Evaluation of the impact of a health forecast alert service on admissions for chronic obstructive pulmonary disease in Bradford and Airedale

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ABSTRACT

Background Chronic obstructive pulmonary disease (COPD) exacerbations are associated with adverse weather conditions. We examined if a forecasting alert service available to general practices in Bradford and Airedale for the winter of 2007–08 reduced COPD admissions.

Methods We compared admissions in 2007–08 with 2006–07 when the service was not available. We examined admissions in December to March, and in the 7- and 14-day post-alert periods. There were five alerts in 2006–07 and four in 2007–08. We compared practices using the service to varying extents with practices not using it.

Results Admission rate ratios for practices using the service were 0.98 [95% confidence interval (CI): 0.78–1.22] for December to March, and 0.82 (CI: 0.57–1.18) and 0.95 (CI: 0.72–1.26) for the 7- and 14-day post-alert periods, respectively. When we took into account the proportion of patients entered on the alerts system and the duration for which practices participated in the service, admission rate ratios for practices fully using the service were 1.11 (CI: 0.80–1.52), 1.22 (CI: 0.73–2.04) and 1.21 (CI: 0.82–1.78) for the three corresponding periods.

Conclusion We failed to show that any change in admissions associated with the forecasting service was significant. More research on the effectiveness of the COPD forecasting service is needed.

Keywords health services

Introduction

It has been estimated that there are approximately 900 000 patients in England and Wales with a diagnosis of chronic obstructive pulmonary disease (COPD). Morbidity from COPD is high and up to one in eight emergency hospital admissions may be due to COPD. COPD admissions are higher in winter and exacerbations are triggered by a number of factors related to cold weather, including increased susceptibility to infection.

The Met Office in the UK has developed a Healthy Outlook COPD Forecast Alert Service, which forecasts when the outdoor environment is likely to adversely affect the health of COPD patients. The forecasts serve as a trigger for anticipatory care to prevent COPD exacerbation. The Met Office has stated that by being alerted in advance of impending high-risk periods, people with COPD are reminded to take appropriate action to keep themselves well, and that the Service can reduce hospital admissions. Further details and costs of the Service are provided on the Met Office's website.
boosting factor, a cold contribution factor and a weighting factor for the amplitude in admissions identified over the Christmas and New Year period. In a detailed analysis of how different measures of cold weather affect COPD admissions, the Met Office reported that all measures of cold showed significant negative correlations with COPD admissions, with daily temperature associations being most significant with an 8-day lag, while wind-chill had the strongest correlation with a 1-week lag accounting for 20% of variation in admissions.

In addition to advantages for patients, the system has potential advantages for health services because it could reduce hospital admissions. Bradford and Airedale Primary Care Trust (PCT) commissioned the Met Office Forecast Alert Service for the winter period of 2007–08. We evaluated if the service had any impact on admissions for COPD.

**Methods**

The service was available to all 87 general practices in the PCT for the 2007–08 winter period and practices could choose to participate. Participating practices were required to enter their patients with COPD on the Met Office system. Some practices operated an opt-in system, where they contacted all COPD patients on their register with information about the service and asked if they wanted to participate, and then entered all patients who consented on the Met Office system. Others used an opt-out system, where the default was to enter all patients on the system and exclude those who asked not to be included. Patients on the system were sent an information pack that described the health forecasting system and how weather could affect COPD symptoms. It also contained detailed advice on self-management of COPD. Patients were given information about the automated telephone call they would receive, which would be triggered by a bad weather alert. Patients were asked for a telephone number they would like to be called on and given options for the time of day they would like to be contacted.

The automated telephone call worked through a script, based on patients’ replies to a series of questions. The calls began with an introduction informing patients that the health forecast indicated that people with COPD may become more unwell in the next 2 weeks and suggested that they read their information pack for further advice. The system then asked them whether they had enough COPD medication to last for the next 2 weeks. If the answer was no, patients were advised to contact their practice for a repeat prescription. The next question patients were asked was whether their symptoms had become worse than normal. If the answer was yes (or if they did not answer), they were advised to contact their practice and speak to a respiratory nurse or general practitioner (GP). They were also told that if their breathing was much worse than usual, they might need urgent attention from their GP. When contacting their practice following a call, patients were asked to tell their practice that they had received a call from the Met Office COPD Forecasting Service.

