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Contents

DISCLOSURE OF CONFLICT OF INTEREST:
The supplement includes point-of-view articles published in HealthManagement.org Volume 22, Issue 3 'AI: Opportunities, Capabilities and Limits and are the sole opinion of the author(s) as part of the HealthManagement.org Corporate Engagement or Educational Community Programme.

Artificial Intelligence – Impact, Challenges and Opportunities

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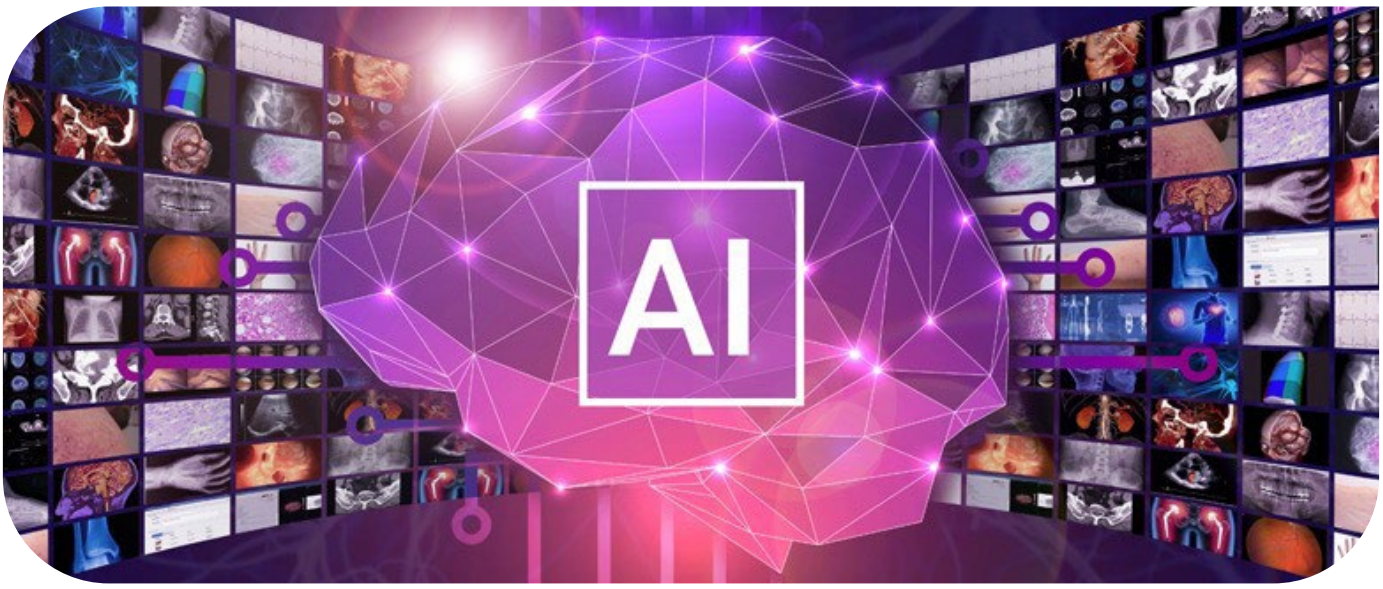
Dr Anjum Ahmed is the Chief Medical Officer at Agfa HealthCare. He has played an essential role in steering the company's innovation strategy for Enterprise Imaging and Artificial Intelligence. Dr Ahmed has over 23 years of global experience in solutions innovation, governance, change management and digital transformation. Before joining Agfa HealthCare, he spent 12 years implementing clinical and imaging IT solutions for a top-tier global vendor. He has published white papers in leading societies, including HIMSS Europe, and ESR, on timely topics such as value-based care and evidence-based use of AI. HealthManagement.org spoke to Dr Ahmed about Artificial Intelligence (AI) and its impact, challenges and opportunities in healthcare.



How have you seen AI change from hype to reality over the last few years?

In recent years, there has been a lot of hype around whether Artificial Intelligence (AI) is real or something in the distant future. There are multiple applications of AI, ranging from deep learning and machine learning to natural language processing. Over the last few years, several AI start-ups have developed these applications. There has also been a lot of hype that AI will replace radiologists or physicians. But the fact is that AI cannot be used in its own silo. It has to work with clinicians to augment their knowledge. A good majority of diagnosticians, globally, are advocating for embedding AI not only for clinical

use, but also trying to understand its impact on education and training.

Did the pandemic impact the development and deployment of AI in radiology?

During the pandemic, there was a need for systems automation, speed and efficiency, and enhancement of clinical workflows. This brought more attention to AI. There were also issues related to fast access to clinically relevant patient information with limited capacity and with clinicians working from home. There were growing requests regarding automation and enabling triage for exams with specific or critical findings. All these are key workflow facets that facilitated the implementation of AI-related applications into clinical practice. Hence, the pandemic has had a remarkable influence on how innovations and technologies could be implemented in practical terms. It has also impacted how regulatory bodies, whether in Europe or the U.S. or Canada, started assessing the practical application of these technologies and their intended use in clinical practice.

AI is not replacing radiologists. Instead, it allows them to focus on the clinical side of the analysis, which is much more meaningful

You have been accompanying a lot of large health institutions in the implementation and adoption of AI in medical imaging. What problems are these institutions usually trying to solve?

The first thing that should be addressed is understanding that AI is not a product or a clinical application. It is a technology that can help healthcare organisations achieve an end goal.

Back in 2016/2017, when the hype around AI started, Agfa HealthCare partnered with a large private healthcare organisation to look at some common challenges related to chest screening. When it comes to diagnostic images, plain films of chest x-rays constitute more than 40 to 50% of the workflow; in some cases, even over 80% if it's a primary care screening setting. This organisation had 90% of their workflow allocated to screening and x-rays. That posed a challenge for them in terms of resources. In addition, there were also challenges related to productivity, staffing and burnout.

