Acute sinusitis: Which factors do FPs believe are most diagnostic and best predict antibiotic efficacy?

A questionnaire-and-case-vignette study reveals misjudgment of infection and antibiotic overprescribing

Practice recommendations

- Pain is not a sufficient criterion to diagnose sinusitis clinically (B).
- Purulence makes sinusitis more likely (B).
- Antibiotics are of moderate benefit in acute sinusitis (A).
- UK family doctors predominantly use specific measures of pain in diagnosis, and rate purulence less strongly.
- Patient psychosocial factors do not appear important in the decision to prescribe.
- The decision to prescribe is influenced most strongly by the FPs belief in the effectiveness of antibiotics.

Acute sinusitis is almost always a self-limiting condition involving the maxillary sinuses. About half of cases are free of bacterial infection, and 70% to 80% of patients will be symptom-free by 2 weeks, with or without antibiotics. Only a small proportion develop chronic sinusitis (>12 weeks), characterized by low-grade symptoms.

However, unlike other upper respiratory infections, acute sinusitis is still over-treated with antibiotics by primary care physicians—85% to 98% of sinusitis patients in the US receive antibiotic prescriptions, 92% in the UK, 80% in Norway, and 67% in the Netherlands. Why is this so, given the self-limiting nature of sinusitis, the very real threat of increasing antibiotic resistance, and the estimated annual treatment costs of £10 million in the UK and $2.4 billion in the US?

Our study aimed to establish criteria used by family doctors to diagnose acute sinusitis, and to determine the most important factors affecting doctors’ decisions to prescribe antibiotics.

What clinical features make diagnosis more likely?

The most rigorous scientific evaluation to date, though admittedly conducted in a selected population, is that of Berg and Carenfelt, who identified 3 symptoms and 1 sign that are most diagnostic of bacterial infection:

- Purulent rhinorrhea with unilateral predominance
- Local pain with unilateral predominance
- Bilateral purulent rhinorrhea
- Pus in the nasal cavity.

Presence of 2 or more of these findings gave a specificity of positive bacterial culture on sinus aspiration of 77% to 78% and a clinical reliability of 86%. This is
reviewed in the Agency for Health Care Policy and Research evidence-based guideline.3

Other studies have confirmed the importance of purulent secretions to a diagnosis of bacterial infection and have suggested several additional predictive features, such as lack of response to decongestants, biphasic illness after a cold, temperature >38.5°C, and tests results such as elevated erythrocyte sedimentation rate or C-reactive protein.10–13 Limited evidence suggests that nasal purulence predicts therapeutic benefit from antibiotic therapy.14

It has been unclear, however, which symptoms and signs family doctors deem important in daily practice.

What influences the treatment decision?

Howie’s classic paper on sore throats showed that the patient’s psychological and social history significantly affected the doctor’s response. Doctors’ beliefs in the effectiveness of antibiotics were not assessed in relation to these factors.15 We were unable to find any studies that have evaluated factors influencing antibiotic prescribing for acute sinusitis. More recent qualitative work on sore throat and respiratory infections has identified a number of specific and general factors that affect prescribing and are likely to hold some relevance for sinusitis.16–18

We constructed a questionnaire and case vignettes to assess physicians’ means of diagnosing and treating acute sinusitis.

Methods

Development of the questionnaire

Identifying the diagnostic criteria. First we reviewed the diagnostic and clinical literature in acute maxillary sinusitis and rhinosinusitis to identify all common symptoms and signs used to diagnose the condition. We also conducted a focus group at a Wessex Research Network (WReN) meeting, with approximately 20 family doctors and nurses contributing to the discussions.
on the “everyday” diagnosis of sinusitis and the development of the items to include in the questionnaire. We identified symptoms and signs using an open-ended approach, asking these professionals to reflect on aspects of their decision-making processes. After eliminating duplications and unclear criteria, we retained 24 symptoms and signs most often used for diagnosis. This inclusive list (TABLE 1) became part of the final questionnaire. Participating doctors were instructed to rate all 24 items for their “importance to you in diagnosis” on a 5-point Likert scale (4 = very important, 3 = important, 2 = moderately important, 1 = slightly important, 0 = not important), and to further select the 5 most important symptoms and signs they actually used to diagnose acute sinusitis in everyday practice.

