Standard Operating Procedures (SOP) for *syngo* Virtual Cockpit

A guideline to Remote Scanning
by Tomasz Bienias

SIEMENS Healthineers

What is *syngo* Virtual Cockpit about?

syngo Virtual Cockpit is a technical solution designed for performing MRI and CT examinations remotely, a concept we call "Remote Scanning". Alongside artificial intelligence, Remote Scanning is one of the leading, current innovations, especially in MRI.

Advantages of Remote Scanning

- Providing virtual access to exams, supporting radiographers and radiologists
- Serving as a plaform for learning and teaching trainees, mentors and research
- Allows users and their health care institutions to think about new ways of working
- And in the era of global warming, it enables radiology departments to work more energy-efficient

However, to understand exactly how Remote Scanning works and what opportunities it provides, it is necessary to properly manage its use and implementation to achieve the perfect start and ensure long-term use. But how can new users achieve this?

How can new users implement Remote Scanning and fully exhaust its possibilities?

This guide is intended to help your radiology department, your team and all of your colleagues to find the right way to start such a project and also to put your ideas on solid ground.

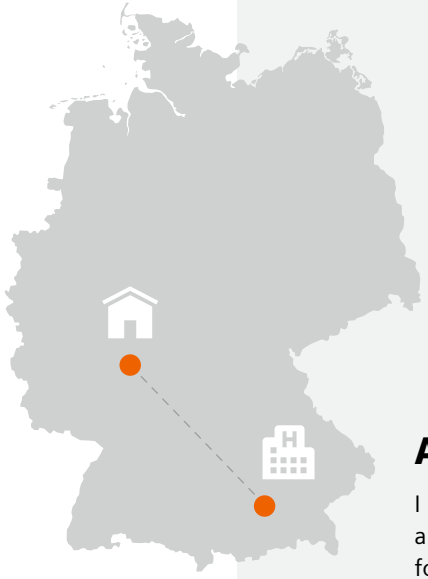
While Remote Scanning is possible with a variety of scanner types, always depending on the respective software, this guideline will focus on its use with MRI.

Introduction and background

Remote Scanning in magnetic resonance imaging (MRI) has gained more and more popularity worldwide after several radiology facilities have tested it for their own MRI fleets and operations [1, 2]. During and after Covid-19, a global wave of new ways of working, including working from home, have also found their place in the radiology healthcare community. Hence, the use of Remote Scanning in the routine has shown many innovative benefits for patients and radiologists.

However, as with many large projects, there are a number of challenges when introducing new products, particularly with IT-based systems in medicine. Nearly 70% of all healthcare IT-based projects fail and technological inventions in healthcare are said to have similar data [3, 4]. The list of reasons for this seems endless.

This guide aims to help and provide advice to understand what Remote Scanning is and how to use it, for those starting or planning remote operations, and for anyone who wants to ensure more stability for their radiology department. In the early days of Remote Scanning, some institutions created their own concepts and Standard Operating Procedures (SOP): "The Munich Standard of Remote Scanning" [5] of the LMU Hospital being one of the first in Europe. It is the goal of this guide to introduce its readers to this workflow supporting them in the creation of their own standards/workflows.



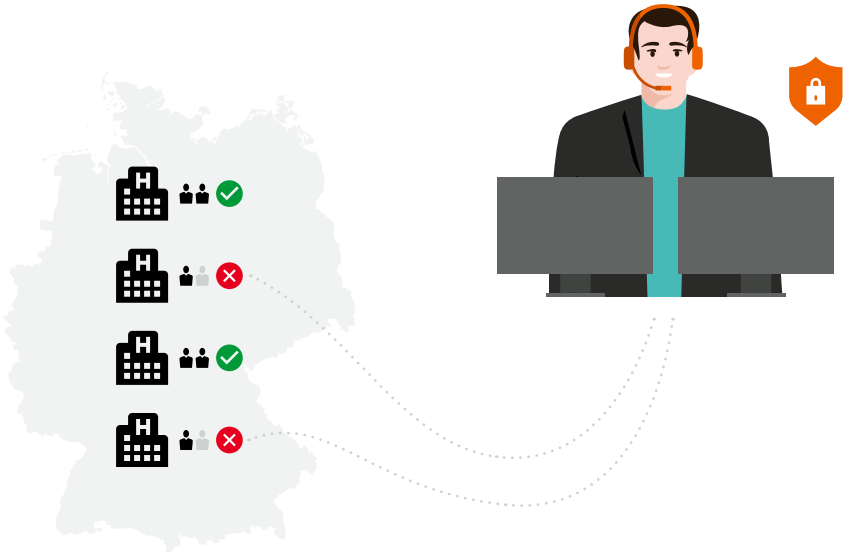
About me

I am Tomasz Bienias. I live in **Frankfurt,** and I am Head Radiological Technologist for Research and Education at *Ludwig Maximilians University Hospital* in **Munich.** For the past three years, I have been scanning remotely. Every day, I access our MRI scanners from a distance of around **350 kilometers –** just as if I were on site.