We collaborated with the healthcare organisation to develop x-ray-related AI technologies that would solve some of these challenges. We soon realised that AI, if developed in a silo, will remain in its silo, and will keep doing things on its own without influencing the outcomes. Hence, the first step is to define what clinical outcomes need to be improved. Once that is defined, one can set certain key performance indicators or metrics.

For our customers, the main challenge with AI deployment is implementing and embedding it into clinical use. The RUBEE™ framework developed by Agfa HealthCare revolves around five core pillars of the AI strategy, ranging from workflow orchestration, triage, advanced visualisation, automation, and precision reporting by capturing the AI generated intelligence. These five specific workflow aspects are what customers need to help address.

How did the work you were conducting improve clinical confidence?

AI is a new technology, and there are still discussions around trust and standards to evaluate the results that it can generate. Radiologists play a crucial role in providing diagnostic intelligence to referring physicians. If referring physicians receive evidence-based information, they can make more informed decisions. One approach we took in the early phases of testing was to validate the results from AI with the radiologist so that they could see the performance of these AI algorithms compared to the radiologist.

An important aspect of AI is machine automation. AI applications can improve the performance, efficiency and speed of certain tasks that humans would take more time to evaluate. The time that is saved improves efficiency and allows radiologists to look at findings and provide diagnostic intelligence. This is one aspect that can help improve the adoption of AI because it can help radiologists perform faster and be more efficient. AI is not replacing radiologists. It allows them to focus on the clinical side of the analysis, which is much more meaningful.

The other challenge is to improve confidence and the adoption rate. This can be done by providing peer-reviewed scientific data and publications. The better the data, the better the algorithm performance. Another way to convince radiologists is to enable them to see the clinical applications and action of their own data and population samples. This gives the clinical user confidence in how AI behaves in a case they may have already evaluated.

Do you encounter any clinical use cases in particularly high demand for AI?

Over the last few years, some of the top use cases that have

evolved where AI is being implemented, tested and validated are around cancer screening programmes. There are also use cases revolving around plain films or x-rays because x-rays constitute a large volume of diagnostic imaging done across public health, institutes, or hospitals.

Another use case that is evolving is the detection of intracranial haemorrhages or workflows related to stroke because speed, time and efficiency are of key relevance in early detection and saving patient lives. There are also emerging use cases related to detecting fractures of the bones or bone age and other musculoskeletal findings like osteoarthritis-related conditions.

The important thing is to look at the clinical areas that the healthcare providers are focused on and embed AI workflow into their current ecosystem. It's all about bringing the clinical relevance of AI into practice.

There are certain solutions in the market that allow radiologists to use AI on a need basis. This is called pay-per-use. The challenge with pay-per-use is that it does not provide automation and real-time assessment. The approach Agfa HealthCare has is in real-time, embedded into the workflow. AI works in the background, and radiologists can already see the results that are processed. That's where you see the benefits for clinicians in real-time.

AI comes with a price tag. What aspects should be considered when hospitals build their business case?

AI is a new innovation. Many scientific publications demonstrate the sensitivity and specificity of AI, but this is based on retrospective data. There is some prospective data where certain studies indicate how it can perform as well as radiologists and how radiologists using AI can improve their productivity. But what does it mean? How do you translate it into numbers? The first thing to look at is speed and efficiency. How fast would the results be available compared to what is being done today? It is important to translate this into minutes – to show how much time is saved.

The other aspect is clinical programmes. It is important to know what clinical programmes healthcare providers are trying to improve. If the challenge is related to missing certain findings, it has to be addressed. If AI can pick findings that would otherwise be missed, that could impact patients' life expectancy and survival rates. The other indirect cost-related aspect of this is the clinical side. The earlier you pick up a particular challenge, the less cost is incurred on performing procedures and subsequent treatments.

The third aspect that certain hospitals look for is evidence. Some cases require more evidence to facilitate the right decision. If AI can provide that evidence, radiologists can help avoid unnecessary procedures and put the patient into the care paradigm earlier.

Another important aspect that customers want to address is faster reporting turnaround times to allow more patients into the screening programme.

What are the three winning arguments to convince customers about AI?

The primary argument favouring implementing AI is that it should be part of the workflow. If it is not part of the workflow, it will only assess and automate findings and results. These results must be accessible to the radiologist to demonstrate that AI is working for them in the background.

The second aspect is displaying results and reporting. There are several applications out there, and they have their own methodology in terms of how they display data. With RUBEE™, we embed and visualise AI results seamlessly in the existing workflow.

The third aspect is time. The goal of AI is to help radiologists save time by making clinical information easily available and providing automated comparisons to have all the information they need without running around to find a scan.

If we present all the above to a clinical user, it's a no-brainer that AI can be implemented and used successfully.

How do you help hospitals reap the benefits of AI - not only the deployment of AI but true augmented intelligence?

Augmented intelligence is the intersection of machine learning and advanced applications where clinical knowledge and medical data converge on a common platform. That's where the enterprise imaging strategy comes in.

One key benefit that the IT organisation and hospitals acquire with the enterprise imaging strategy is consolidation – to break the silos of the imaging workflows and build a common platform. There are multiple AI application developers out there. But that should not mean organisations have to acquire a new AI technology or worry about integration every time. Agfa HealthCare's RUBEE™ framework, developed as part of the Enterprise Imaging strategy, addresses this problem. RUBEE™ comes with a series of carefully curated AI packages that include multiple applications to analyse and display results to the end-user. Clinical users should not have to worry about

The approach we have enables Augmented Intelligence, embedded into the workflow. AI works in the background, and radiologists see the results that are processed by AI in real-time

integrating AI results or applications and automation.

In this issue, we discuss the opportunities, capabilities, and limitations of AI. With this in mind, where do you see AI today?

AI is as good as the data it has been trained on. It will have benefits if it is correlated with the clinical intelligence that resides in the systems already. There are multiple applications to consider when implementing AI. The challenge for the clinical decision-makers is to choose. We have addressed this with the RUBEE™ framework by curating clinical packages of relevant AI applications.

