The technology and techniques used in the detection of pathogenic bacteria

With a global increase in the number of multidrug-resistant “superbug” infections, and the concomitant requirement for bacterial surveillance systems, there is a constant need for specific new detection methods for pathogenic bacteria, with the ideal methods being cost-effective and simple, those which do not require specialised instrumentation or complex chemical sequences that have to be performed by trained personnel.

In a recent BBC/ICM poll, the most common concern about hospital care was the risk of acquiring an infection, such as meticillin-resistant *Staphylococcus aureus* or *Clostridium difficile*, with 40 per cent of people surveyed listing the risk of infection as their biggest fear.1 In the fight against the spread of both nosocomial and community-acquired infections, attempts have been made to increase public awareness about the link between health and hand hygiene through a number of television, radio and advertising campaigns, including the “Hand in hand” campaign2 launched by the East Midlands Strategic Health Authority, which the charity MRSA Action UK suggested should be rolled out nationally.

Multidrug-resistant bacteria are indeed an increasing clinical problem,3 with a particular concern being the transmission of resistance between these bacteria, which could ultimately lead to strains that have limited or no susceptibility to antibacterial agents. For example, although the incidence of glycopeptide-resistant enterococci (GRE) in Europe is currently much lower than in the US (where more than 20 per cent of enterococcal isolates are vancomycin-resistant), a report in 2003 of an *in vivo* transmission of vancomycin resistance from GRE to MRSA highlights the significant risk that would be associated with having co-existing, non-isolated infections because of these pathogens.4

It should also be noted that MRSA is susceptible to very few agents, including the glycopeptides (vancomycin and teicoplanin), quinupristin-dalfopristin and linezolid. Cases of meticillin- and quinupristin-dalfopristin-resistant *S aureus* have already been reported in Europe.5 From April 2009, the Care Quality Commission (CQC) took over responsibility for health and social care regulation from the Healthcare Commission.6 "The Health and Social Care Act 2008: code of practice for the NHS on the prevention and control of healthcare-associated infections, as set out in the regulations made under section 20(5) of this Act." Relevant NHS bodies must have, and adhere to, policies for the control of outbreaks and infections associated with both MRSA and *C difficile*, while acute NHS trusts must have similar policies for other specific alert organisms (see Panel 1).

With specific regard to MRSA, this policy should make provision for the screening of all patients on admission, including the screening of all elective admissions since March 2009, and the provision for screening of emergency admissions on presentation as soon as practicable. This screening should then be used to inform the need for decontamination or isolation of colonised patients.

The Health Protection Agency publishes data derived from the mandatory surveillance of MRSA, *C difficile* and vancomycin-resistant enterococci (VRE) bacteraemia, and the most recent data show that, between January and March 2009, there was a 2.1 per cent increase in MRSA bacteraemia compared with the previous quarter (but a reduction of 29 per cent compared with the corresponding quarter in 2008), while there was a 34 per cent decrease in the number of reported MRSA bacteraemias in the financial year 2008–09.7

The need for rapid and simple methods for the detection of pathogenic bacteria, such as MRSA, GRE, extended-spectrum beta-lactamase-producing organisms (ESBL), *Pseudomonas aeruginosa*, and *Acinetobacter baumanii*, is thus self-evident. We will now concentrate on some techniques available for use in bacteraemia surveillance.

**Techniques**

**Microscopy** Traditionally, pathogenic bacteria are detected by microscopy on the basis of their colonial appearance after inoculation of a culture medium that facilitates the growth

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**Panel 1: Specific alert organism policies required by acute NHS trusts**

The organisms include:

- Meticillin-resistant *Staphylococcus aureus*
- *Clostridium difficile*
- Glycopeptide-resistant enterococci
- Acinetobacter and other antibiotic-related bacteria
- *Legionella*
- Tuberculosis (including multidrug-resistant TB)
- Respiratory viruses
- Diarrhoeal infections
- Viral haemorrhagic fevers
- *Legionella*

Paul W. Groundwater is professor of medicinal chemistry at the faculty of pharmacy at the University of Sydney, Australia. Adam Todd, MRPharmS, is senior lecturer in pharmacy practice, Alan J. Worsley, MRPharmS, is principal lecturer in pharmacy practice and Roz J. Anderson is professor of pharmaceutical chemistry, all at Sunderland Pharmacy School, University of Sunderland.

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The increased requirement for bacterial surveillance techniques that are simple, rapid, cost-effective and specific means that the development of such tests is an area of continued research interest. Fully automated methods that are able to give results in hours rather than days are ideal since these would enable the rapid isolation and decontamination of colonised patients, resulting in a reduction in the opportunities for the spread of infections and cross-infection of patients by a number of multidrug-resistant bacteria.

The rapid and specific identification of pathogenic bacteria will also enable a patient’s treatment regimens to be specifically tailored to suit clinical need. This process will improve patient care and also help to combat the threat of future antibacterial resistance.

Molecular diagnostic methods

The advantages of molecular diagnostic methods are that: they are rapid (results can typically be obtained within a few hours), they can be highly specific and, like the automated culture-based methods, they can be performed in closed systems and have the capacity for automation. These methods are based on the bacterial genotype and often involve real-time polymerase chain reaction (PCR) technology.

Conclusion

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