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Review Article

# Defining and classifying occupational rhinitis

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**Abstract**

Three categories of rhinitis may occur in the workplace: occupational rhinitis, work-aggravated rhinitis and rhinitis-like conditions. In the present paper, we propose a new definition and a new classification of occupational rhinitis that takes into account mechanisms of induction as well as clinical presentation. In parallel with occupational asthma, occupational rhinitis is defined as a type of rhinitis characterized by intermittent or sometimes permanent nasal airflow limitation due to causes and conditions attributable to the work environment. Occupational rhinitis is classified according to its mechanism of induction as immunological or irritant-induced (non-immunological) rhinitis. Occupational rhinitis of the immunological type can itself be episodic or persistent, whereas the non-immunological type is subdivided into acute, chronic and corrosive.

**Key words: Rhinitis; Asthma; Occupational Pollutants; Occupational Health**

## Introduction

Rhinitis and asthma are relatively common conditions in the general population, but rhinitis is far more frequent than asthma.[1,2] Today, occupational asthma is the most prevalent respiratory occupational disease in developed countries.[3] It is likely that occupational rhinitis is more prevalent than occupational asthma among work-exposed populations. However, occupational rhinitis is much less well known than occupational asthma. Unlike occupational asthma, there is no standardized approach to diagnosing occupational rhinitis, several determinants of occupational rhinitis (such as incidence, prevalence, natural history and pathogenic mechanisms) are not well understood, and the morbidity burden of occupational rhinitis on workers and their families remains unknown. No definition and classification of occupational rhinitis has been discussed in depth in the specialized scientific literature. A standardized and consensus-based definition and classification of occupational rhinitis is needed in order to better manage this condition and to enable comparison of research results.

## Defining occupational rhinitis

Defining a disease such as occupational rhinitis constitutes a challenge. In so doing, various approaches could be considered, such as defining the disease in terms of histopathological, physiological or clinical characteristics, either alone or in combination. As an example, a simple approach to the definition of occupational rhinitis would be to base it on both its main pathological feature, i.e. 'an inflammation of the mucous membrane lining of the nose', and its clinical manifestations (e.g. nasal obstruction, nasal discharge and sneezing), all in the context of an occupational setting. However, this approach has limitations. As has been shown in recent studies on the remodelling of the upper airways in allergic rhinitis, the pathologic involvement observed in this disorder comprises not only the well established inflammatory infiltration but also involves structural changes of the glands, the mesenchyma and even the vasculature of the nose.[4] Therefore, a definition that refers only to 'an inflammation of the mucosa' would be both incomplete and inaccurate.

The inclusion of clinical manifestations in the definition of occupational rhinitis is not without difficulties. Referring to common nasal symptoms does not reflect the specificity of occupational rhinitis. There are other nasal symptoms apart from running nose, sneezing and nasal congestion that may manifest in workers exposed to allergens and irritants at the workplace. For example, formation of crusts is reported by Brisman *et al*. in bakers exposed to flour,[5] and dryness of the nose is reported by Kraus *et al*. among workers exposed to cellulose-containing dust during the manufacture of soft tissue paper.[6] It is also well known that workers exposed to chromium in the electroplating industry suffer from frequent formation of crusts as a symptom of more severe nasal manifestations, such as nasal septal ulcerations and nasal septal perforations.[7,8]

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This approach can lead to difficulties in deciding which symptoms should be included in the definition. On this point, the study by Ng *et al.*[9] is quite revealing. They examined the relative importance of different recognized symptoms, signs and diagnostic tests for the definition of allergic rhinitis in a group of 47 subjects diagnosed with allergic rhinitis and 23 healthy subjects. After ranking symptoms from most to least important for the definition of allergic rhinitis, running nose and sneezing ranked first, followed by sniffing and impaired sense of smell, which are not traditionally grouped under the so-called 'common symptoms' of rhinitis. Furthermore, the other two commonly cited nasal symptoms, namely, blocked and itchy nose, ranked below sniffing and impaired olfaction. This observation confirms that a definition of rhinitis based on the presence of clinical symptoms alone may not be adequate.