There is also the technology aspect and the importance of engaging the vendor. When hospitals decide on a particular AI technology, the Enterprise Imaging solution provider should be engaged earlier. It should not be an afterthought.

The third aspect relates to the clinical informatics residing in the EHR. AI can bring automation, but the missing link is clinical intelligence. With machine learning and natural language processing algorithms, this information can be automated and presented to radiologists.

Overall, AI will continue to play an important role in healthcare. As long as the implementation and integration process is handled smoothly, it will help clinicians make evidence-based decisions faster and more efficiently. ■

Integrated Cancer Care and Intelligent Imaging

Ben Newton I GM Oncology I GE Healthcare I UK

Early diagnosis of cancer can lead to better patient care and better outcomes. In particular, the use of intelligent imaging technology along the patient's journey, from screening to diagnosis to treatment, monitoring and follow-up, is essential. HealthManagement.org spoke to Dr Ben Newton, General Manager, Oncology at GE Healthcare, to discuss his views on integrated cancer care, the optimum use of imaging data and clinical information, the importance of early diagnosis and the need to close the gap in cancer care.

Key Points

- Cancer is one of the leading causes of death worldwide.
- Cancer care is complex, and interruptions and delays can significantly impact patient outcomes.
- Fragmentation in terms of access or fragmentation at different levels of care or fragmentation of clinical practice must be overcome by integrating care.
- Technology can support clinicians and patients throughout the patient's cancer journey, whether it's at the stage of screening and diagnosis, determining the right treatment strategy or monitoring patient progress.
- The key is to close the gap in cancer care through early detection and more timely and advanced treatment strategies.

Integrated Cancer Care – Overview and Benefits

Cancer is one of the leading causes of death worldwide. It has an impact on life expectancy and the cost of care. Cancer care is an extremely complex process, and any interruptions and delays can change the course of care and have a significant impact on patient outcomes. It is critical to reduce the time between the appearance of symptoms, diagnosis and initiation of treatment.

The issue of uncoordinated care, sub-optimal management, fragmentation of information and the discontinuous application of interventions may be overcome by using a multidisciplinary team (MDT). An MDT can come together and integrate those datasets in defining the disease, stratifying the patient into a particular type of disease, or understanding (from a differential diagnosis) the exact nature of the problem. These teams consist of radiologists, surgeons, nurses and pathologists coordinating care as a multidisciplinary team, bringing all the strands of evidence together to determine what the symptoms mean. Also, using multidisciplinary teams helps develop ownership at every level and allows clinicians and radiologists to give their input as they are the ones who are delivering care. Bringing together all these colleagues and promoting co-creation and collaboration can only benefit the patient in the long run.

Integrated care can help reduce the gaps in the cancer care pathway and bring patients and caregivers closer together

The goal of integrated cancer care is to propel new thinking, transform care pathways, and better utilise imaging data technology. One of the biggest challenges in cancer care is the lack of consistency. There are nearly 20 million new cancer cases annually, and patients are distributed across the globe. Different health systems have different practice methods, and diagnosis and treatment vary by location. Along the patient care pathway, patients can get different tests done in different locations. They may also interact with several different caregivers along this journey. In addition, patients in rural areas may not have access to the same quality of care or treatment technology. Finally, there are always issues of coordination among the different care providers. Hence, this fragmentation - whether its fragmentation in terms of access or fragmentation at different levels of care or fragmentation of clinical practice - must be overcome through the integration of care and through an overall improvement in screening programmes, faster access to diagnostic tests, use of cutting edge treatments and technologies and personalised treatments. Integrated care can help reduce the gaps in the cancer care pathway and bring patients and caregivers closer together.

Optimising Imaging Data and Clinical Information

A great deal of information is generated at different points in the patient care pathway. Maximising the use of data – imaging data, digital pathology data etc. – can help clinicians draw better insight and make more effective treatment decisions due to improved access to this information. The goal is to enhance the use of the massive amount of clinical information that is available to drive better decision-making and facilitate consistency within the cancer care pathway. Ultimately, the biggest benefit of integrated cancer would be to deliver care to the patient as early as possible and improve their access to treatment.

Data-driven cancer care is the future. More effective utilisation of electronic health records and radiology information systems, imaging and other medical data can help to simplify cancer care and reduce fragmentation and variation.

Integrated Care and Technology

The goal of integrated care can become possible through the use of technology. Technology can pave the way to allow clinicians to deliver earlier diagnosis and use more accurate treatment strategies. This can go a long way in improving the health outcomes of cancer patients. Hence, advanced technology and intelligent tools can be used to connect different imaging networks, enable early cancer detection, improve access to treatment, and promote high-quality, personalised care. Technology can support clinicians and patients throughout the patient's cancer journey, whether it's at the stage of screening and diagnosis, determining the right treatment strategy or monitoring patient progress. It can support and integrate cancer patient data from multiple sources into a single resource that clinicians can use to make optimal clinical decisions. Digital technology can be used to pull information into a centralised framework to display the pathology, the imaging, the medical records and the genomic information that is becoming even more critical to defining the right kind of treatment.

The Importance of Early Diagnosis

Early diagnosis and treatment are crucial to improving the survival rate of cancer patients, and innovative technology and improved patient care models can help facilitate faster diagnosis, as well as more precise treatments.

advanced software engineering techniques can support the goal of personalised and precision cancer care and help integrate clinical, imaging and genomic data from multiple sources into a single interface. Ultimately, integrated cancer care is designed to try to diagnose every cancer patient and

Triaging patients from screening into diagnosis more efficiently can transform cancer outcome

To help improve patient outcomes, cancer care needs to be less siloed and more efficient. Education, awareness, and specificity around testing and screening for multiple risk factors associated with disease and putting those risk factors together with presentation-based information are important for early diagnosis. Once a patient gets into the system, integrated cancer care strategies can help drive and support the triage of patients in the right diagnostic pathway and facilitate definitive diagnosis.

Cancer care is a journey and this journey needs personalised solutions from diagnosis through every stage of treatment - efforts must be made to use the right tools for the right patient at the right time.

