

CONTROLLING OCCUPATIONAL ALLERGIES IN THE WORKPLACE

ANNE KORPI¹, SANNA LAPPALAINEN², EILA KALISTE^{3,4}, PENTTI KALLIOKOSKI¹, KARI REIJULA²,
and ANNA-LIISA PASANEN^{1,5}

¹Department of Environmental Science,
University of Kuopio, Kuopio, Finland

²Finnish Institute of Occupational Health,
Helsinki, Finland

³National Laboratory Animal Center,
University of Kuopio, Kuopio, Finland

⁴present address: State Provincial Office of Southern Finland, Social and Health Affairs, Hämeenlinna, Finland

⁵present address: Finnish Institute of Occupational Health, Kuopio, Finland

Abstract

Objectives: In recent years, the prevalence of work-related asthma has increased. Therefore, more attention needs to be paid to occupational allergens and their avoidance and control in workplaces. However, risk assessment of occupational allergen exposure is difficult because the relationship between exposure concentration, sensitization, and symptoms has not been fully established. This paper introduces a systematic and comprehensive approach to assessing and managing allergen risks at workplaces. **Materials and Methods:** This approach relies on the cooperation and active communication during the whole process between management, employees, and health care personnel, with the assistance of experts when needed. In addition to gathering background information, including allergic symptoms, through questionnaires addressed to the management and employees, hazard identification is also processed in the workplace through observations and measurements. The methods generally recommended to reduce allergen exposure are compared with those used in the workplace. The process is to be carefully planned and documented to allow later follow-up and re-evaluation. **Results:** The multi-faceted approach encompasses several risk assessment techniques, and reveals the prevalence of work-related allergic symptoms. The process effectively focuses on the potential means for controlling allergen exposure. **Conclusion:** Based on this approach, the synopsis on the critical points that require implementation of effective control measures can be presented.

Key words:

Questionnaires, Exposure assessment, Allergic symptoms, Hazard identification

INTRODUCTION

About 250 agents can sensitize by inhalation/via skin contact and cause occupational allergies and asthma. Risk occupations include animal handlers, bakers, hairdressers, plastics and rubber workers, and textile workers. The most common sensitizers are flour dust, enzymes, natural rubber latex, laboratory animals, isocyanates, and acid anhydrides [1–4]. Surveillance programs have proved to be ef-

fective in monitoring the incidence of the disease, the occupations concerned, causative agents, and identification of potential targets for prevention efforts. Such statutory or voluntary programs have been established among others in Finland, France (ONAP), South Africa (SORDSA), Sweden, the United Kingdom (SWORD), and the United States (SENSOR) [5–7]. In Finland, isocyanates, welding fumes, hairdressing chemicals, moulds, flours, and stor-

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Address reprint requests to Anne Korpi, PhD, Department of Environmental Science, University of Kuopio, Biotecknia 2, P.O.Box 1627, 70211 Kuopio, Finland, tel. +358-17-163594, fax +358-17-163750.

age mites were the most frequent causes of occupational asthma in 1986–2002 [8]. In addition, occupational asthma can be caused by agents that are not found on various lists and in databases [4]. The estimates of the proportion of asthma cases attributable to occupational exposure range from 5 to 25% [9–11]. In Finland the corresponding number is 29% for men and 17% for women [12]. The adverse health effects may continue even after cessation of exposure. For example, follow-up studies have indicated that up to 82% of workers previously exposed to diisocyanate may still have symptoms after 10 years of non-exposure [13]. Occupational allergies and asthma are not only a personal tragedy of impaired health, disability and the need for re-education, but they also bring along direct (e.g., hospital admissions and the cost of pharmaceuticals) and indirect (e.g., time and productivity lost from work and premature death) medical costs. In 1996, the economic burden of occupational asthma in the United States was estimated at \$1.6 billion, of which 74% of direct and 26% of indirect costs [14].

