White paper

myExam Companion

Revolutionizing the way radiologists work, while improving patient care

siemens-healthineers.us/myexam-companion

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Introduction

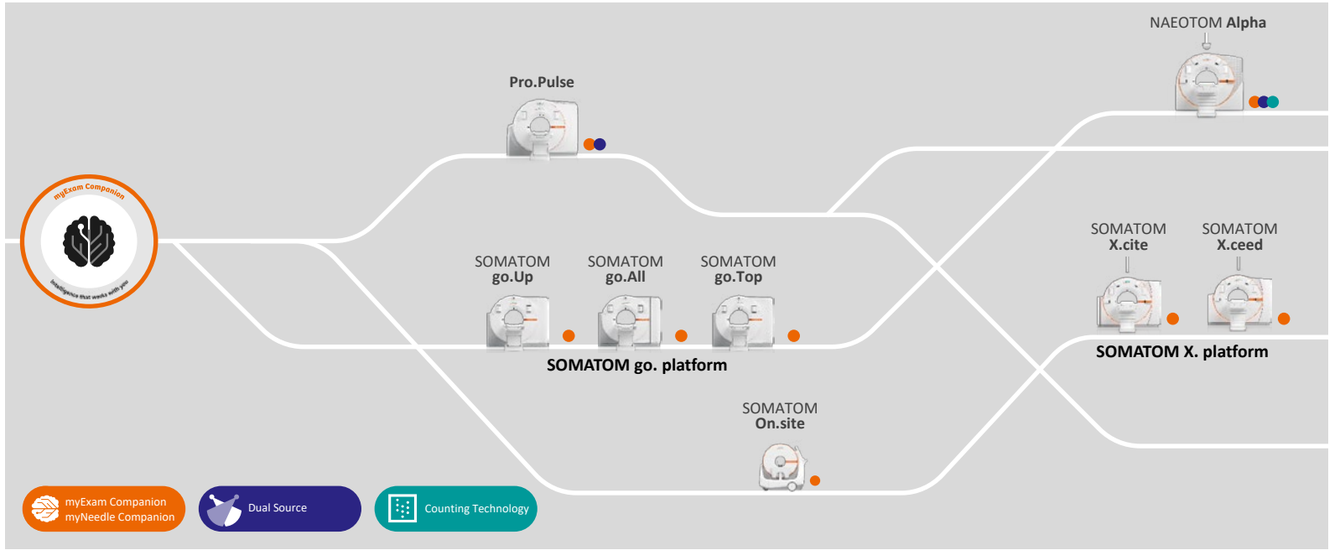
Over the past 30 years, computed tomography (CT) technology has made incredible advancements.[1]

While these improvements have greatly enhanced CT capabilities, they have also made the scanners more complex to operate due to the numerous new features. Users may struggle to keep up with these innovations, much less utilize them fully. Despite the technology's potential, it ultimately depends on human operators to produce the extraordinary, high-resolution images now possible.

myExam Companion is here to bridge this gap, making it easier for users to harness the full power of modern CT scanners.

This white paper delves into the features, challenges, and benefits of this groundbreaking technology.

myExam Companion is a significant step in the evolution of radiology. This intelligent tool enhances workflow efficiency and quality by providing real-time guidance to radiology technologists.

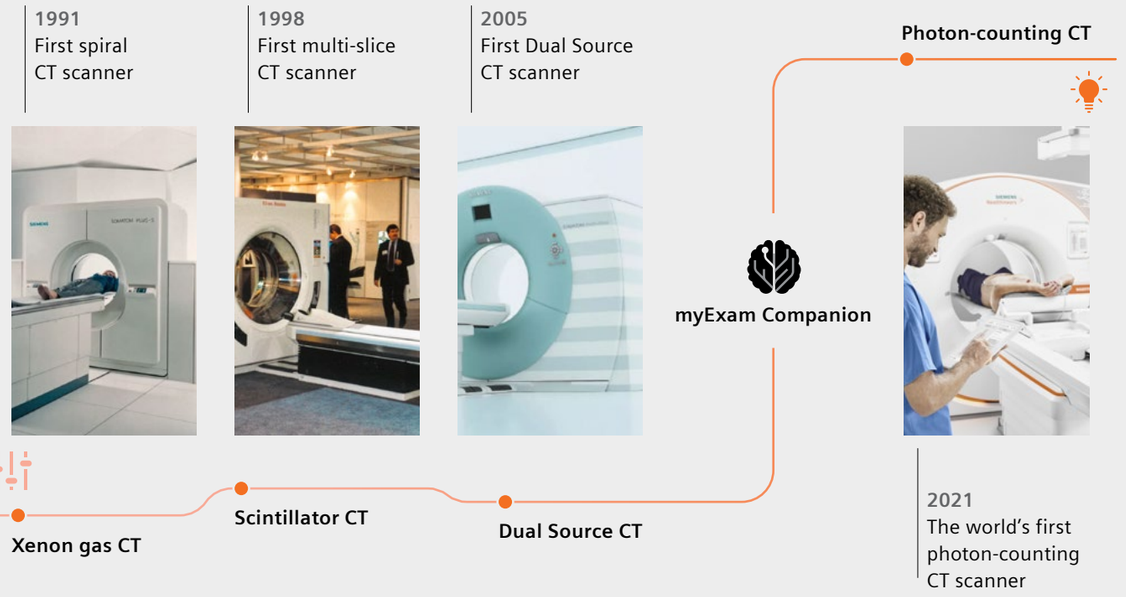


The potential of CT

Over the past few decades, CT scanners have evolved from single-to multi-slice scanners, transitioned from sequential to spiral scanning, and now rotate at speeds so extraordinary that they subject the scanner internals to gravitational forces of up to 40 G. These hardware improvements have paved the way for revolutionary developments in medical imaging, allowing us to capture detailed images of entire organs in a fraction of a second.

