Antimicrobial practice

Primary care workshops can reduce and rationalize antibiotic prescribing

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We describe a controlled study comparing the effects on primary care prescribing in west Gloucestershire, UK, where antibiotic workshops were offered, with those in east Gloucestershire, where microbiology tutorials were given. The year-on-year changes in quantity and costs of antibiotics dispensed following general practice prescriptions were measured. There was no significant difference in the number of antibiotic items prescribed across the county, but the number of prescriptions for broad-spectrum agents (quinolones, cephalosporins and co-amoxiclav) declined by 15.4% in west Gloucestershire, compared with a 6.5% increase in east Gloucestershire ($P = 0.002$). Use of narrow-spectrum antibiotics (penicillin V, trimethoprim and nitrofurantoin), whose use was encouraged, did not change in west Gloucestershire practices, but decreased by 12% in east Gloucestershire practices ($P = 0.003$). There was increased use of clarithromycin and azithromycin in both groups of practices. Antibiotic workshops held in the primary care setting can rationalize antibiotic prescribing. This can reduce prescribing costs and selection pressure by broad-spectrum antimicrobial agents and, perhaps, go some way to reducing the development of resistance.

Introduction

In 1989 The British Society for Antimicrobial Chemotherapy set up a Working Party on the use of antibiotics in general practice. It reported that between 1980 and 1991 there was an overall increase in antibiotic use in England of 45.8%, with a mean annual increase of 5% (95% confidence interval 2–7%).\textsuperscript{1} Growth in antibiotic use in general is most rapid for the heavily promoted antimicrobial agents, and use of antibiotics is encouraged by a large pharmaceutical representative workforce.\textsuperscript{2} Between 1990 and 1996, the county of Gloucestershire, UK, had seen a mean 5% annual rise in antimicrobial use [Prescription Pricing Authority (PPA) information].

Bacterial resistance to antimicrobial agents is a rapidly increasing problem worldwide and has prompted recent reformatory investigations\textsuperscript{3–6} and media attention.\textsuperscript{7} Consumption of antimicrobial agents is considered to be a major factor contributing to bacterial resistance.\textsuperscript{8–10} The first strains of penicillin-resistant pneumococci (MIC > 0.1 mg/L) were isolated in the mid-1960s.\textsuperscript{11} Use of individual antimicrobial agents and total antimicrobial consumption in a community are strongly associated with nasopharyngeal carriage of penicillin-resistant pneumococci in children.\textsuperscript{9} Methicillin-resistant \textit{Staphylococcus aureus} (MRSA) is now a common organism in many hospitals worldwide. The increase in MRSA has occurred not only in large, tertiary care, teaching hospitals but also in small community hospitals, and it is now spreading in the community.\textsuperscript{12}

In 1997, to coincide with the annual review of the guidelines in west Gloucestershire, a series of general practice-based antibiotic workshops was planned. It was anticipated that these workshops would provide objective and balanced information for general practitioners (GPs), to assist them in achieving more rational prescribing of antimicrobial agents. This approach is in line with the recent recommen-
dations of the Standing Medical Advisory Committee in their report *The Path of Least Resistance*,\(^6\) which suggests a national campaign on antibiotic treatment in primary care on the theme of ‘Four things you can do to make a difference’. These four things were: (i) not to prescribe antibiotics for simple coughs and colds; (ii) not to prescribe antibiotics for viral sore throats; (iii) to limit prescribing for uncomplicated cystitis to 3 days in otherwise fit women; and (iv) to limit prescribing of antibiotics over the telephone to exceptional cases. Collection of GP prescribing data would enable us to determine if this workshop approach was effective and to compare the data with those from practices in east Gloucestershire, where no workshops were held.

**Materials and methods**

West Gloucestershire has a population of 317,330 and is served by 188 GPs in 51 practices. East Gloucestershire has a population of 251,469 and is served by 151 GPs in 33 practices. The number of fundholders (practices that hold a budget for prescribing drugs and purchasing of non-acute hospital services), dispensing practices and single-handed practices is shown in Table I. The microbiology service in west Gloucestershire is provided by the Gloucester Public Health Laboratory (PHL), Gloucestershire Royal Hospital; that in east Gloucestershire is provided by the Microbiology Department, Cheltenham General Hospital. The service is similar in both laboratories except that east Gloucestershire actively encourages the collection of a urine sample for culture before treatment of urinary tract infections.