Typically, the need for risk assessment (RA) of occupational allergens arises when a worker complaining of allergic symptoms consults the occupational health services, or when the responsible employer wants to fulfil the health and safety regulations requiring an assessment of all occupational health and safety risks. In both cases, occupational health services and RA teams often feel incapable of handling RA and management of allergen hazards due to several reasons. First, methods for measuring exposure to many occupational allergens are expensive or not available at all. Second, the relationship between exposure, sensitization, and symptoms has not been fully established. Thus, there are no “safe” levels of exposure to many allergens, yet the level of required protection needs to be established. Third, even very low levels of allergen can cause symptoms in sensitized persons. And finally, in the majority of cases, health surveillance is not systematically linked with the competent RA, and this incoherent handling prevents implementation of effective control strategies [15]. To overcome these obstacles and to control allergenic hazards, new tools for RA and management are needed. In this paper, we introduce a comprehensive pro-

cedure for the RA of airborne allergens and for the health surveillance of workers exposed to allergens. The protocol encompasses hazard identification, risk evaluation, and management. The development of the protocol was prompted by the need to assess risks posed by laboratory animal allergens, that is why this paper contains several examples concerning this field [16].

THE FUNDAMENTALS OF THE RISK ASSESSMENT PROCESS

The first step of the RA process is to establish a risk assessment team, consisting of 5–10 persons, representing workers, management, property maintenance, occupational health and safety personnel, and to appoint its coordinator. A work management or occupational safety officer appointed as the coordinator is often a good choice. In addition, an outside expert may be needed to provide additional occupational hygiene or other professional skills. The idea is that the team takes responsibility for the whole RA process, including planning, scheduling, implementing assessments in practice, and deciding on communication and documentation strategies. The shared responsibility within the team ensures that the protocol used is tailored for that particular organization. This is seldom achieved by RAs performed only by experts. A multi-professional team can also process RA work viewed from many different standpoints. However, the roles and responsibilities of the team members need to be clarified. Each member is responsible for a specific area, e.g., health care personnel for the evaluation of the state of workers’ health and health effects posed by allergens. On the other hand, some tasks in the RA process may need the input of several participants, such as the evaluation of the work environment.

Every employee should be aware of the aims and timetable of the assessment process. They should also be able to influence the process. Open communication between all team participants (workers, management, property maintenance, occupational health and safety personnel, and experts) and other employees is of crucial importance. Therefore, the summaries and documents produced dur-

ing the process need to be generally available. The results need to be discussed with the employees after each main step of the assessment. Broad agreement on the results and selected exposure controls will greatly facilitate the achievement of goals. Motivation is also essential to ensure active participation in two questionnaires directed towards the whole personnel: the health questionnaire focusing on allergic symptoms (a modified version of those

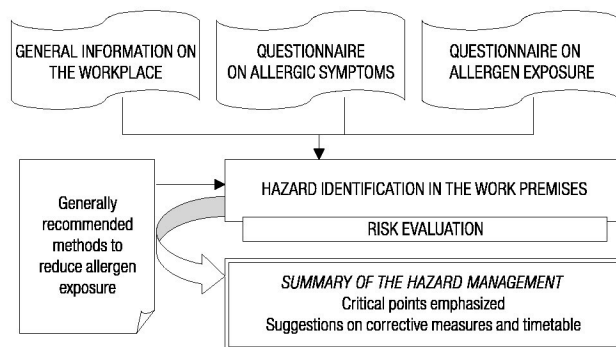


Fig. 1. Components of the risk assessment protocol for occupational allergen exposure. The risk assessment team, including occupational safety personnel with/without assistance from an outside expert is responsible for carrying out each phase of the process, except for questionnaire concerning health, which should be managed by occupational health care services. The management is responsible for providing general information, and the whole staff is invited to complete the health and exposure questionnaires.

