Detection of methicillin-resistant Staphylococcus aureus (MRSA) from growth on mannitol salt oxacillin agar using PCR for nosocomial surveillance

Jayaratne P, Rutherford C

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
A polymerase chain reaction (PCR) amplification of mecA and nuc genes, in clinical laboratories, using yellow colonies on mannitol salt agar containing 6 mg/litre oxacillin (MSO-6) for the detection of methicillin-resistant Staphylococcus aureus (MRSA) in surveillance specimens. The PCR method described in this study is based on the fact that only MRSA are positive for both mecA and nuc gene targets among bacteria that produce yellow colonies on MSO-6.

Type of intervention
Screening and diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
Surveillance specimen swabs from nares, axilla, rectal, and wound sites.

Setting
Hospital. The economic analysis was carried out in Canada.

Dates to which data relate
No dates were given.

Source of effectiveness data
The evidence for the final outcomes was based on a single study.

Link between effectiveness and cost data
Costing was performed on the same specimen sample as that used in the effectiveness analysis and appears to have been conducted prospectively.

Study sample
Power calculations were not used to determine the sample size. A total of 645 consecutive surveillance specimen swabs (265 patients) from nares, axilla, rectal, and wound sites that produced yellow colonies on MSO-6 representing presumptive growth of MRSA were used. Of the total of 1935 specimens, 1290 produced pink colonies at 48 hours on MSO-6 representing no MRSA.
Study design
Prospective cohort study, carried out in a single centre. The duration of the follow-up appears to have been until diagnosis. The loss to follow-up was not reported.

Analysis of effectiveness
The principle used in the analysis of effectiveness (intention to treat or treatment completers only) was not explicitly specified. The outcomes were sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). The average turnaround time was also reported.

Effectiveness results
The diagnostic values for PCR compared with culture methods were 97% specificity, 100% sensitivity, 96% PPV, and 100% NPV. The average turnaround time for PCR was 48 hours as compared with 82 hours for the conventional method.

Clinical conclusions
The lower specificity and PPV of the PCR method compared with the phenotypic method was due to the 11 false-negative samples identified by the culture methods. In the authors’ experience this could have been caused by missing the MRSA during subculture from the MSO-6 to the blood agar purity medium, which is a critical step in the phenotypic method. This could happen when a light growth of MRSA is mixed with a heavy growth of other methicillin-resistant organisms. However, this is not usually a problem for the PCR method because the preparation of the cell suspension as a source of DNA for PCR uses a sweep of yellow growth on MSO-6 rather than picking up a single colony.

Measure of benefits used in the economic analysis
No summary benefit measure was identified in the economic analysis, and only individual clinical outcomes were reported.

Direct costs
Costs were not discounted due to the short time frame of the cost analysis. Some quantities were reported separately from the costs and some cost items were reported separately. Cost analysis covered the costs of materials and labour. The equipment costs were reported separately (not included in the total costs). Labour costs were calculated at a rate based on hands on time. Total cost included additional costs associated with repeat testing of 5% of original tests. The perspective adopted in the cost analysis was not explicitly specified. The price year was not specified.

Indirect Costs
No indirect costs were included.

Currency
Canadian dollars (Can$). The conversion rate was Can$1.00 = US$0.67.

Sensitivity analysis
No sensitivity analysis was carried out.

Estimated benefits used in the economic analysis
Not applicable.
Cost results
The total cost for PCR per test was Can$3.62 compared to Can$4.77 for culture. However, the total cost per specimen was significantly lower due to only 20% of all surveillance specimens producing yellow colonies on MSO-6. In addition to costs associated with daily operation, the capital cost for equipment needed for setting up PCR was approximately Can$8,000 to Can$15,000, depending on the workload.

Synthesis of costs and benefits
Costs and benefits were not combined.

Authors’ conclusions
PCR amplification of mecA and nuc genes using yellow colonies on MSO-6 is a simple, fast, accurate, and cost-effective method for routine use in clinical laboratories for detecting MRSA in surveillance specimens.

CRD COMMENTARY - Selection of comparators
The strategy of using the culture-based method (the gold standard), was regarded as the comparator. You, as a database user, should consider whether this is a widely used health technology in your own setting.

Validity of estimate of measure of effectiveness
The internal validity of the effectiveness results is likely to be high due to the prospective nature of the study design. However, no power calculations were performed to justify the sample size adopted in the study. No information was given to indicate whether the effectiveness analysis was based on intention to treat or on treatment completers. The effects of potential covariates on the effectiveness results were not discussed.

Validity of estimate of costs
Some quantities were reported separately from the costs. Adequate details of the methods of cost estimation were not given. The price year, perspective adopted in the cost analysis, and sources of cost data were not reported. All cost components do not appear to have been included in the total cost analysis, for example capital costs were omitted. It was reported that due to the existence of many other applications for the equipment used for the PCR method it was difficult to calculate the cost portion for the equipment. Therefore, it was noted that the current applications and the total workload have to be taken into account when calculating the equipment costs associated with the PCR method. The effects of alternative procedures on indirect costs were not addressed. Statistical analyses were not performed on cost data or resource consumption. The cost results may not be generalisable to other countries.

Other issues
The authors’ conclusions appear to be reasonably justified given the uncertainties in the data. The issue of generalisability to other settings was not addressed, although some comparisons were made with other studies.

Implications of the study
The authors reported that, after validation, they have been routinely using this PCR method for detecting MRSA in surveillance specimens for over a year. The average workload is 250 PCR tests per week. The main advantage of the PCR method over routine culture methods is the shorter turnaround time, which allows rapid implementation of infection control practices.

Source of funding
None stated