Assessment of respiratory health surveillance for laboratory animal workers

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Introduction

Animal proteins in urine and dander are recognized as potent respiratory sensitizers [1]. Workers exposed to laboratory animal allergens are at risk of developing work-related symptoms of the eyes, nose, lungs and skin, which may herald significant adverse health outcomes, including occupational asthma [2]. UK legislation requires employers to perform risk assessments and to protect employees from such exposures [3,4]. Primary prevention to remove or reduce allergen exposure is the first consideration but where potential allergen exposure persists despite control measures, then health surveillance is required. Establishing robust, reliable and effective systems of health surveillance is a challenge. Several studies of varied respiratory health surveillance programmes have raised questions regarding their efficacy [5,6]. There is also some evidence that questionnaires in employers’ surveillance schemes may not elicit full and frank responses from employees [7].

In line with UK Health and Safety Executive respiratory surveillance guidance MS25, two levels of surveillance can be employed, depending on individuals’ potential exposure to allergens [8]. Low-level surveillance is for employees with brief or intermittent exposure to animal allergens. High-level surveillance is for employees with potentially greater allergen exposure, typically performing animal care tasks such as feeding and cage cleaning, for most or all of a work shift.

This study was carried out in a UK research facility where a health surveillance programme had been...
provided by the occupational health service (OHS) since December 2003. The workers in the facility have been informed of animal allergen risks and are aware of safe working practices, including use of airflow cabinets. Staff shower and change on each entry to the facility. Laboratory clothing and hair caps are mandatory. Personal protective equipments (PPEs), i.e. gloves, face masks or airflow hoods, are available and their use is encouraged. The aim of the study was to evaluate formally the efficacy of a respiratory health surveillance programme for workers potentially exposed to respiratory sensitizers (laboratory animal allergens).

Methods

The study had two components: a retrospective review of laboratory animal workers’ surveillance records held in occupational health (OH) case notes and an anonymous survey of the current workforce. The survey results were compared against the review of surveillance symptom questionnaires from the case notes. This was a deliberate comparison of two questionnaires, the survey using a previously validated tool. A separate audit was undertaken of the validity of the surveillance spirometry in the case notes.

For the case note review, 87 employees were identified from the OH database as participating in the OH respiratory health surveillance programme from January 2004 to December 2005.

These respiratory health surveillance records were given a unique study number as the only link to individual health records. Data from both components of the surveillance programme, i.e. the respiratory symptom questionnaire and spirometry record, were coded for data collection in an Excel spreadsheet.

The OH surveillance questionnaire (Appendix 1, available as Supplementary data at Occupational Medicine online) was developed in house using specific questions on work tasks plus questions on symptoms based on the Medical Research Council respiratory symptom questionnaire. Staff responses to the questionnaire items were recorded in Excel. Individuals who had completed multiple questionnaires during the study period were identified at the time of data entry. These multiple episodes of surveillance per individual were collated so that an individual’s symptom reporting could be followed over the study period and counted only once per person. This reorganization of the data (per individual over the 2 years) allowed estimation of period prevalence of symptoms during the 2 years under study.

A comparator questionnaire for the cross-sectional survey (Appendix 2, available as Supplementary data at Occupational Medicine online) was developed using validated questions from the International Union Against Tuberculosis and Lung Disease (IUATLD) respiratory symptom questionnaire.

Employees currently potentially exposed to laboratory animal allergens at the time of the cross-sectional survey (October 2006) were recruited by letter to which the questionnaire was attached. This was sent by internal mail to their usual work address with a reply envelope to be returned by internal mail to the OH department. It was decided to keep the responses to the cross-sectional survey questionnaire anonymous, to encourage full disclosure from staff, for more accurate estimation of the point prevalence of symptoms.

Survey data were entered into a second Excel spreadsheet. The frequency of symptom reporting for the OHS respiratory questionnaire was compared to the frequency of symptoms reported via the IUATLD-based questionnaire survey using odds ratios. This gave an indication of the sensitivity of the OHS surveillance questionnaire relative to the validated IUATLD questions.

