The bacteriology of a rural general practice: a retrospective six-year study

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SUMMARY. The organisms cultured and their antibiotic sensitivities, together with clinical details, were obtained from all the available bacteriology request/result forms from a rural practice over a six-year period. The 3022 bacteriology specimens analysed yielded 997 potential pathogens. The main infections studied were those of the urinary tract, the upper respiratory tract and the skin and soft tissue. In spite of the fact that trimethoprim alone had never been used in the practice, 29% of urinary tract pathogens were resistant to this drug. Ninety-six per cent of isolates of Haemophilus influenzae *were sensitive to ampicillin. The overall results suggest that most infectious disease in rural general practice can be managed with a limited and inexpensive antibiotic regimen. Such a regimen is described.*

Introduction

THE aim of this study was to formulate an antibiotic regimen for use in a rural general practice. Many factors influence the choice of antibiotics, including cost and possible side-effects. Rational prescribing also requires a knowledge of the antibiotic sensitivities of the organisms associated with infectious disease in the practice area. The present study was designed to acquire this knowledge by the analysis of the practice bacteriology results over a six-year period.

Method

Danby practice is situated in the North Yorkshire moors and the 1750 patients live in three small villages and in four dales. The practice uses its own limited list of antibiotics. During the period of the study these were penicillin, ampicillin, flucloxacillin, erythromycin, oxytetracycline and co-trimoxazole. Urinary tract infections were treated routinely with co-trimoxazole. Other antibiotics were used only on the rare occasions when sensitivity tests suggested they were necessary.

Bacteriology testing is performed at Scarborough Hospital, 35 miles away. Because of transport difficulties there is a time lapse of up to 48 hours between the collection of specimens and their arrival at the laboratory. All swabs are preserved in Amies transport medium. Boric acid is used as a preservative and bacteriostat for urines, which are collected as clean specimens.

The period studied was from June 1979 to May 1985. The organisms cultured and their antibiotic sensitivities, together with clinical details, were obtained from all the available bacteriology request/result forms from this period. The practice also keeps its own slightly less detailed bacteriology records. During the study these were used in the cases of patients who had died or moved from the practice. The information was analysed using a Shelton Signet computer.

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Results

During the six-year period 3022 bacteriology specimens were examined and 997 potentially pathogenic organisms were isolated. The specimens included 1020 post-treatment and routine pregnancy urine specimens from which no significant growth was obtained. The main infections studied were those of the urinary tract, the upper respiratory tract and the skin and soft tissues.

Urinary tract infection

A diagnosis of urinary tract infection was made when pyuria was associated with a bacterial growth exceeding 100 000 colonies per cubic mm. The organisms isolated from these cases are listed in Table 1. *E. coli* account for 61% of the total. Table 2 is a league table of urinary tract antibiotics arranged accor-

Table 1. Organisms cultured from cases of urinary tract infection, upper respiratory tract infection and skin and soft tissue infection.

	Number (%) of organisms cultured		
	Urinary tract infection (n = 325)	Upper respiratory tract infection (n = 1274)	Skin and soft tissue infection (n = 257)
Bacteroides spp.	—	—	3 (1)
Candida spp.	4 (1)	12 (3)	—
Enterobacter spp.	—	13 (3)	—
Escherichia coli	197 (61)	16 (4)	9 (4)
Haemophilus spp.	—	25 (7)	—
Klebsiella pneumoniae	35 (11)	14 (4)	2 (1)
Proteus mirabilis	17 (5)	4 (1)	4 (2)
Pseudomonas aeruginosa	6 (2)	—	23 (12)
Staphylococcus aureus	6 (2)	73 (19)	87 (44)
Other staphylococci	19 (6)	7 (2)	9 (4)
Streptococcus faecalis	27 (8)	—	10 (5)
Streptococcus pyogenes	—	109 (29)	12 (6)
Other streptococci	3 (1)	96 (26)	36 (18)
Other yeasts	4 (1)	—	—
Other bacteria	7 (2)	6 (2)	5 (3)
Total	325 (100)	375 (100)	200 (100)

n = number of cases tested.

Table 2. League table of antibiotic sensitivities of bacteria isolated in urinary tract infection.

