Enabling Timely Access to Medical Images and Information for Better Patient Treatment

Interviewees:	Andreas Nuener,[1] Christian Stark,[1] Astrid Grams[2] 1. Tirol Kliniken GmbH, Innsbruck, Austria 2. Medical University of Innsbruck, Austria

Disclosure:	Nuener and Stark have declared no further conflicts of interest. Grams is an external consultant at the imaging core lab Eppdata GmbH, Hamburg, Germany.
Acknowledgements:	Writing assistance was provided by Eleanor Roberts, Beeline Science Communications, Ltd, London, UK.
Disclaimer:	The opinions expressed in this article belong solely to the named interviewees.
Support:	The publication of this article was sponsored by Siemens Healthineers.
Keywords:	Access to care, care collaboration, connected care, data sharing, electronic health records, health information exchange, healthcare technology, interoperability, medical imaging, remote system.
Citation:	EMJ Radiol. 2023;4[Suppl 1]:2-7. DOI/10.33590/emjradiol/10301931. https://doi.org/10.33590/emjradiol/10301931.

Interview Summary

Medical images have progressed from X-rays on film to digital capture. Sharing images to departments and hospitals remotely from the place of capture has, over the years, been via description only, through an image print-out or by 'burning' them onto a compact disk (CD) or digital versatile disc (DVD). More recently, Internet-linked point-to-point virtual private networks (VPN) mean that departments and hospitals that have access to such systems can request and send images via these links. Cloud-based systems have been replacing these in some institutions, with images held both locally and uploaded to a remote centre. An update to these systems is being trialled in Austria by Andreas Nuener and Christian Stark, based at the University Hospital, Innsbruck, who here discuss the development of such. Utilising a Siemens Healthineers (Erlanger, Germany) eHealth Solutions technology platform, they are planning the automatic registration (provision) of clinical images, such as from sonography, computed radiography, MRI, or CT, in Austria's nationwide electronic health record (EHR) system, Elektronische Gesundheitsakte (ELGA). A small trial of this system demonstrated that any eligible healthcare professional who needs access to the images can do so instantly. Astrid Grams, Medical University of Innsbruck, Austria, illustrated the use of this system via the case scenario of a patient who has had an ischaemic stroke and is being treated at a remote hospital, with the treating physician querying whether or not they need to be transferred to the University Hospital, Innsbruck, for more specialist treatment.

INTRODUCTION

When first developed, a medical image, such as an X-ray, was displayed on film. From the late 1990s, this was superseded by digital capture with images arising from, for example, positron emission tomography, magnetic resonance scanning, ultrasound, or CT, and stored on a radiology department's picture archiving and communication system (PACS). However, to be seen in a department or hospital remote from where they were captured, the image would most often need to be copied to a CD or DVD, and though useful, these could be lost, damaged, or unreadable by another system.[1]

To overcome such problems, sharing images via a point-to-point VPN has been increasingly used over recent years. The limitations of such a system are that image sharing is not necessarily automatic, with the image having to be requested, sent, received, and loaded into another system by the interested party. In some cases, this has been replaced by cloud-based applications, where anyone with an appropriate login can access information using a specific gateway device once an image is uploaded into the cloud.[1]

Medical image sharing is important as, according to a 2016 UK Royal College of Radiologists (RCR) survey report, not having external images and reports available can affect a physician's efficiency, productivity, and quality. Survey participants reported that lack of access to images and reports meant not having complete information about a patient, and work, including medical examinations, procedures, and scans, having to be duplicated.[2] The latter can be costly, both in terms of money and time, as well as lead to repeat exposure to radiation for patients, depending on imaging type.[3] As such, sharing medical images between institutions is recommended, with trials of such over the past decade showing how this can reduce the level of repeat imaging.[1,4-6]

EMJ discussed with Christian Stark, Project Manager for Clinical Information Systems, eHealth and for the implementation of ELGA in the public hospitals of Tyrol, Austria, and Andreas Nuener, Team Leader for the Imaging and Special Systems Group, University Hospital, Innsbruck, a system that is set to aid easy sharing of medical images among healthcare professionals in Austria. They are currently implementing the integration of medical images into ELGA, making it simple and quick to share and view images around the country. Astrid Grams, Deputy Head of the Department of Neuroradiology, Medical University of Innsbruck, helped to illustrate the utility of such a system by discussing how it is being used in stroke care.

PLANNING AND IMPLEMENTING AN INFRASTRUCTURE FOR ACCESSING AND EXCHANGING IMAGES AND MEDICAL DATA

Andreas Nuener and Christian Stark

Traditionally, Nuener discussed, image sharing among Austrian hospitals was via CD/DVD; however, the handling costs of burning CDs/DVDs and then transporting and reading them is high, and nowadays, fewer computers have built in CD/DVD burners and readers. As such, Nuener mentioned, both CD/DVD and VPN technology is "more or less at the end of their usefulness, and we will shut it down in the near future."