A global challenge: Staff shortages

Why are concepts such as Remote Scanning gaining more and more popularity?

Staff shortages in healthcare are a global challenge that greatly affect radiologies [6]. In Germany, for example, almost half of all healthcare institutions are unable to fully staff their radiographer teams [7]. Long-term, this can lead to burnt-out workers as they struggle to manage all workflows around the MRI with little support.



Needless to say, that safety issues can be a likely outcome. This is exactly where Remote Scanning software can positively impact the situation: Thanks to new processes, remote experts can support multiple modalities in different locations and thus drastically reduce bottlenecks. For example, in advanced routines, two radiographers operate one MRI scanner – in times of staff shortages the remote tech can support other modalities of the respective local patient managers and thus ensure no patient appointments need to be cancelled. Both do not experience any additional workload. This reduces stress and at the same time increases safety and quality.

A strong team: Remote experts and patient managers

Remote Scanning was developed to support MRI operators in their daily work.

With this approach, MRI workflows are redefined and clearly divided into two equal teams:

- the remote experts (who take care of scanning)
- the patient managers (who take care of the patient)

As stated before, it is essential to involve the users of the Remote Scanning software of your choice as early as possible to secure their "buy-in" to this new workflow and way of working. They might have further insightful recommendations, reservations or can point out potential problems in your plan.

With a Remote Scanning software, the location from which the scan is conducted, becomes almost irrelevant. Skilled radiographers can operate (multiple) machines from within the MRI-Bay, but also from separate rooms (something we call "remote cockpit" at LMU Munich). These innovative workstations are comparable to isolated surgery rooms, where the radiographer's full concentration is devoted to the patient. For us, this environment has led to a further increase in image quality, especially in complex examinations, such as Cardiac MRIs, as the remote experts are no longer disturbed by their usual routine environment, which can be quite interruptive. With increasing demand, initial successes have further shown that operations can also be expanded to a home office setup (which will be discussed in more detail below).

At the same time, the colleagues who act as patient managers demonstrate improved structuring in this system. During a scan, they have more time for their processes which results in a significant reduction in the workload and enables them to tackle their tasks conscientiously. Complex procedures are easier to prepare and implement. Documents, laboratory, questions, and consultations with patients can be taken care of in the best possible way, leading to optimal patient care even during shorter examination times.

Together, the Remote Expert and Patient Manager create an environment that promotes quality and safety in line with today's changes in MRI and also leads to greater patient and staff satisfaction.

The remote working stations

Remote Scanning is not a “plug-and-play” solution. Like other important innovations, it needs standards in terms of using in routine medical practice. As described above, remote centers can be in separate rooms, next to the MRI scanners or can even be situated on an entirely different floor of the healthcare institution. Most radiology departments have special architectural conditions due to strict safety regulations for MRI and X-ray modalities.

By being able to work outside of these areas, hospitals can create new environments for a healthier workplace, allowing radiographers to work in rooms with windows. Letting in daylight has created a completely new and better working environment for our team. Each radiology department can create such unique spaces and establish itself in a completely new way compared to other medical specialties. How to set up such a center has no limits – so to say, you are the king or queen of your own “remote castle and kingdom”.

Where to start

The beauty of Remote Scanning lies in its flexibility, as each workflow can be unique. However, that also means that all stakeholders – from radiologists to tech assistants – should be involved in the planning of this new way of working to ensure that everyone is on board right from the start.

What to consider

If considering Remote Scanning, it is advisable to promptly inform and involve your IT department, as well as IT representatives from any collaborating hospitals that will be engaged in your remote operations. This is necessary as every digital infrastructure is unique and different institutions may have different IT-security requirements. You should also check whether modalities from other manufacturers can be connected, as these may need additional configuration. If the prerequisites and local data protection laws are provided, you can plan the next step.