Closing the Gap Through Earlier Detection

Moving into precision medicine and using advanced diagnostic tools can improve cancer diagnosis and survival. The future of cancer care is not just developing and introducing new equipment - it is about providing better patient care and using improved solutions and advanced technology designed to improve patient outcomes.

It is important to identify the patients that need care and follow-up after the initial screening process. It is equally important to improve the diagnosis of all types of cancer. Triaging patients from screening into diagnosis more efficiently can transform cancer outcomes. The use of Artificial Intelligence (AI), machine learning (ML) and other

provide these patients with the treatment they need as early as possible so that they can have a better chance of survival. Numerous patients do not have access to asymptomatic cancer screening. They only seek treatment or attention when symptoms appear, but these delays can have a significant impact on their chances of survival. Some patients with false positives are subject to invasive procedures that they may not need at all. This is not only harmful and stressful for the patient, but it also takes up valuable healthcare resources. The challenge is to get patients who are truly positive into treatment quickly and efficiently. This can transform cancer care and improve outcomes while the strain of late diagnosis can be devastating for patients and healthcare systems.

Conclusion

Early diagnosis of cancer can lead to better patient care and better outcomes. Over the years, there have been many important developments in the diagnosis and treatment of cancer through the use of imaging technology along the patient's journey - from screening to diagnosis to treatment, monitoring and follow-up. To help continue to drive improved patient outcomes, integrated cancer care that includes the use of cutting edge treatments and technologies, as well as improvement in screening programmes, faster access to diagnostic tests, and personalised treatments is critical to helping reduce the gaps in cancer care. ■

"One Ring to Rule Them All" in AI – Affidea's Experience

Alessandro Roncacci I Senior Vice-President I Chief Medical Officer I Affidea

An overview of Affidea's experience on the road to AI implementation and the need to understand the complexity of integrating multiple AI solutions safely, offering clear benefits to patients and radiologists.

Artificial Intelligence in Healthcare

Artificial Intelligence (AI) in radiology is growing at a fast pace. A 2020 study from the American College of Radiology on radiologist uptake of AI shows that clinical adoption of AI has increased dramatically over the last five years, with 30% of radiologists indicating that they use AI in some capacity – up from none five years ago.

This is showing, once more, that it is true that "radiologists who use AI will replace radiologists who don't", as Curtis Langlotz, Stanford Hospital and Clinics, said three years ago. At Affidea, we strongly believe in this. The most successful cases we've implemented so far prove that AI is augmenting the radiologists' intelligence and optimising their practices, not just by saving time but by enhancing their precision in diagnosis and potentially preventing what could have been an easy miss, increasing patient safety in some cases and driving operational efficiencies.

Affidea – Driving the AI Disruption With One Ring to Rule Them All

It was key for us to disrupt the utilisation of AI in daily practice, finding a unified and secured platform that can give us access to a catalogue of expert AI applications directly integrated into the workflow and PACS/RIS infrastructure.

Starting in July this year, in Affidea Portugal, we are implementing the Incepto platform that gives our doctors access to a portfolio of AI solutions that we are piloting under one single secured platform, directly integrated with our PACS/RIS infrastructure, without changing any equipment or without having to integrate every AI software separately. The platform is currently piloted in 14 centres, where our radiologists can work daily with the support of five different AI solutions based on local needs and best-in-class available sub-specialties, involving our clinical, operational and IT teams and in collaboration with Incepto specialists from the same fields.

All these solutions that we are implementing in our clinical routine and digital infrastructure come with great benefits for patients and doctors:

- improved patient care through AI-aided detection, measurement and diagnostics confidence;
- operational optimisation through shorter acquisition times, triage and prioritisation;
- reassurance for the medical staff.

Our goal is to accelerate the process of integration of AI solutions in our workflow, to make all our radiologists familiar with this innovative approach and then to roll it out across other Affidea countries where we are ready thanks to previous experiences.

Affidea's Journey to Date in AI Implementation

Over the past three years at Affidea, we have started several pilots to assess the clinical, operational use and commercial opportunity associated with AI-enabled technologies in diagnostic imaging. Our objectives were:

- to verify how some AI solutions focused on neuro, lung, breast, prostate, and oncological examinations or on driving operational efficiencies in MRI can qualitatively support the reporting activity of our radiologists in specific disciplinary areas;
- to understand how these can contribute to increasing the safety of our patients who undergo diagnostic tests;
- to verify how AI can optimise the operational processes in our daily workflow.

We have been heavily investing in digital infrastructure and IT capabilities to give our centres the necessary capabilities to test safely different AI solutions. We are currently working with over six AI vendors and piloting 10 AI solutions in 10 countries.

Affidea's Methodology

At Affidea, we have an ideal environment in terms of geographical presence, multinational clinical expertise, best technology with over 1450 pieces of equipment across 15 different healthcare markets and a team of subspecialty experts.

When we pilot an AI solution, we base our decision on a structured nine-stage framework for the evaluation and commercialisation of AI solutions, including:

- selection criteria for AI solutions, countries and centres.
- legal review, including medical device class and data protection impact assessment.
- technical architecture review, including digital infrastructure and AI solution integration.
- clinical and technical assessment.
- training of healthcare professionals.
- identification of key performance indicators.
- workflow redesigning to assess the benefits of the AI solution.
- commercialisation process.
- preparation of stakeholders' information and communication strategy.

The more we advance on the road to AI implementation, the more we need to think about the complexity of integrating multiple AI solutions in a safe and compliant way, offering clear benefits to our patients and radiologists in every country. Making it simple is not easy, but at Affidea, we have all the competencies, experience and resources to successfully lead this journey, always with clinical excellence, safety and precision at the core. ■

Teamplay Digital Health Platform for Performance Management in Radiology

An overview of teamplay applications for performance management in radiology and how they offer a clear overview of performance data and facilitate radiology directors or clinical administrators to make fast and well-informed decisions.