In Austria, patient health data and reports, along with medication and immunisation records, are held in their eHealth Solutions EHR system, ELGA. Started in 2015, this Austria-wide information system enables eligible users to access healthcare information across institutions, including hospitals, clinics, and primary care providers.[7] ELGA, which has separate portals for healthcare professionals and patients,[7] is based on the Integrating the Healthcare Enterprise (IHE) system, a worldwide initiative to improve interoperability.[8] Stark and Nuener have been working with a Siemens Healthineers eHealth Solutions technology platform towards the goal of automatically integrating imaging data to ELGA, so that medical images are available to whoever has permission to access them (e.g., hospitals and radiology departments). The IHE platform was developed in Innsbruck by ITH icoserve (Innsbruck, Austria), a joint venture between Siemens Healthineers and Tirol Kliniken GmbH (Innsbruck, Austria), an operating company of regional hospitals in the Austrian state of Tyrol.[9]

With the Siemens Healthineers eHealth Solutions platform, the radiographic image can be

streamed or downloaded, but remains within the information technology infrastructure of the radiology department where it was first acquired. "There's no global or central database and no central data archive or repository," explained Nuener.

"The only thing that will be registered," discussed Stark, "is the key object structure link that indicates that an image is available. If you click on that, then the image will be 'fetched' directly out of the local imaging archive and streamed to the recipient." What they are now working toward, Stark explained, "is to officially register images from hospital PACS and make them available to anyone who has access to ELGA." Once the system is in place, this will be done automatically whenever a scan is taken, so anyone with ELGA access can instantly view an image wherever they are.

As discussed previously, current VPN systems need for an image to be requested and sent manually.[1] With the Siemens Healthineers eHealth Solutions infrastructure and ELGA, the image can be accessed wherever and whenever needed, as opposed to it having to be requested from the source. This, according to Nuener, is about switching from a 'push' to a 'pull' strategy. This is similar to the Cross-Enterprise Document Sharing for Imaging (XDS-I; Philips, Amsterdam, the Netherlands) system that works within IHE, where details of images shared between linked hospitals are held in a central cross-enterprise document sharing repository with a copy of the image also held where it was created.[1] However, such systems only work between linked hospitals; the difference with eHealth Solutions from Siemens Healthineers is that by linking to ELGA, it will be available wherever someone uses ELGA and beyond tertiary care into primary care.

To test how such a system would best work, Nuener recounted how they first needed to analyse workflows to understand why and how data, in the form of digital imaging and communications in medicine images, should be transferred between the Medical University of Innsbruck and a partner. For this, they constructed two scenarios between the Medical University and the District Hospital of Kufstein, Tyrol, Austria, which are approximately 74 km apart. In the first scenario, a patient who had a stroke had a CT of the brain at the District Hospital was then transferred to Innsbruck. With their system, Nuener explained: "While the patient is on their way, images can be viewed, and the physicians can make up their mind and make treatment decisions before the patient has arrived. This saves a lot of time as, when you have a stroke, time is everything." The second scenario was if a patient was treated at the Medical University of Innsbruck, but they needed aftercare at the District Hospital of Kufstein. Similar to the above, the imaging data from the Medical University can be easily accessed by the District Hospital, so they can compare the patient's progress over time.

POTENTIAL DIFFICULTIES WITH AN ELEKTRONISCHE GESUNDHEITSAKTE-LINKED SYSTEM OVERCOME

Andreas Nuener and Christian Stark

Nuener and Stark's study proved that the two case scenarios discussed above can work as planned, so they are now focusing on implementing this regionally, and then nationwide. However, there are some obstacles to overcome. "First," said Nuener, "each department has its own portal, everybody does their own thing, and nobody is thinking we can do it together. We have to get rid of the diversity of image portals." This means connecting all radiology departments in all hospitals and clinics with the same image portal. This should not, explained Stark, be a problem, as ELGA is already in place in Austria.[7] There may be concerns that, with such a system, radiology departments would need to change imaging modalities and even machines so that information can be easily exchanged; however, Stark explained, linking with ELGA will eliminate this potential concern. "The modalities can remain as they are as, when the image is being created, there is a process to register the key object structure objects for ELGA behind that, so you do not have to exchange anything from the imaging equipment; it is just another layer above it."