The technical components required for Remote Scanning are intended for professional use. Siemens Healthineers' Remote Scanning software *syngo* Virtual Cockpit is enabling remote experts to manage up to three MRI modalities simultaneously. It is essential that each remote workstation is equipped with three monitors. Two screens are part of the scanning interface and the third one displays programs such as PACS or patient data to provide more useful information regarding the next examinations.

In addition, height-adjustable desks prevent typical office discomfort when working all day. Sufficient light and eye breaks during patient changes in the scanners make remoting easier. A "night mode/ blue filter option" is also recommended for longer periods of work.

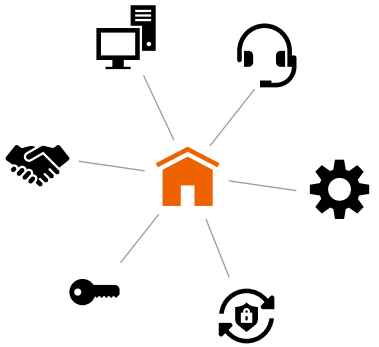
To stay in contact with patient managers or physicians at the MRI modalities, remote experts can use both, the chat as well as the calling functionality, for which we recommend a wireless headset. Alternatively, a classic telephone station can be used. All these features are particularly helpful for consultations regarding difficult examinations or questions about patients implants.

Home office standards

If remote scanning is planned in a home office set-up, it is necessary to use the same equipment as described above. Although laptops allow more flexibility, they are unsuitable in the long term. Multiple and large screens with correct pixel solutions are needed, especially for multimodal operations. If possible, remote experts should have a dedicated room or office for their work. This ensures hardware and data protection from other occupants. Locking the door after work is also recommended. Another important aspect is to opt for an Ethernet cable instead of wireless LAN connections, since it provides enhanced security and improved data transfer speeds. In addition, you should inform your internet provider that you are managing medical equipment and patient care in your home office. They can help if necessary and give you important advice in the event of malfunctions. Another good software solution is to use a virtual private network (VPN) or virtual desktop infrastructure (VDI) that works with your hospital's server structures. If these are available, Remote Scanning should be based on them. A VDI in particular has proven itself in terms of flexibility and security, even with lower end user hardware and data transfer.

If the remote technician needs to use a laptop on a wireless network temporarily, they should be mindful of their data security. We recommend avoiding public places and not performing remote activities in restaurants or cafés. It makes sense to use Wi-Fi with a bandwidth of below 5 GHz. As a rule, hospitals, police, and ambulances operate by radar on these frequencies and have privileges and could destabilize your home network if spaces are needed in this frequency range [8].

Many factors should definitely be clearly defined in the employee's contract and possible home office agreement. This protects employees and employers. Thanks to advancements in digitalization, many companies have started to implement agreements in recent years regarding insurance, software, and hardware provisions for remote work or working outside the office. Many large hospitals now also have similar regulations for IT specialists, as the Covid-19 pandemic has forced them to avoid working on site. Such documents can be used or extended for Remote Scanning purposes outside the department and support a hassle-free start.



The Patient Managers

In today's world, everything is becoming faster, including MRI. Today's MRI scans can reduce examination times by up to 70% thanks to the use of AI [9]. Access to MRI for patients with implants has improved significantly, as an increasing number of devices can detect advanced MR conditions. Additionally, the growing demand for MRI examinations is driven by their exceptional diagnostic capabilities. Overall, this represents a significant advancement, but it also introduces numerous new challenges. Professional preparation for these situations is essential. Colleagues in the role of on-site patient manager bear full responsibility for the patient at all times and handle all traditional responsibilities of a radiographer on-site, except for scanning.

Some of these tasks include:

- Checking with patient regarding implants and reviewing signed medical information sheet (check-list)
- Preparing and positioning the patient in the scanner
- Staying in contact while patients are in scanner
- Checking patient lab results
- Injection of contrast media (in case where needed)
- Preparing patient documents while the scan is taken care of by the remote tech
- They are in direct contact with the next patient, preparing them and answering questions
- Intervening in case of emergencies
- They are responsible for all needed MRI/CT equipment (such as coil systems, cushions and more)

This SOP has resulted in a clearer, even safer, and more comprehensive patient care in comparison to before. This is simply because the patient manager has more time and a better overview of what is happening on site in order to solve problems and conflicts while the remote tech's full focus is on the quality of the scan.

