

Hybrid OR imaging solutions

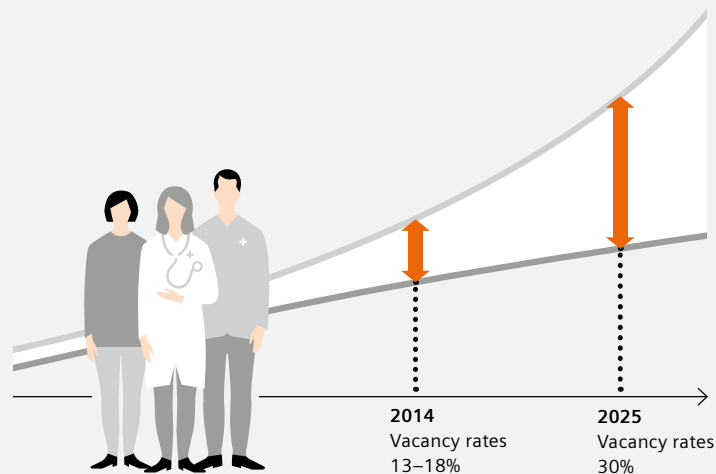
Perfecting minimally invasive surgery
with procedural intelligence



Demand exceeds supply: a growing dilemma for hospitals

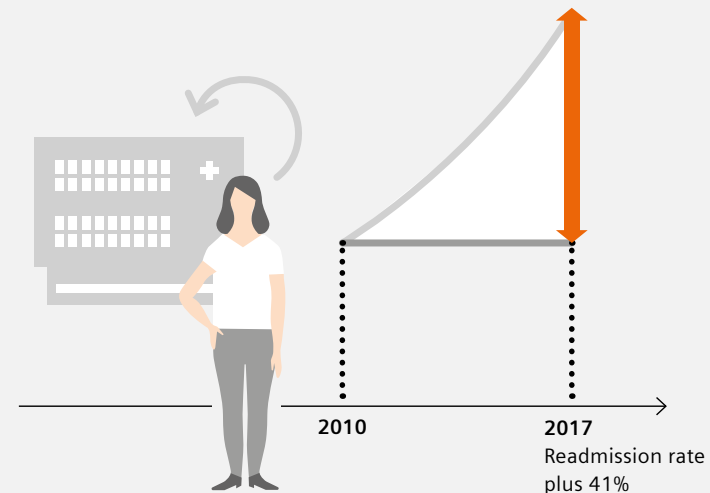
Many hospitals today face staff shortages, limiting their ability to provide optimal treatment in every situation. Innovative solutions that reduce the workload per patient can help alleviate this problem.

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

Perfecting 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: a unique combination of imaging and workflow software that helps optimize clinical operations in the Hybrid OR.

Procedural intelligence brings consistency to your surgical workflows by eliminating cumbersome and repetitive manual input steps. You only have to select custom parameters for every procedure step one time, and then the system will set them automatically for every treatment thereafter. With step-by-step intra-operative guidance, intelligent optimization of image quality and dose, and automated C-arm positioning, our imaging systems with procedural intelligence enable standardized image-guided surgery, regardless of procedural complexity.

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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%.

Interventional fluoroscopy is used for more than 10 million 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.⁴ 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,⁵ 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: interventional fluoroscopy is used for more than 10 million procedures every year,⁶ and practitioners are being diagnosed with brain tumors at alarming rates.

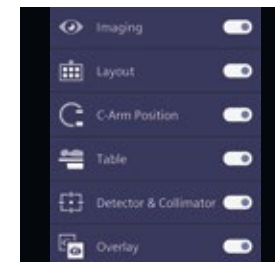
Procedural intelligence helps simplify and standardize your imaging workflows, so that you can provide the best possible treatment for every patient.

Surgical imaging with fewer manual steps

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



**Up to 83%
less manual interaction**



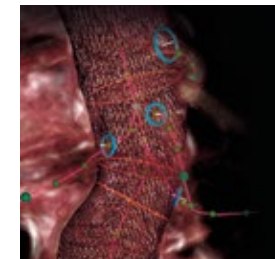
Define optimal parameters and eliminate up to 6 manual system interactions for every Case Flow step.