When a medical image is taken, it is registered to the patient; however, a potential problem that could arise with image sharing is that images are assigned to the wrong patient.[1] Nuener discussed that difficulties in this realm may occur, especially as a patient's identification number

can be different in their local facility than at, for example, the Medical University of Innsbruck. Currently, with the VPN network, all patient records need to be examined and linked by hand, but with the Siemens Healthineers eHealth Solutions platform and ELGA, Nuener described how once an image is taken and registered, such mapping is automatically created within the system so the image is linked to the right patient records. This happens as each patient has one 'Central Patient-ID' within ELGA.[7] "The Siemens Healthineers eHealth Solutions platform," Nuener explained, "compares first name, last name, data of birth, and gender of the patient. The matching criteria are weighted, and if there is a strong matching indication that these 'two' patients in the different hospitals are the same person, then the data are automatically assigned to the correct person. If it is not clear, then [the platform] will provide the data to an administrator, and they can manually assign the correct patient in the receiving system."

THE ROADMAP TO ADVANCE IMAGE EXCHANGE AND THE END GOAL

Andreas Nuener and Christian Stark

At the moment, the above-discussed prototypes of the image exchange system are running in Vienna and eastern Austria between a limited number of organisations, but plans are underway to roll it out across Austria. "The first step," said Stark, "is to make sure the main hospitals and providers are connected with the bandwidth and network connectivity that is sufficient to cope with this system." Next, images from point-to-point VPN systems must be transferred using the eHealth Solutions platform. They will then be registered for ELGA and made available to anyone who needs them and has access to ELGA. These parts of the project, the network infrastructure, and registered images should be completed by the end of 2023 or start of 2024.

"We think that if we, as a big player in Tyrol, start," said Nuener, "and we provide the image data in ELGA, then the smaller hospitals and radiology departments join the plan, and then it keeps moving on. We can achieve our goal that every radiology department and hospital is connected and exchanging imaging data in the next few years." Stark discussed, though, that being a part of the Siemens Healthineers eHealth Solutions platform is an investment. "Somebody has to establish or build up the network connectivity so that images can be transferred in a timely manner. Somebody has to pay for that initial investment, and also for the enduring operating costs. Part of the project, namely the central components, are being financed by the government, by Austrian healthcare insurance, and by the federal states, but our own investment is undertaken by ourselves to connect images to ELGA."

Nuener also discussed how, in the future, "we should think about exchanging healthcare information and images across borders in Europe. In some years, if everybody is using compatible EHR profiles, then it should be possible to connect every department in every hospital in every part of the world, so we can get better exchange and a better connectivity between all of the hospitals."

"Think about a patient from Great Britain or from Germany that has a ski accident," posited Stark. "They have been treated here in Medical University of Innsbruck, undergone surgery, and when they go home, their physicians can access the images via ELGA and the web. That is the big advantage."

CASE SCENARIO: ISCHAEMIC STROKE IN A REMOTE HOSPITAL

Astrid Grams

"The main challenge in stroke," said Grams, "is that it is extremely important to be time efficient and fast when assessing and treating patients." At the Medical University of Innsbruck, there is a dedicated telephone service for stroke emergencies. "There is a radiologist in charge here at the hospital, but it is normally not somebody who is also doing the thrombectomy; that is only a handful of us, and we are mostly at home, during the evenings or weekends, for example, and either the neurologist or our radiologists in charge calls us, informing us about the case."

"Ten–15 years ago," continued Grams, "a remote hospital would make the diagnosis of, for example, stroke with a vessel occlusion, and then the physician in charge would call and

describe the images." The problem here, Grams explained, was that "you did not know how good this person was in image interpretation, and you had to believe, for instance, there is a large vessel occlusion, or there is no haemorrhage, or there is no large infarct already present." Based on this description only, Grams and their team would need to decide whether the patient should be transferred or not, and whether they needed mechanical thrombectomy provided at the Medical University of Innsbruck. "I think some unnecessary transfers occurred," said Grams, "because you cannot be sure about everything. You tended to say, okay, send the patient and then I can have a look; and maybe [there are] patients that we nowadays would not take in because it is not necessary. They would have come here for a more detailed evaluation, and then we would decide there is nothing for us to do." This scenario is reflected in a study from the USA showing that, in cases of patients with a head trauma, when physicians at a specialist hospital could review images while the patient was still in their local hospital and provide input into their care, patient transfers were reduced by 44%, and if the patient remained at their local hospital, management was changed in 44% of patients.[10]

Grams also recalled how, even once transferred, "if you got the CT only when the patient arrived, then you had to have a look at the CT when the patient was already on the table, and you still had to think about 'What is that exactly?', 'What do I have to do?', and 'How do I get there?'." Additionally, Grams described how there would be times when "it was not even possible for some people to burn the images onto a CD, or they had to print the images, or sometimes you did not even get any images, just a patient. Then you had to do another imaging run here in the hospital, so everything was more time-consuming." This is supported by a study involving injured patients being transferred to a trauma centre, which showed that repeat imaging led to longer decision times with regard to treatment.[11] This can also be costly in terms of financing repeat medical imaging and patient safety.[3,12]

"Now, if the patient is in a remote hospital and imaging is performed, and it is clear they need some further help," explained Grams, "the images are directly sent to us, so when the referring physician calls you can have a look at the images and discuss the patient. Everything got faster, and you can just say yes, the patient has to come or no, the patient does not have to come; or, if it is more complicated, you can discuss it internally with neurologists and other specialists and have a decision quickly." Grams also discussed how they can even access this system from their home when they are on call.

