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Why has antibiotic prescribing for respiratory illness declined in primary care? A longitudinal study using the General Practice Research Database

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Abstract

Background Antibiotic prescribing by general practitioners (GPs) increased in the 1980s and peaked in 1995. Prescribing volumes subsequently fell by over a quarter between 1995 and 2000, mostly accounted for by reduced antibiotic prescribing for acute respiratory illnesses. We aimed to investigate changes in consultation rates and the proportion of consultations with antibiotics prescribed for different types of respiratory tract infections.

Methods Data were derived from108 UK general practices, covering a mean of 642 685 patients, reporting data to the General Practice Research Database (GPRD) continuously between 1994 and 2000. Outcome measures: annual age- and sex-standardized consultation rates for 11 different acute respiratory infections per 1000 registered patients and proportions of these consultations resulting in an antibiotic prescription.

Results The standardized consultation rate for 'any respiratory infection' declined by 35 per cent from 422 to 273 per 1000 registered patients, per year. The largest relative reductions in consultation rates were observed for 'common cold' (50 per cent), 'laryngitis' (43 per cent) and 'sore throat' (43 per cent). The standardized proportion of consultations that resulted in an antibiotic prescription for 'any respiratory infection' declined from 79 per cent in 1994 to 67 per cent in 2000. The largest relative reductions in antibiotic prescribing rates occurred in patients recorded as suffering from 'influenza' (52 per cent), 'upper respiratory tract infections' (33 per cent) and 'laryngitis' (30 per cent). Overall, antibiotic prescriptions for all acute respiratory infections declined by 45 per cent.

Conclusion The reduction in antibiotic prescribing in common respiratory infections between 1994 and 2000 has occurred partly because GPs are prescribing antibiotics less frequently when patients consult but mainly because there are fewer consultations with these conditions. Further work should aim to understand the reasons for the decline in consultations for respiratory infections and whether further reductions in antibiotic prescribing are feasible.

Keywords: respiratory tract infections, antibiotics, drug prescriptions

Introduction

Doctors have come under pressure to reduce their prescribing of antibiotics. For some time, it has been apparent that general practitioners (GPs) have been prescribing antibiotics to patients suffering from infections, even though these infections were probably viral in origin and therefore unaffected by antibiotics.[1] This pattern of prescribing behaviour can be rationalized since decisions about whether or not to prescribe are often rooted in the doctor–patient relationship and in the expectations of patients.[2] As a result, antibiotic prescribing rose steadily throughout the 1980s and early 1990s. Between 1980 and 1991, the volume of antibiotic prescriptions in England increased by 46 per cent.[3] Increases were even greater for many European countries over the same period: West Germany recorded an increase of 78 per cent and France of 65 per cent.[4] However, unnecessary prescribing may contribute to the development of antibiotic resistance and with few new antibiotics currently under development, the appearance of widespread antibiotic resistance is a concern.

In 1998, in response to these concerns and the fact that GPs account for 80 per cent of antibiotic prescribing in the United

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Kingdom, all GPs were sent a Department of Health Standing Medical Advisory Committee (SMAC) publication entitled, 'The path of least resistance'.[5] This publication suggested tactics for reducing 'unnecessary' antibiotic prescribing. In particular, the report recommended that GPs could avoid antibiotic prescribing in many cases of respiratory infection including sinusitis, sore throat, otitis media, coughs and colds. Many Primary Care Groups and Trusts responded by introducing prescribing indicators into their Prescribing Incentive Schemes with the aim of reducing antibiotic prescribing.[6]

After reaching a peak in 1995, the volume of all antibiotic prescriptions dispensed in the community has fallen by 26.4 per cent to the year 2000[7] (Fig. 1). These national figures for antibiotic prescription volumes include prescriptions issued by GPs, dentists (~10 per cent of the total) and those prescribed by hospitals but dispensed in the community (1 per cent of the total). The decline in volume was similar for penicillin (27.4 per cent) and non-penicillin prescriptions (25.1 per cent). When standardized using Defined Daily Doses, a measure that takes account of varying durations of prescriptions,[8] the reduction over the same period was 21.7 per cent.