Key Points

- The teamplay digital health platform enables digital transformation by facilitating easy access to solutions for operational, clinical and shared decision support.
- The teamplay performance management applications allow radiology directors to access, monitor and compare their institution's key performance indicators in a single dashboard accessible from anywhere, anytime.
- The teamplay digital health platform combines two different deployment models - cloud and on-edge deployment to enable integrated solutions according to specific use cases and requirements.
- With the teamplay digital health platform, radiology operations can be optimised by accessing and analysing data more effectively, understanding the workflow, optimising operations by taking direct measures and creating a culture of continuous improvement.

The healthcare environment for radiology directors can be extremely challenging. Not only do they have to stay compliant with nationally defined reference levels for applied radiation, but they are also expected to increase efficiency, produce results and provide a data privacy-compliant way to share and manage medical images. In addition, protocol management can be a time and resource-consuming effort. In simple words, radiology teams have to achieve better outcomes and results with less investment and resources. One way to overcome this change is through digitalisation. Siemens Healthineers' teamplay performance management applications allow radiologists to better utilise patient data, improve workflow and optimise daily operations.

Benefits of Teamplay Applications

With teamplay performance management applications, clinicians can access objective data insights to make well-informed and prompt decisions and improve radiology operations. Streamlining operations in a radiology department is not limited to scanning more patients. It is also important to optimise processes and deliver high-quality care while complying with national regulations.

Some of the key benefits of teamplay applications for radiology directors include:

- Ability to monitor quantities like imaging throughput, dose levels, utilisation of staff, rooms, and department resources down to each device and procedure.
- Simplify reporting and gain insights into where workflows need adjustments.
- Link with other teamplay users and their data for comparable benchmarks and effortlessly exchange images and reports.
- Easily connect with other healthcare professionals, hospitals, and institutions through teamplay's rich cloud-based network.
- Access metrics from your own imaging fleet and a shared pool of imaging data.
- Connect and collaborate in a trusted environment with high data privacy and security standards to improve patient outcomes and quality of care.

Teamplay Performance Management Applications

The teamplay performance management applications allow radiology directors to access, monitor and compare their institution's key performance indicators in a single dashboard accessible from anywhere, anytime. Some of these indicators include:

teamplay Dose – Simplify radiation dose management

The application helps identify areas of improvement and administer best-practice exams. All insights in teamplay Dose are based on data extracted from the radiation data of scanners.

teamplay Usage – Increase efficiency and expedite imaging fleet utilisation

Explore workflow-specific data on patients and exams and/or focus on the efficiency and performance of individual devices, identifying optimisation potential to do more with less.

teamplay Images – Share and discuss images in a secure environment

With teamplay Images, images can be shared in a secure environment and additional collaboration features help engage with other peers.

teamplay Protocols – Speed up protocol management by remote access

Speed up protocol management by editing protocols remotely and distributing these protocols to the image fleet.

Teamplay Digital Health Platform – Enabling Your Digital Transformation

The teamplay digital health platform is an enabler for digital transformation in radiology. 6500 institutions in more than 75 countries are already benefitting from this platform by using a broad range of applications developed by Siemens Healthineers and third parties. The teamplay digital health platform enables digital transformation by facilitating easy access to solutions for operational, clinical and shared decision support:

Powerful marketplace

Access to innovations and solutions in digital health and AI from Siemens Healthineers and curated partners. These solutions can help radiology departments transform a complex multisite, multivendor imaging environment into an integrated imaging service line with a patient-centric focus throughout the entire workflow.

Digitally enabled collaboration

Sharing and collaborating with peers and patients via standardised interfaces between institutions and care settings.

Scalable deployment models

Innovative and flexible software deployment combining cloud and on-edge to serve your individual needs with a broad portfolio of transformative and AI-powered applications. The deployment models are based on the client's infrastructural demand and preferences and offer flexibility and scalability with future-readiness. The applications can be accessed easily via the digital marketplace that provides state-of-the-art SaaS (software-as-a-service) business models and

scalable computing power.

Seamless interoperability

One vendor-, system-, device-neutral digital health platform for cross-departmental and cross-institutional interoperability in a secure and regulatory-compliant environment. It allows easy connection of devices and systems, aggregates data from various sources and provides advanced analytics that results in actionable insights. With the teamplay healthcare digital platform, big data can be converted into smart data and can be used to increase the effectiveness of clinical routines through improved patient outcomes and reduced cost.

Strong platform partner

Secured environment to consume, deploy or operate digital solutions globally by leveraging Siemens Healthineers' ever-expanding infrastructure and services with over 32,000 connected systems, 6500 institutions in 75 countries and more than 30 million patient records accessible cross institutionally through seven major data centres worldwide.

Data Where It Needs To Be

Digital solutions require an innovative and flexible software deployment. Siemens Healthineers' teamplay digital health platform offers this flexibility by combining two different deployment models - cloud and on-edge deployment to enable integrated solutions according to specific use cases and requirements. Leveraging the benefits of both deployment models is called hybrid computing which is enabled by edge technology. With hybrid computing, you can:

- Manage local and global data as per preferences and regulatory requirements and ensure continuous operations.
- Benefit from instant data processing and storage on the local edge device and aggregate and balance load in the cloud when needed.
- Benefit from fully managed operations remotely from cloud: up-to-date software and algorithms, state-of-the-art security and high availability of apps.