Radiographers who particularly enjoy working with patients, might prefer the patient manager role at times. Young and less experienced radiographers can greatly benefit from working directly with patients when they first join a new organization. This experience enables them to develop a deeper understanding of patient safety, complex implant situations, and familiarize themselves with MRI hardware, such as coil systems, early in their careers. Additionally, they are always connected to a more experienced colleague through the Remote Scanning software, who can provide support if, for example, they encounter a scan with which they are unfamiliar. In some countries, there are only few restrictions regarding who can take on the role of a patient manager. The main prerequisites include certain trainings in basic medical knowledge as well as in-depth training in MRI and MRI safety. This regulation allows healthcare providers to specifically train new hires, nurses, or paramedics for this. Colleagues in these positions have made excellent contributions during radiographer shortages, leveraging their specialized medical knowledge. However, it is important ro recognize that different countries may have varying rules and regulations regarding MRI personnel. Anyone interested in adopting Remote Scanning should be encouraged to do extensive research into the laws and guidance of local governing authorities. When in doubt, it does make sense to start remote operations using junior radiographers or new hires, who have already completed their radiographer training, as patient managers. This also allows more autonomy in their new position, since they are always connected to a more experienced colleague through the Remote Scanning in case they encounter a scan which they lack experience with.

Remote Tech and Patient Manager: Hand in hand

It has proven to be very important to ensure remote experts stay in touch with local teams. Working with remote experts unfamiliar with the on-site patient managers has shown reduced project stability, as each clinic follows its own standards and employs distinct MRI protocols with tailored solutions. One of the key factors in the success of a Remote Scanning project is maintaining the human aspect. Remote experts, patient managers, and physicians must work together and in tune. Regular meetings and trainings of remote operators and patient managers ensure better teamwork and more qualitative diagnostics. Once or twice a year has proven to be a good standard. It is essential for remote experts to comprehend and be aware of the local conditions of each MRI, including all associated methods.

The human factor – the key to stability and success.

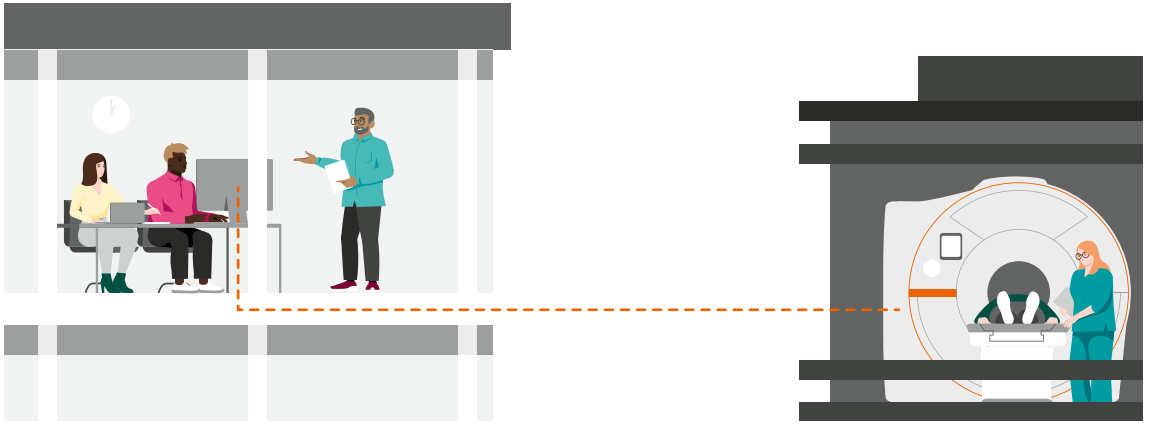
The same applies to local staff. Working with Remote Scanning should be familiar, since the staff might be apprehensive towards working with strangers. Corresponding results show a lot of delays and failures in the workflow because there is a lack of trust. If possible, remote techs and patient managers should have the option to switch roles occasionally.

Education in MRI through Remote Scanning & research

Opportunities for learning, stimuli for research

The radiographers of tomorrow have to master a variety of highly complex medical imaging techniques, both in theory and practice. The knowledge that trainees gain during their education and at training centers combined with further practical learning and training through Remote Scanning offers many advantages and can significantly enhance their skills. Students can learn more about demanding complex examinations, such as Cardiac MRI or various pathological cases, while being supported by a more experienced MRI colleague. In the future, it could even be possible to connect radiographer schools to local Remote Scanning installations, allowing students to observe and practice live scans at the hospital as part of their curriculum without requiring travel to the hospital site. Although this can not substitute for on-site training, it should be considered as beneficial addition to their education.