The reasons for the decline in antibiotic prescribing have not been well evaluated, although such information would clearly be of value in promoting future changes in prescribing practice. Aggregated prescribing data have limited application because they do not provide information about the clinical conditions associated with this reduction. Only a database recording diagnostic codes linked to prescription data for GP consultations can reveal whether GP antibiotic prescribing has declined for any given condition. Several databases are available describing activity in primary care, but the largest of these in the United Kingdom is the General Practice Research Database (GPRD).[9]

In a survey of antibiotic prescribing using data derived from the GPRD, Frischer *et al.*[10] found that between 1993 and 1997, most of the reduction in total antibiotic prescribing was accounted for by reductions in prescribing for respiratory infections. They reported that in 1997 respiratory infections accounted for 59 per cent of all antibiotic prescribing. But these data only covered the West Midlands and 23 per cent of participating practices dropped out during the study period. Antibiotic prescribing patterns in one NHS Region may not be representative of England as a whole since prescribing is know to vary substantially between different NHS Regions in England.[11]

We aimed to describe changes in antibiotic prescribing for respiratory infections from 1994 until 2000. In particular, we aimed to investigate changes in consultation rates and the proportion of consultations with antibiotics prescribed for different types of respiratory tract infections.

Methods

Practices and patients

The GPRD is a primary care database recording clinical data starting in 1986. It is derived from 755 general practices covering a registered population of over 9 million patients in the United Kingdom.[9] We selected all 108 practices which continuously provided 'up-to-standard' data to the GPRD from 1994 to 2000. The mean number of patients registered at these practices over the 7 years was 642 685. There were 637 039 patients registered in 1994 and 646 336 in 2000.

Diagnostic codes

We first identified consultations for respiratory illness. The GPRD employs both Oxmis (Oxford Medical Information

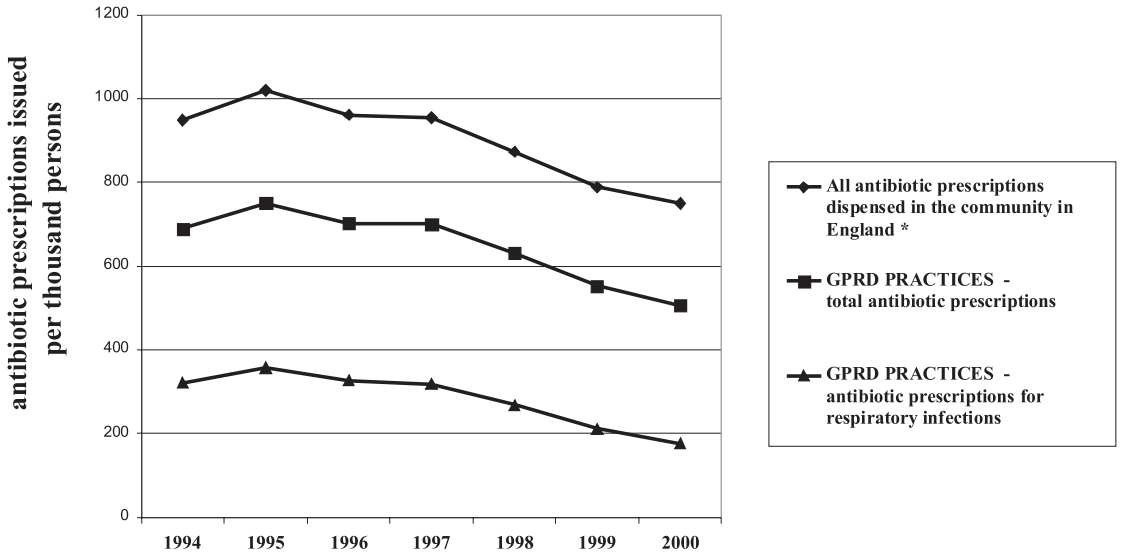

Fig. 1 Antibiotic prescriptions issued by GPRD practices and all prescriptions dispensed in the community in England.
* Source: Department of Health, Statistics Division 1E, Prescription Cost Analysis System.

