UTI testing technology cuts screening time to four hours

26 September 2016

Credit: University of East Anglia

Researchers using DNA sequencing to profile antibiotic resistance in infection have achieved a turnaround time from 'sample to answer' of less than four hours for urinary tract infections (UTIs).

The nanopore MinION device is being researched by the University of East Anglia (UEA) as a way to speed up investigation of infection including UTIs – one of the most common reasons patients are prescribed antibiotics.

Traditional culture methods take two to three days to characterise bacteria and test their antimicrobial resistances from a urine sample. Early results from the UEA group's method showed that the Oxford Nanopore Technologies device can characterise bacteria and predict their antimicrobial resistances in just 12 hours from a urine sample.

This has now been shortened to as little as four hours, as published in the *Journal of Antimicrobial Chemotherapy*.

While most UTIs are mild, serious cases can lead to hospitalisation. At worst, bacteria can enter the bloodstream causing urosepsis, a life-threatening condition. In this case antibiotics are vital and must be given urgently.

Faster prediction of whether the UTI is caused by a highly-resistant type of bacteria will allow precise tailoring of treatment. The patient will get an antibiotic that is sure to be active against their pathogen, and society's limited antibiotic resource will be better managed. This will help in the fight against increasing antibiotic resistance, one of the biggest challenges facing society today.

As highlighted in the O'Neill report in May of this year, overuse of antimicrobials and the resulting increase in antibiotic resistance could - if all antibiotics fail - lead to the loss of 10 million lives a year by 2050 if no action is taken. This government-commissioned report stresses the potential of rapid diagnostics to improve both treatment and antibiotic stewardship and called on the governments of the richest countries to "mandate now that by 2020, all antibiotic prescriptions will need to be informed by up-to-date surveillance information and a rapid diagnostic test wherever one exists".

Prof David Livermore from UEA's Norwich Medical School said: "Identifying specific pathogens and resistance to antibiotics as quickly as possible is the key to reducing the number of patients who are 'over treated' with broad-spectrum antibiotics while waiting for results to come through from the micro lab – a process that presently takes a couple of days'.

"This 'carpet-bombing' approach -of giving a broad spectrum antibiotic whilst you wait for results -leads to poor antibiotic stewardship. It's vital that we move beyond it. The way to do so lies in accelerating lab investigation. That way, treatment can be refined earlier. This will benefit the patient, who gets an effective antibiotic, and society, whose diminishing stock of antibiotics is better managed."

The findings published today showed the MinION nanopore sequencing can significantly accelerate diagnosis and resistance profiling, identifying pathogens and acquired resistance genes correctly,

without culture.

Dr Justin O'Grady from Norwich Medical School said: "This study is the first to use MinION sequencing to rapidly diagnose pathogens and antimicrobial resistance in clinical samples, without growing them. Improvements in the sequencing technology, data analysis and sample preparation mean we've reduced the turnaround time to four hours.

"Getting results this fast would allow clinicians to adjust antimicrobial very early, even before the second dose is given – most antibiotics are given around once every eight hours."

In the study, human cells were removed from patients' urine samples, then the bacteria were recovered and their DNA was sequenced by MinION. Sequences were analysed and the results compared with standard culture and antibiotic susceptibility testing.

Dr O'Grady said: "Both the type of bacteria and the acquired resistance genes were identified reliably, agreeing with conventional laboratory testing.

"Challenges remain, though. The approach is currently best suited to difficult cases, but improving hospitals' antibiotic stewardship requires new diagnostics to be deployed widely.

"Our method currently requires heavily-infected urine and our rapid analysis can't yet predict those resistances that arise by mutation – changes to existing genes. But the technology is developing rapidly and we expect to overcome these limitations in the near future."

The paper 'ID of bacterial pathogens and antimicrobial resistance directly from clinical urines by nanopore-based metagenomic sequencing' is published in the *Journal of Antimicrobial Chemotherapy* today (Monday 26 September).

Provided by University of East Anglia