To the horizon: The brink of an AI revolution in prostate cancer?

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To the Editor:

Noorbaksh-Sabet *et al.* published an excellent review in ***The American Medical Journal of Medicine***, summarising AI potential.[1] They describe wide utility (e.g. dermatology and stroke) however, do not consider surgery and urology, which embrace cutting-edge technology, including fusion-biopsy and robotics,[2] and will be early AI adopters. Indeed, prostate cancer creates huge healthcare burden, thus being ideal for AI transformation.

MRI has revolutionised prostate cancer diagnosis, greatly outperforming TRUS-guided biopsy.[3] However, MRI still suffers false negatives and inter-radiologist variability. Development of prostate recognition algorithms, would enable machine learning to automate detection, and reduce workforce demands, subjectivity and inter-observer error. Ishioka *et al.* recently developed a computer-aided diagnosis algorithm for MRI interpretation[4] by training deep convolutional neural networks to recognise 'cancer' and 'benign' tissue. After analysis of two million images, it missed zero tumours in one dataset and two in another, thus out-performing human radiologists. With increasing clinical reliance on pre-biopsy prostate MRI, we will almost certainly continue to see an ever-expanding trend for computer-based MRI analysis.

The histopathological appearance of prostate cancer is heterogenous, and interpretation is reserved for expert uropathologists. By using a deep learning model (used by Google) a Cornell-based team developed a digital system that outperforms general pathologists in correct identification of Gleason grading (70% vs 61%). Furthermore, this system was uniquely able to assign 'precision grading' for Gleason scores (e.g. Gleason 3.7). Another team conducted supervised learning, based on prostatectomy specimens, to teach a computed-aided system to interpret digitised histopathology (assessing glandular/cellular features). The automated system had an unweighted kappa agreement of 0.51 with pathologists – for comparison, agreement between pathologists themselves was 0.45 - 0.62.[5] At present, it appears early digital prostate pathology systems are able to perform at a similar (or greater) level than pathologists, and it is certain that they will progress further in the next 5-10 years. Expert uropathologists are fundamental for development of computer-based analysis, but if these systems can reduce workload, minimise inter-reader errors, and perform analysis in a timely, reproducible manner, then a future for digital histology seems certain.

Eventually, men could be automatically enrolled to undergo a machine-read MRI (figure 1). Then they might have an autonomous robotic targeted biopsy, which could be interpreted automatically through an AI algorithm to provide rapid, accurate diagnoses. Is this idealised pathway science fiction, or is it on the horizon?

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FIGURES

Figure 1. Infographic illustrating a proposed future AI-based pathway for prostate cancer diagnosis.