For the second component of the study, evaluating the quality of spirometry performance in OH, all spirometry records for the study period were reviewed. For each recorded spirometry, the presence or absence of personal identity data, evidence of recent spirometer calibration check, use of same spirometer for multiple spirometry tests, acceptable measure of reproducibility and acceptability of expiratory effort in each spirometry record were assessed for quality appraisal.

For each episode of spirometry, the values for forced expiratory volume in 1 second (FEV$_1$) and forced vital capacity were entered along with the percentage of predicted reference group values. Assessment was undertaken by two reporters individually as to whether expiratory effort was acceptable (e.g. reached satisfactory plateau), and where assessments differed, agreement was reached by discussion.

The study proposal was submitted to the Grampian Regional Ethics Committee, who decided that full application for ethical approval was unnecessary. The audit component did not need ethical approval.

Senior management for the research institution, the local manager of the animal facility and the institution health and safety manager all agreed to the study proposal. Subjects for the cross-sectional study participated voluntarily after receiving the questionnaire and explanatory letter.

Results

Eighty-seven employees were identified as enrolled in the respiratory health surveillance programme during the 2 year study period. Two of the employee case notes were not retrieved from offsite archives in time for inclusion. Case notes for 85 individuals were examined: 56% female (mean age 38.8 years; range 25–61 years) and 44% male (mean age 40.5 years; range 24–65 years).

These case notes contained 162 complete episodes of surveillance during the study period. An ‘episode’ was defined as completion of a questionnaire, with or without
spirometry. Twenty-six episodes (questionnaires with spirometry) were pre-placement with animal work. Follow-up episodes included 46 classed as high-level surveillance and the remaining 90 were low level. Nineteen employees had only one surveillance episode during the study period, depending on their date for starting or leaving employment. Fifty-seven employees had two surveillance episodes, and nine had more than two episodes, e.g. new employees with high-level exposures or those declaring symptoms.

Assessment of the surveillance programme (questionnaire) revealed that, over the study period on average, 22% of responses to individual items were missing. The most commonly omitted items were the questions on dates of stopping animal work and reasons for stopping, which were ignored in 78% of returned questionnaires. (Other employees reported interruptions to animal exposure due to the episodic nature of their research.) Items on frequency of exposure, symptoms, medical history and smoking were most likely to be answered, with only 3–12% of data missing.

Daily potential exposure to animal allergens, either continuous or intermittent, was reported by 35% of employees during the study period. Twenty-one members of staff changed their category of exposure in consecutive questionnaires, either increasing or decreasing exposure by one or more category. Post-mortems, other examinations and weighing were the most frequently reported activities associated with animal contact.

In 7%, the question on tightness of chest/wheezing/difficulty breathing after animal work was answered affirmatively. These questionnaires came from just seven individuals. The number of individuals reporting any symptoms during the 2 year study period is shown in Table 1.

In total, 36% of employees reported a history of smoking, 10% of whom were current smokers. There was no association between smoking status and symptom reporting. Employees were asked whether they wore respiratory protection when working with animals but many left this question unanswered (Table 2). In those who responded, overall the uptake of PPE was <40%. Some individuals reported use of both masks and hoods while some used neither.

Responses from individuals with varying exposures to animals at work were analysed. Among those reporting daily continual exposure to animal allergens, 47% reported that they did not use either a mask or a hood. There was a trend of decreasing use of PPE with decreasing frequency of exposure. In the least exposed category (less than monthly exposure), 83% of employees reported no use of masks or hoods (Table 3).

The responses above were compared to the responses to the cross-sectional survey (Table 2). The IUATLD-based study questionnaire was issued to 92 employees. Four were returned as the individuals had left employment. From a possible 88 subjects, 53 questionnaires (60%) were returned in which 2% of data fields were missing overall.

The four IUATLD respiratory symptom items elicited reports of one or more symptoms from 11 respondents. These were filtered by positive responses to one or more of the questions relating symptoms to work periods or tasks (questions 5–8, Appendix 2). Only five respondents were identified as having potentially work-related symptoms.

