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Digital Platform and Artificial Intelligence in Renal Pathology

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Pathology is in the midst of a global shift, transitioning from traditional analog methods dependent on glass slides and microscopes to digital approaches utilizing digital image files. This transformation has been further accelerated by the development of artificial intelligence (AI)-based programs in pathology, some of which are already in use in diagnostic settings. Consequently, leading medical institutions worldwide are actively pursuing the successful implementation of digital pathology systems (DPS). Some institutions have begun utilizing AI-based programs, including morphometric evaluation for markers such as Ki-67, ER, PR, and HER2, as well as disease classification, such as prostate cancer screening and grading. However, implementing DPS in medical institutions and integrating AI-based programs into diagnostic processes pose significant challenges. Overcoming these hurdles requires addressing various technical and operational issues. The primary challenge lies in integrating DPS with existing medical health information systems within hospitals. Moreover, the utilization of AI-based algorithms necessitates the development of programs demonstrating high-performance levels suitable for diagnostic purposes. Additionally, for clinical implementation, adequate validation of performance, evaluation of generalizability, assurance of safety, and resolution of uncertainty in algorithmic judgments are crucial prerequisites. Despite the development of numerous AI-based pathology programs worldwide, very few meet these requirements. There is also a scarcity of sufficient data and validation systems for their development. Additionally, the introduction of platforms such as cloud or on-premise systems for use in medical institutions is still in its nascent stages. Renal pathology stands out as a prime target for leveraging digital pathology platforms and AI-based diagnostic assistance programs. Given its complexity, diagnosing renal pathology demands specialized expertise in integrating various diagnostic domains. While efforts are underway to develop AI-based pathologic assistance programs, challenges persist in predicting patient prognosis and treatment responsiveness for renal diseases such as

glomerulonephritis, diabetic nephropathy, and renal transplant rejection.

Keywords: digital pathology system, artifitial intelligence, renal pathology, diagnositc paltform, integration