We were supplied with anonymized admissions data on COPD (ICD-10 J400–J449) for all practices for the winters of 2006–07 and 2007–08. We compared admissions of patients aged 30 years or more in 2007–08 with admissions in 2006–07 during three time periods—all winter (defined as December to March), 7 days following an alert and 14 days following an alert. The rationale for the all-winter period was to examine the general effect of taking part in the service on COPD care by patients and general practice staff. The 7- and 14-day post-alert periods were to examine the specific effect of the automated telephone calls on COPD self-management by patients, including seeking medical advice as appropriate, during anticipated poor weather conditions. We counted the day of the alert as the first day of the 7- and 14-day periods. There were five alerts in the 2006–07 winter period, when none of the practices took part in the Met Office system, and four alerts in the 2007–08 winter period.

The PCT also supplied the number of patients on the COPD register of each practice in 2007 and the number of patients who had been entered on the Met Office system by each practice. Although several practices chose to join the forecasting system, some only implemented the system part way through the winter period while others which had chosen to join did not register any patients on the system.

For each Bradford practice, we derived two estimates of practice exposure to the forecasting service from the data supplied. The first of these exposure measures simply categorized practices by whether they participated for the whole winter period, part of the winter period or did not participate in the forecasting service. The non-participation category included practices that had opted to join but did not enter any patients on the system.

The second exposure measure was the ratio of the number of patients on the Met Office system to the number of registered COPD patients, weighted by the proportion of alerts that patients would have received. Thus, for example, if a practice had 50 patients on its COPD register, 40 of whom were entered on the Met Office system, and the practice patients only received two of the four alerts in the 2007–08 winter period because the practice joined the service part way through the winter, this second exposure
measure, which we termed ‘exposure scale’, would be $\frac{40}{50} \times 0.5 = 0.4$.

For the purpose of modelling practice level COPD admission counts, the data set was structured so that it contained two records per practice, one corresponding to the winter period of 2006–07 and the second corresponding to winter 2007–08, with a practice identifier for each practice. Each record contained the practice level all-winter and 7- and 14-day post-alert admission counts. Both exposure indices were set equal to 0 for all records pertaining to the 2006–07 winter period. A winter period label was used to distinguish winter 2006–07 data from winter 2007–08 data. Poisson regression models implemented using STATA v. 9.0 were used to model practice level COPD admission counts from the two successive winter periods, thereby constituting a before and after forecasting intervention scenario comparing practices with different levels of exposure. Robust standard errors were used to take into account any overdispersion. Practice exposure was entered as a continuous variable and the practice identifier and winter label were entered as categorical variables. Separate models were run for the two practice exposure measures and for each of the three admission periods (all winter, 7- and 14 days).

### Results

There were 453 admissions for COPD in the 2006–07 winter period and 431 admissions in the 2007–08 winter period from all 87 practices in the PCT. Exposure category could not be calculated for one practice and exposure scale could not be calculated for two practices because of missing data.

Table 1 shows admission counts by exposure category in 2006–07 and 2007–08 and the ratio of admission counts for the two winter periods. Fifty-one practices (59%) did not use the service, 10 joined part way through the 2007–08 winter period and 25 participated for the whole winter period. There were no obvious trends in ratios towards benefit across categories. Although the ratios were lower for participating practices in the 7- and 14-day post-alert periods, CIs were wide. Table 2 shows admission counts by scale of exposure. Again, there were no clear trends towards benefit with higher exposure.

Table 3 shows the results of the Poisson regression analysis. When the exposure category was used, the admission rate ratio for all winter for practices using the service relative to those not using it was 0.98 (95% CI: 0.78–1.22), i.e. a 2% reduction with 95% CI of 22% reduction to 22% increase, providing little evidence that participation in the service had any effect on all-winter admissions. The admission rate ratio for the 7-day post-alert period of 0.82 (CI: 0.57–1.18) suggested that admissions for practices that participated for the full winter period were 18% lower than in the previous year but the CI was wide (43% lower to 18% higher). Similarly, the rate ratio of 0.95 (CI: 0.72–1.26) for the 14-day post-alert period provided no evidence of a significant effect.

### Table 1 Admissions for COPD in Bradford and Airedale PCT by category of general practice exposure to the Met Office Forecast Alert Service