Taking into account the above considerations, a definition of occupational rhinitis modelled on the definition of occupational asthma (which has wide acceptance) may be more appropriate. Occupational asthma has been defined as 'a disease characterized by variable airflow limitation and/or bronchial hyperresponsiveness due to causes and conditions attributable to a particular environment and not to stimuli encountered outside the workplace'.[3] Notice that this definition is based on the presence of observable physiopathological changes that occur in the lower airways.

Thus, occupational rhinitis may be defined as a type of rhinitis characterized by intermittent and sometimes permanent nasal airflow limitation, due to causes and conditions attributable to the work environment. Like the definition of occupational asthma, this definition of occupational rhinitis is based on a physiopathologic finding, namely, the demonstration of variable or permanent nasal airway limitation and its necessary work-relatedness.

Although similar, this definition of rhinitis has two important differences from the definition of occupational asthma. The first is the temporal clinical presentation of occupational rhinitis. In contrast to occupational asthma, in which the patient may be asymptomatic from one episode to another, symptoms of rhinitis are not infrequently continuous, with the affected victim complaining of permanent impairment. Secondly, a physiopathological manifestation resembling bronchial hyper-responsiveness is not taken into account in the above definition of occupational rhinitis. Increased airway responsiveness to nonspecific stimuli is a characteristic of asthma which can be objectively provoked by the administration of increasing concentrations of histamine or methacholine, causing the one-second forced expiratory volume to decrease by 20 per cent from the baseline value.[10] Nasal hyper-reactivity may be analogous to bronchial hyper-responsiveness, namely, an exaggerated response of the nose to nonspecific stimuli causing nasal airway narrowing. Unfortunately, in spite of several attempts, no investigative method has been found that will trigger nasal hyper-reaction in a way similar to the provocation tests used to trigger a bronchial hyper-reaction in an asthmatic patient.[11]

We believe that, for the purpose of defining rhinitis of occupational origin, it is fundamental to consider a physiological change in the nose that may be attributed to the work environment and that at the same time is measurable by objective techniques. Nasal obstruction meets this criterion. It can be evaluated by clinical examination and be demonstrated objectively by methods such as acoustic rhinometry, rhinomanometry and peak nasal inspiratory and expiratory flow techniques. Furthermore, the rationale for considering nasal obstruction in any definition of rhinitis due to allergen or irritant exposure (and, of course, in rhinitis due to occupational exposure) is that it is the nasal symptom that best reflects the underlying pathological mechanism involved (i.e. inflammation of the nasal mucous membrane). The hypothesis in this case is simple – any degree of inflammation of the nasal mucosa should in theory lead to a decrease in nasal patency, which may be objectively measured.

## A new classification of rhinitis in the workplace

An approach similar to the well known and accepted classification of asthma observed in the workplace[12] is proposed here, in order to classify rhinitis of occupational origin in a way that is useful for clinical practice and epidemiologic research. As shown in Figure 1, we distinguish three categories of rhinitis that may occur in the workplace: occupational rhinitis, work-aggravated rhinitis and rhinitis-like conditions. Rhinitis may either be caused or exacerbated by exposure to the work environment. Rhinitis caused by an occupational exposure meets the definition of occupational rhinitis. Subjects with work-aggravated rhinitis have pre-existing rhinitis, symptoms of which are triggered by exposure to irritants in the workplace (e.g. fumes, vapours and dust). The category 'work-aggravated rhinitis' is borrowed from the concept of work-aggravated asthma, which comprises pre-existing asthma aggravated by workplace exposure.[12]

Contrary to asthma, there are no studies supporting the existence of work-aggravated rhinitis. Nevertheless, there are reasons to believe that it is not erroneous to utilize this term when classifying rhinitis in the workplace. First, rhinitis is three times more prevalent than asthma in the general population.[11] As a consequence, many people with pre-existing rhinitis will enter the workforce. They may be exposed to occupational irritants and/or allergens that will exacerbate or worsen their pre-existing rhinitis. Second, empirical knowledge derived from otorhinolaryngological practice indicates that the existence of individuals who would fall within this category is highly likely. Otorhinolaryngologists commonly assess patients with a diagnosis of rhinitis (other than occupational) who claim that their symptoms are made worse by exposure at work. We therefore propose that work-aggravated rhinitis become a formal category within the classification of rhinitis in the workplace.

