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Artificial Intelligence Implementation in Specific Cancers and Personalized Therapy

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Description

The advancement of Whole Slide Imaging (WSI) has cleared the door for the use of Artificial Intelligence (AI) to digital pathology. The availability of WSI in recent years has facilitated the fast development of many AI systems. WSI-based digital pathology paired with neural networks can automate time-consuming and labor-intensive slide examination procedures. AI based on Machine Learning (ML) has been shown to outperform pathologists by reducing inter- and intra-observer subjectivity, getting quantitative data from slide pictures, and discovering hidden visual patterns important to disease subtype and development. In this article, we detail the functioning of several AI technologies such as neural networks and deep learning, as well as how different diseases benefit from them. AI has been proven to be beneficial in a variety of organs, with this review focused on the liver, kidney, and lungs. Also highlight how AI and image analysis may not only objectively grade illnesses but also find disease characteristics with prognostic significance. Finally, the present state of AI integration in pathology and give our vision for the future of digital pathology.

While pathologists manually viewing physical slides and collecting morphological data for diagnosis in both clinical and non-clinical contexts remain the gold standard, inter-observer variability hinders the comparability of outcomes across studies and locales. The discipline has been concentrated on the light microscope, which is still used today. The era has stayed mostly unaltered. With the rapid advancement of several sectors, particularly cancer, pathology modernization is urgently required to keep up with the rising needs for more robust methods of reading, diagnosing, and stratifying patients in a more objective and simplified manner. To that end, new technologies developed over the last two decades have resulted in the creation of digital pathology, opening the way for AI-based slide reading and analysis. Whole Slide Imaging (WSI) is one of these technologies. It is a revolutionary technique that enables for the scanning of microscope slides using a dedicated whole slide scanner to obtain high-resolution pictures and digitize histology slides.

When used with Machine Learning (ML) and other types of neural networks, Once trained on data, AI networks can scan digital microscope slide pictures and make diagnoses. This is referred to as picture analysis or morphometric analysis. ML is a branch of AI that detects and learns from a given dataset using algorithms and extrapolates to new datasets for more accurate learning. Deep learning (DL), a subset of ML, learns data by running it through many layers of artificial neural networks, simulating the function of neural connections in the human brain. Unlike traditional ML algorithms, which need more organized data as input, DL algorithms may accept raw data inputs and then use neural networks in intermediary layers to structure the data and make it comprehensible to the rest of the algorithm. DL is especially useful in pathology since it involves less preparation of complicated imaging data connected with slide reading in order for the algorithms to evaluate histopathological pictures properly. Important ML algorithms include many forms of neural networks.

Neural networks are algorithms designed to emulate and recreate the cognitive processes of the human brain. Neural networks work by receiving various forms of data as input and processing it *via* many hidden layers described by an algorithm, which alters the data and finally returns an output. Several neural network subtypes, such as Deep Neural Networks (DNNs), Convolutional Neural Networks (CNNs), and Artificial Neural Networks (ANNs), each have their own set of applications. Patterns may be extracted by neural network algorithms, and they can learn how various biomarkers or cell architectures connect to different diagnoses.

Based on the WSI slides, the knowledge gained from the training set is used to illness diagnosis, patient stratification, or prognosis prediction. AI will be able to continually learn from fresh patient data and enhance their models as they operate. This study will look at how WSI and ML may be used in several domains of medicine. One example will be the application of AI technology in precision cancer and customised treatment. Deep learning and digital pathology have been used to treat tumours in many organs such as the lung, liver, kidney, breast, skin, and whole-body. Based on ML data, computers can objectively assess illnesses and provide accurate prognoses. This study will concentrate on three important organs, the lungs, liver, and kidney, as well as how AI has been used to cancer and non-oncology disorders. This analysis will focus on the many sorts of scenarios that gain the most from AI technology.