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 analysis**



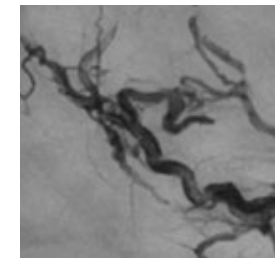
Procedural intelligence reduces preparation time from typically fifteen minutes to just one minute thanks to automated data processing for EVAR procedures.

Standardized image quality at ALARA dose

Select your preferred image quality level for the anatomy, devices, or materials you need to visualize. Using self-adjusting algorithms, our OPTIQ software will select the right imaging parameters while keeping the radiation exposure to a minimum for the OR team and the patient.



**Up to 50% less dose
for DSA and fluoroscopy**



In arteriovenous malformation treatment with material containing tantalum, for example, the dose can be reduced from 0.15 $\mu\text{Gy}\cdot\text{m}^2/\text{f}$ to 0.026 $\mu\text{Gy}\cdot\text{m}^2/\text{f}$ at the same device visibility.⁷

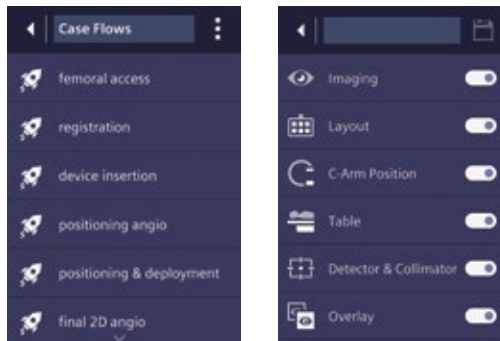


Vascular surgery

Perfecting EVAR with procedural intelligence

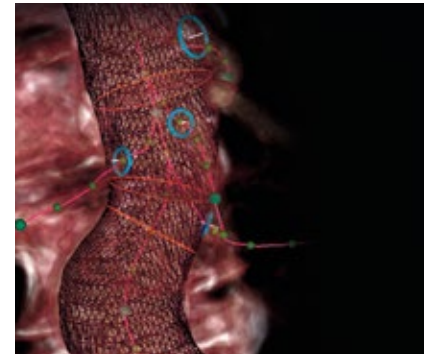
Procedural intelligence helps you speed up your endovascular procedures. With intra-operative software guidance, intelligent optimization of image quality and dose, and automated C-arm positioning, even complex cases are greatly simplified. You can also standardize every workflow step thanks to EVAR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

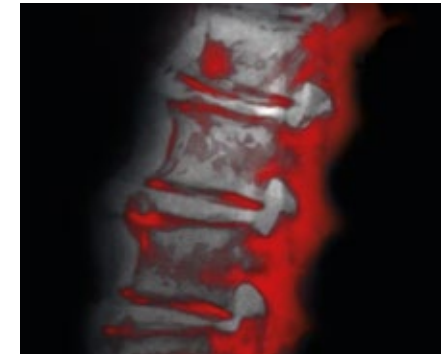
Preparation



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



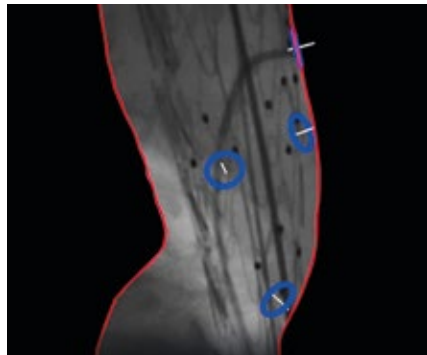
Fast registration for fusion imaging

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.”

Dr. med. Frank Marquardt | 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

Review stent positioning using high-quality 3D imaging to reduce early reinterventions.

Review the clinical evidence

EVAR treatment in itself can lower complication rates⁸ and even reduce the risk of mortality compared to open surgery.⁹ Using fusion imaging – a core component of procedural intelligence – unlocks additional benefits for you and your patients.



30% shorter procedure time¹⁰

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



57% less iodine contrast media¹¹

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

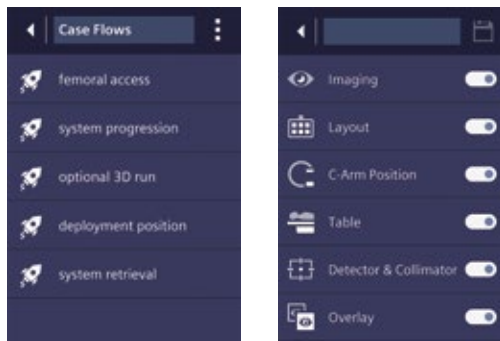


Cardiac surgery

Perfecting TAVI with procedural intelligence

Procedural intelligence helps you 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 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.

