

Between Bits, Bytes, and Beds – How AI Applications can change Stationary Care

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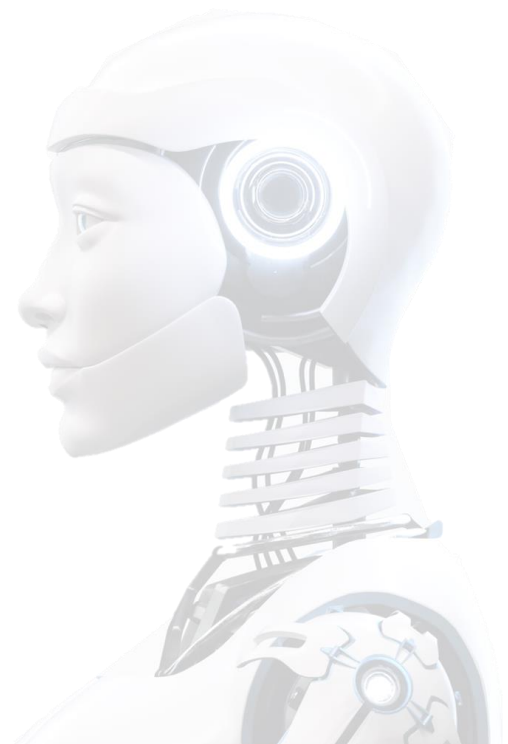
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1 Artificial Intelligence in the Healthcare Sector on the Rise

Artificial intelligence (AI) has become a part of everyday life for many people and is being used within many applications both in professional and private contexts. The technology integrated so seamlessly that it is not always discernible when AI is providing support. In particular, the use of generative AI (genAI), AI algorithms that generate objects such as images, text, videos, programming codes, but also music and art, could change the game and release significant economic value. Applications in this category have become mainstream with the launch of ChatGPT by OpenAI in November 2022¹ and are now indispensable. The rapid growth of artificial intelligence is reflected in the user numbers of ChatGPT: Within five days of its release, one million users could be recorded, marking it the fastest growing digital product so far and user numbers increased to 180 million by December 2023.²

Even in the healthcare sector, traditionally considered a slow adopter of new technological innovations, AI is gaining increasing prevalence and holds significant potential. For instance, a study from 2023 could show that the answers of chatbots in a forum for medical questions were rated as more empathetic by patients than the answers of doctors.³ Specifically in the inpatient sector, generative AI could be used for many use cases. In addition to the medical field, other areas like administrative or organizational support offer a lot of potential for AI. The healthcare organization Baptist Health South Florida for example uses AI-generated recipes in its kitchens to promote a more efficient and sustainable use of food and to reduce food waste in total. In addition, the use of AI-generated recipes also offers the possibility to meet the individual nutritional needs of patients, which is a major challenge in everyday hospital life.⁴

According to a report by McKinsey & Company, genAI could unlock up to \$1 billion in value by analyzing unstructured and previously unused data in the healthcare sector.⁵ However, on the one hand, the regulatory requirements for the use of AI in the healthcare sector must first be stated and corresponding guidelines defined. On the other hand, companies themselves must prepare for the use of modern applications and technologies and create both the know-how and the technical basis for this. Despite those obstacles, the sector should still prepare itself and analyze thoroughly where AI technologies could improve the quality of medical care while ensuring the security of patient data. It is a question of balancing the innovative possibilities offered by AI with the essential responsibility to use these technologies safely and ethically.

2 Balancing Hype and Reality – AI Applications in the Inpatient Sector

When talking about the use of AI in healthcare, the question arises of how to deal with highly sensitive patient data in a regulatory and ethical manner. The keyword "safe AI" (safe artificial intelligence) is essential and should always be considered when starting to develop applications for healthcare. Safety and data protection are essential aspects that should never be neglected in the rapidly developing world of AI technologies despite its chances and opportunities.

Specifically in the field of AI, it can also be observed that the innovations and requirements are more strongly demanded from the users than with previous information technology innovations. Through the widespread use in the private sector, the access to these technologies is easier and can be transferred to the daily work routine. This raises the question of why, for example, automated speech input, translation, and transcription are already established in the private sector, but there are still few solutions available for healthcare, where their use could create enormous relief for clinicians. This imbalance between euphoria about the possibilities and resignation due to regulatory and bureaucratic hurdles should be balanced so that the potential of AI can also be exploited in the German healthcare system.

In the quest for rapid solutions to intricate issues, delving into research and real-world application cases proves invaluable, allowing for the discernment of mere fantasies from tangible opportunities. The inpatient sector has

already demonstrated remarkable progress and holds the potential to unveil innovative AI concepts at various levels. We've gathered some of the most compelling examples for your consideration.