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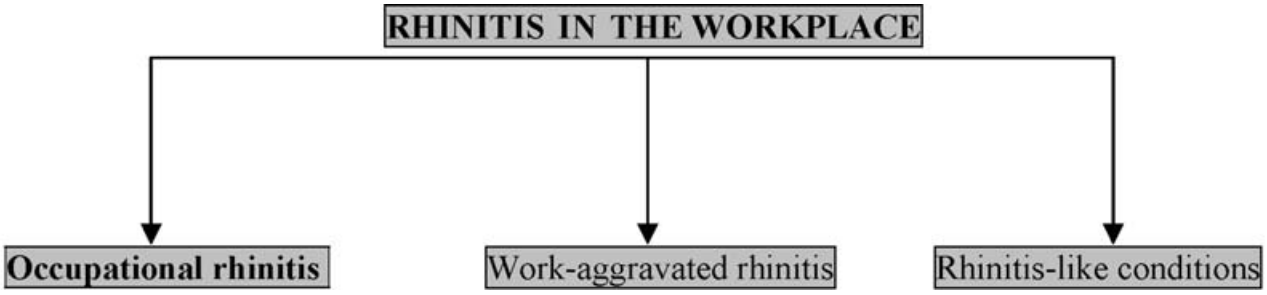



FIG. 1
Types of rhinitis in the workplace.

'Rhinitis-like conditions' refers to certain specific exposures at work that may generate rhinorrhoea mimicking rhinitis, for example, exposure to cholinesterase-inhibiting substances (e.g. organophosphate pesticides) and to cold air. Organophosphates (e.g. carbaryl, malathion, parathion and pyrethrum) are rapidly absorbed after inhalation. They increase the activity of the secretory glands and induce an intense, watery nasal discharge. Cold air exposure is associated with increased rhinorrhoea due to enhanced glandular secretory activity involving cholinergically-mediated neuronal pathways.[13,14] These reactive conditions are not accompanied by an inflammation of the mucosa and should therefore be classed within a separate category, namely, rhinitis-like conditions.

## Occupational rhinitis

The difficulties in formulating a classification of occupational rhinitis arise from inaccuracies in the initial categorization of occupational rhinitis as a subtype of rhinitis. Traditionally, rhinitis has been classified into three main types: allergic (seasonal or perennial), infectious (acute or chronic) and 'other' (occupational rhinitis, idiopathic rhinitis, hormonal rhinitis, drug-induced rhinitis, nasal polyps and primary atrophic rhinitis).[15] In such a classification, allergic causes of occupational rhinitis are not taken into consideration and occupational rhinitis is relegated to being an isolated type of non-allergic, non-infectious rhinitis. This clearly does not correspond to reality.

A more appropriate, although still incomplete, classification of occupational rhinitis has been suggested by the Joint Task Force on Practice Parameters in Allergy, Asthma and Immunology, which has developed guidelines for diagnosis and management of rhinitis.[16] This agency classifies rhinitis in three main categories: (1) allergic rhinitis, (2) non-allergic rhinitis, and (3) conditions that mimic symptoms of rhinitis. This classification includes occupational rhinitis under both the allergic and non-allergic rhinitis categories. When the agency defines occupational rhinitis, it subclassifies it into allergic and non-allergic types.[16]

Instead of classifying occupational rhinitis as allergic and non-allergic, we propose a classification inspired by that used for occupational asthma,[17]