**Antibiotic guidelines**

East and west Gloucestershire both have guidelines for antibiotic prescribing in primary care. These guidelines are reviewed annually and encourage good prescribing practice with limited use of broad-spectrum agents. They were drawn up in collaboration with the pharmacy advisors in east and west Gloucestershire, consultants in each speciality and local GPs. They are approved by the local Drug and Therapeutics Committees and Local Medical Committees. The guidelines are based on local antimicrobial sensitivity patterns and draw from trials of antibiotic use in general practice and advice contained within the *Drug and Therapeutics Bulletin*.\(^13\text{–}22\)

**The workshops**

The west Gloucestershire workshops were conducted by one Gloucester PHL consultant microbiologist (C.A.M.McN.) in February and March 1997 to coincide with the circulation of the updated 1997 west Gloucestershire GP antibiotic guidelines. The forum of small workshops was chosen because previous studies had shown that this setting was more effective than formal lectures or educational leaflets.\(^23,24\)

Twelve antibiotic workshops were held in west Gloucestershire over a 7 week period in February and March 1997. Practice managers and postgraduate tutors were asked to suggest times and locations that would suit GPs throughout the area. Invitations were sent out to all practice managers to circulate to all GPs. Permission was sought from each senior partner and attending GP to analyse data on practice antibiotic prescribing. GPs were welcome to attend any workshop. The workshops were all approved for Postgraduate Education Allowance (PGEA) and were assessed by each participant (possible score 0–40). Gloucestershire Health Authority funded light refreshments; the pharmaceutical industry was not invited to provide any support.

Each workshop lasted 1.5–2 h and began with a poster presentation of antibiotic use by local practices, followed by a discussion of the new ‘GP antibiotic guidelines’, which was supported with illustrations shown on an overhead projector. The poster featured bar charts of the number of antibiotic items per thousand prescribing units for total

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<th>Table I. Practice characteristics</th>
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<tr>
<td><strong>West Gloucestershire</strong></td>
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<tr>
<td>Population</td>
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<tr>
<td>Total number of practices</td>
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<tr>
<td>Attended workshops or tutorials</td>
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<tr>
<td>Urban</td>
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<td>Rural</td>
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<td>Fundholding</td>
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<td>‘Seventh-wave’ fundholding</td>
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<td>Training</td>
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<td>Dispensing</td>
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<td>Single-handed</td>
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<td>Total number of GPs</td>
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antibiotic use, and for cephalosporin, quinolone, macrolide, trimethoprim, amoxycillin and nitrofurantoin use. The bar chart key indicated the typical cost of a 5 day course of antibiotics. The aim of the poster presentation was to highlight differences in antibiotic prescribing between practices, to encourage discussion and to suggest that differences in use may not necessarily produce differences in clinical outcome.

The more formal part of the workshop commenced with the workshop aims and key messages. The aims of the workshop were: to introduce the new antibiotic guidelines; to reduce antibiotic use; to encourage the use of narrow-spectrum agents; and to improve communication with GPs. The key messages were: (i) is an antimicrobial needed?; (ii) newer antimicrobials are not necessarily better; (iii) co-amoxiclav, quinolones and cephalosporins should be reserved for difficult cases; and (iv) penicillin, amoxycillin, flucloxacillin, erythromycin, trimethoprim, nitrofurantoin or oxytetracycline are suitable for most infections seen in general practice.

As over 50% of antibiotics are prescribed for respiratory tract infections,22 a commensurate amount of time was spent covering this area and encouraging reduced use of antimicrobial agents, particularly cephalosporins and co-amoxiclav, in line with evidence from recent publications.13-17 The management of urinary tract infections, skin and soft tissue infections,18 diarrhoea, genitourinary tract infections, herpes infections and MRSA were also addressed. GPs were encouraged to use the newer macrolides and quinolones only as second- and third-line agents in more difficult cases.19-21 GPs were discouraged from using oral cephalosporins.22

In east Gloucestershire, a series of practice-based microbiology tutorials was given by a consultant microbiologist (Dr S. Edmondson) from Cheltenham General Hospital. Tutorials were given on microbiology-related subjects of the GPs' choice; these did not focus exclusively on changing antibiotic use. Guidelines were distributed at these tutorials. If the use of an oral macrolide or penicillin was discussed, the use of clarithromycin and/or amoxycillin rather than erythromycin and/or penicillin was encouraged.

