A pharmacist-initiated program of intravenous to oral antibiotic conversion

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 pharmacist-initiated programme of conversion from parenteral to oral antibiotics in patients with mild and moderate infections. The intervention programme targeted those antimicrobials with high use or high cost to the study institution including ampicillin-sulbactam, ciprofloxacin, imipenem-cilastatin, cefuroxime, cefazolin, ticarcillin-clavulanic acid, ceftizoxime, and the combination of tobramycin with either piperacillin or ceftazidime.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
Patients with a non life-threatening infection (urinary tract, skin and soft tissue, community-acquired pneumonia, osteomyelitis, nosocomial pneumonia, pneumothorax, chest tube prophylaxis) who had the following characteristics: receiving a targeted antibiotic, having white blood cell count less than 15,000/mm^3, having been afebrile for at least 24 hours, and being able to take oral antibiotics. The excluded patients consisted of those with life-threatening infections, such as sepsis, bacterial endocarditis, and meningitis.

Setting
Hospital. The economic study was carried out in Detroit, USA.

Dates to which data relate
The effectiveness and resource use data appeared to have been collected between 1993 and 1994. The price year was not explicitly specified.

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

Link between effectiveness and cost data
Costing was prospectively undertaken on a subset of the same patient sample as that used in the effectiveness analysis.

Study sample
Power calculations were not used to determine the sample size. A total of 242 patients entered the study during a one-year period; of whom 200 comprised the converted group with a mean (SD) age of 50.1 (18.1) years versus 42 in the non-converted (control) group who met the study criteria for conversion but who were not converted for a variety of
Study design
This was a prospective hospital-wide cohort study, carried out in a single centre. The duration of the follow-up appears to have been until discharge from the hospital. The study appears to have had no loss to follow-up. After making contacts with physicians regarding the patients meeting study criteria and their potential conversion therapy, therapy options were discussed and an equivalent oral antibiotic was chosen based on the patient's infection, culture results, bioavailability of the oral agent, and achievable blood levels. A patient's physician had the right to refuse the conversion recommendation or to switch the patient back to the intravenous regimen at any time. The study was performed after analysing the preliminary findings from a prospective 1-month pilot conversion study on 38 patients.

Analysis of effectiveness
The principle used in the analysis of effectiveness appears to have been intention to treat. The clinical outcomes were clinical response to therapy, the percentage of patients discharged home taking oral antibiotics, adverse effects, temperature, and white blood cell counts. The study groups were found to be comparable in terms of demographic data and infection diagnosis.

Effectiveness results
The effectiveness results were as follows:

The positive response was 99% in the converted group versus 100% in the control group (2 cases in the converted group had negative response to oral therapy within 48 hours and were subsequently switched back to a parenteral antibiotic).

The percentage of patients discharged home taking oral antibiotics was 77% in the converted group versus 77.5% in the control group (NS).

The number of deaths was 2 in the converted group, however, these deaths were found not to be related to infection.

Neither of the groups experienced any adverse antibiotic effects.

White blood cell counts showed transient increase in four patients (2.3%) in the converted group while receiving therapy, but the overall trend was downward or within normal limits at discharge home in all patients.

One patient in the control group experienced fever while receiving intravenous antibiotics; the fever decreased within 48 hours.

All patients were afebrile on discharge.

Clinical conclusions
All patients tolerated therapy well. As in previous studies, the study group experienced a positive clinical outcome and decreased length of stay.

Measure of benefits used in the economic analysis
The summary benefit measure adopted in the study appears to have been infection cure rate. Since the cure rates were similar in the two groups, the study was carried out as a cost-minimisation analysis.