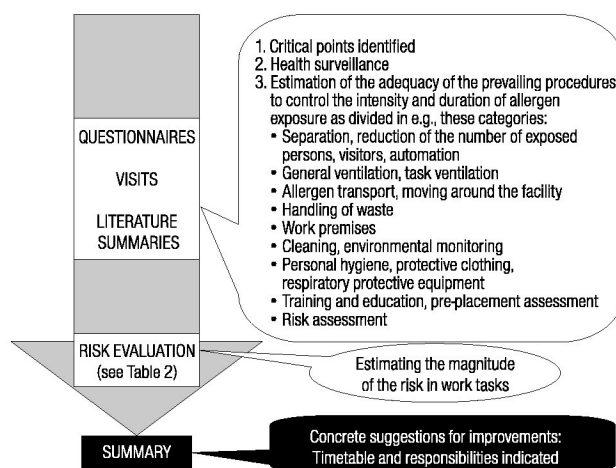


Fig. 2. Outputs and purpose of each phase of the risk assessment process. The objective of the risk assessment is to find out whether current or planned arrangements are adequate to all circumstances. Following the risk assessment its results should prompt those involved to initiate the necessary action.

presented by Bush et al., Seward and Bush, and Stave [17–19]) and the other designed to identify tasks involving allergens/allergenic material and individual controls.

The suggested process includes: 1) preliminary hazard identification with three questionnaires (one addressed to the management and two to the whole personnel); 2) further hazard identification and investigations in the workplace (by observation and measurements) with the help of check-lists, and 3) risk evaluation and management culminating in the suggested control actions (Figs. 1 and 2).

Preliminary hazard identification through questionnaires

Information on allergen hazards is obtained from the management and employees through three questionnaires. The first questionnaire is addressed to the management asking to provide background data on the work premises and allergens present. In addition, it aims at giving general information regarding the safety management. The questions must be specified according to the line of industry and type of activity, but they may include the following items:

- Activities in the facility, including agents used, their quantities, and storage conditions.
- Identification of the allergens.
- Ground plan of the premises and number of personnel in various tasks/premises.
- Health survey practices and records on occupational diseases.
- Working and cleaning routines.
- Type, function, maintenance, and location of ventilation system (including, e.g., safety/fume hoods, enclosures, and local ventilation systems).
- Safety documents, such as operational safety bulletin directions, training and orientation directions for new employees, reports on previous hazard identifications, accidents, responsibilities, and personal protective equipment.

The employees are asked to evaluate their work, exposure, and work safety in the second questionnaire. This questionnaire should include the following points:

- Brief description of duties/work tasks.

- Personal evaluation of the exposure to allergens (agents and exposure time specified).
- Protective methods and exposure controls applied.
- Abnormal high exposure situations experienced.
- Work safety training.
- Suggestions on exposure control.

In addition to employees exposed daily to allergens, those without direct contact with allergenic material and those with only sporadic visits to the premises where allergenic materials are handled should be included in the process. This is important because information on allergen hazards may have been forgotten in the basic training of these workers. As exposure controls, a choice of personal protective equipment and special technical isolation measures (e.g., safety/fume hoods, and specifically ventilated work areas) can be listed in order to guide the responses. With respect to training, it is advisable to ask if the respondents feel that they have received or not enough information related to allergen hazards.

The third questionnaire, which seeks information on allergic symptoms, is an essential part of the RA process. The results reflect both the level of work safety and the potency of allergen hazards in the workplace. It is natural that occupational health services are closely involved because the evaluation of workers' health belongs to their regular duties and because of confidential information. It is recommended that the health questionnaire be completed at an appointment and thereafter at annual intervals to ensure that possible sensitization to allergens is detected early enough. However, if a person suffers from allergic symptoms, a more frequent health surveillance intervals (2 to 3 times a year during the first 3 years of employment) might be relevant.

The questionnaire is designed to be completed by each person who could be in contact with allergens. For example, students, apprentices, maintenance technicians, and laundry workers should not be forgotten.

The questionnaire usually contains the following items:

- Background questions about age, sex, personal and family history of allergy, smoking, having pets, and past occupational history, including work with various occupational allergens.

- Doctor-diagnosed allergy, especially to relevant occupational allergens.

- Nasal symptoms (runny or stuffy nose, sneezing spells), ocular symptoms (watery, itchy or red eyes or swelling of eyes), respiratory symptoms (sputum production, wheezing, shortness of breath, persistent cough, sore throat, throat irritation, hoarseness), skin symptoms, and swelling of lips:

- the symptoms are graded “not at all or occasionally”, “few times a year”, “monthly”, or “weekly/daily”,
- it is specifically asked, if these symptoms are present during working with allergenic material,
- possible changes in the respiratory, ocular, or skin symptoms during the past 12 months are also enquired about and graded as “unchanged”, “increased”, or “decreased” if the person has first responded as having these symptoms.