2.1 Medical Use Cases

A major advantage of generative AI (genAI) is that it can provide data to train other AI algorithms. Data quality and quantity are major challenges in healthcare for the development of reliable models for diagnoses or treatment predictions. Using genAI, it is possible to increase the required data set by providing synthetic data and using it as training data. For example, synthetic MRI and CT images have been successfully generated, which were then used to train models for breast cancer diagnosis when not enough real medical data was available.⁶ A similar approach could also be carried out using DALL-E2, also a product of OpenAI. Scientific studies have shown that, realistic ultrasound images could be generated by entering specific text components. Additionally, it was possible to improve the quality of radiological images that were not of sufficient quality to train further algorithms, for example by supplementing missing areas.⁷ These approaches offer enormous potential and could accelerate the development of new AI tools in radiology significantly.

After the appropriate development and training of AI algorithms, they are often used in medicine for image classification, for example to support the detection of tumors in imaging procedures. However, the reliability is not yet high enough to make independent decisions and the results still need to be checked by a medical professional. To make this process more traceable, the Charité has developed an AI diagnostic tool for breast cancer that not only shows the treating physicians a tumor in tissue sections, but also provides an explanation of which pixels in the image contributed to the diagnosis.⁸ This makes the decision-making process of the AI more transparent for the medical staff and the plausibility of the decision is easier to understand. This is an important step to increase the acceptance of this technology by medical staff and reduce misdiagnoses.

A research project on the establishment of AI systems at the University Hospital of Freiburg is dedicated to the combined analysis of PET and MRI images to determine the biological properties of aggressive brain tumors, so-called glioblastomas.⁹ This makes the metabolism of the tumor visible, for example areas with high or low cell activity. These results help to limit the radiation therapy to particularly dangerous tumor areas in order to ensure a higher efficiency of treatment while simultaneously protecting the patient. The project is also remarkable for its interdisciplinary approach, as it involves specialists from the fields of artificial intelligence, radiation oncology, nuclear medicine, neuroradiology, medical physics, neuropathology, and neurosurgery. The combination of know-how from different areas is in particular important for the development of successful AI in healthcare. Another goal of the project is to make the digital tools tested here available to researchers worldwide in order to standardize treatment internationally and thus improve the quality of life and treatment outcomes of those affected.

2.2 Organizational Use Cases

GenAI and other AI models can also provide significant added value in non-medical areas. In addition to diagnosing and treating diseases, a large part of the daily work of healthcare providers is to correctly document and interpret test results, decisions, and conversations. Especially in complex treatment cases in oncology, an exchange between different departments and experts is necessary, in which a correct and traceable documentation is of the utmost importance. To provide support in this area, a project in the field of liver tumor boards is currently being funded at the Charité. The problem was that at the agreed board meetings, only insufficient and incomplete information was regularly available. This led to delays in the decision making process and thus in the treatment of patients. As part of the project, the exemplary implementation of an innovative decision support system, the so-called ADBoard for liver tumors, is to be investigated. AI methods such as natural language processing (NLP) and machine learning (ML) serve as the technological basis for the automated provision of data as well as the support of decision-making processes, including the derivation of treatment recommendations.¹⁰ This will help to reduce delays in treatment.

Another time-consuming process in hospitals is workforce planning, which poses a major challenge even for experienced planners. Estimated needs must be aligned with available staff, qualifications, and legal requirements, which leads to high complexity and also increases the risk of understaffing or overstaffing. This is where a project by ATOSS Software GmbH, Fraunhofer IKS, Flying Health GmbH, and the University Medicine Mainz comes in. Using a machine learning model, future needs are specifically determined based on historical data and aligned with existing requirements and regulations. This provides planners with company-specific forecasts that make planning easier and, through optimal staffing of wards, also lead to increased patient safety and relief for staff members.¹¹

Overall, AI algorithms can help to simplify complex processes and create efficiencies. Many use cases can even be implemented without using highly sensitive patient data, which means that there are lower implementation hurdles. The need for this is high, as healthcare providers in Germany report that a lot of time is lost to documentation and bureaucracy, which could be used for the benefit of patients.

2.3 Conceptual ideas

It is particularly exciting when you have genAI creating a vision for the future of healthcare. The Stralsund-based company GWA Hygiene has taken advantage of this approach and had a vision of the patient's room of the future created by an AI. The resulting images are impressive and illustrate what the future of healthcare could bring.



Figure 1: Patient's room of the future, created with midjourney; Source: GWA Hygiene

The main goal of GWA Hygiene is to simplify patient care processes in hospitals and relieve staff. Toralf Schnell, Chief Market Management Officer of GWA Hygiene, explains that the looming undersupply due to demographic change cannot be ruled out, and that new and innovative measures must be found to ensure the medical quality of treatment in Germany. GWA Hygiene's approach is also reflected in the futuristic patient room (see Figure 1). A guarded zone around the patient's bed collects data that is used to evaluate the patient's condition and provide this information to nursing and medical staff. A small sensor on the ceiling serves as a detector for measuring heat profiles, movements, or noises. These data are evaluated using sensor fusion and AI-based analysis and can be used for example for delirium prevention or fall detection.¹² The company is constantly developing new scenarios and trains the AI accordingly to ensure optimal patient safety through the evaluation of a variety of data.

