Clinical and financial benefits of rapid bacterial identification and antimicrobial susceptibility testing

Barenfanger J, Drake C, Kacich G

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
Rapid bacterial identification and antimicrobial susceptibility testing (RAST).

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
Patients for whom antimicrobial susceptibility testing (AST) was performed in a normal (NAST) or rapid (RAST) manner.

Setting
Memorial Medical Center, Southern Illinois University School of medicine, USA.

Dates to which data relate
The analysis was based on a historical cohort during the period from May 1997 to December 1997. The samples received for culture from 21 May to 30 September (excluding samples received in 12 days in July which were included in RAST group) were included in the NAST group. Samples received from 20 July to 31 July and from 27 October to 16 December, when an additional evening verification of the ready reports was performed by a technologist, were included in the RAST group. Limited resource use data (average lengths of stay for the treatment and control groups) were reported. The year of the direct and indirect costs employed was not stated.

Source of effectiveness data
The effectiveness data were based on a single study.

Link between effectiveness and cost data
The costing was undertaken retrospectively on the same patient sample as that used in the effectiveness analysis.

Study sample
All patients whose samples were cultured in the relevant time periods for the normal and rapid reporting of the results from AST formed the study sample. The patients from the RAST group were DRG-matched by patients from the NAST group which resulted in final samples of 523 patients in the NAST and 242 patients in the RAST groups. No power calculation was reported.
Study design
This was a prospective cohort single centre study with different cohorts in the treatment and control groups providing data for the analysis.

In the normal manner (NAST), between 8 and 9am bacterial isolates were inoculated in the Vitek system (bioMerieux, St Louis, Mo). During the day shift (7 am to 3:30 pm) approximately half of the Vitek reports were ready to be verified and were verified by a technologist. If the data were acceptable, they were verified electronically in the Vitek system and automatically downloaded to the laboratory information system (LIS). The verified data were available to the physicians via computer access to the LIS at any time. At 10pm each night (once every 24 hours) a printed copy of all laboratory reports was generated and was available to the physicians making rounds the following morning. The reports, which were not yet ready to be verified in the day shift, were verified between 7 and 9am the next day.

For the RAST group, the procedure was exactly the same, except that a technologist on the second (evening) shift was scheduled to verify the reports, which became ready for verification after the day shift was over. Evening-shift verification was done at about 8:30 pm and took less than an hour. Data, which were verified on the second shift, were included in the cumulative report generated in 10pm.

The data for the patients' stays in the hospital were analysed. The physicians were not aware of any change of practice in microbiology.

Analysis of effectiveness
The intervention was comprehensive for all samples during the respective time periods, therefore more closely resembling intention to treat analysis. All categories of diagnosis-related groups (DRGs) for patients in the RAST group and the matching categories of DRGs for patients in the NAST group were included. The primary benefits analysed were the turnaround time (time from the receipt of a sample in the laboratory to the incorporation of verification of first AST result in the laboratory information system (LIS)), mortality, length of stay, orders and timing of antimicrobial agents.

The two patients groups were comparable in terms of age and severity code of DRGs and differed only in terms of the turnaround time.

A review of the medical records of 75 patients from the NAST and 75 patients from the RAST groups (quasi-randomly selected) was performed to determine whether physicians prescribed appropriate antimicrobial therapy sooner for RAST patients.

Effectiveness results
Approximately 50% of NAST sample results and 90% of RAST sample results were verified by the end of first day.

The average turnaround time for the reporting of AST results for all patients was 39.2 hours for the RAST group and 44.4 hours for the NAST group. The difference of 5.2 hours was statistically significant, (p=0.001).

The mortality rate for the RAST group was 7.9% and for the NAST group was 9.6%, (not statistically significant).

The average length of stay was 10.7 days in the RAST group and 12.6 days in the NAST group, (statistically significant difference of 2.0 days, p=0.006).

The percentage of patients for whom appropriate antimicrobial therapy was initiated within 48 hours of receipt of their samples in the laboratory was 94% for the RAST group and 77% for the NAST group, (statistically significant difference, p<0.006).