Systems) and READ codes. Appropriate clinical codes were identified by searching the GPRD code dictionaries. READ codes are hierarchical and searches followed a logical search process. OXMIS codes are non-hierarchical and searches were conducted using an iterative process amongst three co-authors (MA, RL and MG). Acute respiratory infections were categorized as: upper respiratory tract infection (14 codes); influenza (eight codes); common cold/coryza (28 codes); ear infection (49 codes); sinus infection (31 codes); throat infection (61 codes); tonsillitis (38 codes); laryngitis (35 codes); tracheitis/bronchitis (66 codes); chest infection/lower respiratory tract infection (106 codes); other respiratory infection (14 codes); other infection with respiratory organisms or symptoms (42 codes); all respiratory infections (total of all diagnostic codes: 424). The category 'all respiratory infections' comprised all of the codes included in the 10 subdivisions of respiratory infection, excluding duplicated codes. It also contained other codes for respiratory infections that could not be allocated into one type of respiratory infection such as the code for 'respiratory tract infection'. Full details of the codes used are available from the authors. For selected analyses, 'chest infection' and 'tracheitis/bronchitis' were grouped together as 'lower respiratory tract infections' and the remaining conditions were grouped as 'upper respiratory tract infections'. Owing to the exclusion of duplicated codes accounting for 2553 conultations out of a total of 1.3 million, the data for 'upper respiratory infections' differed from the true value by approximately 0.2%

Antibiotic prescribing volumes

In order to compare the total volume of antibiotic prescribing for the 108 selected practices over the 7 year study period with known national prescribing volumes for England during the same period, a search was conducted for all antibiotic prescriptions issued in the 108 practices over the study period. All antibiotics listed in the British National Formulary (BNF) section 5.1 were included with the exception of anti-tuberculous and anti-lepromatous drugs.[12] We also estimated the proportion of consultations for each respiratory illness which was associated with antibiotic prescriptions by identifying whether an antibiotic prescription was given on the same date as the consultation.

Analysis

The raw data were grouped by sex, age group (4 years or less, then 10 year groups to 85 years and over) and practice. Age- and sex-standardized consultation rates per 1000 registered patients for each respiratory illness were calculated by year. Similarly, the age- and sex-standardized proportion of consultations which was associated with a prescription for an antibiotic was calculated for each condition. Finally, we estimated the age- and sex-standardized antibiotic prescription rate per 1000 registered patients for each condition (a measure of prescribing volume). The European standard population was used for reference. We evaluated trends in proportions using logistic regression for grouped data, adjusting for 10 year age group and sex. Robust variance estimates were used to allow for clustering by practice.

Results

From 1994 to 2000, the standardized rate of consultations for 'any respiratory infection' fell by 35 per cent from 422 to 273 per 1000 registered patients per year. Consultations for respiratory infections peaked in 1995 and when measured from this point, the reduction in the standardized rate was 43 per cent. Com-

