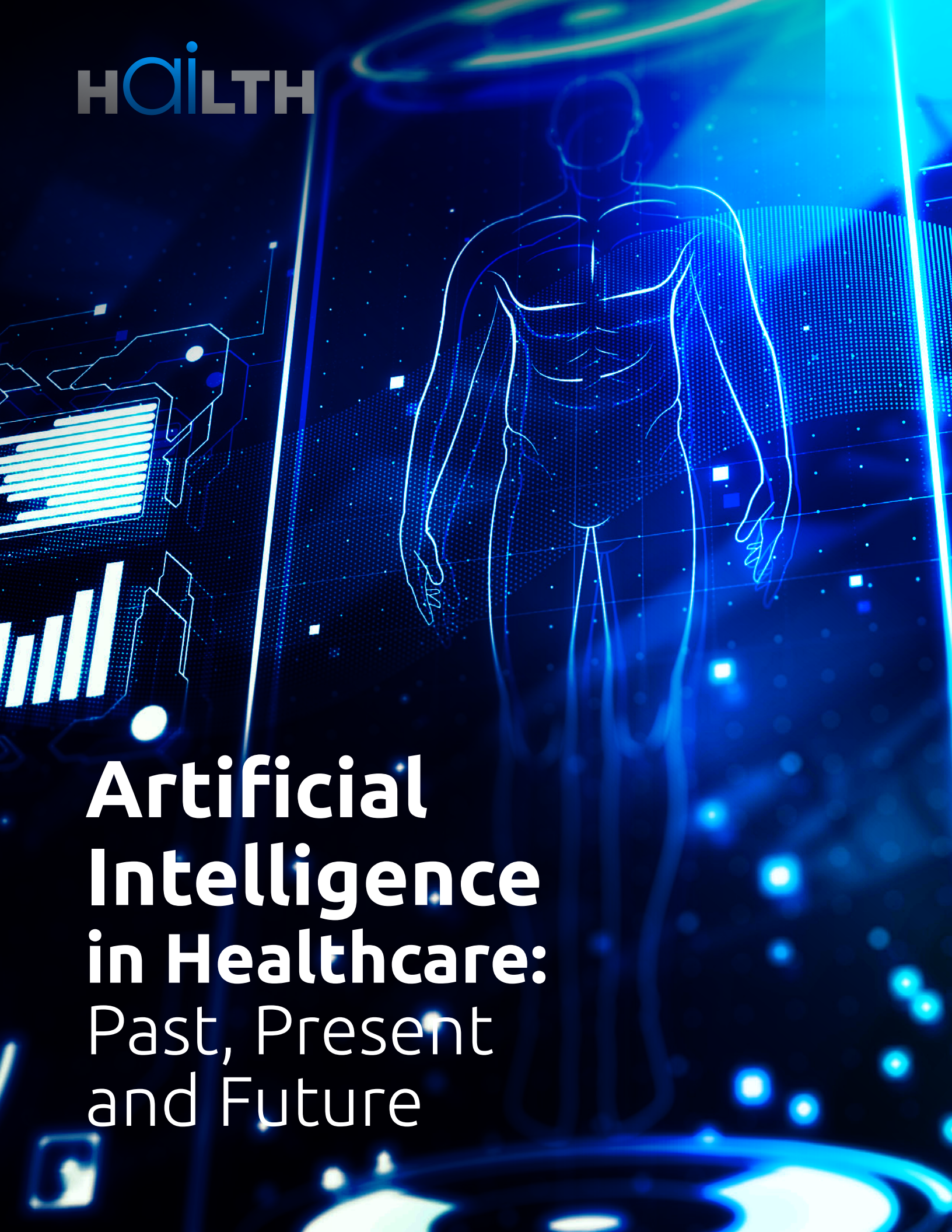

Artificial Intelligence in Healthcare: Past, Present and Future

While the adoption of artificial intelligence (AI) is low among businesses, senior executives are aware that AI isn't merely a hype. Enterprises across sectors are looking at the technology to see how to leverage it for their business. A Mckinsey report estimates that 40 percent of all the potential value that can be created by analytics comes from AI techniques that fall under an umbrella term – "**deep learning**" (that utilizes multiple layers of neural networks). That being said, the field of radiology is no exception.

> The more images you see, the more examinations you report, the better you get.

The abovementioned words are the motto of radiologists. The same works for ML, and particularly for DL. In the past decades, medical imaging has evolved from projection images like radiographs or to tomographic images such as ultrasound (US), CT, tomosynthesis, positron emission tomography, etc., becoming more complex. Even though the shift to three-dimensional (3D) imaging began in the 1930s, it wasn't until the commencement of the digital era that this approach allowed anatomic detail and functional information to be captured.