Construction of case vignettes. For the second part of the questionnaire we used 2 case vignettes to explore clinical judgment. The vignettes reflected the importance of psychosocial variables, as shown in the work of Howie in explaining respiratory prescribing in family practice. We also included such cognitive factors as doctors’ beliefs about therapy. Case vignettes allowed us to evaluate several real-life factors that influence judgment in prescribing decisions.

A small group of doctors and researchers (the authors) met to consider the themes in the literature and our own qualitative work databases. We discerned and agreed on 6 important features relevant to clinical judgment in prescribing for acute sinusitis in everyday practice. These features were included in the vignettes:

- timing of surgery (running late vs on time)
- family history (complication of sinusitis vs none)
- housing (good vs poor)
- nutrition (good diet vs poor)
- patient’s frequency of attendance (frequent attendance vs infrequent attendance)
- patient’s belief in antibiotics (positive vs uncertain).

We then constructed a prescribing decision “dilemma” based on the 2 clinical vignettes, both of which contained plausible symptoms of acute sinusitis in line with Social Judgment Theory. One case (PATIENT A) was unlikely to be acute bacterial sinusitis. The other case (PATIENT B) was a probable case of acute bacterial sinusitis. We used Berg and Carenfelt’s evidence-based predictive diagnostic criteria to ascertain diagnostic likelihood.
These plausible scenarios exhibit differing levels of diagnostic likelihood and have been enmeshed with the various permutations and combinations of important decision-making factors (in bold).

The doctors were then asked, “What is the likelihood of your prescribing immediately for this patient?” and “What is the likelihood of your prescribing delayed antibiotics for this patient?” Responses were recorded on 6-point Likert scales ranging from highly likely to highly unlikely. Doctors were also asked about their beliefs—i.e., how effective they think antibiotics are in treating acute sinusitis (and complications separately) on 5-point Likert scales (4 = very effective, 3 = effective, 2 = indifferent, 1 = ineffective, 0 = very ineffective).

The final questionnaire included:
- Family doctor details and demographics (age, gender, number of years as a family doctor, number of hours worked per week), and the health centre (type, list size of registered patients, number of partners)
- A clinical features section itemizing symptoms and signs used to make a diagnosis of sinusitis
- The 2 clinical vignettes incorporating clinical and psychosocial variables
- Questions on the likelihood of prescribing, and questions about the beliefs of the effectiveness of antibiotics.

**Questionnaire distribution**
The questionnaires were piloted on a small group of doctors before mailing to 1024 family doctors in the Hampshire Health Authority. Each doctor received a different example of the 64 possible factor combinations for patient A, which were randomly paired with 1 of the 64 possible factor combinations for patient B. We produced 16 replicates of these pairings, and then assigned these scenario-pairs randomly to the 1024 doctors in the Wessex locality (Hampshire, Dorset, and Wiltshire).

After 3 mailings, 557 replies were received; 537 were fully completed and used in the analysis (54.4% response rate). To assess response bias, we compared the Townsend Index (material deprivation score). This is an area level unweighted sum of 4 census variables standardized as Z-scores. It was derived from the practice/premise zip codes of all participating and nonparticipating doctors.21

**Statistical methods and analysis**
**Diagnostic factors.** We present the mean scores with 95% confidence intervals for
each of the variables (since the median is insensitive to small changes when the range is narrow). Factor analysis with varimax rotation was also performed on the scores to identify clusters of variables that doctors use in diagnosis (using STATA version 7). Factor analysis is a special statistical method for dealing with multi-way frequency tables, and which involves reducing correlated variables to a single factor (such as a symptom/sign cluster). Varimax rotation is a method of extracting the principal component factors by using a variance maximizing method on the data set.22

Case vignettes. The doctors’ likelihood of prescribing antibiotics for vignettes A and B was reduced to a dichotomous variable (likely vs unlikely to prescribe to correspond to a treatment decision). Multiple logistic regression was used to investigate this variable with the psycho social variables, demographic variables (including the Townsend Index of deprivation) and doctors’ beliefs in antibiotics. Extracted factors from the factor analysis of the symptoms and signs were also included in the analysis. Backwards elimination was used with variables at the \( P \leq 0.05 \) level remaining in the models.