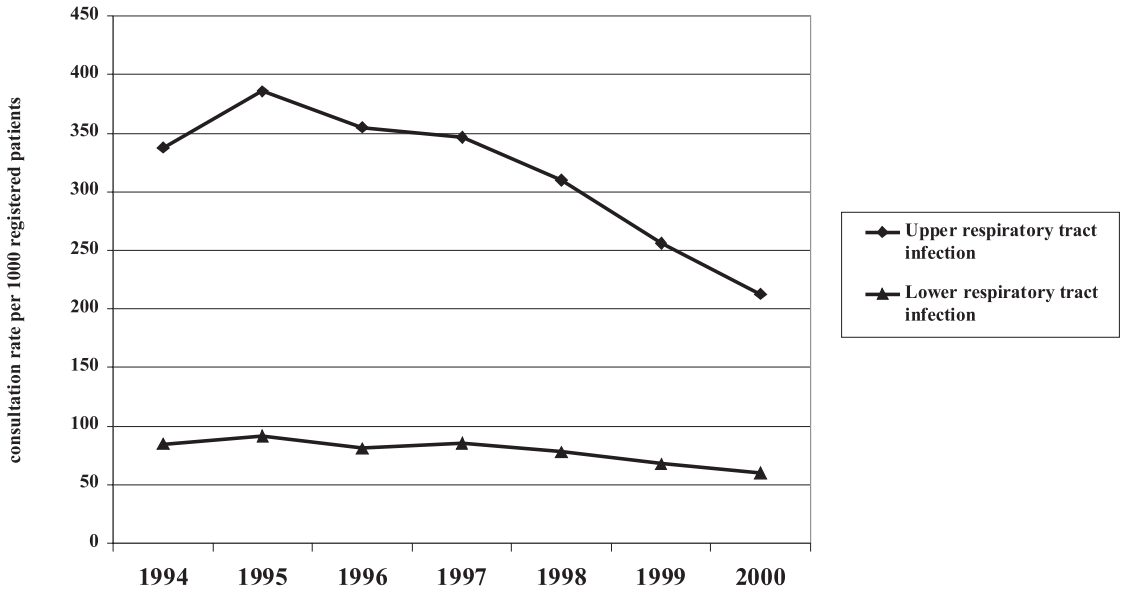

Fig. 2 Standardised consultation rates for upper and lower respiratory tract infections.

Table 1 Consultation rates for different respiratory illnesses and per cent of consultations associated with prescription of antibiotics between 1994 and 2000 in 108 GPRD practices

	1994	1995	1996	1997	1998	1999	2000	OR*	95%	CI	*p*-value
All respiratory infections											
Consultation rate (per 1000)†	422	477	436	432	388	324	273	0.89	0.88	0.90	<0.001
Prescribing proportion (%)‡	79	78	79	77	72	68	67	0.89	0.87	0.91	<0.001
Prescription rate (per 1000)§	334	374	344	334	281	221	183	0.87	0.86	0.88	<0.001
Ear infection											
Consultation rate (per 1000)†	45	50	45	45	41	35	28	0.92	0.91	0.94	<0.001
Prescribing proportion (%)‡	89	89	87	87	86	83	81	0.92	0.89	0.94	<0.001
Prescription rate (per 1000)§	40	44	39	39	35	29	23	0.91	0.89	0.93	<0.001
Sinus infection											
Consultation rate (per 1000)†	25	27	25	24	20	17	15	0.91	0.90	0.92	<0.001
Prescribing proportion (%)‡	91	91	92	92	90	90	91	0.98	0.96	1.01	0.142
Prescription rate (per 1000)§	23	25	23	22	18	16	14	0.91	0.90	0.92	<0.001
Sore throat											
Consultation rate (per 1000)†	68	72	67	65	57	46	39	0.91	0.89	0.92	<0.001
Prescribing proportion (%)‡	77	79	78	76	69	63	60	0.86	0.83	0.88	<0.001
Prescription rate (per 1000)§	53	57	52	49	39	29	24	0.87	0.86	0.89	<0.001
Tonsillitis											
Consultation rate (per 1000)†	37	37	38	36	33	28	26	0.94	0.93	0.96	<0.001
Prescribing proportion (%)‡	92	92	91	90	90	89	88	0.92	0.89	0.95	<0.001
Prescription rate (per 1000)§	34	34	34	32	29	25	23	0.93	0.92	0.95	<0.001
URTI											
Consultation rate (per 1000)†	116	139	129	124	115	92	76	0.92	0.90	0.94	<0.001
Prescribing proportion (%)‡	69	69	70	67	58	49	47	0.83	0.79	0.87	<0.001
Prescription rate (per 1000)§	80	97	90	83	67	46	36	0.87	0.84	0.89	<0.001
Common cold											
Consultation rate (per 1000)†	14	15	14	13	13	9	7	0.89	0.87	0.93	<0.001
Prescribing proportion (%)‡	19	22	24	22	16	15	13	0.93	0.86	1.00	0.058
Prescription rate (per 1000)§	3	3	3	3	2	1	1	0.85	0.80	0.90	<0.001
Influenza											
Consultation rate (per 1000)†	10	18	13	14	12	13	9	0.96	0.93	0.99	0.002
Prescribing proportion (%)‡	54	48	58	48	40	34	26	0.84	0.79	0.89	<0.001
Prescription rate (per 1000)§	5	9	8	6	5	4	2	0.88	0.85	0.91	<0.001
Laryngitis											
Consultation rate (per 1000)†	7	7	6	6	5	4	4	0.91	0.89	0.92	<0.001
Prescribing proportion (%)‡	67	65	64	60	52	44	47	0.85	0.82	0.87	<0.001
Prescription rate (per 1000)§	4	4	4	3	3	2	2	0.85	0.83	0.87	<0.001
Tracheitis/bronchitis											
Consultation rate (per 1000)†	29	30	26	27	24	21	18	0.92	0.90	0.95	<0.001
Prescribing proportion (%)‡	89	90	90	89	87	85	83	0.90	0.88	0.93	<0.001
Prescription rate (per 1000)§	26	27	24	24	20	17	15	0.91	0.88	0.94	<0.001
Chest infection											
Consultation rate (per 1000)†	55	61	55	58	54	47	42	0.95	0.93	0.97	<0.001
Prescribing proportion (%)‡	91	91	91	91	90	88	89	0.96	0.93	0.98	<0.001
Prescription rate (per 1000)§	50	56	50	53	49	42	37	0.95	0.93	0.97	<0.001