Cardiac examinations offer a prime example of this progress.[2] These scans must capture images of the heart during the brief 100-150 ms when it is not moving. Despite this incredibly brief window of opportunity, today's CT scanners are up to the task of producing high-resolution images of coronary arteries and heart valves—allowing for better diagnosis and treatment planning around heart-related conditions.

These and many other developments have expanded the possibilities of medical imaging, offering tremendous potential for improving patient care.



The challenge for technologists

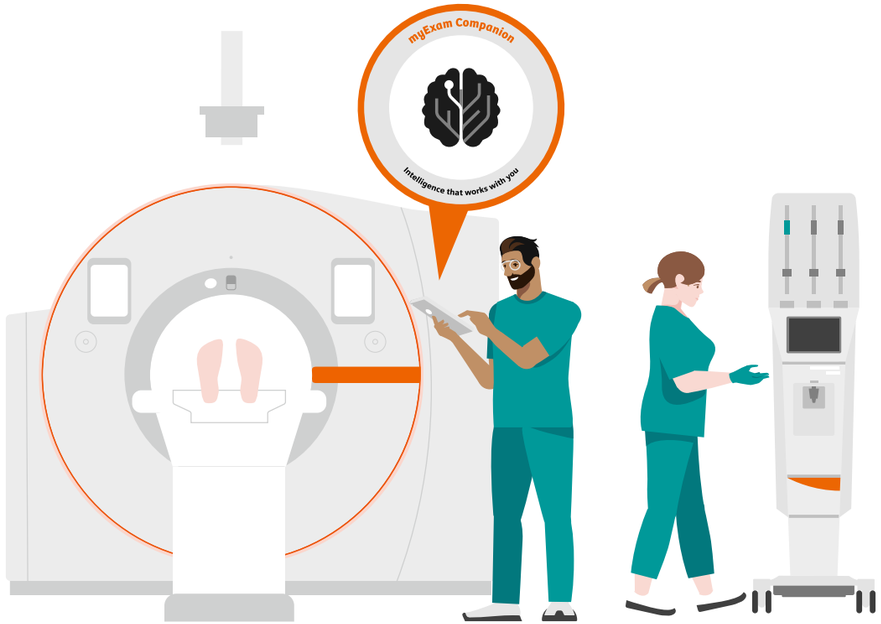
However, while the quality of the technology and the range of things it can do have advanced by leaps and bounds, the way that CT scanners are operated has not kept pace. Over the past three decades, new features have been introduced that allow for a wide array of scanning modes, or "protocols," tailored for specific clinical applications. These protocols are typically generated through the modification of factory template protocols—with the user adjusting and customizing to fit individual clinical and workflow needs.[3] Different healthcare institutions may choose to further customize these scanning protocols to meet their own particular needs, and providers within those institutions may choose to demand their own specific protocols—all of which results in a potentially bewildering array of protocols. And as it always has, it falls to radiology technologists to manage these protocols and ensure that the right one is used for each patient, all while prioritizing patient care, safety, and image quality.

Radiology technologists often work with various imaging modalities, including X-ray, ultrasound, and MRI, frequently switching between machines from different manufacturers. The user interfaces of these machines can vary significantly. These differences can place a significant burden on technologists, requiring them to be proficient in multiple systems.

In response to these challenges, technologists may default to their own preferred scanning modes or resort to averaging—a type of one-size-fits-all shortcut—which can potentially result in nonstandardized protocols, higher radiation doses than necessary, or suboptimal image quality. Some valuable technologies provided by manufacturers may go underutilized due to these practices.

The simple truth for radiology technologists today is that while their basic job description has not changed, the job itself has gotten much more complicated.[4] And it is not just technologists. Healthcare providers have a whole new set of challenges, including rapidly increasing patient numbers; lack of standardized processes; complex workflows; the need to maintain a high quality of care, patient safety, and patient satisfaction; and a shortage of qualified technologists.

The last problem is an extremely serious one. Radiology departments are growing, and the number of technologists is not keeping pace. As departments expand, either through the acquisition of new systems or the integration of smaller practices, they may end up with a multitude of systems, each requiring specific expertise. This situation can lead to operational inefficiencies, and it can certainly limit the number of staff who are capable of effectively managing these various types of equipment.



The solution to this is widely understood to be standardization of workflow. In radiology, this involves setting scan parameters to achieve the lowest possible radiation dose, highest image quality, and reproducible results for doctors interpreting the examinations.[5] This is a challenging task considering the countless possible configurations of scanning parameters. Simply suggesting commonly used protocols, while a helpful step, falls short of fully utilizing the system's capabilities. It basically provides an average solution for the patient being scanned, without allowing technologists to explore new dose-saving settings and technologies, potentially compromising patient safety. What is really needed is automated and error-free guidance[6] through the manual and error-prone scanning landscape—an intelligent algorithm that mimics technologists' behavior while optimizing CT scanner capability for patients being scanned.

In 2019, Siemens Healthineers introduced myExam Companion, leveraging years of data analysis to provide technologists with master-level guidance, and to take a major step toward enhancing the efficiency of radiology departments and standardizing workflows. An example of this can be seen in Figure 1: There is a clearly defined interface, including natural language guidance questions, in the center of the screen for easy and efficient interaction between the technologist and the machine.