Results

Of 537 completed replies from Wessex family doctors, 60.7% were male and 37.8% were female. The median age was 45 years, with 15 years as a family doctor. 65.4% had professional collegiate membership and 8.4% had a special interest in otorhinolaryngology. The health center characteristics were 37% urban, 43% suburban, and 18% rural, with a median number of partners of 5.5 and list size of approximately 10,000 registered patients. The number of sessions per week was 7.4. The Townsend Index of material deprivation ranged from –6.0 to 9.92.

In our analysis of nonresponders we found that nonresponders were from practices in more deprived areas (\( t\text{-test; } t_{995}=2.433, P<.05 \)). The mean score for responders was –0.24 and for nonresponders 0.26. The demographics of our sample was identical or very close to that for Hampshire and England for gender, individual list size, and age, but differed in average number of partners from 5.5 (sample), 4.3 for Hampshire, and 3.2 for England.23 Since number of partners was not significant in any analysis these results should nevertheless be generalizable.

Diagnostic factors

The importance (mean score) of each symptom and sign used by doctors in diagnosing acute sinusitis are shown in TABLE 1. Factor analysis with varimax rotation identified four groups of variables used—nasal symptoms (without purulence), purulence, being unwell, and pain (TABLE 2).

Case vignette—patient A

(unlikely bacterial sinusitis)

In this vignette, 37% of doctors would prescribe an antibiotic. From multivariate analysis the most important variable in the decision to prescribe was belief in the effectiveness of antibiotics in treating symptoms (TABLE 3). Nasal symptoms without purulence (factor 1), and pain (factor 4) were independently significant in the model, as was Townsend Index of deprivation. Two variables were predictive in univariate analysis—the practice type/urban vs suburban (\( P=.019 \)), and number of years as a family doctor (\( P=.03 \))—but were not independently predictive in multivariate analysis.

Case vignette—patient B

(likely bacterial sinusitis)

In this vignette 82% of doctors would prescribe an antibiotic. From multivariate analysis the most important variable in the decision to prescribe was belief in the effectiveness of antibiotics to treat symptoms, followed by belief in their effectiveness in treating complications (TABLE 4). Family history was predictive in univariate analysis but not in multivariate analysis.
None of the other psychosocial variables, nor any family doctor or health center characteristics (eg, number of partners, list size, collegiate membership, special interest in otorhinolaryngology) were significant in affecting the decision to prescribe in either case vignette, in either univariate analysis or in multivariate analysis.

**Discussion**

This study shows that family doctors in the UK diagnose and treat presumed acute sinusitis in a manner contrary to available evidence.

**Family doctors mostly use measures of pain rather than presence of purulence when diagnosing acute sinusitis. The 4 highest rated symptom and sign scores were indices of pain. Unilateral pain and rhinorrhea were also important.**

**Doctors’ beliefs in the importance of nonpurulent nasal symptoms** were significantly associated with prescribing, though sinusitis was unlikely. Purulent nasal symptoms did not reach significance for either case vignette. Doctors’ reliance on pain and nonpurulent nasal symptoms is in contrast to studies indicating that symptoms or signs of purulent nasal secretions are the most predictive of bacterial sinusitis.9

A Cochrane review concluded that antibiotics were moderately effective when acute sinusitis was confirmed by diagnostic tests. In contrast, a recent primary care trial with broader entry criteria including maxillary pain, purulent discharge, or pain on bending forward (without formal diagnosis) showed no significant improvement in recovery time following antibiotics.24