Figures are standardized for age and sex with reference to the European Standard Population.
*Change in relative odds of outcome per year adjusted for age, sex and clustering by practice.
†Age- and sex-standardized rate of consultations for that condition per 1000 registered patients.
‡Age- and sex-standardized percent of consultations for that condition at which antibiotics were prescribed.
§Age- and sex-standardized rate of antibiotic prescriptions for that condition per 1000 registered patients.

parable figures for the consultation rates for the different categories of respiratory infection are summarized in Fig. 2 and Table 1. The largest relative reductions in consultation rates were observed for 'common cold' (50 per cent), laryngitis (43 per cent), sore throat (43 per cent) and sinusitis (40 per cent).

In 1994, the proportion of consultations for 'any respiratory infection' that resulted in an antibiotic prescription was 79 per cent. After remaining almost constant for 3 years, the proportion then fell to 67 per cent in 2000, a relative reduction of 15 per cent. Comparable figures for the standardized proportion of consultations in which antibiotic were prescribed for each of the categories of respiratory infection are summarized in Fig. 3 and Table 1. The largest relative reductions in antibiotic prescribing occurred in patients recorded as suffering from 'influenza' (52 per cent), 'upper respiratory tract infections' (33 per cent), 'laryngitis' (30 per cent) and 'sore throat' (22 per cent).

Reductions in both the number of consultations for respiratory infections per year and in the proportion of those in which an antibiotic prescription was given, resulted in a large fall in the volume of antibiotic prescriptions issued. Between 1994 and 2000, the reduction in the standardized antibiotic prescription rate for patients presenting with 'any respiratory infection' was 45 per cent and, from the peak in 1995, the reduction amounted to 51 per cent (Fig. 1 and Table 1).

Over the same period (1994–2000), crude antibiotic prescriptions per 1000 registered patients for all clinical indications, were examined in the 108 GPRD practices. The total number of antibiotic prescriptions issued per 1000 registered patients peaked in 1995 and then fell by 33 per cent up to the year 2000 (a reduction of 27 per cent between 1994 and 2000) (Fig. 1). The comparable reduction in antibiotic prescribing for non-respiratory infections was 16 per cent from the 1995 peak and 11 per cent from 1994. At the beginning of the survey, 47 per cent of all antibiotic prescriptions were prescribed for respiratory infections; by the year 2000 this figure had fallen to 35 per cent.

Discussion

Findings

We have observed a 44 per cent reduction in antibiotic prescriptions for respiratory infections over the period 1994–2000. Some of this reduction was attributable to reduced prescribing by GPs to patients presenting with a respiratory infection. But the larger part of the reduction arose because the rate of consultation with respiratory infections declined.