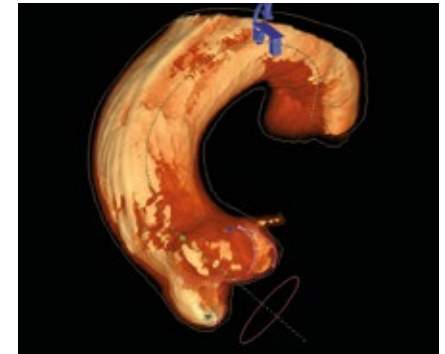
Acquisition



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



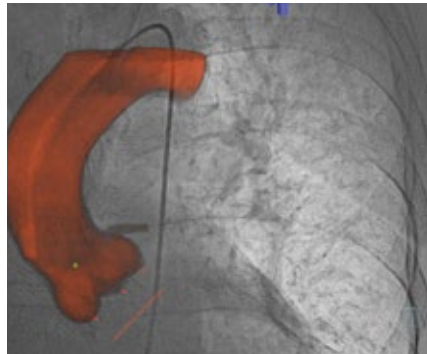
Automatic segmentation and indication of anatomical landmarks

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

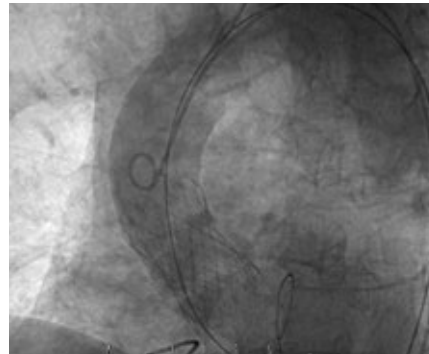
Deployment



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 procedures allow minimally invasive treatment of patients with severe symptomatic aortic stenosis. Here are some of the key benefits you stand to gain by using our imaging systems equipped with procedural intelligence.



Double the quality of valve positioning¹²

Using our assisted workflow with intra-operative guidance may help increase the quality of valve positioning and reduce the amount of contrast media necessary, potentially improving treatment of patients with comorbidities and renal insufficiency.



Impact on patient

Studies show that the absence of paravalvular leaks are linked to better 3-year survival rates. Since our workflow optimizes valve positioning, it helps to improve outcomes.

Flow steps

Image courtesy of Bernhard Schieffer et al., 2017, University Hospital of Giessen and Marburg