AI and Radiology: A Giant Opportunity

The increasing amount of data to be processed can influence how radiologists interpret images: from inference to detection and description. When image analysis takes up a lot of time, the time for evaluating clinical and/or laboratory contexts is automatically compromised. The radiologist is then reduced to doing the task of an image analyst. The clinical interpretation is left to other physicians. This is dangerous, not only for the radiologists but also for the patients: non-radiologists may have a full understanding of the clinical situation but they lack radiological knowledge.

In such a scenario, AI is a boon to radiology. Similar to natural intelligence, AI can look at medical images and identify patterns after being trained using vast numbers of images. This will provide information about abnormal findings. This is important as not all abnormalities are representative of diseases and ought to be actioned. AI systems learn on a case-by-case basis.

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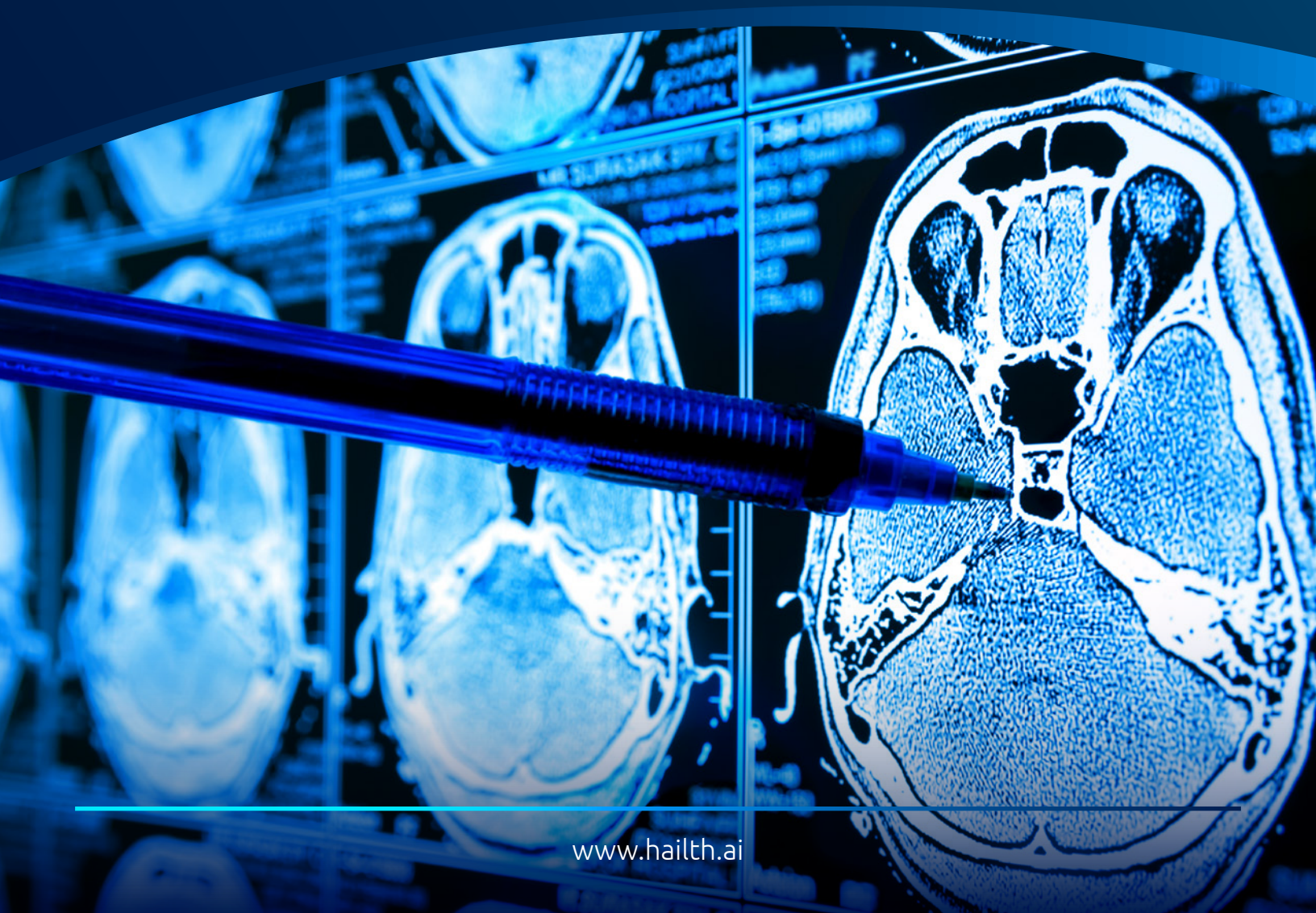
AI Speed Detection of Acute Brain Hemorrhage

A CASE IN POINT

On May 14 2015, Dr. Derek Shepherd (a.k.a McDreamy), the neurosurgeon from Gray's Anatomy, saved four individuals injured in a car accident. He was pulling back onto the road and that's when a semi-truck slammed him. Derek was rushed to the nearest hospital, which was woefully incapable of saving his life.