	Number of organisms tested	Sensitivity (%)
1. Cephalexin	276	*93*
2. Gentamicin[a]	158	*91*
3. Nitrofurantoin	272	*87*
4. Nalidixic acid	275	*79*
5. Trimethoprim and/or sulphamethoxazole	187	*75*
6. Trimethoprim	276	*71*
7. Ampicillin	280	*67*
8. Sulphamethoxazole	99	*53*

[a] Not suitable for use in general practice.

ding to the sensitivities of the bacteria grown. The number of bacteria tested against each antibiotic is also given. Sensitivity to co-trimoxazole was not tested. However, 187 bacteria were tested separately for sensitivities to both trimethoprim and sulphamethoxazole and showed 75% sensitivity to one or both of these. Specifically, 95% of strains of *E. coli* were sensitive to nitrofurantoin, 79% to trimethoprim and 59% to sulphamethoxazole.

Upper respiratory tract infection

Organisms other than those recorded as 'normal flora' were isolated from 375 (29%) throat swabs from 1274 cases with upper respiratory tract infection. The frequency of 'positive' swabs was greatest in pre-teenage children from whom 64% grew organisms other than 'normal flora'. The organisms obtained in upper respiratory tract infection are also listed in Table 1. Undoubtedly some of these were not responsible for the illness. *Streptococcus pyogenes* was the most frequent organism but it was present in only 29% of cases from whom organisms were obtained and in only 9% of all swabs from patients with upper respiratory tract infection. In cases where tonsillitis was the major feature bacteria were cultured from 45% and half of these were *Strep. pyogenes.* Table 3 is the league table of antibiotics arranged according to the sensitivities of the bacteria cultured in upper respiratory tract infection. Specifically, 22 of the 23 isolates of *H. influenzae* were sensitive to ampicillin.

Table 3. League table of the antibiotic sensitivities of bacteria isolated in upper respiratory tract infection.

	Number of organisms tested	Sensitivity (%)
1. Erythromycin	308	*89*
2. Ampicillin	199	*85*
3. Cephalexin	330	*83*
4. Tetracycline	356	*82*
5. Penicillin	309	*72*

Skin and soft tissue infection

Bacteria other than those labelled 'normal skin flora' were isolated from 149 (58%) of 257 cases of infection of the skin and soft tissues. Multiple growths sometimes occurred, especially from leg ulcers. The 200 bacteria cultured are listed in Table 1. Potential pathogens were grown from 19 of 25 cases of impetigo, from 64 of 90 wound swabs and from 60 of 73 leg ulcers. The most common organisms cultured from the cases of impetigo were *Staphylococcus aureus* (63%) and *Strep. pyogenes* (21%); from wound infections the most common organisms were *Staph. aureus* (43%), *Streptococcus spp.* (not group A) (18%), *E. coli* (9%) and *Strep. pyogenes* (8%); from leg ulcers the most common organisms were *P. aeruginosa* (32%), *Staph. aureus* (26%) and *Strep. pyogenes* (14%). Table 4 is the league table of antibiotics according to the sensitivities of the skin swab isolates. Specifically 23% of strains of *Staph. aureus* were sensitive to penicillin.

Other infections

Gastroenteritis. Campylobacter spp. were the only pathogens obtained and were grown from five of 25 faeces specimens.

Vaginal discharge. Potential pathogens were grown from 38 (45%) of 84 vaginal swabs. *Candida spp.* were found in 19 cases; *T. vaginalis* in only two.

Table 4. League table of the antibiotic sensitivities of bacteria isolated in skin and soft tissue infection.

	Number of organisms tested	Sensitivity (%)
1. Gentamicin[a]	25	*100*
2. Flucloxacillin/methicillin[a]/ cloxacillin	97	*99*
3. Erythromycin	128	*89*
4. Fucidin	91	*88*
5. Cephalexin	136	*69*
6. Tetracycline	151	*62*
7. Trimethoprim	95	*55*

[a] Not suitable for use in general practice.

Conjunctivitis. Bacteria, chiefly gram-positive cocci, were grown from 14 (27%) of 52 conjunctival swabs. Thirteen of these were sensitive to chloramphenicol.

Chest infections. During the study period sputum culture was not attempted, as we were advised that the long transit times to the laboratory would be prohibitive with unpreserved sputum. Since then we have tested this by taking sputum specimens from 15 cases of which three grew pathogens — one each of *Strep. pneumoniae, H. influenzae* and *H. para-influenzae.* All were sensitive to ampicillin.