ARTIS icono floor

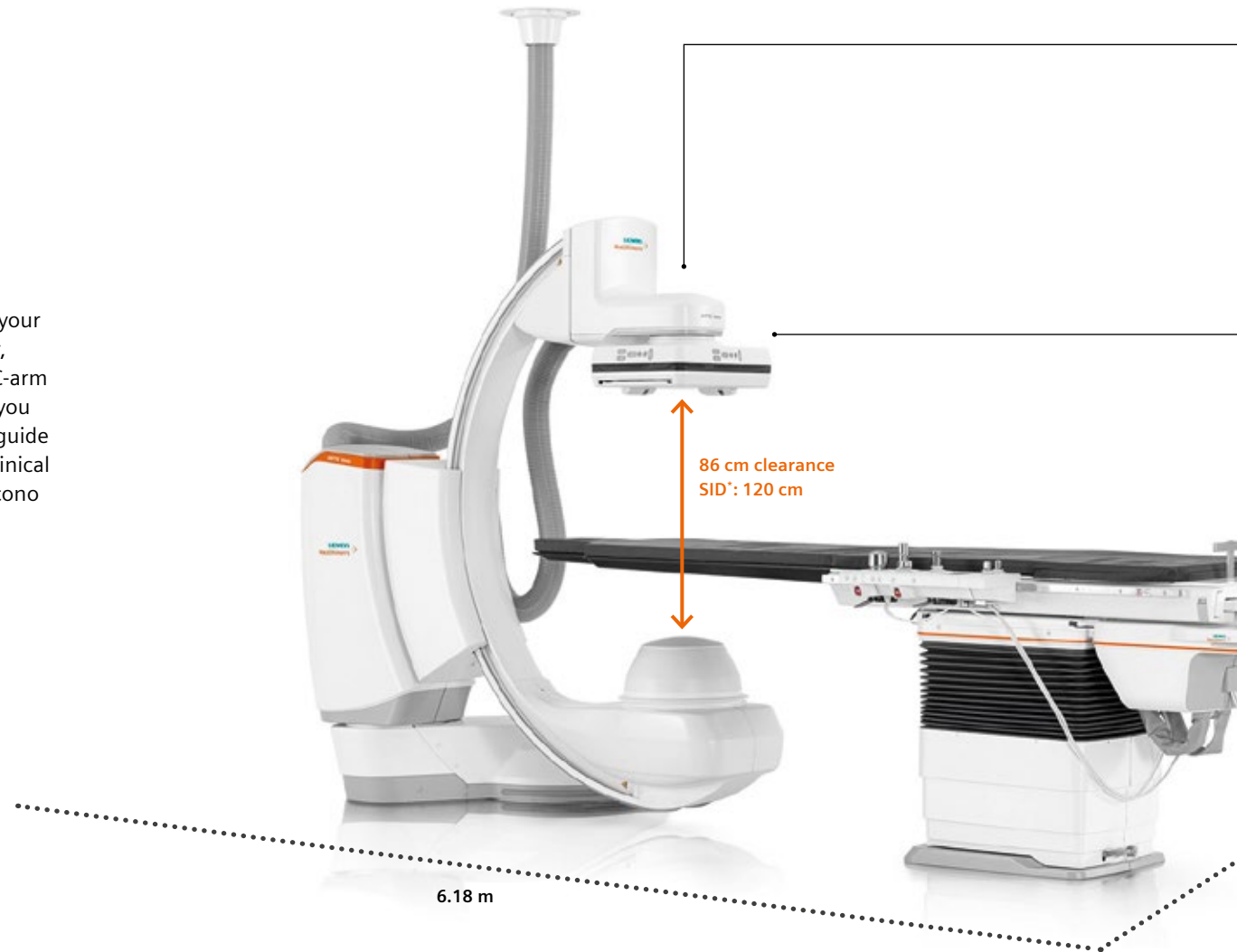
An icon of innovation for cardiovascular procedures

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 even the most complex cases to optimize clinical operations. Moreover, the small footprint makes ARTIS icono floor a perfect match for every existing OR.

28m²
minimum
room size

Procedural intelligence benefits

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





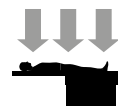
Minimal space requirements

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



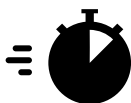
Motorized C-arm movements

The multiaxis floor stand with fully motorized movements provides full patient coverage (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.



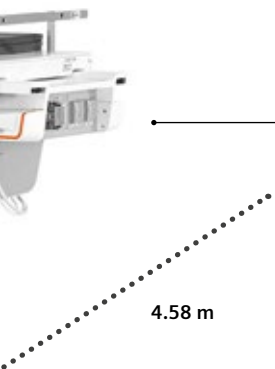
Fast 3D scan times from head side

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



Advanced infection control

The seamless exterior with smooth surfaces and antimicrobial paint acts as a safeguard against spills and permits easy cleaning. This passive infection control support simplifies regular cleaning and disinfection efforts.



Minimum room size

28 m²

Recommended room size

38 m²

Intraoperative 3D imaging position

Head side

Max. 3D volume size (diameter x height)

23.5 cm x 17.5 cm

Working height

107 cm

ARTIS pheno

Cutting-edge robotic imaging for multidisciplinary utilization

Investing in a cutting-edge Hybrid OR prepares you for treating any patient regardless of the condition. ARTIS pheno – the only robotic C-arm system on the market – brings true multidisciplinary capabilities to your institution, enabling minimally invasive treatment across all specialties for maximum room utilization. Thanks to procedural Intelligence, ARTIS pheno provides all the support you may need to standardize your workflows for even the most complex cases to optimize clinical operations.

100%
room
utilization

Procedural intelligence benefits

- ✓ Surgical imaging with fewer manual steps
- ✓ Intelligent analysis of pre-operative 3D data
- ✓ Standardized image quality at 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 coverage of the entire thorax or abdomen with a diameter of 43 cm.



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.