Strengths and weaknesses of the study

The GPRD practices are broadly representative of general practices throughout the United Kingdom and the age–sex composition of registered patients is very similar to that of the national population.[13] Moreover, by selecting only those practices reporting data to the GPRD in all 7 years of the study, the results were not subject to bias arising from changes in the type of GPRD practices. Reduction in antibiotic prescribing identified in GPRD practices was consistent with the pattern of national reductions over the same period (Fig. 1). Nevertheless, GPRD practices reduced their antibiotic prescribing to a greater extent than was documented nationally. Our study did not standardize the volume of antibiotic prescribing by converting

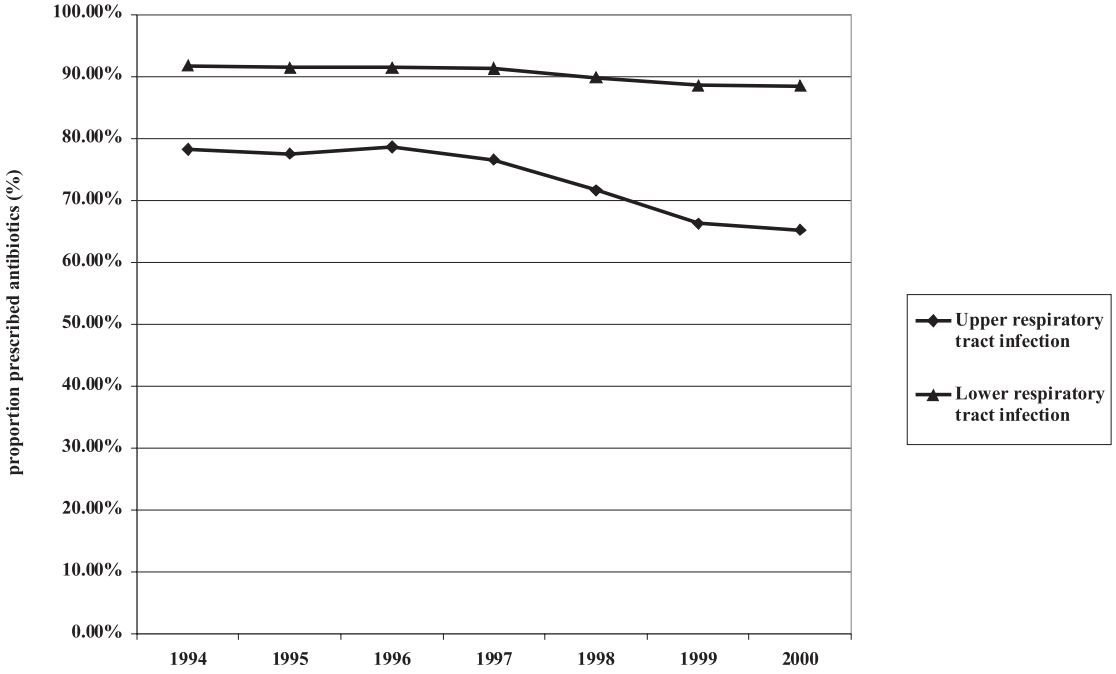

Fig. 3 Standardised proportion of consultations with antibiotics prescribed for upper and lower respiratory tract infections.

prescriptions into Defined Daily Doses (DDDs).[8] National data demonstrated a larger fall in volume as measured by the number of prescriptions rather than as standardized doses. This suggests that reductions in the number of prescriptions dispensed may have been partially offset by somewhat longer courses or higher doses. We have not studied changes in the duration or dosage of each prescription issued. Finally, our study has confined itself to explaining the 45 per cent reduction in antibiotic prescribing volumes for respiratory infections. We have not attempted to explain the 11 per cent reduction in antibiotic prescribing for other infections over the same period, although two thirds of all antibiotics are currently given for other indications.

Findings in relation to other studies

Our results extend the findings from the previous GPRD based study of respiratory infections by linking antibiotic prescribing with consultation rates.[10] Covering a period of 5 years from 1993 to 1997, GPRD practices in the West Midlands reduced their antibiotic prescribing for respiratory infections by 13 per cent. The authors did not comment on changing consultation rates for respiratory infections. In October 2003, Fleming *et al.*[14] reported a reduction of around 45 per cent in consultation rates for respiratory tract infections presenting to general practice during the years 1995–2000. This is a very similar reduction to that identified in the present study. Their data were derived from the Weekly Returns Service of the Royal College of General Practitioners, a surveillance network providing data from general practices covering a population of 600 000 patients. Unlike our own study, they were not able to identify which consultations for respiratory infections had resulted in the issue of an antibiotic prescription.