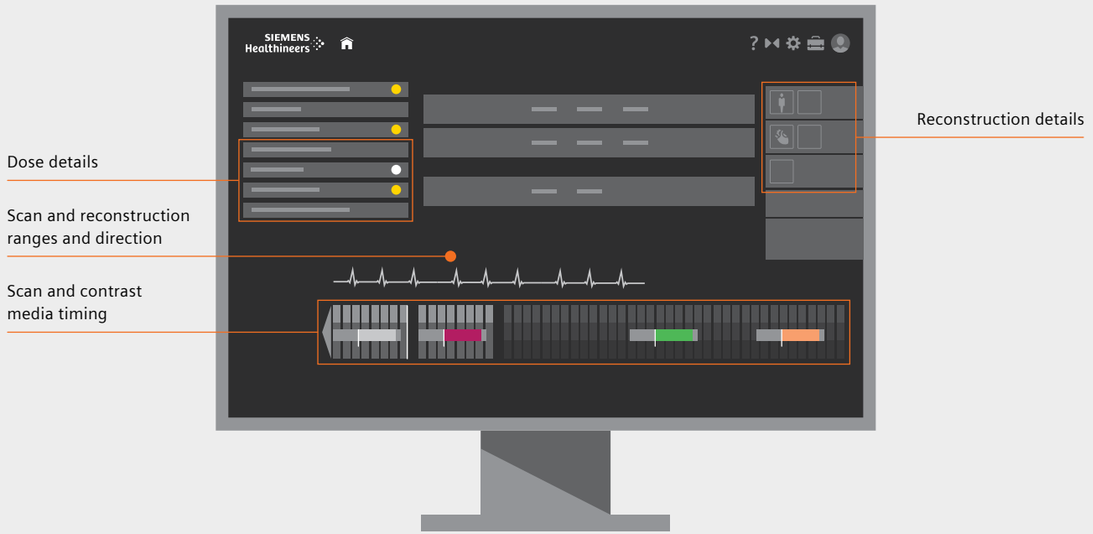


Figure 1: Example of a user interface guided by myExam Companion, with multiple scan parameters being adjusted simply by providing an answer in natural language, rather than having to set each one manually

The solution: myExam Companion

myExam Companion may be thought of as the brain guiding the imaging operation. It clusters several technologies that obtain specific input from the patient—all the knowledge required to carry out the function—and adapt the scan and reconstruction parameters accordingly, thus achieving more individualized and standardized outcomes in an automatic way.

In this way, myExam Companion changes the work context for technologists, making their decision-making faster and consistent. Instead of having to choose between supporting technologies, ponder different algorithms, and select appropriate parameters, technologists can now know, almost instantly, what the optimal choices are. The final decision is still theirs, but they can know that the suggested decision—the one that optimizes the technological potential of the scanner—is always at hand.

Supporting technologies: the nuts and bolts

Figure 2 provides a graphic overview of the cardiac scanning process as an example, including many new algorithms.[7] These technologies are designed to support operators along the CT imaging process, from preparation to acquisition to reconstruction. It is obviously critical that operators be aware of these aids and employ them correctly. Until the introduction of myExam Companion, those algorithms had been semiautomatic. Users would have to carefully and deliberately select every function. According to the manufacturer's analysis, the use rates of some of those functionalities, despite their potential, remained low. It could be argued that remembering about, and how to use, each of these functions during every individual scan is simply too difficult, even for the best technologists.

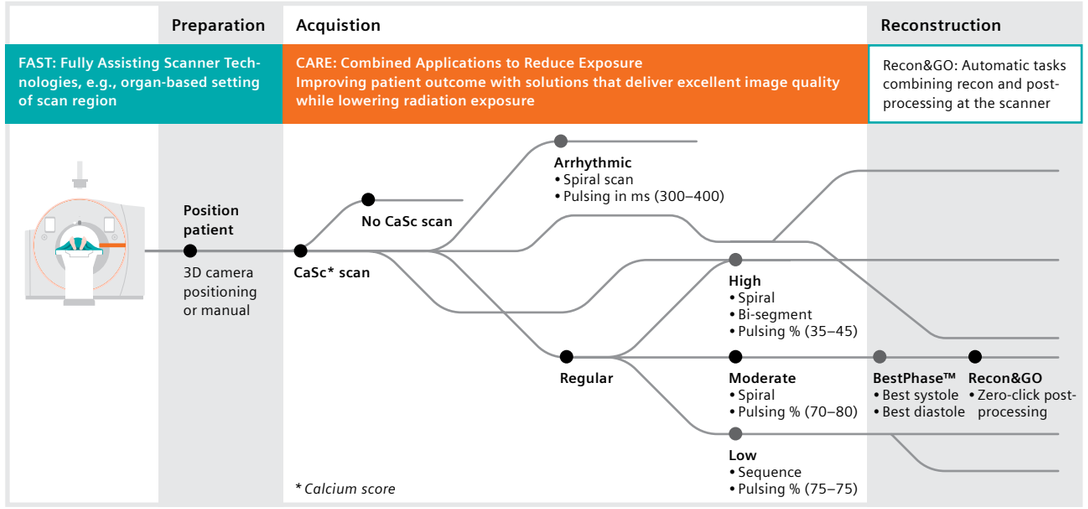


Figure 2: This figure demonstrates the complexity of carrying out a cardiac scan while trying to leverage the full potential of the scanner. It is a graphical description of the decision-making process that must be undergone by the technologist for every single patient. In addition, an overlay on top briefly describes available supportive technologies, which further complicate the process for the technologist.

Clinical decision trees

The main engine of myExam Companion is a set of clinical decision trees that interact with the operator, acting as decision-support tools, visually displaying possible decisions and suggestions.[8] From there, the branches can easily be evaluated and compared to select the best courses of action. Clinical decision trees are then connected to exam protocols, and multiple decision trees can be connected to the same basic protocol, making it easy for technologists to select exactly how particular scans should be run for specific patients.