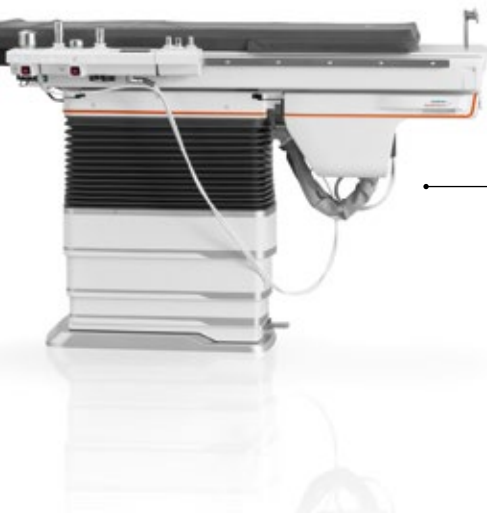
Wide-space C-arm

With its unique usable clearance of 95.5 cm (37.5"), the wide-space C-arm provides ample space around the patient, making it easier to ensure safe conditions for treatment while working with long devices and instruments and accommodating larger patients.



Advanced infection control

The seamless exterior with smooth surfaces and antimicrobial paint acts as a safeguard against spills and permits easy cleaning. This passive infection control support simplifies 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 or 32 cm x 23.5 cm

Working height

Flexible isocenter 104–150 cm

ARTIS pheno

Perfecting minimally invasive surgery – no matter which procedure



Endovascular
aortic repair



Transcatheter aortic
valve replacement



Video-assisted
thoracoscopic surgery



Spinal
fusion



Deep brain
stimulation



Iliosacral joint
fixation

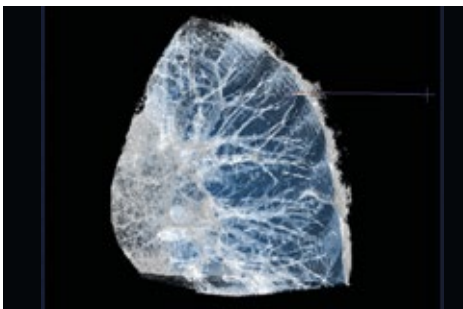


Minimally invasive liver
cancer treatment



Thoracic surgery

Perfecting video-assisted thoracoscopic surgery with procedural intelligence



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

Therapy challenges

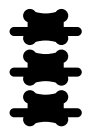
Lung cancer screenings enable physicians to discover tumors at an early stage. If the lesions are small and deep, minimally invasive surgery can prove challenging. CT-based needle localization in the interventional suite followed by transfer to the OR potentially carries the risk of needle dislocation, 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. With ARTIS pheno, thoracic surgeons can optimize clinical operations by reducing the overall procedure time and the time-at-risk for the patient.

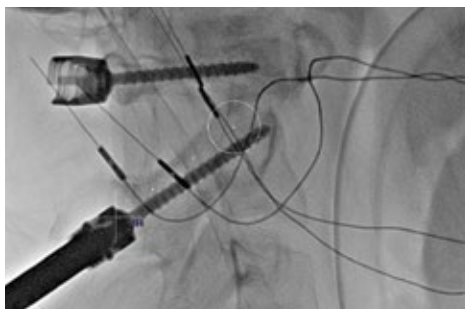
ARTIS pheno highlights

- *syngo* DynaCT Large Volume for visualizing the whole thorax – including skin – 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

Perfecting spinal fusion surgery with procedural intelligence



Images courtesy of Ao et al.,
Tainan University, 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%.

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

Our solution: speed, precision, less repetition

ARTIS pheno provides individualized pre-operative planning, intraoperative guidance, and immediate post-operative quality control for spinal fusion. With *syngo* Needle Guidance, surgeons can plan and place pedicle screws precisely without the help of a navigation system. Studies show that using intra-operative image guidance during spinal fusion can reduce revision rates to about 1%. ARTIS pheno can be used to visualize more than 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.