Antibiotic prescribing
The PPA collects information on all prescriptions issued by GPs that are dispensed by community pharmacists, dispensing practitioners or appliance contractors.26 The information collected includes the name and cost of the drug and the number of items dispensed (an item is defined as each preparation on the prescription). The drugs dispensed are then used to calculate the cost of each item, and the information is entered on to a computer, by the PPA, to produce Prescribing Analyses and Cost (PACT) data. Drugs are categorized by the section of the British National Formulary25 into which they fall. Hence, information is available for individual drugs (such as trimethoprim), and for categories of drugs (such as cephalosporins and generic drugs). This information is available at practice, Health Authority (HA) and national levels. Because prescribing is heavily influenced by general practices' demography, data presented at the workshops was ascertained as items per 1000 prescribing units. This is a measure of patients' needs for prescribed drugs weighted for age; patients aged under 65 years count as one unit, while those aged ≥65 years count as three units. So that valid comparisons of interventions can be made, authorities compare themselves with other similar authorities nationwide. The Prescribing Support Unit has recently reviewed the clustering of HAs, so that comparisons can be made with other HAs within the same cluster. Six variables were used to compare HAs. The HAs were clustered using hierarchical clustering employing Ward's method. Out of 12 clusters of authorities, Gloucestershire was part of the largest cluster, which contained 20 HAs. The other clusters contained three or four HAs.

Antibiotic use in each practice in Gloucestershire was determined by cost and units of use (using the PACT data) for the period 1 April–31 July for the years 1996 and 1997. The use of broad-spectrum antimicrobial agents (ciprofloxacin, co-amoxiclav, cefaclor and clarithromycin) and narrow-spectrum antimicrobial agents (phenoxyethylpenicillin, trimethoprim, amoxycillin and nitrofurantoin) was also examined.

Statistical methods
For each practice the difference in prescribing before and after the workshops was calculated. If the workshop had had a specific effect on antibiotic prescribing, practices that had been offered the workshop might be expected to have shown a greater fall in prescribing than practices not offered the workshop. This would have remained so even if there were a general trend to lower prescribing.

We examined the change in antibiotic use in each individual practice. The Mann–Whitney U-test was then used to compare the changes in antibiotic prescribing in the two groups of practices, the 51 that had been offered the workshop and the 33 that had not. This test does not require the changes in prescribing to have a normal distribution.

Results
The number of ‘seventh-wave’ fundholders (those who became fundholding in 1996) and training practices was similar in both parts of the county. The proportion of practices that were fundholders was greatest in east Gloucestershire (50% versus 32%) and the proportion of dispensing practices was slightly lower (30% versus 36%) (Table 1). Of the 188 west Gloucestershire GPs, 101 (54%) attended the workshops. Forty (80%) of the 51 practices in west Gloucestershire were represented by at least one doctor (Table 1). The workshops were well received by
participants, with a score of $\geq 32/40$ allocated by 87% of those who attended. Refreshments for the workshops cost £711. Consultant time was not charged but took up 55 h, which included the workshops, travel time, preparation, organization and administration.

Of the 33 practices in east Gloucestershire, 75% had microbiology tutorials. Overall antibiotic use per patient unit in the year before the workshops was similar in east and west Gloucestershire. Overall antibiotic use by number of items fell across the whole of the county between April–July 1996 and April–July 1997, by 3.4% in west Gloucestershire and 2.2% in east Gloucestershire (Table II). Considerable success was achieved in restraining the prescription of broad-spectrum antibiotics. The number of prescriptions for the quinolones, cephalosporins and co-amoxiclav declined by 15.4% in west Gloucestershire after the workshops, while it increased by 6.5% in east Gloucestershire ($P = 0.002$). There was increased use of clarithromycin and azithromycin throughout the county; the increase in the west was half that in the east (19.8% versus 38%), but this difference was not statistically significant ($P = 0.42$) (Table II). Use of narrow-spectrum antibiotics (penicillin V, trimethoprim and nitrofurantoin), which was encouraged, stayed at the same level in west Gloucestershire, but decreased by 11.7% in east Gloucestershire practices ($P = 0.003$) (Table II).

The cost of broad-spectrum antimicrobial agents fell by 9.3% in west Gloucestershire, with a saving of £8330 over the 4 month period analysed, but increased by 8.8% (£7000) in east Gloucestershire ($P < 0.001$). Overall antibiotic spending fell by 1.3% (£3400) in west Gloucestershire between April–July 1996 and April–July 1997, and increased by 3.8% (£8710) in east Gloucestershire, but this difference was not statistically significant ($P = 0.94$) (Table III).