Discussion

The treatment of infectious disease is facilitated by knowledge of its causative agents, but these are not the same in general practice as in hospitals[1] and also change with the passage of time.[2] They may also vary with geographical area (Beale AS, Sutherland R. Unpublished data, Beecham Pharmaceuticals Research Division). Therefore, knowledge of the local pattern of infections and antibiotic sensitivities for any practice wishing to formulate an antibiotic regimen is necessary. The acquisition of such knowledge in a rural practice has the problem that culture of some organisms may fail because of the long transit time of specimens to the laboratory. In the present study *H. influenzae* in upper respiratory tract infection was found less frequently than in reports from urban practices.[1,3] This may well be due to the loss of some organisms in transit from our practice. The proportion of urinary tract infections caused by *E. coli* in our practice (61%) is less than is usually reported in general practice (Beale AS, Sutherland R, unpublished data).[1,3] This is probably a regional effect, since it has been reported that *E. coli* is less frequent in urinary tract infection in north-east England than in the UK as a whole (Beale AS, Sutherland R, unpublished data).

The present study revealed a higher than expected resistance to trimethoprim in bacteria associated with urinary tract infections. Twenty-nine per cent of all urinary pathogens and 21% of strains of *E. coli* were resistant to this drug. Although resistance to trimethoprim has been increasing in the UK, these levels are higher than those previously reported in general practice (Beale AS, Sutherland R, unpublished data).[1,4] It had been hoped that the use of co-trimoxazole would have prevented the development of resistance to trimethoprim. That it has not done so is possibly due to the high frequency of organisms resistant to sulphamethoxazole. Our finding of 75% of urinary pathogens sensitive to trimethoprim and/or sulphamethoxazole may underestimate the efficacy of co-trimoxazole; however clinical studies suggest that there is little synergistic action in this preparation.[4] Our league table of urinary tract antibiotics based on sensitivities is headed by cephalexin and gentamicin

followed by nitrofurantoin. Gentamicin, needing parenteral administration, is not a drug for general practice use. Nitrofurantoin has the advantage of not destroying the normal gut flora. As a result of the study we now use nitrofurantoin as first choice antibiotic for urinary tract infection, with cephalexin reserved for serious cases with pyelonephritis.

Viruses are known to cause most upper respiratory tract infections.[5] Our finding of bacteria in less than 30% of cases of upper respiratory tract infection supports this, especially since some of these bacteria were probably not responsible for the disease. This latter factor reduces the significance of our league table of antibiotics based on the sensitivities of bacteria grown in upper respiratory tract infection, which is headed by erythromycin followed by ampicillin and cephalexin. In fact most cases of upper respiratory tract infection do not require antibiotic treatment. We give penicillin to young children with tonsillitis to eradicate *Strep. pyogenes,* the most frequent and most important bacterium found in this condition. The high sensitivity (96%) of *H. influenzae* to ampicillin justifies our use of this drug in acute otitis media, especially in young children. We have insufficient data from sputum specimens to draw definite conclusions about chest infections. Work elsewhere[6] suggests that the bacteria most frequently associated with these are *Strep. pneumoniae* and *H. spp.* The sensitivity testing of these bacteria, obtained from throat swabs and sputum in the present study, indicate that both ampicillin and oxytetracycline should be effective in treating most chest infections.

The finding that *Staph. aureus* is the most frequent organism associated with skin and soft tissue infections confirms other work.[1,7] The *P. aeruginosa* came entirely from chronic leg ulcers and was not associated with cellulitis. Such growths do not require antibiotic treatment. All the organisms tested from skin and soft tissue infections were sensitive to gentamicin and 99% to flucloxacillin, methicillin or cloxacillin. Gentamicin is a valuable drug for the treatment of serious hospital infections and its use in topical skin preparations is to be deplored. Flucloxacillin remains our drug of choice for treating skin and soft tissue infections. Erythromycin is used in patients allergic to penicillin.

The antibiotic regimen adopted as a result of this study is given in Figure 1. The regimen does not include amoxycillin plus clavulanate nor the newer cephalosporins. These drugs are expensive and of potential value in the treatment of serious infections caused by resistant organisms. The study suggests that most infections in a rural practice are treatable using a limited and relatively inexpensive antibiotic regimen. The study is being continued so as to monitor future changes in the bacteriology of the area.

Infection	*Antibiotic*
Cystitis	Nitrofurantoin
Pyelitis	Cephalexin
Tonsillitis	Penicillin
Otitis media	Ampicillin
Chest infections	Ampicillin or oxytetracycline
Skin and soft tissue infection	Flucloxacillin
Conjunctivitis	Topical chloramphinicol

Erythromycin is used instead of the penicillins in cases of penicillin allergy. Ampicillin is used for the treatment of urinary tract infection in pregnancy.

Figure 1. *Antibiotic regimen adopted by the practice for the primary treatment of common infectious diseases.*

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