Clinical conclusions
The speeding of the process of reporting the results from AST enabled the physicians to have this crucial information
and initialise appropriate antimicrobial therapy sooner, which resulted in a statistically significant decrease in patients' length of stay.

**Measure of benefits used in the economic analysis**

No summary measure of benefits was used in the economic analysis. The benefits are therefore associated with the effectiveness results reported above. The costs were analysed separately for the two study groups and thus the cost-effectiveness analysis has a cost-consequences design.

**Direct costs**

Fixed (overhead and costs of administration) and variable (i.e. pharmacy services, imaging, laboratory and microbiology) direct costs related to the patients' stays in the hospital were calculated based on costs provided by the clinical data management team.

Analysis of a subset of the departmental costs included in the overall and variable costs was performed to investigate the sources of cost saving.

The means of each DRG group in the two study groups were used to calculate the mean of all DRGs in order to control for the potential unequal distribution in the NAST and RAST groups of patients with different DRG categories.

**Statistical analysis of costs**

Two-tailed t-tests were used to directly compare the two groups.

**Indirect Costs**

Fixed indirect costs were reported to have been included but their origin was not specified.

**Currency**

US dollars ($).

**Sensitivity analysis**

No sensitivity analysis was reported.

**Estimated benefits used in the economic analysis**

This was not applicable. See the Effectiveness Results section above.

**Cost results**

The average total cost was $13,227 for the RAST group and $15,622 for the NAST group, (statistically significant difference of $2,395, p=0.04). The average variable cost for a patient was $4,927 for the RAST group and $6,677 for the NAST group, (statistically significant difference of $1,750, p=0.001).

The subset analysis showed that the average cost of pharmacy services, imaging, laboratory and microbiology were smaller for the RAST group: $811 versus $1,196, $285 versus $354, $592 versus $633 and $92 versus $103, respectively.

**Synthesis of costs and benefits**

This was not relevant for the type of economic evaluation reported.
Authors' conclusions
As well as offering clinical benefits, the RAST strategy is a potentially significant cost saving technology having the biggest impact on the decrease of the average variable costs of the patients.

CRD COMMENTARY - Selection of comparators
The comparator was appropriately selected and justified for the setting of the study, namely the usual practice of AST results processing and reporting at the study hospital. Users of this database should consider whether the usual practice at their setting and the intervention are applicable.

Validity of estimate of measure of effectiveness
The study sample was relatively representative of the study population. The patient groups were shown to be comparable at analysis and appropriate statistical analysis was undertaken. The validity of the results is therefore likely to be high.

Validity of estimate of summary measure of benefit:
The authors did not derive a measure of health benefit. The analysis was therefore a cost-consequences design.

Validity of estimate of costs
The study was not explicit about which cost categories were included in the analysis. Costs were not reported separately from the quantities. No statistical analysis of quantities was performed with the exception of the average length of stay. A statistical analysis of cost differences was not performed. The costs were incurred over a period shorter than one year and discounting was therefore not applicable. The price date was not reported. As these features tend to limit the generalisability of the results, users of this database are advised to consider the cost in their own settings.

Other issues
The authors made appropriate comparisons of their findings with those from other studies, but did not address the issue of generalisability to other settings. The authors' conclusions appropriately reflect the study scope.

Implications of the study
The study results suggest that speeding up the reporting of results of AST improved the patients' treatments and shortened their stay in hospital, thus generating significant cost savings. The study design (non-randomised controlled trial) and the lack of direct clinical outcomes (other than mortality) makes it difficult to come to conclusions regarding the effectiveness of the intervention.

Source of funding
None stated.

Bibliographic details

PubMedID
10203497

Other publications of related interest
Indexing Status
Subject indexing assigned by NLM

MeSH
Bacteria /isolation & purification; Bacterial Infections /diagnosis /mortality; Humans; Microbial Sensitivity Tests /economics; Time Factors

AccessionNumber
21999000834

Date bibliographic record published
31/08/2001

Date abstract record published
31/08/2001