The routine has shown that radiographers working remotely have greater opportunities to address complex issues and acquire in-depth knowledge of MRI physics. This allows more professional research if accepted by the ethical and medical commitee. Remote techs have more opportunities for their own project management and through the exchange with local patient managers, direct feedback and joint brainstorming leads to better implementation and thus to better and higher quality results.



In case of a blackout

If you scan from home, it is also necessary to develop contingency plans in case the data line or power is suddenly interrupted for an extended time. Teams should agree on code words such as “flying without pilots” or “remote is off” to be able to react quickly. In radiology departments utilizing remote scanning, other remote technicians can cover the situation until the connection has stabilized again. It has also proven effective in case of internet outages to inform the provider that you are working in a “critical infrastructure” when scanning remotely for a hospital. This requires the provider to prioritize restoring the connection [10, 11, 12]. As a result, Remote Scanning users can receive enhanced support during connectivity failures. It is also very important to know for how long the network provider is legally allowed to interrupt internet connectivity for any given user. In Germany normal contracts allow an interruption for no more than 24 hours [13]. Additionally, after 48 hours, the provider needs to offer users an alternative internet connection (for example through mobile data) as well as retribution. Due to longer distances, if the MRI Systems for remote techs are not reachable in times of longer failures, an alternative workplace with a stable internet connection should be considered, especially in VDI use cases.

Sustainability through Remote Scanning

Even in a connected world like ours, access to care and quality MRI exams is still a challenge for many patients. In addition to long waiting times, patients sometimes have to travel large distances to specific health care centers in other cities or even other countries. This leads to high CO_2 emissions. By following this guideline, it is possible to reduce or even avoid these burdens on patients and the planet.

Furthermore, experienced remote techs working from home or a central location can use their knowledge of MRI techniques to support patient managers in smaller hospitals without having to travel long distances by car. This not only helps seriously ill patients in other areas but also contributes to a reduction in greenhouse emissions by creating new opportunities for renewable energy initiatives in radiology.

Remote techs consume additional energy when working from home – but there are ways to offset this. In Germany, for example, the government has reached an agreement this year to support the purchase of balcony power plants for renewable energy [14]. Many local politicians are also providing financial support for these projects and new laws will be passed in Germany over the next few years. This makes it appealing for home office techs to also invest in technologies like this. On the one hand side, they can generate the energy they are consuming and at the same time, lower their costs. The initial results of this promising renewable opportunity have made a huge positive impact in our own remote project. This approach can reduce the high energy costs at home as well as the problems caused by global warming if many more remote workers decide for this as well.

Conclusion

In times of staff shortages, high demand, and more complex conditional implants in MRI, new workflow strategies are needed. Remote Scanning as a digital base combined with team collaboration is a fabulous concept that can help in MRI routine scanning, education, as well as training, and research.

Establishing workflow concepts that include physicians, radiographers, and IT staff offer many opportunities regarding new work, flexibility, and improving MRI knowledge for radiographers. To implement this strategy as a longtime solution, a professional standard in every MRI department like this SOP is highly recommended. Additionally, more experienced remote operators are able to support younger team members during complex MRI scans and are able to compensate in times of staff shortage. Furthermore, the image quality can be improved through an increased degree of concentration of remote radiographers. Patient safety can be enhanced, since local patient managers can focus on these aspects without having to worry about scanning. Remote cockpit centers and home office workstations should be set-up with same quality equipment and hardware leading to attractive job opportunities and a revitalized working environment for many MRI departments in the healthcare sector. Regularly meetings and training events between home-office techs and local teams can help maintain a professional routine. Since Remote Scanning reduces the technologists' commutes and patients' travel to hospitals, Remote Scanning arguably has a sustainable impact. Adding a balcony power plant can also reduce energy costs in home-office remote operations and remote cockpit stations. Ultimately Remote Scanning not only facilitates knowledge sharing and enhances training for emerging radiographers but also has the potential to make education in this field more appealing, inspiring a new generation to pursue in radiography.

syngo Virtual Cockpit is not commercially available in all countries. Future availability cannot be guaranteed.

Technical and organizational preconditions need to be ensured before using *syngo* Virtual Cockpit.

Please contact your local Siemens Healthineers organization for further details.

The results by Siemens Healthineers' customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), it cannot be guaranteed that other customers will achieve the same results.

The author of this white paper is Tomasz Bienias, Head Radiological Technologist for Research and Education at Ludwig Maximilians University Hospital in Munich.

Siemens Healthineers Headquarters
Siemens Healthineers AG
Siemensstr. 3
91301 Forchheim, Germany
Phone: +49 9191 180
siemens-healthineers.com

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