<table>
<thead>
<tr>
<th>Exposure category</th>
<th>Number of practices</th>
<th>Admissions</th>
<th>Ratio of admissions (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All winter (December to March)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not participate</td>
<td>51</td>
<td>203</td>
<td>195</td>
</tr>
<tr>
<td>Participated for part of 2007–08 winter</td>
<td>10</td>
<td>57</td>
<td>55</td>
</tr>
<tr>
<td>Participated for whole of 2007–08 winter</td>
<td>25</td>
<td>183</td>
<td>172</td>
</tr>
<tr>
<td>Total</td>
<td>86</td>
<td>443</td>
<td>422</td>
</tr>
<tr>
<td>In 7-day post-alert period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not participate</td>
<td>51</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>Participated for part of 2007–08 winter</td>
<td>10</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>Participated for whole of 2007–08 winter</td>
<td>25</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>Total</td>
<td>86</td>
<td>120</td>
<td>104</td>
</tr>
<tr>
<td>In 14-day post-alert period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not participate</td>
<td>51</td>
<td>107</td>
<td>97</td>
</tr>
<tr>
<td>Participated for part of 2007–08 winter</td>
<td>10</td>
<td>28</td>
<td>23</td>
</tr>
<tr>
<td>Participated for whole of 2007–08 winter</td>
<td>25</td>
<td>95</td>
<td>82</td>
</tr>
<tr>
<td>Total</td>
<td>86</td>
<td>230</td>
<td>202</td>
</tr>
</tbody>
</table>
Table 3 also shows the effect of the exposure scale variable, which took into account the proportion of COPD patients entered on the alerts system and the duration for which practices participated in the service, on admission ratios. There was little evidence of any effect and none of the estimates were less than 1, with admission rate ratios of 1.11 (CI: 0.80–1.52), 1.22 (CI: 0.73–2.04) and 1.21 (CI: 0.82–1.78) for the all-winter, 7-day and 14-day admission periods, respectively.

Discussion

Main finding of this study

We found no evidence of any significant reduction in admissions associated with the adoption of the Met Office COPD forecasting service over the 2007–08 winter period in Bradford and Airedale PCT. This lack of evidence related to both the 7- and 14-day post-alert periods, during which a specific effect of the automated telephone alert calls on COPD admissions would be expected, and to the all-winter period, during which a more general effect in terms of improved COPD care leading to fewer admissions might be expected.

Limitations of this study

There are a number of limitations to our evaluation, which need to be considered and which could have hampered detection of a significant effect of the Met Office system on COPD admissions. A relatively small number of practices took up the service and of those that took it up, few entered most of their patients on the system. In addition, there were relatively few alerts during the periods compared,
limiting the power of the study. Practices taking up the service may have been different from those not doing so and other measures affecting COPD care could have been introduced by practices, masking any effect. Inaccuracies in COPD registers and in details of patients on the Met Office system would have resulted in practice exposure scale misclassification, potentially diluting any underlying association. There may also have been errors in completeness and coding of COPD admissions. We used an ecological (practice-level) study design that has inherent limitations, because there was no individual-level record linkage between admissions, COPD registers and patients on the Met Office system.

What is already known on this topic
Exacerbation of COPD is more common in winter and the seasonality in admissions and mortality in COPD are well documented. However, whilst admissions to hospital for COPD exacerbations cause increased pressures on hospital beds during the winter months, relatively few patients with an exacerbation are admitted, with most being treated on an outpatient basis. An association between cold weather and GP consultations for lower respiratory tract infections has also been documented, with an increase in consultations following a drop in temperature in the 20 days previous to the consultation. Falls in outdoor and indoor temperature are associated with decreases in lung function, as measured by forced expiratory volume in 1 s and forced vital capacity.

Inhalation of cold air causes cooling of the nasal epithelium and this reduction in nasal temperature is sufficient to inhibit respiratory defences against infection such as mucociliary clearance and the phagocytic activity of leukocytes.

What this study adds
Despite the limitations, the lack of association we have observed could be real. There are several possible reasons for a lack of effect which would benefit from further research. Although there is evidence for the effectiveness of automated computer-based telephone technologies in relation to delivery of health messages, the effectiveness of the automated telephone call script as a communication and health intervention tool needs to be assessed. It would be useful to know how successful the automated system is in reaching the intended person in a household and which patients find the automated system difficult to engage with. The information packs contain clear, evidence-based advice and it would be useful to find out the extent to which they are read and acted upon. The effectiveness of the service depends on the level of existing COPD care because if COPD care is already good, not much more action could be taken in response to an alert. In addition, forecasts have inherent uncertainty and it would be informative to know if forecasted weather turns out to be as bad as predicted.

Our results do not appear to support summary evaluation results provided by the Met Office on their website, which show a 20.5% reduction in admission rates in practices that used the service and a 48% reduction in practices with more than half of their COPD patients registered on the system. However, given the relatively wide CI around our estimates, we cannot rule out a reduction of around 20% in admission rates, which would mean that our results are not completely incompatible with the Met Office figures. More research on the effectiveness of the COPD forecasting service is needed and it would be useful if PCTs planning to commission the service incorporate detailed evaluation as part of the package.

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References
1 National Institute for Health and Clinical Excellence. Chronic obstructive pulmonary disease—National clinical guideline on management of


