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The Accelerate Pheno™ system in clinical practice: fast and accurate turnaround for critical results

Dr. Claire Thomas
******@***hhft.nhs.uk

Director of Infection Prevention
and Control - Hampshire Hospitals
NHS Foundation Trust
Basingstoke
UK

Our clinical experiences of using the Accelerate Pheno™ system have greatly benefited patient care, providing earlier diagnostic certainty. Two complex sepsis cases are discussed, where the impact of rapid identification, with antibiotic sensitivities, of the causative organism from blood cultures is described.

At Hampshire Hospitals NHS Foundation Trust, we endeavour to be ahead of the curve in diagnostics, being patient care focused, with a bedside to bench clinical approach. However, with our existing laboratory standard of care, our turnaround time for critical results like blood cultures was not optimal, and antibiotic initiation for sepsis is empirical. We evaluated the Accelerate Pheno™ system within our busy clinical microbiology laboratory during 2016/7.

We began using the Accelerate Pheno™ system as a lab evaluation in 2016, and as a full clinical evaluation with 100 assays in 2017, alongside our existing gold standard methodology. We developed a clinical algorithm for the use of the Accelerate PhenoTest BC, and could swiftly see that it was giving us what we wanted for our patients—rapid identification (ID) and a rapid antibiogram.

Antibiotics stewardship

We endeavour to have very tight control of antibiotic stewardship within our Trust. As rates of antibiotic resistance are rising in the community and in the hospital, we try to get the antibiotics right first time, giving our clinical teams guidance via local antibiotic policies (smartphone app), but this is not always accurate, and in rapidly deteriorating septic patients, there is a tendency to escalate up to 'end of the line', broad-spectrum antibiotics. We do not achieve diagnostic certainty until we get a positive blood culture, and then often only at day 3 of illness. So we were keen that the Accelerate Pheno™ system would play not only a huge role with improving how we treat sepsis and other infections, but also with antibiotic stewardship. This system would give us rapid timely results compared to our current system, which can take up to 3 days.

Clinical workflow

We hold a daily clinical microbiology/infection ward round that visits positive blood culture patients and septic patients. Each working day we see intensive care and high-dependency unit patients on our round with a laptop that has the latest results linked to the laboratory. We loaded signal-positive blood cultures on to the Accelerate Pheno™ system 7 days a week during normal working hours. We would stop taking blood cultures off the system at 22.00. We linked the results to an email that we could pick up wherever we were, on or off site. Our aim would ultimately be for the on-call doctors to have this result sent to them electronically at night, with an agreed clinical reporting system.

Significantly reduced identification and antibiogram times

The Accelerate Pheno™ system turnaround time was found to be extraordinary in terms of the ID, which was much appreciated by our users. The mean ID time was 1.35 hours, with the antibiogram coming through at a mean time of 6.65 hours.

Sensitivity and specificity

If we had a Gram-negative result, we would put it straight on the system. The sensitivity was 96.3% and the specificity was 99.8%. We had a categorical and MIC agreement with the standard of care. Its essential agreement was 97.9%, and the categorical was 97%.

We did use it for Gram-positives, but not as many found it useful for distinguishing *Staphylococcus aureus*, from *S epidermidis*, in selected cases.

Minimal training required

Training to use the system only takes around 30 minutes, and we hope to use it on the other sites, as we have 3 hospitals on different sites in

our Trust, with 1 central microbiology laboratory. It takes 3-5 minutes to put each sample on. We are about to roll it out for full clinical use. Of note, it could be used by other trained scientific staff, not only by microbiologists.

Conclusion

The tool proved incredibly valuable towards significantly reducing the ID time to one and half hours, providing an antibiogram within 6-7 hours, and giving diagnostic certainty when managing septic cases, for us and the ward clinicans. We could access results remotely when on call, and as we have hospitals on three sites, it could be used for rapid diagnostics on one of the other sites as our laboratory is centralised.

Case Reports

Case 1:

A 31-year old male on the haematology unit with acute myeloid leukaemia had a recent *Clostridium difficile* infection and a central line enterococcal infection. He was on prophylactic posaconazole and the lines were removed. From rectal swabs he had been found to be colonised with a multidrug-resistant (MDR) *Pseudomonas*, suspected to be a carbapenemase producer. He deteriorated rapidly over the course of a few hours with shortness of breath, fevers, and clinical signs of sepsis. He was empirically started on piperacillin-tazobactam, with an aminoglycoside (amikacin). We took blood cultures at 11.00; his white cell count at this point was 0.3, so he was still essentially neutropaenic, with platelets of 38 and haemoglobin of 9.

The blood culture signal on the machine was positive at 16.31 with a Gram-negative organism on gram film. We processed the blood culture according to our normal standard of care, and also on the Accelerate Pheno™ system. The ID came through at 19.11 as *Pseudomonas aeruginosa*, which worried us because of what he was colonised with. We were already in the middle of an outbreak investigation, as the haematology unit had recently had a patient with MDR *Pseudomonas*, a GES-5 carbapenemase producer resistant to meropenem, ciprofloxacin, ceftazidime, gentamicin, sensitive to amikacin and colistin. The patient was stable, and we decided to keep him on the piperacillin-tazobactam and amikacin for the time being, but we asked to be called immediately if he deteriorated. We ensured we had colistin on the unit so that if he deteriorated we could give him that.

Six hours later we had the full antibiogram. It was an MDR organism that fitted with what he was colonised with. This allowed us to rationalise the antibiotic choice. We phoned the haematology doctors at 02.00 and changed the antibiotics to colistin and amikacin, with the information given. Using the Accelerate PhenoTest™ BC gave us clarity—we knew what we were dealing with, and it helped us to manage the patient as appropriately as possible with very targeted antibiotics. On review we realised he had a perineal tear. The patient recovered from his neutropaenia, and antibiotics were stopped at 2 weeks after the positive blood culture. With our standard system we would have had to wait for at least another 24-48 hours to identify the organism. In a very immunocompromised patient, it could have been extremely detrimental if we had not got this right.

Case 2:

A 26-year-old female came in to the emergency department, after a collapse at home, with a queried septic arthritis. We were called in by the orthopaedic ward who said she was profoundly septic. On review, she was in respiratory failure with low blood pressure and acute kidney injury on a background of Noonan's syndrome. She was quite a complex patient with cardiac issues, secondary to her Noonan's. She was seen by the orthopaedic team at 11.00, and started on empirical treatment: intravenous meropenem. She had a background of penicillin allergy with a rash, so although meropenem is very broad-spectrum, that seemed reasonable at the time. The blood culture was signal positive at 11.00. The lab informed me at 11.15 that there was a Gram-negative bacillus coming through in the blood culture. They put this straight on to the Accelerate Pheno™ system. The patient was picked up by the high-dependency outreach team and transferred to intensive care. At 12.30, we got an ID and it was a Serratia marcescens, which we know to be a carrier of an AmpC resistance mechanism and therefore highly likely to be MDR. The antibiotic susceptibility testing (AST) then came through at 17.30, and it confirmed that we were doing the right thing with meropenem, but we felt we could also give gentamicin as she was on dialysis filtration, and still deteriorating. We isolated her in a side room for optimal infection control, as this was a MDR organism, and she was subsequently found to have influenza A. She was subsequently found to have pneumonia, possibly secondary to having influenza A in the community. We were able to optimise her treatment over and above what we would normally do with our standard of care and have surety that we were using the right antibiotics. This knowledge also helped greatly with infection control actions. The patient made a recovery after a time in intensive care and the high-dependency unit (HDU).

For more information about the technology mentioned in this article, visit axdx.com/icu-mgmt

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