Clinical decision trees were conceived with the support of AI, which analyzed large numbers of scans worldwide to determine optimal settings for procedures such as cardiac scans. In this demanding scanning scenario, the patient is positioned with the support of an AI-driven 3D camera. Technologists perform the breathing exercises with the patient while the scanner acquires the heart rate of the patient and the variability of that rate. With those inputs, myExam Companion will determine if the scan should be performed in a spiral or sequential mode, whether the scan should be performed during the systolic or diastolic phase, and finally, propose the pulsing parameters in percentages or milliseconds.

The system will also decide, based on information taken from the radiology information system (RIS) or a question asked to the user in natural language about the patient's age, whether there should be a calcium score scan for calcification evaluation. After the initial topogram, the system will adapt kV and mAs settings individually to the patient, to provide optimal dose and image quality. At the reconstruction phase, the system will automatically perform postprocessing steps for cardiac imaging. In the era before the intelligent workflow assistant, all of those tasks and decisions would have fallen to technologists. In Figure 3, a cardiac scanning scenario can be observed, with a scanning path automatically suggested for the user indicated in orange. It is important to note that the user does not need to recall all the technologies and parameter values. They are kept and stored in the decision trees. In case it is needed, it is possible to create an institution-specific decision tree with strategies tailored to individual users (illustrated in Figure 5). This needs to be defined only once at the very beginning of initial scanner setup.

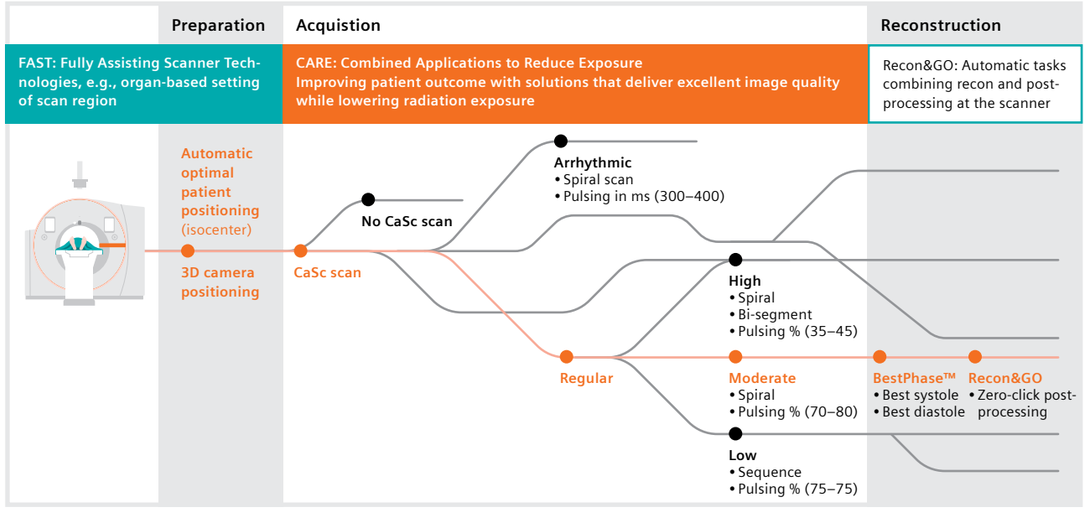


Figure 3: This figure shows the same cardiac scan process as in Figure 2, but with the support and guidance of an intelligent workflow aid—myExam Companion. Inputs from a 3D camera, ECG analysis and patient info from the RIS system are integrated in order to apply the best possible individual scan strategy, utilizing scanner technologies for low dose while maintaining the highest image quality.

myExam Compass

myExam Compass collects the attributes and questions configured into the clinical decision trees and attached to the particular protocol and presents them to the user in a single overview, providing control to the user. In Figure 4, a cardiac strategy can be observed. myExam Compass will automatically collect as much information as possible about the patient, without the need for input from the technologist. For example, heart rate and heart rate variability are collected automatically and used to determine the acquisition process. In this particular scenario, some input is required from the user. But the system will behave proactively without the need for the operator to remember this specific step. Technologists will be asked if the patient's age is above a certain threshold. That information will determine the calcium score scan necessity. With myExam Compass, complicated scan strategies (Figure 4) are suggested to the user with minimal manual input, while utilizing all of the technologies.

myExam Cockpit

myExam Cockpit is responsible for teaching the algorithm how to fully utilize the potential of the scanner to optimize the dose and achieve optimal images. This includes setting up the clinical decision trees by combining protocol parameters with patient characteristics such as body weight and heart rate.

In a contrast medium enhanced procedure, contrast materials help distinguish or "contrast" selected areas of the body from surrounding tissue, helping physicians diagnose medical conditions by improving the visibility of specific organs, blood vessels, or soft tissues. Part of what decision trees can do is to prepare the contrast-medium procedure so that the only thing the operator needs to do is answer a yes-or-no question, rather than manually preparing the whole scan process.[9] Decision trees can also add or remove bolus tracking and automate the workflow so that the user does not have to set multiple parameters manually anymore.

