Machine learning goes with the flow

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An artificial intelligence (AI) algorithm trained to listen to patients pass urine is able to identify abnormal flows and could be a useful and cost-effective means of monitoring and managing urology patients at home. It is presented today at the European Association of Urology annual congress (EAU22), in Amsterdam.

The deep learning tool, Audioflow, performed almost as well as a specialist machine used in clinics, and achieves similar results to urology residents in assessing urinary flow. The current study focuses on sound created by urine in a soundproof environment, but the ambition is to create an app so patients can monitor themselves at home.

Lower urinary tract symptoms, problems related to the working of the bladder and the urethra, are common and affect an estimated 60% of men and 57% of women.

Uroflowmetry is an important tool for the assessment of patients with symptoms, but patients have to urinate into a machine during outpatient visits. They are asked to urinate into a funnel connected to the uroflowmeter which records information about flow. During the COVID-19 pandemic access to clinics has been restricted, and even where patients can attend, the test can take a long time with queues to use a single machine.

Dr. Lee Han Jie and colleagues at Singapore General Hospital collaborated with colleagues in the engineering department to develop an algorithm and recruited 534 male participants between December 2017 and July 2019 to train and validate it. Participants used the usual uroflowmetry machine in a soundproofed room, and recorded their urination using a smartphone.

Using 220 recordings, the AI learned to estimate flow rate, volume, and time which can indicate when there is an obstruction or if the bladder is not working well. It was trained to listen to and analyse male urinary flow which is different from that of women and would need a separate sample to learn to analyse female urination.

Results were compared to a conventional uroflowmetry machine and to a panel of six urology residents who separately graded the dataset. The AI

agreed with conventional uroflowmetry for over 80% of recordings, and compared to the specialist urologists and external residents for identification of abnormal flows, it achieved an 84% rate of agreement.

Dr. Lee says: "There is a trend towards using machine learning in many fields, because clinicians do not have a lot of time. At the same time, particularly since the pandemic there is a shift towards telemedicine and less hospital-based care. We were keen to develop a way to monitor our patients to see how they are doing between hospital visits."

"Our AI can outperform some non-experts and comes close to senior consultants," he continues. "But the real benefit is having the equivalent of a consultant in the bathroom with you, every time you go. We are now working towards the algorithm being able to work when there is background noise in the normal home environment and this will make the true difference for patients."

Audioflow will now be rolled out as a smartphone app via primary care physicians so it can be tested in the real world and learn from different datasets in different noise environments.

Christian Gratzke, Professor of Urology at University Hospital Freiburg and member of the EAU22 Scientific Congress Committee of Urology says: "Giving patients the ability to measure urinary flow at home is more comfortable for them and reduces time waiting in the clinic. This is a well-executed study with a significant number of patients and represents a promising approach to developing a portable app that can be used at home. I look forward to seeing the real-world results."

Provided by European Association of Urology