The effectiveness of antibiotics for acute sinusitis in family practice populations is

<p>| TABLE 3 |
|---------------------|---------------------|---------------------|
| <strong>Vignette A (unlikely bacterial sinusitis): Belief in antibiotic effectiveness for symptoms the most important variable in decision to prescribe</strong> |</p>
<table>
<thead>
<tr>
<th>CRUDE ODDS RATIO (95% CI)</th>
<th>ADJUSTED ODDS RATIO (95% CI)</th>
<th>WALD TEST Z (P VALUE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctor’s belief in effectiveness of antibiotics in treating symptoms of acute sinusitis</td>
<td>2.16 (1.62–2.88)</td>
<td>2.14 (1.52–3.0)</td>
</tr>
<tr>
<td>Pain (factor 4)</td>
<td>1.49 (1.21–1.83)</td>
<td>1.31 (1.05–1.64)</td>
</tr>
<tr>
<td>Nasal (factor 1)</td>
<td>1.37 (1.12–1.67)</td>
<td>1.44 (1.17–1.78)</td>
</tr>
<tr>
<td>Townsend deprivation score</td>
<td>1.07 (1.01–1.14)</td>
<td>1.08 (1.01–1.15)</td>
</tr>
<tr>
<td>Health Centre type*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>urban</td>
<td>0.62 (0.42–0.93)</td>
<td>0.63 (0.38–1.07)</td>
</tr>
<tr>
<td>rural</td>
<td>1.09 (0.64–1.86)</td>
<td>1.22 (0.62–2.33)</td>
</tr>
<tr>
<td>Number of years as a family doctor</td>
<td>1.03 (1.00–1.05)</td>
<td>1.02 (0.99–1.04)</td>
</tr>
</tbody>
</table>

*The comparison group were suburban practices.*
yet to be clarified, and there are no clearly agreed predictors of treatment response in any healthcare setting.2,24–29

The importance of doctors’ beliefs in benefit of antibiotics for symptom relief and the high reported prescribing rate contrast with current evidence for only moderate effectiveness of antibiotics.1–3,24–29 Further evidence is needed to guide appropriate antibiotic prescribing in acute sinusitis-like illness in family practice.

Psychosocial factors seemed unimportant. The family history was associated with the decision to prescribe in probable sinusitis, but its effect was not independent when controlling for the doctors’ beliefs. Apart from the sociodemographic variable—the Townsend Index of the practice—one of the psychosocial factors we identified as important appeared to be significant in the decision to prescribe. This contrasts with the original work from Howie in which psychosocial factors had strong bearing on the decision to prescribe for sore throat both lend support to this assertion.16,30

Study limitations. Our sample was taken from doctors practicing in Wessex, where there is a broad range of health care settings. The response rate of 54.4% was low.

We found that practices with higher Townsend scores were under-represented in our sample. This means the absolute level of reported prescribing effects may have been slightly underestimated for the first vignette. However, this did not affect the main aim of our study, which was to assess the relative rather than absolute importance of variables in both diagnosis and prescribing. Including the Townsend score in the model did not significantly confound estimates for other variables.

The main limitation of the study, therefore, is that we were assessing reported decisions to diagnose and prescribe: in this context doctors may have felt pressure to report evidence-based practice rather than what they do in reality. However, family doctors do not have easy access to evidence about diagnostic criteria for sinusitis since it has been little summarized and not widely debated in the Family Practice/Primary Care literature.5,10,11,13 Diagnostic criteria are more widely reported in world literature, and include technology assessments.3,31 However reporting bias seems an unlikely explanation for our results.
Our case studies focus on acute purulent maxillary sinusitis and not pan-sinusitis or chronic sinusitis. The Berg and Carenfelt criteria are not known predictors of complications of acute sinusitis but these are rare. The criteria are, however, known to perform as well as radiology against a gold standard of microbiological diagnosis (receiver operator characteristic curves), and the included mucopurulent symptoms and signs have more recently been found to be predictive of treatment response.14

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