- The intensity of contact with occupational allergens (“not at all”, “less than 10 times/days per year”, “monthly”, “weekly”, “daily”, “weekly periodically”, or “daily periodically”) and the information on personal protection (use of gloves, respiratory protection, eye protectors, protective clothing, and special footwear).

An example of the summarized questionnaire concerning allergic symptoms is presented in Table 1. An analysis of the data collected by the health questionnaire provides an opportunity for an early diagnosis of allergy and a clear indication of the need to improve preventive measures and exposure controls in the workplace. For example, the prevalence of work-related allergic symptoms can be compared with the range of generally reported prevalence of relevant allergic symptoms among the corresponding/respective reference population, e.g., 10–32% for laboratory animal workers, 5–29% for bakery workers, 8–23% for animal farmers (or even 40% according to Radon et al. [20]), and 17–39% for workers exposed to diisocyanates [17,21–25]. In some cases, when appropriate medical and immunological tests have been conducted, the prevalence of (skin) sensitization can be used to relate the workplace situation to the one prevailing in the same line of industry. For example, the prevalence of natural rubber latex sensitization in healthcare workers ranges from 2.9 to 17% [26].

Table 1. Summary of allergic symptoms, exposure, and protective methods of all persons regularly or irregularly staying or visiting premises where allergenic material is present (modified from Korpi et al. 2007 [16])

Summary of the questionnaire concerning health, n (%)
General characteristics of the workers
Sex, male/female
Age, year, mean (SD)
Allergy (physician-based diagnosis),
Allergy to the specific allergenic material*
Smokers, male/female
Pets
Weekly exposure to allergens*
Daily exposure to allergens*
Exposure to allergens 10 instances/year or less
Allergic symptoms weekly or daily
Ocular
Nasal
Lower respiratory tract
Skin
Allergic symptoms related to work with allergenic material
Ocular
Nasal
Lower respiratory tract
Skin
Change in the frequency of symptoms during the past 12 months
Ocular symptoms unchanged/ increased/ decreased
Respiratory tract symptoms unchanged/ increased/ decreased
Skin symptoms unchanged/ increased/ decreased
Use and type of respiratory protection
Always when working with allergenic material
In some work situations
Use of protective clothing
Special clothing, gown, overall, coverall, head covering, special footwear, eye protectors, gloves; always/during some tasks, etc.

* Specify the allergen in question.

Further hazard identification through investigations in the workplace

Hazard identification at various working sites can be performed by either the whole RA team or by only some of its members. The team might also conclude that the work environment needs to be evaluated by an experienced occupational hygienist. The results of the above mentioned questionnaires help to focus the inspection at the work premises. In general, inspected premises may include corridors; rooms where allergenic materials are handled,

housed, stored, and cleaned; dressing rooms; social premises; instrument laboratories; and premises for waste disposal. During the hazard identification, at least the following issues should be surveyed:

- number/quantity of allergenic material,
- dustiness,
- storage of allergenic material,
- types of activities in the room,
- transfer routes of allergenic material,
- work practices and methods,
- control actions and personal protection (observations can be compared with the results obtained by the questionnaires).

During the hazard identification, the workers present should be interviewed. If the questionnaire concerning health has revealed an allergic background and/or the work-related allergic symptoms, it is of particular importance to focus on the spread of allergens and protective measures. Attention should be paid to the possibilities of reducing unnecessary exposure. The function of ventilation (general and local ventilation and allergen transport) and the pressure differences between adjacent premises should be recorded. Overpressure in rooms with allergen sources contributes to the spreading of allergen emissions into the adjacent spaces. Transport of allergens can also occur through clothing and even via filed documents exported from premises. Therefore, attention should be paid to the frequency of changing protective clothing and their storage apart from personal clothes as well as to the ways how to minimize the contamination of paper documents. Even though recommended limit values are lacking for many allergens, the measurements of allergen concentrations enable comparisons between different premises and work tasks, and they support the identification of allergen-spreading. The measured allergen concentrations can also be compared with those reported in the literature to recognize high risk situations. During the whole hazard identification process, the existing procedures and activities should be compared with the generally recommended methods for reducing allergen exposure. These preventive measures can be classified into four categories: 1) substitution (elimination and replacement); 2) engineering controls; 3) administrative