Table 1. Symptoms reported on health surveillance compared to symptoms reported to cross-sectional survey

<table>
<thead>
<tr>
<th>Symptoms reported on health surveillance</th>
<th>Number of individuals (N = 85)</th>
<th>Two year prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest tightness/wheeze</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Eczema/rash</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Sneezing/runny nose</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Itchy/watery eyes</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Symptoms reported to cross-sectional survey</td>
<td>Number of individuals (N = 53)</td>
<td>Point prevalence (%)</td>
</tr>
<tr>
<td>Wheeze/whistle</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Chest tight on waking</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Waking at night breathless</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>1 or more symptoms</td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>Related to work time/tasks</td>
<td>5</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 2. Reported use of PPE in all surveillance forms reviewed (N = 162)

<table>
<thead>
<tr>
<th>PPE</th>
<th>Yes, n (%)</th>
<th>No, n (%)</th>
<th>Sometimes, n (%)</th>
<th>Missing data, n (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mask</td>
<td>32 (20)</td>
<td>101 (62)</td>
<td>16 (10)</td>
<td>13 (8)</td>
<td>162</td>
</tr>
<tr>
<td>Air-fed hood</td>
<td>12 (7)</td>
<td>97 (60)</td>
<td>2 (1)</td>
<td>51 (31)</td>
<td>162</td>
</tr>
</tbody>
</table>
During the 2 year health surveillance period, seven individuals reported work-related chest symptoms via the OH questionnaire, giving a 2 year period prevalence of 8% of employees. The survey questionnaire elicited more reports of respiratory symptoms, but not all were work related. The prevalence of work-related symptoms reported to the cross-sectional survey was 9%. The odds ratio for detection of work-related chest symptoms between the two questionnaires was 0.9 (95% confidence interval 0.2–2.9).

Ninety-one spirometry records involving 52 individuals were reviewed for the spirometry audit. Twenty-three individuals provided just one set of readings, 22 had two spirometry records and 7 individuals had provided three or more readings. Overall, 25% of records were acceptable for all specified quality criteria, with recording of calibration checks and use of the same machine being the main negative factors (Table 4).

Only one spirometry record was abnormal on the basis of dynamic lung volumes (<80% of predicted), with an FEV₁ of 77% of the predicted value. That individual also had potentially work-related symptoms and was investigated further. No individual needing investigation was identified by spirometry alone.

As an outcome of this health surveillance programme, 62 employees continued on the surveillance programme at the levels appropriate to their high- or low-level exposures. Four individuals (mostly PhD students) left animal work as their projects had ended. Five individuals had more frequent surveillance having declared new symptoms or pet allergy.

Fourteen individuals (16% of the workforce under surveillance during the 2 year study period) were seen by the OHS doctor. Six had symptoms that were deemed not to be work related; diagnoses were hay fever (two), acute upper respiratory tract infection (three) and psoriasis (one). Eight had further investigation, by specific and total IgE and serial peak flow recording, leading to four referrals to the occupational respiratory disease clinic. Three were confirmed as having occupational asthma. A fourth individual was likely to have occupational asthma but left the area before the diagnosis was confirmed.

### Table 3. Use of PPE and potential allergen exposure by individual

<table>
<thead>
<tr>
<th>Potential animal allergen exposure</th>
<th>Daily continuous, n (%)</th>
<th>Daily intermittent, n (%)</th>
<th>Weekly, n (%)</th>
<th>Less than monthly, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total individual exposures = 106 (21 employees changed category in consecutive questionnaires)</td>
<td>23</td>
<td>14</td>
<td>39</td>
<td>30</td>
</tr>
<tr>
<td>Mask/hood both no</td>
<td>11 (47)</td>
<td>7 (50)</td>
<td>25 (64)</td>
<td>25 (83)</td>
</tr>
</tbody>
</table>

One of the three confirmed cases was completely removed from exposure. Despite advice about avoiding allergen exposure, two confirmed cases chose to continue occasional, i.e. less than daily, low-level animal contact under surveillance. The 2 year period prevalence of confirmed occupational asthma was 4% of potentially exposed employees.

### Discussion

This study has shown that surveillance of a workforce exposed to animals is feasible and can identify individuals with work-related asthma. However, the main trigger for recognition of cases was symptom reporting rather than change in lung function tests, which is similar to findings from other studies both in laboratory animal work and in bakery workers and paint sprayers [5,9,10].

