Penicillin sensitivity of gonococci
An evaluation of monitoring as an index of epidemiological control

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Summary
The penicillin sensitivities of 1,167 gonococci isolated during a 30-month period from male patients, and 794 gonococci isolated from female patients were analysed retrospectively. More strains from males were relatively resistant than those from females, and a higher proportion of relatively resistant organisms was isolated from each sex when the infection had been acquired outside the area served by the clinic.

During the course of the study a fall in the number of relatively resistant strains was seen amongst the locally acquired organisms, whilst no such drop occurred in the strains acquired elsewhere; it is postulated that improved contact tracing may have been responsible. Regular monitoring of the penicillin sensitivity of gonococci has been shown to be a sensitive index of gonorrhoea control.

Introduction
The concept that the penicillin sensitivity of gonococci may be used as an index of control is not new (Morton and Higson, 1966; Lomholt and Berg, 1966), and regular monitoring has been advocated (Ronald, Eby, and Sherris, 1968).

In this retrospective study, the penicillin sensitivity of gonococci has been investigated with three objectives. Firstly to compare the penicillin sensitivities of gonococci isolated from male and female patients. Secondly, to compare the sensitivities of organisms acquired in the Sheffield area (referred to as 'local' strains), with those acquired in other areas (called 'elsewhere' strains). Finally, to test the assertion that penicillin sensitivity testing is an essential tool of control (Ronald and others, 1968) by examining results obtained in the area of one clinic.

Patients and methods
During the 30-month period October 1, 1972, to March 31, 1975, the penicillin sensitivities were determined in 1,961 culture-positive cases of gonorrhoea isolated from patients attending the Sheffield Special Clinic. 1,167 had been isolated from males, and 794 from females, and these represented 91·1 and 80·4 per cent. respectively of the infections diagnosed in male and female patients.

A positive cultural diagnosis of Neisseria gonorrhoeae was established by sugar fermentation or by fluorescent antibody testing, and the penicillin sensitivity of subcultures was determined using a plate dilution method (Reyn, Bentzon, and Ericsson, 1963). The results obtained were expressed as 50 per cent. Inhibitory Concentrations (IC50), and were standardized using reference strains from the State Serum Institute, Copenhagen. Cultures with IC50 of 0·08 i.u. penicillin per ml. or more, were regarded as being relatively resistant.

The locale of the patient's infection was determined from the medical and social history. Local infections were taken as those acquired within the Sheffield city area. Infections resulting from exposures in the rest of the country and abroad were considered to have been caused by 'elsewhere' strains. Infections from abroad (1·41 per cent.) were not analysed separately.

The response to treatment was also investigated.

Recurrence of infection was defined as the finding of gonococci by Gram-stained smears or culture within 1 week of treatment with procaine penicillin, 1·2 m.u. for males and 2·4 m.u. for females.

Results
To provide data for longitudinal study, the results were divided into five consecutive 6-month periods; the total numbers of cases diagnosed were higher during the second and fourth periods, that is during the summer months, and more males than females acquired their infection 'elsewhere' (Table I). Throughout the period of study, a higher proportion of males were infected with a relatively resistant strain than females, whether they were infected
Discussion

When the was seen 24-8 per cent. however, the strains fell during locally (28-8 strains relatively there 1st (6 Sex TABLE II (28-8 strains relative 1st Female 1st 186 (23-1) 141 102 71 69-6 31 30-4 39 28 71-8 11 28-2 2nd 204 (17-6) 170 141 102 72-3 39 27-7 28 20 69-0 9 31-0 3rd 189 (17-5) 143 115 94 81-7 21 18-3 28 21 75-0 7 25-0 4th 224 (19-2) 184 146 110 75-3 36 24-7 38 26 69-4 12 31-6 5th 185 (15-7) 156 129 108 83-7 21 16-3 27 19 70-4 8 29-6 Total 988 (18-6) 794 633 485 76-6 148 23-4 161 114 70-8 47 29-2

TABLE II Recurrence rates after treatment in sensitivity (SS) and relatively resistant (RRS) infections

Cases in which penicillin sensitivity known

<table>
<thead>
<tr>
<th>Study period (6 mths)</th>
<th>Total cases</th>
<th>Known recurrences</th>
<th>Rate per cent.</th>
<th>Recurrences</th>
<th>Total cases</th>
<th>Rate per cent.</th>
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<th>Rate per cent.</th>
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<td>195</td>
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locally or elsewhere. With the 'elsewhere' strains, there was no appreciable change in the number of relatively resistant strains isolated from males or females during the study. In the local strains, however, the proportion of relatively resistant strains was seen to fall. Comparing the first and final years of the study, the number of relatively resistant local strains fell from 153 to 85 in males (39-0 per cent. to 24-8 per cent.) and from 70 to 57 in the local female strains (28-8 per cent. to 20-7 per cent.).

Table II shows that there was no appreciable change in the recurrence rate during the study period. When the organism was relatively resistant the recurrence rate was higher than when the organism was sensitive.

The difference in the incidence of relatively resistant strains isolated from male and female patients in this study was constant in each of the five study periods. Is a difference in sexual behaviour responsible? If a small number of females carrying relatively resistant strains was responsible for a high proportion of the male infections, this might account for the sex difference found. Should this be the case, it emphasizes the need for active contact tracing of the highly promiscuous female, whether a professional or an enthusiastic amateur.

The local pool of undiagnosed gonorrhoea is constantly being modified, for contact tracing and treatment of the asymptomatic carrier reduces the pool. At the same time, the promiscuous male having acquired infection from the pool, spreads the infection before developing symptoms or being traced. (Willcox, 1965a, 1965b). Strains from other parts of the country and abroad may also be introduced into
the local pool, and the latter may be more resistant
(Warren, 1968). In this study, the sensitivities of the
local and elsewhere strains have been monitored
separately, and a difference has been found. Had
they been considered together, the decrease in the
number of resistant organisms found would not have
been shown to be due to an improvement in the local
pool.

Neither the number of cases diagnosed nor the
recurrence rate during the period of study gave any
indication of control, or of its lack. By monitoring
the locally acquired infections, control, in terms of a
drop in the proportion of relatively resistant strains
of gonococci isolated, has been demonstrated.
During the period of study a second trained social
health worker was employed in the clinic to trace
and bring in named male and female contacts of
patients with gonorrhoea, and the change observed
may have resulted from improved contact tracing.

It is concluded that, while there was no quanti-
tative evidence of control in the study described,
definite qualitative improvement in control during
the period was apparent, and that penicillin sensi-
tivity testing is not only an essential tool for assessing
gross control, but also has potential to measure
finely the quality of gonorrhoea control programmes.

References
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