Direct costs
Costs were not discounted, as the time frame of the study was less than one year. Quantities were reported separately from the costs in terms of length of stay (LOS) only. Cost items were reported separately in general categories. The cost analysis covered the costs of antibiotic therapy and hospital stay. Antibiotic costs included ancillary costs such as
intravenous bags, infusion sets, and infusion devices. The perspective adopted in the cost analysis was that of the hospital. The LOS data were calculated for 172 patients in the converted group and 40 patients in the control group. It was deemed that including patients with prolonged LOS due to unrelated complications or diseases would have artificially increased the LOS data. To calculate the cost saving due to decreased LOS, a random sample of 10 patients in the intravenous group was used to estimate the costs of care on the last day of stay. For hospital cost charge ratio was used to estimate the costs of LOS. The date of the price data was not explicitly specified. The cost analysis did not cover the costs of personnel time for pharmacy and nursing staff since these were deemed to be fixed costs regardless of the conversion programme.

**Indirect Costs**
Not included.

**Currency**
US dollars ($).

**Sensitivity analysis**
Not conducted.

**Estimated benefits used in the economic analysis**
It was reported that all infections in both groups were ultimately cured.

**Cost results**
The total cost savings due to the conversion programme for the converted group was $176,221.12 ($15,149.24 due to antibiotic cost savings and $161,071.88 due to LOS cost savings).

**Synthesis of costs and benefits**
Costs and benefits were not combined since the study became a cost-minimisation analysis after it had been established that efficacy rates were equal in terms of cure rate.

**Authors' conclusions**
The intervention programme appeared to provide a cost-effective conversion from parenteral to oral antimicrobial administration without compromising patient care.

**CRD COMMENTARY - Selection of comparators**
A justification was implicitly provided for the choice of the comparator (not using the conversion programme and using intravenous antibiotic); in 1993, more than 90% of all antibiotics prescribed in the study institution were parenteral. You, as a database user, should consider whether this is a widely used health technology in your own setting.

Validity of estimate of effectiveness:

The internal validity of the effectiveness results can not be guaranteed due to the non-randomised nature of the study design and the fact that the follow-up period may not have been long enough to cover relapse or reinfection (an important element for validating the safety and efficacy of an antibiotic-conversion programme), as acknowledged by the authors. The high acceptance rate (83%) of the study recommendations was deemed to be the major contributing factor to the study's small control group. However, some of the reasons, given by the authors, suggest that the control group might have been different in prognosis compared to the converted group. The study sample appears to have been representative of the study population. The study groups were comparable in terms of gender, mean age, and diagnosis.
No specific statistical analysis was performed to account for the effects of other potential confounding variables.

**Validity of estimate of measure of benefit**
The benefit measure (cure rate) was obtained directly from the effectiveness analysis; as the groups were similar in terms of this measure, the study was, therefore, a cost-minimisation analysis.

**Validity of estimate of costs**
Quantities were reported separately from the costs in terms of LOS. Some details of methods of cost estimation were given. Statistical analysis was performed on LOS data. With respect to the perspective adopted, no important cost items appear to have been omitted other than staff time, which was assumed to be an element of fixed costs. The use of cost-to-charge data to estimate actual costs was deemed to be one of the limitations of the cost analysis as the study institution lacked a cost-accounting system to acquire cost data. Direct and indirect costs imposed on patients and society in general were not discussed. Cost results may not be generalisable to other settings.

**Other issues**
Given the inherent limitations of the study design, lack of sensitivity analysis, and statistical analysis of the costs, the study results should be interpreted with some degree of caution. The issue of generalisability to other settings was not addressed, although appropriate comparisons were made with other studies; it was concluded that the studies already published demonstrated that oral therapy could be as effective as parenterally administered antibiotics in the treatment of infections ranging from mild and moderate to severe. The study enrolled patients with mild and moderate infections and this was reflected in the authors' conclusion. The authors do not appear to have presented their results selectively.

**Implications of the study**
Future studies should incorporate relapse, reinfection, and actual cost data to evaluate fully the impact of the intervention. Despite the limitations, the authors believed that the intervention programme had a positive impact in the study hospital. It was anticipated that expansion of the programme in the future to include additional antibiotics will result in even greater cost savings.

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