Transforming Healthcare with Artificial Neural Networks: Challenges, Innovations, and Ethical Imperatives

A neural network processes data through interconnected layers. It starts with an input layer that receives data, processes it through hidden layers, and delivers a result in the output layer. The connections between artificial neurons are defined by weights, which adjust the strength of the signals. Initially, the network produces inaccurate results because it requires training. Through iterative learning, the network adjusts these weights to improve its accuracy and effectiveness (Pruciak, 2021).

One significant application of Artificial Neural Networks (ANNs) is in healthcare. Pruciak (2021) discusses the challenges in developing neural networks for this field, highlighting the need for exceptional accuracy and reliability. He cites IBM Watson as a notable example of an advanced AI system. Training this neural network for medical applications required over two years, during which millions of pages of medical journals, patient records, and other documents were uploaded into the system. As a result, IBM Watson now supports healthcare professionals by suggesting diagnoses and recommending treatment plans based on a patient's unique traits and medical history.

Beyond IBM Watson, ANNs are also used in image-based diagnosis and predictive analytics. Google's DeepMind developed an algorithm capable of detecting over 50 eye diseases, such as macular degeneration and diabetic retinopathy, through high-resolution optical coherence tomography scans. Its accuracy is comparable to that of leading ophthalmology specialists. (Suleyman, 2018; De Fauw et al., 2018).

Another example is Aidoc, a platform using neural networks to help radiologists interpret medical images. It detects critical conditions like brain hemorrhages and strokes by analysing CTs and MRIs and flags urgent cases for immediate attention. By streamlining workflows and enabling faster diagnosis, Aidoc improves patient outcomes and helps save lives (Aidoc, n.d.; Wismüller and Stockmaster, 2020).

In my opinion, ANNs have already begun to revolutionise the healthcare industry and will continue to do so in the future. Their exceptional ability to process vast amounts of data rapidly is groundbreaking, allowing them to perform tasks that are beyond human capabilities at such speed and scale. For instance, they can analyse medical images such as X-rays, MRIs, and CT scans within seconds to minutes, while specialists like radiologists, neurologists, or orthopaedic surgeons may require significantly more time depending on their workload and the complexity of the cases (Zhang et al., 2022). This rapid analysis facilitates faster treatment decisions, which can be lifesaving in emergency situations where every moment counts.

These systems are particularly valuable in identifying patterns that might elude even the most experienced healthcare professionals, making them indispensable in disease detection. For example, ANNs can detect subtle anomalies in medical images or lab results that may be too nuanced for the human eye to perceive. In early-stage cancers, they can identify faint irregularities, such as small nodules on lung CT scans, enabling earlier diagnoses and improving patient outcomes (Cellina et al., 2023). Furthermore, models trained on extensive datasets can uncover hidden risk predictors by correlating seemingly unrelated factors. In cardiology, for instance, neural networks have linked retinal imaging features to cardiovascular risks, providing insights that were previously unknown to experts (Arnould et al., 2023).

The ethical imperative to make ANNs in healthcare universally accessible is rooted in the principles of equity, justice, and the universal right to health. Providing access to these transformative tools is not merely a technological challenge but a moral responsibility (Bouderhem, 2024). Despite their transformative potential, these technologies remain inaccessible to many. Bridging this gap is essential to ensure they serve as a global equaliser in healthcare (Smith et al., 2020). Efforts must focus on reducing costs, creating open-source tools, and lowering licensing fees, particularly for low-resource settings. Additionally, investments in research tailored to the unique healthcare needs of these regions and fostering local partnerships can help design solutions that are culturally and contextually appropriate (Baumann, 2013; Parikh et al., 2023).

Collaboration between governments, private companies, and healthcare providers is crucial to making these tools widely available. Governments can provide incentives for companies to deploy affordable solutions in public hospitals, while private firms can focus on innovation tailored to regional needs. By working together, stakeholders can ensure these advancements reach all communities, bridging the gap between innovation and accessibility (Vestberg and Smith, 2025; Rodrigues, 2023).

With their unparalleled ability to transform patient care, improve efficiency, and uncover groundbreaking insights, neural networks have immense potential to shape the future of healthcare. However, it is vital to address accessibility challenges and foster equitable implementation, ensuring these tools benefit individuals worldwide and leave no one behind.

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