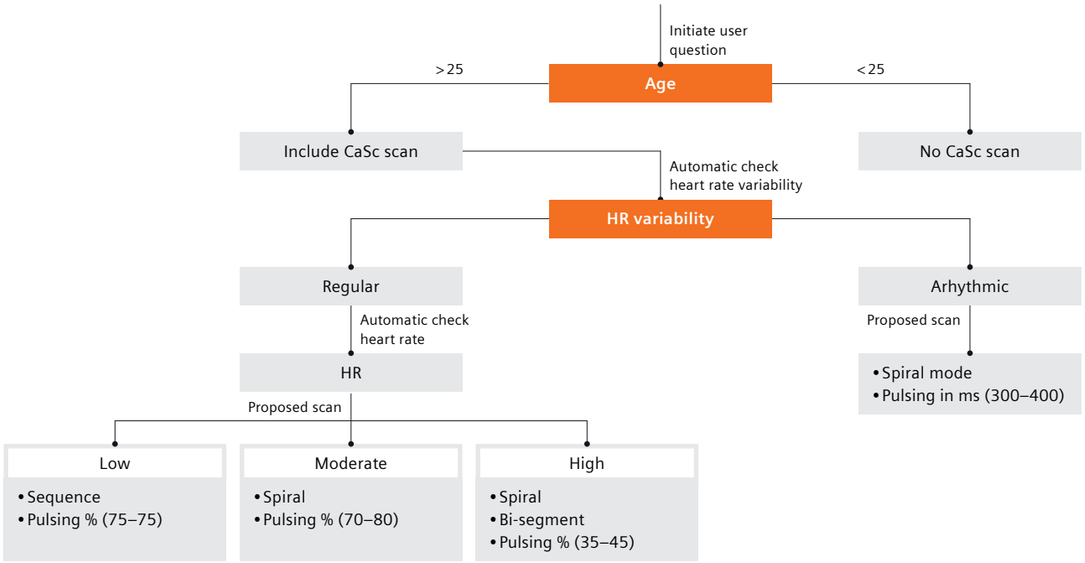


Figure 4: A block-diagram representation of myExam Compass executing a cardiac decision tree, initiating user-dependent input and navigating with automatically acquired input from the ECG signal in order to obtain an optimal, individual scanning strategy.

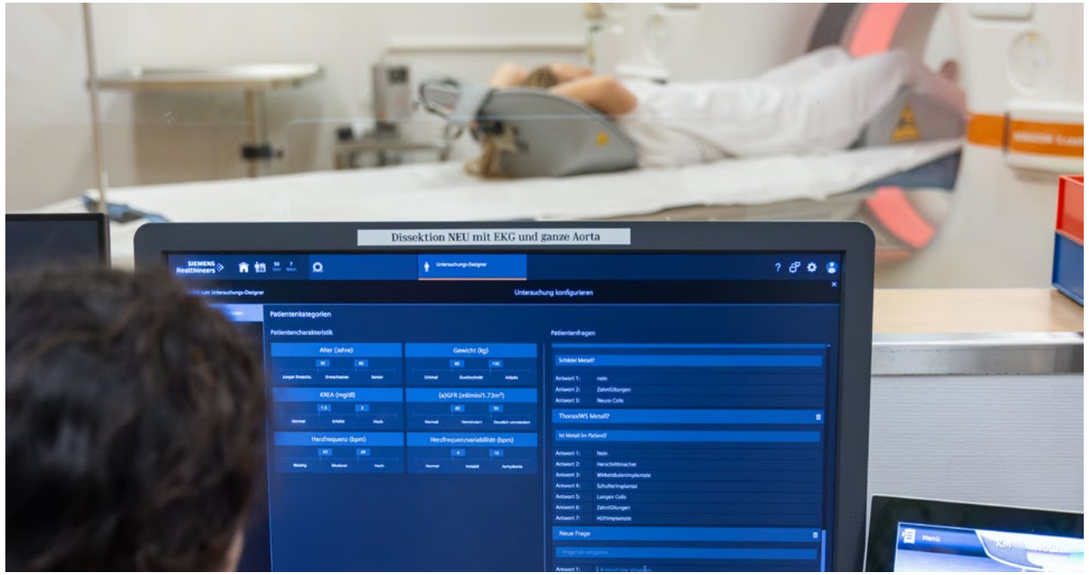


Figure 5: A user defining a site-specific strategy based on factory settings—teaching the scanner a desired strategy for optimal protocol selection and scan settings. With myExam Cockpit, guiding questions in the native tongue of specific institutions can be set.

myExam Companion at a glance

Real-time protocol guidance: The system helps technologists select the most appropriate scanning protocols based on the patient's clinical condition and the desired image parameters. This ensures consistency and standardization in image acquisition.

Patient-centric imaging: myExam Companion takes patient-specific factors into account, such as physical attributes and anatomy, to optimize image quality while reducing radiation exposure.

Workflow optimization: By automating routine tasks, such as positioning instructions and image acquisition parameters, myExam Companion allows technologists to focus on patient care and critical decision-making.

Quality control: The algorithm monitors image quality, flagging potential issues in real time and providing recommendations for corrective actions.

Benefits of myExam Companion

Improved consistency: One of the most significant advantages of myExam Companion is its ability to standardize imaging protocols across different technologists and facilities. This consistency ensures that the quality of diagnostic images remains high.

Enhanced efficiency: By streamlining the imaging process and reducing the need for manual adjustments, myExam Companion enables radiology technologists to complete exams faster and with greater confidence.

Improved technologists' satisfaction: The simplified and clear user interface, based on natural language and the ability to work with a remote tablet, enhances user experience.

Accuracy from the outset: With quality control and optimization, myExam Companion leads to consistent image quality, providing radiologists with more consistent information.

Putting myExam Companion to the test

In support of this white paper, researchers from Kantonsspital Baden in Switzerland conducted a series of measurements to assess the potential of myExam Companion. The research team consisted of 46 radiology technologists selected for their varying levels of expertise in the field.[10] The technologists were divided into two categories: experienced (31 users) and inexperienced (15 users). Experienced users had at least two years of experience in CT operation. Inexperienced users had less than one year of experience, very often working with other modalities.