Conclusion

Overall, Siemens Healthineers' teamplay digital health platform enables radiology departments to connect different imaging modalities and generate, collect, analyse and access patient data through a range of powerful applications. The teamplay performance management applications provide greater transparency in the workflow and help radiologists increase their productivity and better balance their department's resources. With centralised protocol management, clinicians can deliver a higher quality of care and ensure standardisation. With better data analysis, clinicians can perform in-depth analytics with intuitive dashboards. In addition, the teamplay performance management applications help radiology teams understand cost inefficiencies within their workflow and can implement changes accordingly to optimise operations. In other words, radiology operations can be optimised by accessing and analysing data more effectively, understanding the workflow, optimising operations by taking direct measures and creating a culture of continuous improvement. ■

Application of Artificial Intelligence in Healthcare

Sourabh Pagaria | Executive Vice President & Managing Director, Southern Europe | Siemens Healthineers

Artificial Intelligence is believed to lead the process of digitalisation and transformation in healthcare. How can healthcare organisations prepare for this change? What opportunities does AI offer for the healthcare sector? Which AI-based radiology tools are expected to make a difference? HealthManagement.org spoke to Sourabh Pagaria, Executive Vice President & Managing Director of the Southern European business of Siemens Healthineers to get some insight on these important questions.

What, in your opinion, is the true value of digitalisation in healthcare?

The role of digitalisation as a game-changer in the healthcare world was clear since the outbreak of COVID-19. It is the key enabler in providing high-value patient care. But in the course of these two years, we have also understood that digitalising healthcare in a sustainable way goes beyond adopting new tools and technologies. It requires a cultural change and a re-alignment of organisations around data-driven digitally-enabled processes and care models. Simply digitalising current processes and procedures is not enough. With this said, in my opinion, the true value of digitalisation can be broken down into the following elements: increasing efficiency, expanding access to care, improving clinical outcomes and accelerating innovation cycles. For instance, home-based telemedicine or teleconsultation can reduce care costs in several chronic conditions. Teleradiology can give remote locations and standalone imaging clinics access to teaching hospital quality care, and allow clinicians to collaborate and share information productively in virtual spaces. Digitalisation can help connect caregivers and patients for better coordination and knowledge sharing while strengthening integrated care across the health systems.

What specific opportunities do you see with respect to the application of medical AI technology in healthcare?

In the future of healthcare, Artificial Intelligence (AI) will be indispensable for translating the growing volumes of data into decision-relevant knowledge. In general, digitalisation, data and artificial intelligence are key for scaling the application of technical advances as AI-enabled tools identify meaningful relationships in raw data, extract relevant insights, and apply those lessons to new patient cases. For example, during the COVID-19 outbreak, it was essential to identify as quickly as possible if a specific patient was suffering from COVID-19 pneumonia or if the pneumonia had a different cause. This is what the rapid AI-based algorithm Siemens Healthineers developed does by automatically quantifying air space opacities associated with COVID-19 pneumonia. To sum up, whenever analyses are too difficult, time-consuming, or inefficient to perform alone, AI provides valuable assistance to clinical professionals, allowing them to stay focused on their patients and better use their own expertise. AI can help bridge the gap between the demands of ever-increasing, extremely complex data and the number of radiologists to simplify data interpretation through sophisticated AI algorithms, thereby improving the diagnostic process. Moreover, AI-powered clinical decision support systems could help free up precious physician and specialist time which could then be used by them to provide more emphatic and personalised care to the patients as comprehensively and productively as possible.

AI is expected to lead the process of transformation in healthcare. What good practices do healthcare organisations need to adopt to better prepare for this?

Healthcare organisations should shift towards building a digital enterprise with a clear commitment to managing data as a strategic asset. Healthy systems have to integrate data from multiple sources on secure and easily accessible data platforms.

In our view, there are four steps to be taken to create smart data management:

1. Set data strategy and establish governance
2. Capture data securely and automatically
3. Validate data via automated clean–up
4. Connect data via secure, accessible platforms and EHRs

These four steps will result in reliable and secure data that, together with advanced modelling and AI, empowers data-driven decisions within a health system – be it in the clinical, operational space, or directly helping consumers make the right decision in their care.

sources (e.g., pathology, lab, genetics, imaging) to best navigate and stratify patients for their personalised therapy. We cannot predict the future, but we can prepare for a future that is increasingly unpredictable with the tools we already have. For example, AI algorithms enable automated detection

With AI-assisted image analysis and triaging algorithms improving by the day, radiology, as we traditionally know it, will have a very different and pivotal role to play in the future

For effective application of AI in healthcare, there needs to be a clear definition of automatised diagnosis. What do you think this entails?

One of the most pressing concerns in radiology today is the exponential growth of data and the shortage of medical staff to handle the complex and ever-increasing amounts of information. The important base material for AI-powered "outcomes" is an important "connector"- individual electronic health records (EHR) that help aggregate patient histories with in-vitro, in-vivo, genomics information, lab data and much more. With patient permission and understanding, AI-powered technology will take this vast amount of data and transform it into actionable insights. This AI-assisted technology generally has been dubbed the diagnostic decision support system (DDSS), and surveys have shown it could improve diagnostic accuracy by nearly 9%. Significant gains have especially been reported in recent years, for instance, in AI-assisted cardiac risk assessment. AI can cull through hundreds of thousands of cases to calculate where a heart patient fits into a risk stratification to inform cardiologists' decision-making. AI algorithms must be properly trained. Our Siemens Healthineers' Artificial Intelligence is based on algorithms trained with an extensive amount of curated data. I'm talking about more than 1.4 billion entries, and we run more than 1,200 AI experiments a day on our supercomputer and today, we have more than 800 patent families related to artificial intelligence.

Which next-generation AI-based radiology tools do you foresee in the future?

The radiology community is largely coming to terms with the fact that AI is not a threat but rather a tool that helps them become more precise, effective and efficient. Nowadays, AI is already playing a transformative role. In the long term, with AI-assisted image analysis and triaging algorithms improving by the day, radiology, as we traditionally know it, will have a very different and pivotal role to play in the future where it will help to centre and integrate data from various

of anatomical structures, intelligent image registration and reformatting. Abnormalities and segment anatomies are automatically highlighted, and results are compared to reference values in order to increase precision and speed up the workflow. These efficiency gains will become increasingly important given the growing demand for diagnostic imaging and rising cost pressure.

Can AI also address the impact of staff shortages and access to qualified clinicians in remote areas?