**Discussion**

The design of this study allows us to analyse the countywide effects on antimicrobial prescribing of an education cam-

<table>
<thead>
<tr>
<th>Drug group</th>
<th>Workshop offered (51 practices)</th>
<th>Workshops not offered (33 practices)</th>
<th>$P$ (Mann–Whitney U-test)</th>
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<tbody>
<tr>
<td>BNF 5.1 items (all antibacterial agents)</td>
<td>before 71 657, after 69 199, change $-2458$ ($-3.4$)</td>
<td>before 53 867, after 52 658, change $-1209$ ($-2.2$)</td>
<td>0.09</td>
</tr>
<tr>
<td>Narrow-spectrum antibacterial agents$^a$</td>
<td>before 15 177, after 15 038, change $-139$ ($-0.9$)</td>
<td>before 10 704, after 9 456, change $-1248$ ($-11.7$)</td>
<td>0.003</td>
</tr>
<tr>
<td>Broad-spectrum antibacterial agents$^b$</td>
<td>before 10 475, after 8863, change $-1612$ ($-15.4$)</td>
<td>before 8626, after 9187, change $+561$ ($+6.5$)</td>
<td>0.002</td>
</tr>
<tr>
<td>New macrolides$^c$</td>
<td>before 3432, after 4112, change $+680$ ($+19.8$)</td>
<td>before 3293, after 4547, change $+1254$ ($+38.0$)</td>
<td>0.42</td>
</tr>
</tbody>
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$^a$Penicillin V, trimethoprim and nitrofurantoin.
$^b$Quinolones, cephalosporins and co-amoxiclav.
$^c$Clarithromycin and azithromycin.

**Table III.** Change in antibiotic use (cost) before and after prescribing workshops over the 4 month period 1 April to 31 July for 1996 and 1997

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>BNF 5.1 cost (all antibacterial agents)</td>
<td>before £266 620, after £263 220, change £-3400 ($-1.3$)</td>
<td>before £226 770, after £235 480, change £+8710 ($+3.8$)</td>
<td>0.94</td>
</tr>
<tr>
<td>Narrow-spectrum antibacterial agents$^a$</td>
<td>before £14 360, after £14 580, change £+220 ($+1.5$)</td>
<td>before £10 730, after £9 570, change £-1160 ($-10.8$)</td>
<td>0.016</td>
</tr>
<tr>
<td>Broad-spectrum antibacterial agents$^b$</td>
<td>before £89 460, after £81 130, change £-8330 ($-9.3$)</td>
<td>before £80 690, after £87 790, change £+7100 ($+8.8$)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>New macrolides$^c$</td>
<td>before £47 370, after £51 170, change £+3800 ($+8.0$)</td>
<td>before £39 940, after £48 920, change £+8980 ($+22.5$)</td>
<td>0.29</td>
</tr>
</tbody>
</table>

$^a$Footnotes as in Table II.
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campaign aimed at GPs. We could have just analysed the effect on west Gloucestershire practices. However, the number of practices that did not attend the antibiotic workshops in west Gloucestershire was small (11; 22%) and these practices may have had different prescribing habits. The mix of urban, rural, ‘seventh-wave’ fundholders, training and dispensing GPs in the east and west of the county is similar. The number of fundholding practices in the east was greater, which we would have expected to lead to a reduction in antibiotic use in this part of the county. Antibiotic prescribing patterns were compared with those in the same time period in the year before, which should have reduced any possible seasonal bias or differences in microbiological advice given in the two parts of the county. The Mann–Whitney test does not require the changes in prescribing to have a normal distribution.

The measurable aims of the antibiotic workshops were: to reduce overall antibiotic prescribing; to reduce the use of broad-spectrum and newer antimicrobial agents; and to increase the use of narrow-spectrum antimicrobial agents. The first aim was attained, but there was also a reduction in the east of the county. The microbiology workshops held in the east, although not specifically aimed at antibiotic use, probably had some effect on overall prescribing. The antibiotic workshops in west Gloucestershire did lead to a significant reduction in broad-spectrum antimicrobial agents. Although there was no increased use of narrow-spectrum agents in west Gloucestershire, we did not see the 11% drop in use experienced in east Gloucestershire.