For the purpose of this study, the SOMATOM X.ceed scanner equipped with myExam Companion from Siemens Healthineers was used for analysis and monitoring.

The study's approach was to generate quantitative measurements of different aspects of CT scanning that would be important for healthcare providers. Measurements were conducted in two distinct phases, in accordance with long-standing research methodology. First, a baseline was set with scans performed without the assistance of myExam Companion—in other words, using standard manual procedures and protocol selection, and with reconstruction preparations by technologists performing the examinations. The baseline having been set, myExam Companion was activated, aiding in the areas of scan preparation, acquisition, and reconstruction. This allowed for a comparison between results obtained during the traditional scanning process and results obtained with the new technology. Same operators, same institution, same workflows. This study was one of the first ever to focus on the influence of an intelligent workflow on everyday CT practice.

Time reduction

Yet another thing analyzed by the researchers was the influence of a myExam Companion-aided workflow on experienced users and inexperienced users. The first thing analyzed was the potential for time savings—something near and dear to the hearts of patients, technologists, and administrators alike. Researchers looked at the time necessary to perform individual scanning setup, as well as the effect of the acquisition and recon process on the overall time required to accomplish each examination.

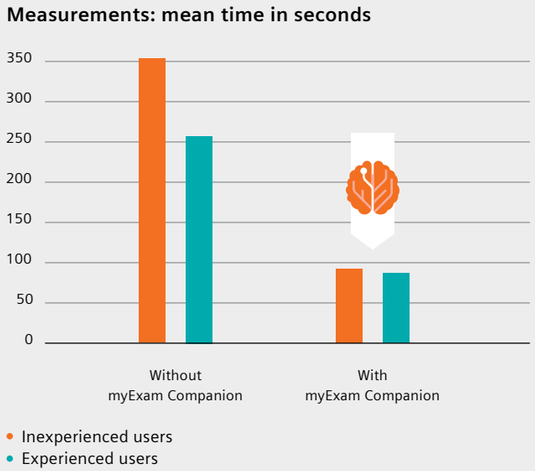


Figure 6: Results of time measurements for both baseline and myExam Companion measurements

The results in Figure 6 speak clearly to the time-saving potential of myExam Companion. The experienced user group saw a 66% reduction in time needed when using the myExam Companion workflow. For inexperienced users, the results were even more impressive. A time reduction of 74% was observed. One of the biggest time savings was observed in the cardiac workflow, with a 73% time saving due to intelligent workflow automation.

The study also looked at the distribution of time savings across different parts of the examination. What it found is that, excluding the recon process, intelligent workflow automation alone can save up to 40% of the time needed for the examination. An additional time saving of 26% can be achieved in automating the recon process.

Reduction in manual interaction
The second area analyzed was manual input, quantified by number of clicks (Figure 7). By counting the number of clicks required to perform certain tasks, the physical effort involved can be evaluated. Fewer clicks means less effort. Furthermore, to achieve fluency in performing a task, the human brain builds a model of the steps required to do that task. The fewer steps, or clicks, that are required, the faster certain processes can be mastered.[11] With decreased manual input, the whole process is less error-prone and more consistent across different users.

Once again, myExam Companion was compared to the baseline. And once again, as Figure 7 demonstrates, it brought about real improvement.

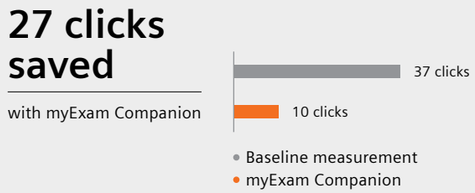


Figure 7: Results of click counts for both baseline and myExam Companion measurements

To perform a workflow without intelligent assistance, it took technologists an average of 37 clicks. With the support of myExam Companion, an average of only 10 clicks was necessary.

New staff learning curve
The study included technologists with varying levels of experience to investigate the learning curve and the time required to master the new scanner operations. It compared the influence of the intelligently aided workflow on experienced CT users with its effect on less experienced users who work with other modalities but occasionally perform CT scans.

The learning curve progress can be observed both through time measurements and the number of clicks. First, focusing on time measurements, the impact of myExam Companion is considerable. Experienced technologists took 257 seconds to perform a scan without the benefit of our new technology. With myExam Companion, experienced users took only 87 seconds.

Inexperienced users took 353 seconds for an examination without myExam Companion, but with the technology, that number dropped to an extraordinary 92 seconds—almost as fast as their more experienced colleagues. Not only the sheer time reduction requires consideration here, but also how close the times of examinations aided by the intelligent assistant were for experienced and inexperienced users.

Operator comfort

At the end of the day, time saved and clicks reduced can suggest that a technology might be preferable, but only operators can say for sure. Which is why the subjective opinion of the operators—how they felt about the technology they were using—was considered in the assessment. After each examination, technologists were asked to complete a questionnaire comprising of several questions, the two most important of which were:

- How would you rate the effectiveness of the application used for conducting the examination?
- Did you also use the Scan&GO tablet to conduct the examination?

Assessment of workflow effectiveness by CT operators

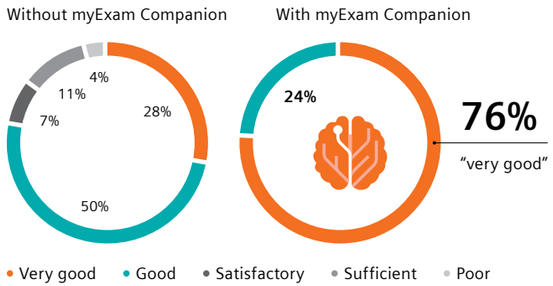


Figure 8: Workflow assessment by the operators for baseline and myExam Companion measurements

What the numbers in Figure 8 indicate is that CT operators respond very well indeed to a system that saves them time and effort. In the baseline measurement phase, only 28% of the users—13 technologists out of 46 participating in the study—described the workflow as very effective. With myExam Companion, that figure rose significantly, with 76% of the users 35 technologists) describing the workflow as very effective when working with the intelligent workflow aid.