Healthcare, like much of the rest of the economy, is facing a labour shortage. AI can lighten the load for overworked providers through everything from automation to triaging patients. It has the potential to significantly improve access to high-quality healthcare and also improve diagnosis and therapies. Not only in highly specialised centres but also in remote, poorly populated areas and emerging countries. It can automate repetitive tasks, allowing healthcare providers to focus on higher-level cognitive tasks and patient care. Through digital technology, it is possible for clinicians to provide care at a distance. Some specialties, including radiology and pathology, have already adopted technology to enable consultations from a distance. With radiologists in short supply, teleradiology brings continuous radiology coverage to even smaller or remote locations, allowing more patients to benefit from specialist care.

There have been numerous problems with EHRs. Do you think AI could address some of these issues and make EHRs more efficient and easy to use?

Health systems struggle with fragmented systems of care, and interoperability between hospital and primary care physicians' data is often lacking. As a result, information during care transactions can be lost, and patient data is not fully leveraged when developing care plans. Here the concept of "moving information, not patient" should be embraced by healthcare institutions, shifting toward that digital enterprise model where data

are collected and connected to secure and easily accessible data platforms from segmented sources. Clinicians will be able to collaborate and share information productively, reducing information loss during care transitions.

AI has potential in healthcare. However, are there any limitations that need to be kept in mind?

What needs to be understood is that change and transformational speed in healthcare institutions isn't the same as in other industries (e.g. consumer-related industries). Healthcare is a heavily regulated environment; the demands are rigorous and very specific. Moreover, the regulations can differ from country to country. As much as hospitals and clinics may be keen on using AI technologies for informed decision-making, these technologies must always be validated in clinical studies. By doing so, healthcare institutions gain a solid understanding of what the transformation will be and if it will do good for the patient, ultimately leading the patient to a better situation. Digitalisation in healthcare is the key enabler in providing high-value patient care. ■

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Telemedicine Care Combined with AI: Capabilities & Benefits

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An overview of the application of AI (artificial intelligence)-enabled systems in telemedicine and the Comarch healthcare strategy to develop building blocks of this new care system.

Key Points

- The management of chronic disease and geriatric disorders is one of the biggest challenges for healthcare systems.
- Telemedicine solutions bring innovative answers to the needs of healthcare providers.
- AI (artificial intelligence)-enabled systems can unlock the potential of telemedicine at every step of the patient pathway.
- AI-based virtual medical assistants can support telemedicine tools in the development of preventive medicine.
- Systems combining telemedicine and AI technologies can support healthcare providers to make the right diagnosis and choose the right treatment.
- Beyond remote monitoring, AI technologies enable the distant delivery of care to specific groups of patients thanks to smart robots and chatbots.

Introduction

The management of chronic disease and geriatric disorders such as cardiovascular disease, osteoporosis, diabetes, dementia and obesity is one of the biggest challenges for our healthcare systems. The population of patients affected by these disorders is dramatically growing, while the nature of a chronic condition requires prompt and continuous care. In this context, telemedicine solutions bring innovative answers to the needs of healthcare providers suffering from work overload, while proposing more fluid care pathways and better quality of life for patients.

Telemedicine systems, from preventive care to telediagnosis, remote monitoring and treatment management, are based on the digital exchange of data between patients and healthcare players. This data-driven positioning paves the way for the use of another key innovative trend in the healthcare ecosystem: AI (artificial intelligence)-enabled systems. Indeed, AI is the key lever for developing the potential of telemedicine at every step of the patient pathway, with different levels of maturity and various benefits. This paradigm in the core of the Comarch healthcare strategy, as the company is actively developing building blocks of this new care system enabled by telemedicine and AI.

AI-based virtual medical assistants supporting remote preventive care

Preventive care is the key to countering the development of chronic disorders in healthy populations, as well as for those who find self-care challenging. In this area, telemedicine solutions such as patient-operated applications and self-diagnostic booths paired with connected medical devices are great tools to help individuals engage with preventive care. AI-based virtual medical assistants can be used in this particular case. They generate synchronous and task-oriented computer-generated dialogue with the patients, similar to a dynamic questionnaire that directs the conversation to collect relevant health-related data. In addition to enhancing data collection, AI medical assistants can also generate automatic pre-diagnosis and health advice based on the generated data.

Comarch has brought to the market two patient-operated applications for preventive care: a health diary in the shape of a mobile application, Comarch HealthNote, and a self-diagnosis booth, Comarch Diagnostic Point. Both solutions are continuously developed and improved, notably thanks to AI tools such as the medical assistants cited above.

AI combined with telemedicine supporting healthcare providers to analyse clinical data

The saturation of healthcare facilities unfortunately leads to delays in diagnosis as patients encounter difficulties getting appointment quickly. It is even more critical in the context of complex diseases that require several appointments with different specialists in order to make a diagnosis. This organisational barrier is now overcome by a new patient pathway based on telemedicine and AI. Instead of performing physical visits, clinical data can be generated remotely through a connected medical device or phone camera (for example, ECG data in cardiology, face pictures in genetics, skin pictures in dermatology). Data are then transmitted to healthcare providers through a telemedicine application which is where AI comes into play. Algorithms based on machine learning are able to analyse these single points of data to propose a diagnosis, by comparing them with huge quantities of existing data. The Los Angeles County Department of Health Services foresees the related benefits in the context of diabetic retinopathy, for example, as a new protocol for diagnoses using an AI analysis tool will enable diagnosis using only retinal pictures (Varshneya 2021).

In addition to analysis of single points of data, AI can also unlock the management of the huge amount of data generated remotely during long-term testing or screening. These large sets of data require powerful AI-enabled algorithms to expedite the diagnosis process. At Comarch, we already offer cardiac telemonitoring services, which analyse and detect silent atrial fibrillation in a 30-day ECG examination thanks to AI tools (Wiśniewski 2021).

AI systems can also perform remote triage of patients by analysing early signs of deterioration thanks to connected medical devices and a patient-operated application. For example, the Department of Health Science and Technology at Aalborg University (Denmark) recently launched a clinical study aimed at testing an AI-enabled algorithm in telemonitoring to predict exacerbations in patients with COPD (Secher et al. 2022).