Could the fall in antibiotic use have resulted solely from the introduction of the antibiotic guidelines? The guidelines are reviewed annually and updated regularly but, despite this, Gloucestershire had seen a mean 5% annual rise in antimicrobial use. This is in keeping with previous findings that practice-based formularies do not lead to a reduction in antimicrobial prescribing.28,29

These results show that practice-based education directed specifically at antimicrobial use can reduce the use of broad-spectrum drugs; in the long-term, this may help to reduce the emergence of multi-resistant bacteria. In future educational programmes, it would be useful to equate antimicrobial use to carriage of resistant commensal flora in the upper respiratory or gastrointestinal tract. A programme to reduce unnecessary antibiotic use in acute respiratory infections was introduced successfully in Havana, Cuba.50 In this programme, a refresher training programme reduced antibiotic prescribing in respiratory tract infections by 54%. In Iceland, an education programme to reduce antimicrobial prescribing was aimed at the public and at medical and paramedical personnel. This led to a reduction in antibiotic use and a reduction in antibiotic resistance in pneumococci isolated from children’s nasopharyngeal swabs.9,31 The Icelandic results showed that the prevalence of selected types of antibiotic resistance in the community can be reduced. A recent study on the treatment of tonsilitis showed that patients who were given penicillin were more likely to visit the doctor again in a future attack than those who were given advice alone.32 Even after only one consultation, prescribing antibiotics significantly enhances belief in the efficacy of antibiotics and intention to consult in the future.

Keeping GPs well informed about the appropriate use of antibiotics and significant developments in the field is important to enable them to evaluate objectively information provided by the pharmaceutical industry which is likely to continue to encourage use of their new broad-spectrum products. In the workshops, discussion between attending GPs was strongly encouraged and users of narrow-spectrum antimicrobial agents were urged to promote their use to other participants. We believe this led to greater acceptance of the narrow-spectrum agents than could have been attained by a lecture from a microbiologist. A workshop with approximately 12 participants from several different practices allowed a greater discussion and promotion of narrow-spectrum agents.

A recent systematic review of interventions to improve professional practice showed that conferences and workshops, during which no explicit effort was made to facilitate practice change, or printed materials alone failed to demonstrate changes in performance or health outcomes.33 In contrast, outreach visits led to reductions of 12–49% of inappropriate prescribing.

Although 80% of practices were represented at the antibiotic workshops, only 54% of GPs came. The effect on antimicrobial prescribing could be much greater if all GPs could be encouraged to attend. We have presented results for the whole of west Gloucestershire; if prescribing of attending practices only is assessed, the effect on prescribing is even greater [21% reduction in broad-spectrum antimicrobial agents and 5% decrease (£10 410) in overall antibiotic costs]. Attendance by GPs working in rural practices was not as good as that by GPs from urban practices, probably because of time and distance constraints. Every effort must be made, however, to reach the former practices so that the aims of the workshops can be met across the whole of a targeted area. As well as PGEA approval and food being made available, meetings should be held in practices that are poor attenders. The cost savings generated would also justify GP locum payments. It would be possible for a trained pharmacist or clinical scientist to visit practices on a regular basis, to give updates on recent advances and to encourage rational prescribing, as long as this was not seen by GPs just as a cost-cutting exercise. Regular visits could lead to a greater and more sustained reduction in antimicrobial use. For maximum effect, future workshops should be held in September to November, just before the peak antibiotic prescribing period. Patient education is also important and is suggested in the recent SMAC report,6 but it only works when used in conjunction with other interventions.33

It will be interesting to see how long the reduction in broad-spectrum agents is maintained. PACT data are not
immediately available, so we will have to wait some months before we can analyse the data 1 year after the workshops. The main limitation of PACT data is that the system provides only details of the drugs prescribed and how much those cost. The data cannot be linked to demographic or clinical data on patients and, therefore, cannot be used to calculate age- and sex-specific prescribing rates, or to examine prescribing rates for specific conditions, so it is not possible to ascertain the indications for which cephalosporins and quinolones were used. It is also not possible to determine if the workshops led to more appropriate prescribing. In the future it would help greatly if a unique patient identifier (such as the NHS number) and clinical indication were included on prescriptions. This would allow calculation of age- and sex-specific prescribing rates and allow PACT data to be linked to other clinical data sets, enabling microbiologists and other specialists to use more directed education and audit clinical use.

The pharmaceutical companies use face-to-face consultations with GPs to increase their antibiotic sales with great success. Our workshops were designed to redress the balance and encourage reduced and rational antibiotic use. In view of the positive effect on prescribing costs, more resources are justified for education of groups of GPs in surgery settings. The returns in terms of prevention, or slowing down of development, of antimicrobial resistance would be of even greater value than financial benefits.

Acknowledgements

We wish to thank all those GPs who attended the workshops and reduced their antibiotic prescribing, Steve Edmondson for his helpful comments, Gloucestershire Health Authority for supporting the initiative and Jill Whiting for her indefatigable secretarial support. The west Gloucestershire GP antibiotic guidelines are available from Gloucester Public Health Laboratory, Great Western Road, Gloucester GL1 3NN, UK.

References

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