controls, including work practices and education; and 4) personal protective equipment [18,27]. Substitution involves the use of non-allergenic material (e.g., using paints without isocyanates or non-latex gloves instead of latex ones), the introduction of alternative techniques (e.g., using mechanical mixing instead of hand mixing in bakeries), and in some occasions also computer modeling instead of using allergenic materials. The engineering controls, in turn, are attempted to isolate workers from hazards. To follow the isolation principle, the possibility of performing certain tasks in premises where prevailing (background) allergen levels are lower should be evaluated. As administrative controls, modification of work practices is often needed to minimize exposure (e.g., using moist sweeping

instead of dry sweeping). Personal protective equipment may be needed to provide a barrier between employees and hazards that cannot be adequately controlled by other means. Respiratory protection can reduce the severity and frequency of symptoms in allergic individuals when total exposure avoidance is not possible [18,27,28]. In summary, the controls should reduce both the intensity and the duration of exposure [28–34].

For some occupational allergens, comprehensive intervention programs already exist to reduce asthma symptoms. These include protein allergens found in natural latex gloves [35], laboratory animal allergens [28–34], diisocyanates [36], enzymes in the detergent industry [37], and in bread baking [38].

Table 2. Estimation of the magnitude of the risk among workers. Risk classification relies on the likelihood of exposure and allergic symptoms or diseases recorded. In addition, the prevalence of health effects should be compared with generally reported prevalence in corresponding reference populations to assess the need for controls

Consequences Probability of exposure	No reports on health effects or allergic symptoms present or occurring seldom (max. a few times a year)	Harmful health effects**	Serious health effects***
Not likely If threshold limit values (TLV*) are available, the allergen concentrations are below 10% of TLV If TLV are not available, the allergen concentrations are below or near the detection limit Control actions (e.g., engineering controls, personal protective equipment) seem to be adequate compared with the checklist	Insignificant or trivial risk	Small or tolerable risk	Moderate risk
Possible Increased allergen concentrations; if TLV are available, the concentrations are ≤ 50% of TLV Incomplete control actions	Small or tolerable risk	Moderate risk	Significant or substantial risk
Probable High allergen concentrations; if TLV are available, the concentrations are > 50% of TLV Incomplete control actions High concentration of allergenic substance; or uncontrolled significant allergen sources	Moderate risk	Significant or substantial risk	Intolerable risk

*Occupational exposure guidelines, such as TLV, exist for certain isocyanates, enzymes, anhydrides, amines, metals, plastics, and certain chemicals. On the other hand, TLV values for mites, insects, seafood, fish, dander, hair and urine of animals, plants, vegetable gums, soybean compounds, several wood components, fungi, several enzymes, medicaments, and dyes are lacking [2,37].

**For example, nasal, ocular, respiratory and skin symptoms reported at least weekly; or increasing prevalence during the past 12 months; or greater prevalence of symptomatic personnel than generally reported in the reference population (exposed to same allergens or same occupation);

*** Allergic diseases (asthma, occupational allergies) or symptoms associated with the workplace and occurring daily; or increased symptoms during the 12 past months; a high number of occupational diseases.