When his ambulance showed up at the hospital, the on-call doctor didn't want to admit him. He kept saying that it was not a trauma center and was not equipped to deal with four car accident victims alongside Derek. Although they admitted him, they didn't take a head CT and were unaware of Derek's brain injury.



McDreamy's scenario is a reality at a majority of hospitals across the world. In reality, most of these institutions have easy access to CT scanning, but the burden encountered by the personnel working in radiology departments from the ever-increasing workload and imaging complexities is a clear indication that timely and accurate diagnosis of cases like intracranial hemorrhage (ICH) may suffer. Hospitals lacking on-demand radiology services are likely to rely on a resident to report the scan, where the potential to miss a finding is greater.

Intracranial hemorrhage (ICH) is a devastating sub-type stroke, accounting for 10-20% of all strokes worldwide. The mortality rate of ICH in a month is approximately 40%, which hasn't changed over at least the past 20 years. If patients survive the ictus, then the resulting hematoma present within brain parenchyma starts triggering adverse events, resulting in long-term neurological deficits. Symptoms tend to appear without warning, as in the case of Derek, but they develop gradually. And according to research conducted by Harvard Medical School, symptoms worsen over a period of 30 to 90 minutes.

With an AI algorithm in place would have identified a bleed from a head CT. And adequate treatment on the basis of findings could possibly have saved Derek's life.

AI in Radiology: What Should the Industry Expect?

With the irreversible increase in imaging data and the possibility to identify findings that humans can or cannot detect, radiology is moving from being just a subjective perceptual skill to more objective science. A radiologist's work is limited by subjectivity, indicating variations across interpreters. The focus on inter- and intra-reader variability and the work committed to enhancing both the repeatability and reproducibility of medical imaging over decades highlights the need for reproducible radiological results. From a broader perspective, the trend toward data sharing works in such a scenario. The point is that AI holds the capability to replace routine detection, characterization, and other quantification tasks currently being performed by radiologists using cognitive ability, as well as to accomplish the integration of data mining of electronic medical records in the process.

Finally, AI applications have a huge possibility of bolstering reproducibility of technical protocols, enhancing image quality and reducing radiation dose, decreasing MRI scanner time, and optimizing staffing and CT/MRI scanner utilization, thereby bringing down costs. These AI applications are expected to simplify and accelerate a technician's work, resulting in an average higher quality of examinations. This may counteract one of the limitations of AI, i.e. the limited ability to recognize the effects of positioning, etc., also due to the lack of standardized acquisition protocols. In other words, AI needs high-quality studies, but its application will lead to better quality. Thus, standardization in radiology may become attainable, increasing productivity.

The quicker and standardized detection of image findings has the potential to shorten reporting time to produce automated portions in reports. Structured AI-aided reporting represents a field where AI may have a larger impact, helping radiologists utilize relevant data for diagnosis and also presenting it concisely.

AI to Change Radiology. Not Replace Radiologists.

The concern that unique diagnostic computer algorithms will soon replace radiologists is gaining ground. However, the reality is that AI is not a threat but a tool that can support radiologists to improve results. On the one hand, automated image interpretation is becoming an indispensable aid to cope with increasing workloads. According to a recent analysis by the Mayo Clinic, radiologists in the US have an average reading time per CT or MRI image three to four seconds.

It comes as no surprise that radiologists could use some help – says neuro-radiologist Christoph Stippich of the University Hospital Basel, Switzerland. On the other hand, AI is also a promising research tool. Drawing on extensive image data sets, intelligent algorithms, for instance, may permit the performance of non-invasive tumor profiling to predict the course of a disease or the response to therapy. AI could, thus, augment the explanatory power of medical images.

Strategic Steps to Take

The developments will soon be experienced on a broader basis per recent research from the Canadian Association of Radiologists suggests. According to the study, AI will be integrated into the existing Picture Archiving and Communication Systems (PACS) for routine tasks prone to common human errors, such as detection of lung nodules on x-rays or cancer in brain tumors from CT scans.

Upstream and down-stream radiology workflow processes like image data acquisition and reporting are likely to be increasingly managed with AI algorithms. For radiology as an academic discipline, this means that it will have to work more closely with IT and computer science departments in the future.

Leading healthcare institutions in particular need to invest in human capital and hardware to set up advanced AI laboratories. Radiological education and training are also likely to undergo an evolution. For instance, if radiologists have to learn about the physics of MRI, then gathering knowledge about the principles of imaging informatics is mandatory.

While the US radiologists have been able to get an additional certificate as an Imaging Informatics Professional, the area has recently been included in the European curriculum for subspecialty training in radiology. This will open up new job profiles and career opportunities. It'd come as no surprise to see more AI-savvy radiologists in the future.