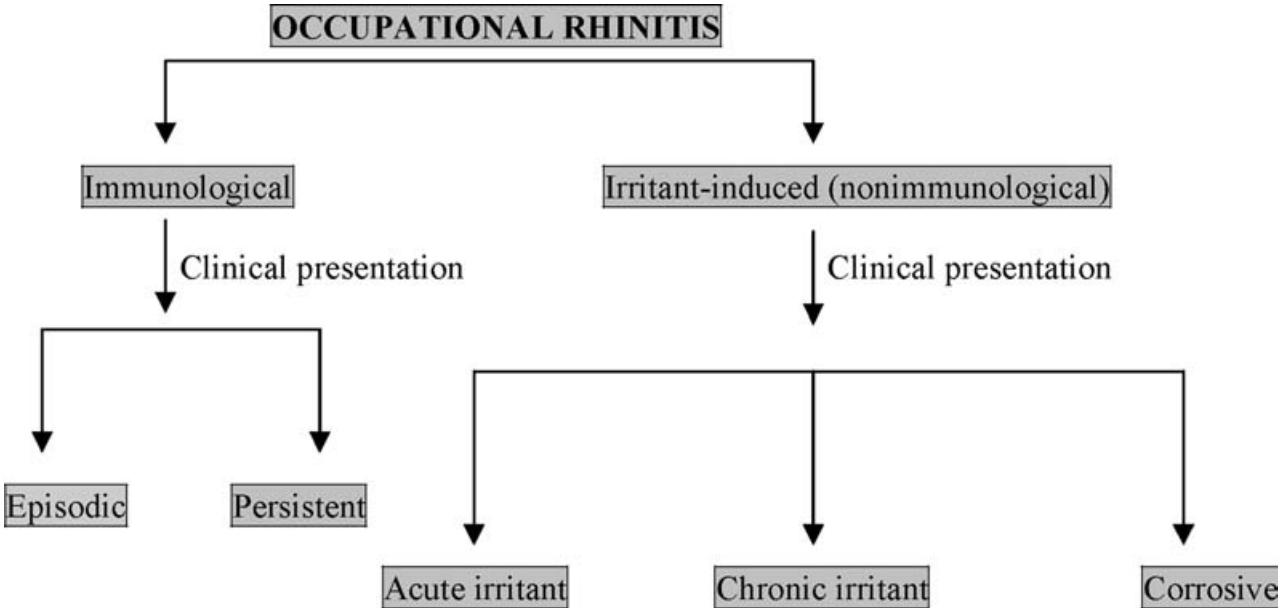



FIG. 2
Occupational rhinitis classification, based on induction mechanism and clinical presentation.

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which is based on induction mechanism and clinical presentation. This classification is summarized in Figure 2.

Occupational rhinitis may be classified according to its mechanism of induction into: (1) immunological and (2) irritant-induced (non-immunological) rhinitis.

*Immunological occupational rhinitis*

Immunological occupational rhinitis is characterized by the acquisition of sensitization. This category includes occupational rhinitis caused by high molecular weight agents and low molecular weight agents. High molecular weight agents are protein-derived agents of biologic origin (e.g. animal, plant and microbe); low molecular weight agents are chemicals (e.g. of natural, synthetic or metallic origin).[11] High molecular weight agents produce occupational rhinitis with a latency period, mainly through an immunoglobulin (Ig) E dependent mechanism. In this well known mechanism, the interaction between the antigen and the IgE leads to mast cell degranulation and release of inflammatory mediators. Low molecular weight agents are substances that are too small to be immunogenic by themselves. Therefore, they cannot act as antigens alone. However, it has been observed that some of these substances (e.g. isocyanates, anhydride acid and platinum salts) can combine with a protein to form a hapten–protein conjugate that can behave as an antigen and launch a full IgE allergic response.[3]

The classification in Figure 2 makes provision for different clinical presentations of immunological occupational rhinitis. It divides immunological occupational rhinitis into two subcategories: episodic and persistent. The episodic category represents those cases with a recurrent or periodical pattern of symptoms. In contrast, persistent immunological occupational rhinitis would include those cases with persistence of symptoms even when the worker is away from exposure at work.