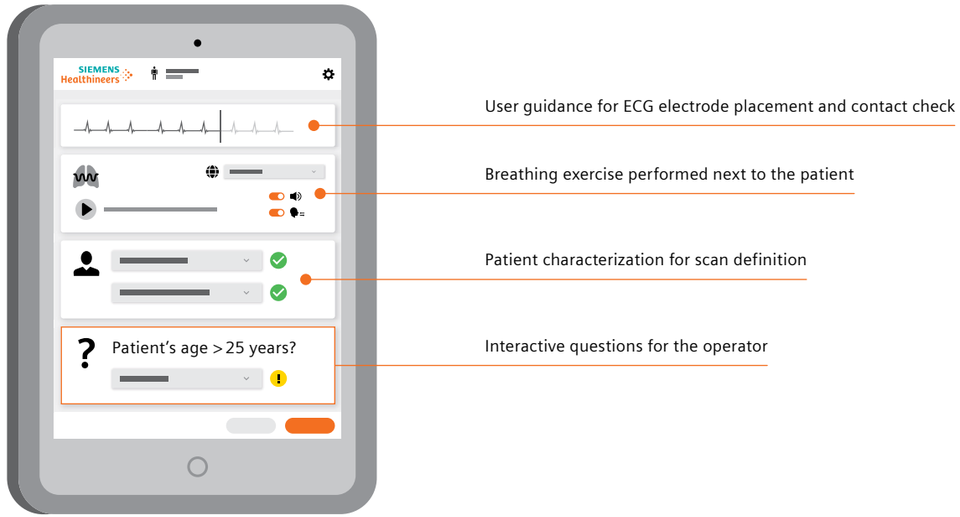


Figure 9: Example of a tablet user interface guided by myExam Companion. It can be used as a separate control device or in hybrid mode with a classic operator's console, where initial steps of scan preparation can be performed next to the patient in a more flexible manner and then continued at the console.

As an alternative to the traditional console in the control room, scanner operation is also possible from a tablet (Figure 9) with the simplified user interface—the Scan&GO application. Its wireless operation provides additional flexibility and allows the operator to stay closer to the patient. The utilization of this alternative Scan&GO workflow was also analyzed in this study. The mobile device utilization (Figure 10) also increases with the new system. In the baseline measurements, only 16 technologists used Scan&GO tablets in their workflow. With myExam Companion, 34 technologists used the tablets. That translates into an increase from 35% to 74% of technologists making use of tablets in their CT operation because of the myExam Companion workflow. This makes it much easier for technologists to be by the patients' side, taking care of them and answering their questions, with the subsequent potential effect on patient satisfaction and well-being.

Utilization of tablet

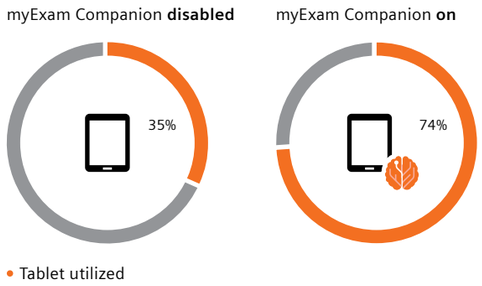
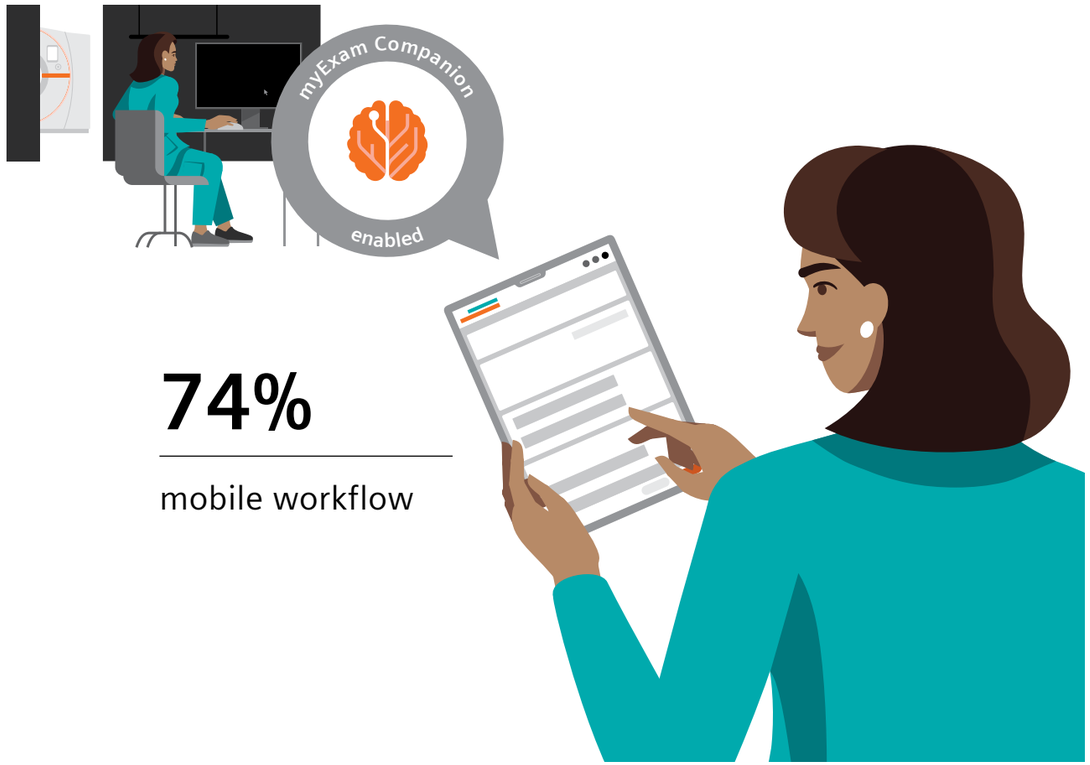