Decision-making tools supporting treatment decisions and AI applications improving treatment adherence

Systems combining telemedicine and AI technologies can support healthcare providers when deciding on the most suitable treatment for each individual. While telemedicine applications allow the collection of real-time data, AI-algorithms can perform rapid analysis of this information to provide the most relevant proposal for treatment based on the current condition of the patient. The NextDREAM Consortium Group headed a large-scale study assessing the efficiency and safety of an automated AI-based decision-support system which produces a full insulin titration recommendation and personalised management tips for healthcare providers who are remotely monitoring patients with diabetes. The study demonstrated that remote insulin adjustments suggested by the AI advisor perform as well as expert physician dosage changes.

In the context of remote care, AI application also improves treatment adherence. Indeed, when patients are at home, it makes it harder for healthcare providers to supervise the intake of medicine – and adherence is a key success factor for each drug-based therapy. For this reason, the AiCure company developed a mobile application dedicated to schizophrenia. It

integrates with a face recognition system and checks whether prescribed drugs have been taken. During their pilot study in 2017, the company reported an 89.7% drug adherence rate [compared to 71.9% for traditional drug adherence monitoring] (Bain et al. 2017).

mobile body and screen for patient-doctor communication. The camera moves in accordance with the doctor's instructions, and the robots can measure clinical parameters of the patient thanks to telemedicine functionalities [for example, electronic stethoscope, blood pressure, temperature, ECG and pulse-oximetry] (AIP Conference Proceedings 2018).

AI is the key lever for developing the potential of telemedicine at every step of the patient pathway

AI-enabled robots and chatbots delivering care in the context of telemedicine

Beyond remote monitoring, AI technologies enable the distant delivery of care to specific groups of patients thanks to smart robots and chatbots. Indeed, it is now a priority to create new care delivery ensuring better access and continuity of care to counter the lack of availability of healthcare providers, and to reduce the high costs of homecare. To this end, some synchronous and task-oriented computer-generated dialogues have been developed for mental health applications. They allow constant access to care for this target group, which may require assistance at any time of the day.

Elderly people could also benefit from AI-enabled care with the development of smart robots assisting them in their daily tasks and in the management of their health issues. For example, the Dr Rho Medical Telepresence Robot allows elaborate teleconsultations to be carried out thanks to its

Conclusion

Regarding the various applications of the combination of telemedicine and AI presented here, three main categories of solutions can be identified, each at different levels of maturity. First, the AI-based decision-making tools supporting healthcare providers in making a diagnosis or selecting the relevant treatment are quite mature, as they are already in use in various care facilities. AI virtual assistants who support patients during self-diagnoses or deliver care in the context of mental health issues (for example) are promising solutions but have not yet been integrated into care practices. Last, smart robots also represent a great opportunity to unlock telemedicine capabilities, but are still at the development stage. Indeed, the two last applications require additional clinical studies to prove their efficiency and their safety, and represent large investments in research and development at the technological and organisational levels. ■

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Innovative Technologies Will Address Health System Challenges

Thales I France

Innovation is the fuel for any improvement in society because technology always pushes back limitations. Thales envisions to build on its advanced expertise to meet the healthcare challenges of tomorrow. Bringing performant secure health-care access to anyone, anywhere, will overcome critical medical issues.

New Challenges

After the pandemic revealed the weakness of global health systems, our societies have seen public health concerns coming back at their core preoccupations: ageing populations, the rise of chronic diseases, increased cost of health care, and inequalities. Entire parts of societies stalled in accessing care in the past decades: rural and suburban locations, lower-income neighborhood and minorities, elderly and disabled people. Although they displayed outstanding resilience and commitment, healthcare professionals faced shortages issues, with critical impact on patients. These factors are an immediate threat to the sustainability of healthcare systems, in Europe and worldwide.

Governments have implemented ambitious public policies to mitigate this short-term risk, and build more efficient care pathways, in the benefit of the patients. This historical investment effort focusses on recruitment, facilities, equipment and digitalisation. Also, medical desertification is a reality for many patients, and needs to be addressed. Private players need to join forces and help address these challenges.

Technological Answers

Healthcare in 2030 will not look like healthcare in 2020. Digitalisation, territorial mobility, and technological advances will drive significant improvements for the common benefit of all.

Renouncement to care is often a matter of distance. In the coming years, we will see the development of mobile solutions in the territories. They bring the service closer to the patient, relieve the emergency services and tackle the problem of equal access to care. These fleets of lightweight, high-performance connected systems will have to go with fleet monitoring and preventive maintenance solutions to avoid downtime.

Teleradiology will expand to solve the unequal distribution of radiologists worldwide, while providing high-quality diagnosis to every patient. The deployment of 5G makes rapid tele-diagnosis possible, regardless of where the patient is located. This high connectivity comes with new cybersecurity threats, and requires protecting any component of the chain, from systems to data transfer.

Artificial Intelligence (AI) and data analysis will play an increasingly important role in healthcare. Indeed, AI helps radiologists worldwide as a diagnosis companion, and is a way to free up time and resources. The collection of data bundles, from the system component to the clean image, is vital to break new frontiers.

Our Contribution

Thales, a global innovation company in security and critical operational missions, is at the forefront of this urgent tall order. We aim to build an innovation network to pool experts from SMEs, start-ups as well as public organisations. We leverage our expertise to provide our customers with:

- Lightweight, high-end flat panel detectors to unlock the next generation of portable x-ray systems
- User-defined imaging solutions, to smooth the operator's workflow
- Innovative remote maintenance and fleet monitoring solution,
- Cybersecured solutions, leveraging the expertise that Thales already deploys in critical activities such as aerospace, defense and government

More is yet to come, and we look forward bringing these advancements to the market while paving the way for a better healthcare. ■

Thales will be present at ECR 2022 in Vienna, We welcome you to our booth #229 (Hall X2).

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