08\)60071-8](http://doi.org/10.1016/S1015-9584(08)60071-8).
- ¹³ Michael McNally et al., "Three Dimensional Fusion CT Decreases Radiation Exposure, Procedure Time and Contrast Use during Fenestrated Endovascular Aortic Repair," Journal of Vascular Surgery 61, no. 2 (2014): 309–16, <http://doi.org/10.1016/j.jvs.2014.07.097>.
- ¹⁴ Kodali et al., "Two-year outcomes after transcatheter or surgical aortic-valve replacement" The New England Journal of Medicine, 2012
- ¹⁵ Yin-Kai Chao et al., "A Comparison of Efficacy and Safety of preoperative Versus Intraoperative Computed Tomography-Guided Thoracoscopic Lung Resection," Journal of Thoracic and Cardiovascular Surgery 156, no. 5 (2018): 1974–1983.e1, <https://www.ncbi.nlm.nih.gov/pubmed/30119900h>
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- ²⁰ Richter et al., Injury, Volume 47, Issue 2, February 2016, "Accuracy of computer-assisted iliosacral screw placement using a hybrid operating room." With detector in landscape orientation and syngo Dyna CT Large volume (optional), large diameters (43 cm / 16.9") can be visualized, e.g. the Pelvis incl. proximal femur in a single scan
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