Figure 10: Utilization of mobile workflow, with tablet assessed by the operators, baseline and myExam Companion measurements



Conclusion

myExam Companion from Siemens Healthineers has the potential to revolutionize the field of radiology. Intelligent algorithms that help to avoid manual, repetitive workflow steps are now a reality. This is an intelligent scanning assistant that leverages its access to optimal scan mode and technology to easily help adapt the scanning process to the patient being scanned.

The numbers from the case study with Kantonsspital Baden in Switzerland speak for themselves: A 66% reduction in the time needed by experienced users, and a 74% reduction for inexperienced users. A 73% reduction in the number of clicks needed. Not to mention an almost 50% increase in the number of users declaring themselves satisfied with the efficiency of the process. Reduced complexity of workflow, reflected in time saved and a reduced number of clicks, is a huge benefit. In addition, replacing a bewildering number of possible protocols with intelligent guidance is helpful not only for users but also for healthcare providers seeking to standardized their processes.

myExam Companion was created through AI analysis of thousands of scans in order to optimize imaging protocols and workflow. This advanced algorithm is designed to increase efficiency in healthcare facilities. Intelligent workflow assistants like myExam Companion help to increase consistency in scan preparation, acquisition, and reconstruction—all while supporting scans that are tailored to the specific characteristics and the specific needs of the patient (e.g., breath-hold capability).

It is a classic win-win. Doctors can be confident that they are receiving optimal images. And from a C-level perspective, there is increased efficiency thanks to the speeding-up and simplifying of the workflow, which allows more patients to be scanned. And finally, every member of staff can operate the system with potentially less need for an extensive training.

Increased workflow efficiency, improved patient care: myExam Companion is leading the way to a brighter future for radiology.

About Kantonsspital Baden

Kantonsspital Baden (KSB) is the main healthcare hub in the east of Switzerland's Aargau region. The 400-bed hospital and its several satellite locations offer the area's approximately 350,000 residents excellent access to safe, cutting-edge healthcare close to home. To be able to offer high-quality medical care, it employs more than 2,000 staff members and currently has seven CT scanners from Siemens Healthineers in use at its locations. All seven are dual-energy scanners. KSB was a clinical use test site for the introduction of the SOMATOM X.ceed scanner. More than 100 technologists work in the radiology department. While the senior technologists are mainly employed at the main site, most users rotate between the different sites and sometimes between modalities. As KSB is a teaching hospital for technologists, the technologists' teams are generally made up of both experienced and less experienced users.

KSB has seen a huge increase in the number of examinations, which strongly implies that scanning processes need to be further optimized. The decision trees suggest KSB can achieve this by simplifying the examination through a better structure for the users.

KS_B Kantonsspital Baden Ort der Gesundheit

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References

1. Hsieh J, Flohr T. Computed tomography recent history and future perspectives. J Med Imaging (Bellingham). 2021;8(5):052109.
2. Manna C, Silva M, Cobelli R, Poggesi S, Rossi C, Sverzellati N. High-pitch dual-source CT angiography without ECG-gating for imaging the whole aorta: intraindividual comparison with standard pitch single-source technique without ECG gating. Diagn Interv Radiol. 017;23(4):293-299.
3. Lee S, Yoon SW, Yoo SM, Ji YG, Kim KA, Kim SH, et al. Comparison of image quality and radiation dose between combined automatic tube current modulation and fixed tube current technique in CT of abdomen and pelvis. Acta Radiol. 2011;52(10):1101-6.
4. World Health Organizaion. State of the world's nursing 2020: investing in education, jobs and leadership. 2020. who.int/publications/i/item/9789240003279 [accessed February 21, 2024].
5. Hojreh A, Homolka P, Gamper J, Unterhumer S, Kienzl-Palma D, Balassy C, et al. Automated tube voltage selection in pediatric non-contrast chest CT. PLoS One. 2018;13(10):e0204794.
6. Payne TH. Computer decision support systems. Chest. 2000;118(2 Suppl):47S-52S.
7. Royuela A, Abad C, Vicente A, Muriel A, Romera R, Fernandez-Felix BM, et al. Implementation of a Computerized Decision Support System for Computed Tomography Scan Requests for Nontraumatic Headache in the Emergency Department. J Emerg Med. 2019;57(6):780-790.
8. Daniel S, Kopp M, Vollbrecht T, Zeilinger M, Fitz T, Muttke A, et al. Personalization of thoracoabdominal CT examinations using scanner integrated clinical decision support systems—Impact on the acquisition technique, scan range, and reconstruction type. Eur J Radiol. 2023;167:111078.
9. Martens B, Hendriks BMF, Mihl C, Wildberger JE. Tailoring Contrast Media Protocols to Varying Tube Voltages in Vascular and Parenchymal CT Imaging: The 10-to-10 Rule. Invest Radiol. 2020;55(10):673-676.
10. Das A, Das O. User learning can affect software system's response time. Simul Model Pract Theory. 2022;115:102437.
11. Roldán-Álvarez D, Martín E, García-Herranz M, Haya PA. Mind the gap: Impact on learnability of user interface design of authoring tools for teachers. Int J Hum Comput Stud. 2016;94:18-34.

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