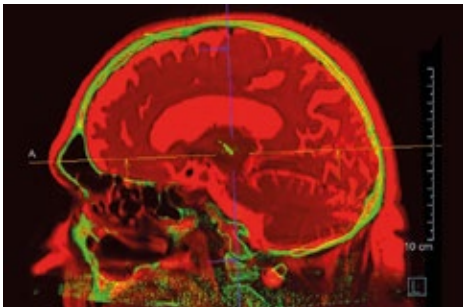
ARTIS pheno highlights

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



Neurosurgery

Perfecting deep brain stimulation with procedural intelligence



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 provides intra-operative 2D imaging in addition to stereotactic guidance. This live imaging can help the surgical team advance the electrodes toward the planned location in the brain. Fusing *syngo* DynaCT with pre-operative MR images also allows for immediate confirmation of results after the procedure. Using ARTIS pheno in the Hybrid OR for intra-operative 3D assessment eliminates the need for transporting the patient back to the radiology department for another CT scan, saving approximately 90 minutes of time. As a result, anesthesia time is reduced, additional repositioning is avoided, and the hospital can schedule additional cases to increase OR utilization.

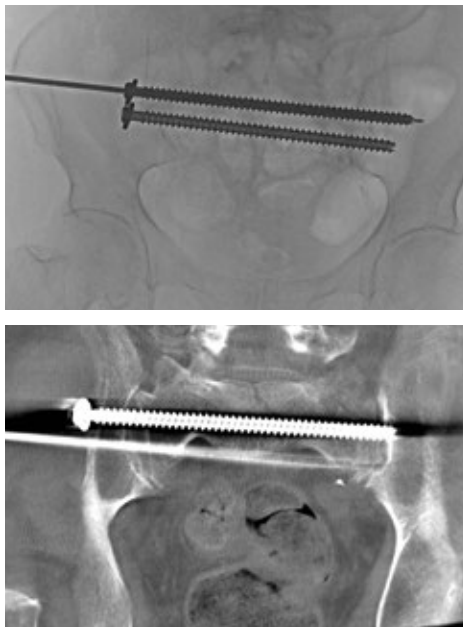
ARTIS pheno highlights

- Fusion imaging with pre-operative MRI and CT for outstanding image guidance
- *syngo* DynaCT for 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

Perfecting iliosacral joint fixation with procedural intelligence



Images courtesy of Luzerner Kantonsspital, 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 corridor, all the way to the contralateral side – without injuring the important nerves and arteries.

Our solution: more precision

ARTIS pheno enables surgeons to perform precise 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 control of the results with *syngo* DynaCT takes only 4 seconds. In some cases, this minimally invasive approach permits the patients to walk again within one day after surgery.

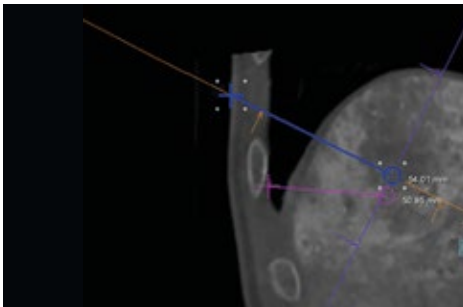
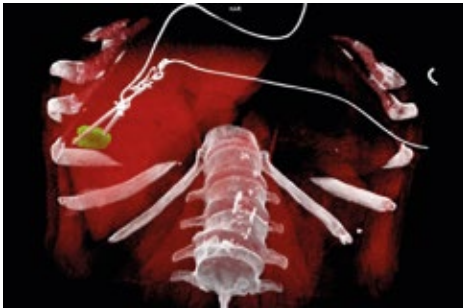
ARTIS pheno highlights

- *syngo* DynaCT Large Volume for visualizing the complete pelvis 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
- Antimicrobial C-arm coating, and floor-mounted design that keeps the ceiling free, for maintaining the highest infection control standards



Abdominal surgery

Perfecting minimally invasive liver cancer treatment with procedural intelligence



Images courtesy of Solbiati et al.,
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 needles. 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 can reduce the length of patients' hospital stays and reduce complication rates compared to open surgery.

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>.
- ⁴ 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>.
- ⁵ 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>.
- ⁶ Homepage of the Organization for Occupational Radiation Safety in Interventional Fluoroscopy, accessed March 29, 2019, <http://orsif.org>.
- ⁷ 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., MED; 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.
- ⁸ 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.
- ⁹ 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).
- ¹⁰ 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>.
- ¹¹ Ibid.
- ¹² Karl K. Poon et al., "Impact of Optimising Fluoroscopic Implant Angles on Paravalvular Regurgitation in Transcatheter Aortic Valve Replacements – Utility of Three-Dimensional Rotational Angiography," EuroIntervention 8, no. 5(2012): 538–45, <http://doi.org/10.4244/EIJV8I5A84>.