Thinking further, artificial intelligence and especially genAI could support the creation of new concepts and designs that are free from human bias. Based on their own experience, humans have established assumptions about how, for example, a house, a transportation vehicle or other common objects should look like. If these limitations can be overcome by genAI, surprising concepts can emerge in the development of new products, which promise a major leap in innovation through new design concepts. An example of how this can work was given by a team at Northwestern University. A specifically programmed AI was asked to design a robot that could move on a flat surface. After nine attempts, the system created a blueprint for a robot that was able to walk using pneumatic muscles (s. Figure 2).¹³ This process of "instant evolution" could also have far-reaching implications in the medical field. The use of genAI could shorten the development process of medical products and create completely new solutions. This would simplify and accelerate research, which typically takes several years or decades.

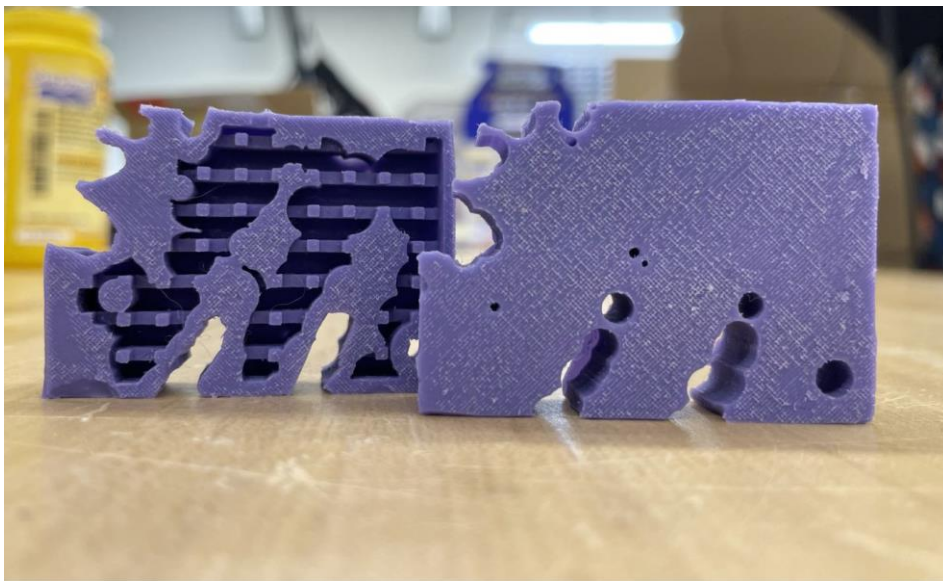


Figure 2 AI-designed robot for movement, the left side shows the "air muscles";
Source: Northwestern University

3 Conclusion

Based on the use cases described here, it is clear that the use of AI will revolutionize everyday life, as well as healthcare. The potential of AI technology suggests that the entire process of medical care can be made more efficient through its use. This optimization is e.g. achieved by simplifying the evaluation of medical image data for users, or by automatically generating the necessary documentation from a conversation using algorithms. This can improve the quality of medical treatment and ensure the provision of care.

However, it is striking that the application areas presented in this paper are still far from the current care routine. These are primarily research projects that can show what will be possible in the future. In order for these projects to make their way into the daily work of healthcare facilities, the appropriate measures must already be taken today, building on the current technological upsurge. Even if the enthusiasm for the topic of artificial intelligence is positive, the security aspect must not be neglected. At this point, the IT departments of the facilities are called upon to familiarize themselves with the technology and the necessary prerequisites for its sustainable use at an early stage, and to provide the corresponding infrastructure for this. Otherwise, there is a risk of the emergence of "shadow IT," where employees, without coordination with IT departments, deploy commercial, non-private AI applications like ChatGPT in the course of their work, leading to security risks and data protection issues. If

institutions do not develop a concept on how AI can be safely and effectively used by employees, they will find ways to circumvent the IT department to streamline their daily work using AI technology, potentially neglecting critical security aspects.

In summary, it can be said that AI algorithms are on the rise and will definitely find their way into healthcare. The range of applications that are possible in the status quo or is already difficult to grasp in its entirety, and it is to be expected that these possibilities will continue to develop rapidly. However, in order for a successful transfer from research to daily use, the necessary infrastructure and the required level of digitization must already be ensured today. At the same time, binding quality and compliance guidelines must be developed so that a "safe AI" is ensured at every time.

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