Risk evaluation and management: suggestions on control measures

The summary of the hazard identification performed at various work sites forms the basis for risk evaluation and helps to direct proposals for the control measures to be taken. British standard 8800 can mostly be followed [39]. Even though the exact estimation of the magnitude of the risk is often impossible the risk can usually be classified as insignificant, small, moderate, significant, or intolerable, based on the results of the RA process as depicted in Table 2. The exposure can be regarded as sufficiently low when the person suffering from allergy is free of symptoms without medical treatment [33]. The categorization of the risk at a group level should depend on: 1) the sensitizing potency of the allergen; 2) the duration and intensity of exposure to allergens; 3) the severity of allergenic symptoms reported; and 4) the control actions selected. The risk classifications are based on the results of questionnaires, visits, and evaluation of followed work practices (Table 2, Figure 2). When the premises/work environment and methods are evaluated and critical allergen hazard points identified, the previously summarized methods of controlling allergen exposure serve as guiding principles and help to focus on relevant issues. A low-risk category results from adequate exposure control, and the results of health surveillance indicate a low incidence of occupational allergy [31]. On the other hand, the prevalence of work-related allergic symptoms grades for a higher risk category, which in turn indicates the need to assess controls. Additional control actions are to be implemented within a reasonable timetable if the risk classification results in moderate or significant risk. The work must be ceased and major improvements in control actions are needed when the risk is evaluated as intolerable. In such cases, the options for exposure control measures must be carefully inspected and should start from the option showing the highest preventive power and the lowest health burden, in the following order:

- structural prevention and elimination of hazards;
- engineering controls and minimizing emissions;
- utilizing control technology, ventilation, exhaustion;
- working practices, wet processes, cleanliness, order;
- personal protection, respirators;

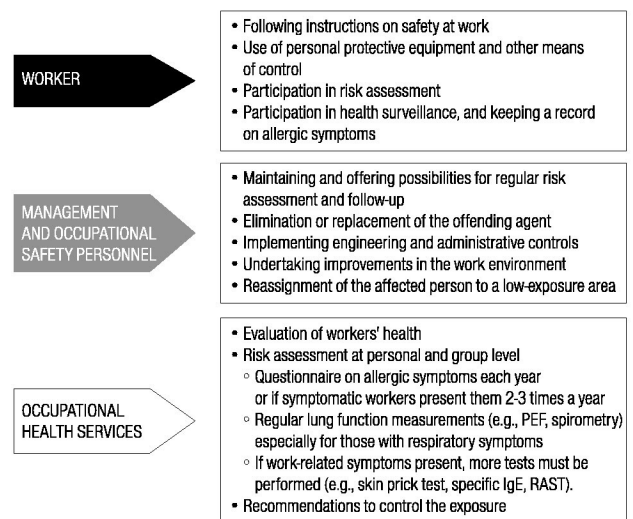


Fig. 3. Responsibilities and possibilities of workers, management, occupational safety personnel, and occupational health services to control occupational allergies.

- limiting exposure times;
- decontamination;
- health surveillance, early diagnosis and treatment, and reassigning the affected person to a low-exposure area.

Although occupational health care personnel play an important role in the evaluation of health effects, it is recommended that the final risk evaluation be performed by the RA team. However, it should be remembered that RA and management should involve the entire workplace and be repeated on an annual basis [15] (Fig. 3). In the RA summary, dates and contents are set for the follow-up with periodic reviews of the existing system, as required. Previous summaries of each questionnaire, hazard identification tours and hazard management form the basis for regular follow-ups, and the effects of any modifications and changes in the work environment can then be easily reassessed.

CONCLUSIONS AND IMPLICATIONS

The increased prevalence of occupational allergies and asthma gives rise to an urgent need for developing methods to establish the level of required protection. However, RA and management of occupational allergen exposure are a complex process. The risk assessment of allergens cannot be based only on measurements of allergen con-

centrations, but on a comprehensive overview of all factors influencing allergen exposure. This results from the lack of threshold values or “safe” levels estimated for exposure to a number of allergens. In this paper, a step-by-step approach covering allergen hazard identification, evaluation, management, and constant follow-up is presented. The protocol enables the participation of the whole personnel in the RA process – under the guidance and supervision of the RA team comprised of professionals representing various fields. During this process, workers’ health status and present work procedures are recorded and assessed as to whether they comply with the requirements for adequate allergen control. The main goal of the presented approach is to help to identify critical points, and indicate the ways of reducing unnecessary exposure. Workers play an important role in the RA process and during implementation of exposure controls. The personnel should be well informed about allergy issues and this protocol provides continuous assistance and feedback to workers and safety personnel on occupational safety. It also serves as a means of education when proper techniques for working with allergens to reduce exposure come up along the process.

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