This was a small study as subject selection was limited by the size of the workforce at the research facility. The subjects comprised a heterogeneous group with differing exposures in terms of both duration and tasks undertaken. This study has to be regarded as observational and did not have the power to detect statistically significant differences that could be applied to other settings. Nevertheless, some generalizations can be made.

The workforce was relatively unchanged in the period between the review of case notes and the cross-sectional study. The 87 individuals identified as undergoing surveillance in the study period included 83 who were still...
at work at the time of the cross-sectional survey. This suggests that the OH questionnaire and the survey reached the same population and are comparable at that level. The study was designed to optimize the survey response rate by complete anonymization, as it is well recognized that workers may deny work-related symptoms to avoid being told they have to stop exposure [7,11]. However, the 60% return was disappointing and the two populations cannot be regarded as identical.

The IUATLD questions were chosen for the survey as it has been assessed for validity and reliability and is used as a comparator for questionnaire development [12,13]. This gave further difficulties in methodology; because the survey instrument was different from the surveillance questionnaire, only a limited comparison is possible. For instance, OH surveillance asks ‘During the past year have you experienced any of the following symptoms following exposure to animals (except when you had a cold or similar infection); tightness of chest/wheezing/difficulty in breathing?’ and the survey asks ‘At any time in the last 12 months have you had wheezing or whistling in your chest?’ with later questions about associations with work.

However, broad statements can be made about some outcomes, for instance, the prevalence of work-related respiratory symptoms (occupational asthma until proved otherwise) in the survey and identified cases in the surveillance programme.

During the 2 year study period, seven individuals reported work-related chest symptoms via the OH questionnaire. This gives a 2 year period prevalence of 8% of employees. The survey questionnaire elicited more reports of respiratory symptoms but not all were work related. The prevalence of work-related symptoms reported to the cross-sectional survey was 9%. The two questionnaires therefore appear to have a similar detection of work-related symptoms. Both are comparable with findings in previous research in laboratory animal workers but higher than the frequency of reported symptoms in bakery workers exposed to flour dusts [5,9]. However, it is not shown that this surveillance captures all potentially symptomatic individuals as the comparator survey response rate is only 60%, and it is unknown whether non-respondents would have similar symptom prevalence. In addition to annual surveillance, employees are encouraged to report new symptoms arising.

The OH questionnaire was more likely to have missing responses than the cross-sectional survey with some items commonly ignored. A review of questionnaire content and layout is underway.

Spirometry was limited in its benefit as part of surveillance. All three cases of occupational asthma found in the 2 year study period were identified by questionnaire, without abnormal spirometry. This is consistent with a recent evidence-based review of respiratory health surveillance and other studies [9,14,15]. Furthermore, there was a significant number of inadequate records (around one in seven) when considering the spirometry tracings for reproducibility and expiratory effort compared with American Thoracic Society and European Respiratory Society guidelines [16]. An additional source of concern was the poor recording of calibration and the use of different machines. While potentially this reduces the capacity to identify small but important changes in lung function, it is less likely to be of relevance if using some of the newer electronic devices where calibration is not needed.

The OH respiratory health surveillance programme appears to have a sufficiently sensitive symptom questionnaire, but could improve completion rates. A review of the layout and content of the OH questionnaire is planned. The OHS is moving towards ‘paper light’ records and there is an opportunity to redesign the health questionnaire as an electronic document. Mandatory answer fields could improve questionnaire completion.

At least 84% of spirometry recordings were found to be carried out to an acceptable standard. This reflects typical ‘real-life’ practice and is being improved by consistency of equipment and additional staff training. The close link with the local tertiary centre is likely to have assisted in case detection by clarifying the clinical pathway to further investigations for symptomatic employees.

Communication between the employer and OHS provider remains essential to act on the surveillance outcomes for individuals and for the workforce as a whole. This study identified low use of PPE reported by employees who responded to the question, and if non-respondents are also non-users of PPE, then the true uptake is even less than suggested here. Regular health surveillance episodes can be an opportunity to reinforce information to the employer about workforce education on risk reduction and to employees regarding appropriate PPE use.

Key points

- Respiratory health surveillance is challenging to carry out effectively but can detect occupational airways disease.
- Symptom questionnaires can identify possible cases requiring further investigation.
- In this study, lung function tests did not add to case finding.

Conflicts of interest

None declared.

References


