



Occupational exposure and asthma control

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Poor control of asthma may be the result of ongoing exposure to disinfectants <http://ow.ly/njzC30fJFMj>

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In this issue of the *European Respiratory Journal*, DUMAS *et al.* [1] describe associations between occupational disinfectant exposure and asthma control in US nurses. Asthma control was defined by using the Asthma Control Test (ACT) and based on responses to five questions on activity limitations, frequency of symptoms and frequency of use of quick-relief medication in the past 4 weeks (β -agonist inhaler, *e.g.* albuterol, for symptom control). This instrument is not commonly considered an end-point in studies on occupational exposures and asthma, while asthma control is of particular relevance for asthma patients at work. Thus, the use of asthma control using the ACT is of particular interest [2]. According to the Global Initiative for Asthma Statement, asthma control is the extent to which manifestations of asthma can be observed, or have been reduced or removed by treatment. Asthma control has two dimensions; treatment of symptoms and future risk of adverse outcomes. Variables that can determine future adverse outcomes are lung function, exposure to allergens and non-specific stimuli (smoking, indoor and outdoor air quality), socio-economic and psychological problems, comorbidities and eosinophilia. These variables also determine future outcomes of occupational asthma. The ACT includes a limited set of these, in particular variables associated with treatment of symptoms.

DUMAS *et al.* [1] made use of a large cohort study that had been established in 1989. Nurses with asthma were invited in 2014 to complete two questionnaires on their current occupation and asthma. A population of more than 4100 asthmatic nurses was available for analysis. Information on disinfectant use was collected earlier, in 2013, in an independent random sample of more than 9000 nurses. The questionnaire responses on exposure to disinfectants were used to assess the likelihood of exposure for all existing relevant job-task combinations based on self-reports. This resulted in a job-task-exposure matrix for seven major disinfectants/cleaning products (formaldehyde, glutaraldehyde, hypochlorite bleach, hydrogen peroxide, alcohol, quaternary ammonium compounds and enzyme-based cleaners) which was used to assign exposure to each individual in the study on the basis of their job-task combination. For more than 4000 individuals, complete data was available on disinfectant use in healthcare institutions and on asthma and asthma control.

The effect of disinfectant exposure on asthma control had odds ratios that varied between 1.10 and 1.33 for one decrease in asthma control category, adjusted for age, smoking status, body mass index, race and ethnicity. For five out of seven disinfectants these associations were statistically significant (formaldehyde, glutaraldehyde, hypochlorite bleach, hydrogen peroxide and enzyme-based cleaners). These associations seem weak to moderately strong, but are not likely explained by study design or exposure assessment methodology. Exposure assessment on the detailed job-task level is considered the optimal approach

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associated with limited exposure misclassification and thus potential underestimation of exposure response relations [3–6]. These relatively modest associations should not be interpreted as indicative for a limited role for disinfectant exposure with regard to asthma.

In surveys in hospital personnel, using similar generally similar methodologies, strong associations have been observed between disinfectant exposure and asthma [7–11]. For instance, a study in seven healthcare institutions in France showed that exposure to quaternary ammonium compounds, a specific disinfectant with the exposure assessed through a very detailed approach, increased significantly the risk of reported physician-diagnosed asthma and nasal symptoms at work (adjusted odds ratios 7.5 and 3.2, respectively). All the above-mentioned studies indicate that many workers in healthcare have an occupational exposure to disinfectants; percentages vary but range from 30–60%. The strong associations, in combination with the fact that many are exposed, suggests that many asthma cases would not have occurred without disinfectant exposure.

The more detailed analyses presented by DUMAS *et al.* [1] shed some more light on the role of disinfectant exposure and asthma control. In particular, cleaning of medical instruments was more strongly related to poor and very poor asthma control. The use of sprays was also considerably more strongly associated with asthma control; asthmatic patients with poor and very poor control appeared to use sprays more often. Combined exposure, to different disinfectants, was also indicative of poor asthma control. These relationships seem plausible because some specific activities are likely to be associated with higher exposure levels, multiple exposures, or longer duration of exposure [6, 12, 13]. In particular, sprays are believed to lead to higher exposure than classical wet application of disinfectants. In a recent study, it was shown that individuals reported symptoms more frequently when they worked on departments with higher exposure levels [14]. Recent biomarkers studies for disinfectant by-products have also shown that nurses are more exposed to a range of chemicals in comparison to the general population [6]. Thus, activities indicative of relatively high and combined exposure are particularly associated with poor asthma control.

There is a general belief that continuing occupational exposure in individuals with occupational asthma influences their prognosis negatively [15]. Exposure reduction is associated with a more limited improvement of asthma compared to exposure cessation, but objective information on the magnitude of the exposure reduction is generally absent and this sheds doubt on the quality of these exposure cessation studies [16]. This conclusion is mainly based on studies in asthmatic subjects who were sensitised to agents in the work environment. No or very little information is available for other phenotypes. The study by DUMAS *et al.* [1] provides little information on the asthma phenotypes involved in their study. Poor asthma control was not associated with childhood asthma or adult onset asthma, but little additional phenotypical information was available. Disinfectants are often irritants; some are sensitising agents or have adjuvant properties [7, 17–21]. Asthma control may differ between patients with different underlying causes of symptoms, but to be able to study this aspect, more detailed phenotypical information is required. A complication is that the mechanisms by which disinfectants and cleaning products affect respiratory health are, to a large extent, still unclear [22]. There is a need for more information on underlying mechanisms, particularly because this could also help understand long term risks and prognosis [20]. For instance, it remains a question whether poor asthma control was due to ongoing exposure to disinfectants in patients with work-related or irritant-induced asthma, similar to the worse outcome in occupational asthma caused by continuing exposure to sensitising agents.

Disinfectants are used to clean medical devices and surfaces to prevent transmission of nosocomial infections. The use of these agents will continue. Unfortunately, occupational disease registries see a disproportionately high number of cases of work-related asthma occurring in healthcare occupations due to disinfection and cleaning products, with the majority of cases in nursing, operating theatre personnel, endoscopy and radiology staff [23, 24]. In combination with the mounting evidence regarding the asthma risks associated with these chemicals, there is a need for exposure reduction to control development of asthma and improve asthma control in exposed individuals. Respiratory physicians should be aware of the fact that many of their colleagues may have developed asthma in the healthcare industry and need appropriate treatment. Exposure reduction should be part of the remedy offered, and some recommendations are available on how to limit exposure without increasing the risk of spreading infectious diseases [25].

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