A big advantage of being able to see images and medical information prior to the patient arriving, discussed Grams, is that "you can directly organise your team and can think about what kind of intervention you will do. You have all that preparation for the patient already done, so everything is much, much faster. Aftercare is also much more efficient, and there is a lot more documentation from us and all the referring physicians and general practitioners. Previously, if you had to give a second opinion on something, somebody called you, you gave your opinion, and it was never documented. Now we document everything, and it is in ELGA, and every physician can easily have a look at it, so we have fewer telephone calls [and no more] asking or having to repeat the same things 10 times."

As well as making these rapid treatment decisions, Grams discussed how the Medical University of Innsbruck also offers a service whereby remote hospital physicians can ask for a second opinion about less urgent patients. "Specialists from other hospitals can send the images first, and then they call or write an email and ask if we can talk about the patient, and I can either have a look directly, or reply to the email, or call back. For non-emergency cases, they just would not have asked some years ago, so it is also better for the patients because they have more specialised opinions and information." Prior to this, Grams explained how, "for physicians in remote hospitals, it was more difficult, because they were not so aware of all the possibilities. It was a complicated procedure to even present a patient to us, so maybe some of the patients that are now introduced to us, they would not have been introduced, or the referring physicians did not even know that it is possible." Another scenario Grams described, both for urgent and less urgent patients, was when "the referring physicians did not think it was unclear; they just did not call us, so the patients had their fate decided without our opinion."

CONCLUSION

By linking image sharing systems, such as the eHealth Solutions platform and infrastructure from Siemens Healthineers, to nationwide EHRs, such as ELGA in Austria, registering and accessing medical images becomes automatic, removing the need for outdated CDs/DVDs, incompatible VPNs, and software systems where data is duplicated or where errors can occur. Immediate, easily accessible medical image sharing, as evidenced here in the case of stroke, means that a patient's images can be assessed by more specialist physicians at centres remote from where they originated. Patients are also able to receive extended specialist care that is not necessarily available locally. This can lead to rapid treatment decisions by experts in the field, including whether to transfer a patient for more specialist treatment, or the expert being able to advise a physician on alternative treatment plans for patients being managed locally.

References

1. Vreeland A et al. Considerations for exchanging and sharing medical images for improved collaboration and patient care: HIMSS-SIIM Collaborative white paper. J Digit Imaging. 2016;29(5):547-58.
2. The Royal College of Radiologists (RCR). It's good to share: medical image and report exchange between UK health service providers. 2016. Available at: https://www.rcr.ac.uk/system/files/rcr2016_image_sharing.pdf. Last accessed: 3 July 2023.
3. Timpone VM et al. Redundant imaging in transient ischemic attack: evidence from the nationwide emergency department sample. J Am Coll Radiol. 2021;18(11):1525-31.
4. Vest JR et al. Health information exchange and the frequency of repeat medical imaging. Am J Manag Care. 2014;20(11 Spec No. 17):eSP16-24.
5. Lu MT et al. Reducing the rate of repeat imaging: import of outside images to PACS. AJR Am J Roentgenol. 2012;198(3):628-34.
6. Flanagan PT et al. Using the Internet for image transfer in a regional trauma network: effect on CT repeat rate, cost, and radiation exposure. J Am Coll Radiol. 2012;9(9):648-56.
7. Elektronische Gesundheitsakte (ELGA). About. Available at: https://www.elga.gv.at/en/about/. Last accessed: 3 July 2023.
8. IHE International. Integrating the Healthcare Enterprise. Available at: https://www.ihe.net/. Last accessed: 3 July 2023.
9. Tirol Kliniken. Homepage. Available at: https://www.tirol-kliniken.at/page.cfm?vpath=index. Last accessed: 3 July 2023.
10. Moya M et al. The impact of a telehealth web-based solution on neurosurgery triage and consultation. Telemed J E Health. 2010;16(9):945-9.
11. Emick DM et al. Repeat imaging in trauma transfers: a retrospective analysis of computed tomography scans repeated upon arrival to a Level I trauma center. J Trauma Acute Care Surg. 2012;72(5):1255-62.
12. Christensen EW et al. Drivers of ischemic stroke hospital cost trends among older adults in the United States. J Am Coll Radiol. 2023;20(4):411-21.