Our data suggest that antibiotic prescribing for upper respiratory tract infections, and several categories of these infections, started to decline well before all GPs received the 1998 SMAC report encouraging more restrictive antibiotic prescribing.[5] Several other publications pre-dating the distribution of the SMAC report may have increased awareness among GPs of the need to constrain antibiotic prescribing.[15–17]

The observed reductions in respiratory infections presenting to GPs may have been an artefact caused by re-classification as another category of respiratory infection. For example, GPs could have recorded more codes for chest infection to 'justify' antibiotic prescribing. In line with the findings of Fleming *et al.*[14], we found no evidence of concomitant increases in other diagnostic categories for respiratory diseases or for unspecified viral infection to suggest re-classification (data available from authors).

Apparent reductions in respiratory infections may be attributable to data loss arising from primary care consultations outside the GP surgery such as out-of-hours activity by local GP co-operatives, Walk-In Centres or NHS Direct. However, these factors are unlikely to explain the reductions observed in this study as GPRD practices capture their out-of-hours data and other providers of primary care were only operational in the final year of our study. Again, increases in telephone consultations could not have contributed to the observed decline in consultations for respiratory infections since telephone consultations are recorded in GPRD practices.

The most likely explanation for reductions in the diagnostic codes of respiratory infection is that patients decided not to attend their GPs as a result of growing awareness that self care was preferable. Patient education campaigns have been designed to deter patients from seeking antibiotics for minor illnesses.[18] Similarly, lessons learnt during previous consultations for respiratory infections may have influenced subsequent consulting behaviour. Patients who do not receive an antibiotic for a respiratory infection are subsequently less likely to consult if they experience a similar infection.[19] Patient education might be expected to emphasize self treatment for colds and influenza—the two infection categories that experienced the greatest reduction in our data. Conversely, patients are probably more aware of the risks of untreated chest infections and codes for this category reduced less than any other codes.

Alternatively, there may have been a true reduction in the incidence of respiratory infections in the community. We consider this unlikely. The threshold at which patients decide to consult can have a large effect on the apparent incidence of disease; only a fraction of all illness in the community is ever seen in general practice and this includes most types of respiratory infection.[20] Biological changes resulting in the attenuation of a wide variety of viruses and bacteria seem less plausible.

Implications of findings

Antibiotic prescribing has reduced substantially since its peak in 1995. Furthermore, the greatest reductions appear to have occurred in those infections most likely to be caused by viral infection. Nevertheless, it is hard to understand why over 90 per cent of cases of sinusitis received an antibiotic in 2000 when current recommendations suggest that most resolve spontaneously and that antibiotics are often not indicated.[21] Similarly, there is much evidence that antibiotics have little to offer patients with otitis media but 81 per cent of patients still receive an antibiotic.[22] The SMAC report[5] specifically targeted sore throats as an area for curtailing antibiotic prescribing but in 2000, we found that 60 per cent of cases still received an antibiotic. Further reductions in antibiotic prescribing should still be attainable.

Further research

It appears that both GP prescribing behaviour and patient consulting behaviour has changed over the 7 years of the study. Further research is needed to determine the feasibility of interventions to achieve additional reductions in antibiotic prescribing for illnesses likely to be viral in origin. Our findings imply that antibiotic prescribing thresholds increased over the 7 year course of the survey. Little is known about the factors that trigger changes to the prescribing threshold and whether such

changes may affect subsequent patient behaviour and their consultation threshold. Further work is needed to investigate whether a 'virtuous circle' occurs in primary care in which patients who do not receive antibiotics for an acute infection, subsequently consult less frequently when they next experience similar symptoms.

Current government targets for primary care involve reducing the waiting times for GP appointments—will increased access to GPs result in a reduction in the consultation threshold and more respiratory infections presenting to primary care?

Conclusions

Our study has documented reductions in antibiotic prescribing for respiratory infections over the years 1994–2000. The clinical categories of respiratory infection accounting for this reduction have been demonstrated but further reductions in some categories seem feasible.

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Competing interests. Nil declared.

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