This subdivision deserves additional consideration. Traditionally, the otolaryngological literature classifies rhinitis into two types based on duration of symptoms, i.e. acute and chronic rhinitis. Acute types correspond to those cases of rhinitis that resolve completely. The most well known example is the common cold. Chronic rhinitis comprises all those other cases of rhinitis that, independently of their mechanism of induction, have a chronic course with frequent relapses and exacerbations. Allergic rhinitis is commonly regarded as a chronic respiratory disease because it can be treated and controlled but not cured. Therefore, nasal symptoms in allergic rhinitis manifest over time, depending on the degree of sensitization and the persistence, frequency and intensity of the exposure. In this sense, all cases of immunological occupational rhinitis are chronic and may have an episodic or persistent pattern of clinical presentation. Another plausible clinical scenario is progression, during the natural history of the disease, from the episodic to the persistent type due to poor environmental and medical control of the rhinitis. This leads to irreversible changes in the nasal mucosa which will manifest essentially as nasal obstruction.

*Irritant-induced occupational rhinitis*

This category includes cases of occupational rhinitis caused by low molecular weight agents, in which non-allergic, less well-known pathogenic mechanisms are involved. We distinguish three subcategories: acute irritant, chronic irritant and corrosive. Clinically, this type of occupational rhinitis would take the form of an acute or a chronic rhinitis secondary to varied types of chemicals found at the workplace.

*Acute irritant.* This subcategory includes those cases of rhinitis in which a previously healthy, asymptomatic worker develops nasal symptoms after exposure to irritants in circumstances such as inhalational accidents. Two clinical patterns may be seen, depending on the resolution or persistence of the nasal symptoms. In the first pattern, the patient becomes asymptomatic after a period of up to 12 weeks. In the second pattern, nasal symptoms fail to resolve after 12 weeks and persist for months and even years. This second pattern also implies that a patient may progress from an acute to a chronic form of irritant-induced occupational rhinitis.

This classification of irritant-induced occupational rhinitis as acute or chronic, based on number of weeks of duration, has not been made arbitrarily – it is borrowed from the parameters that define rhinosinusitis as acute and chronic based on duration of symptoms established by a Task Force of the European Academy of Allergology and Clinical Immunology in a recent position paper on rhinosinusitis and nasal polyps.[18] It is not erroneous to use these parameters, considering the close link between the nose and the sinuses, since there is contiguity of the mucous membranes. Although it is possible to observe cases of rhinitis without involvement of the sinuses, it is rare to observe a case of sinusitis without concomitant rhinitis. Even in the absence of findings to support this affirmation, we suggest that compromise of the sinuses in occupational rhinitis of all types is highly likely.

One suggested non-immunological mechanism for acute and chronic irritant occupational rhinitis is that the exposure to an irritant leads to the release of a neuro-sensory transmitter called substance P and other mediators of inflammation, which originate from nerve endings and trigger a neurogenic inflammatory response.[19,20] This mechanism has been proposed in the occurrence of the reactive upper airways dysfunction syndrome (RUDS). This syndrome is a reaction of the upper respiratory tract analogous to the reactive airways dysfunction syndrome (RADS) of the lower respiratory tract,[21] an asthma-like syndrome classified as an irritant-induced type of asthma without a latency period. Reactive upper airways dysfunction syndrome is observed in persons acutely exposed (by inhalational accident)

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to high levels of an irritant. The main features of the syndrome are the rapid onset of respiratory symptoms (within 24 hours after exposure) mimicking an asthma crisis and the persistence of respiratory hyper-reactivity for months and even years in individuals without pre-existing respiratory illness.[22,23] Analogously, RUDS may be defined as a form of acute irritant-induced rhinitis (without a latency period) followed by a hyper-reactivity of the nose with persistent symptoms. As in RADS, symptoms in RUDS are manifested by individuals without pre-existing upper respiratory tract illness who are exposed to high levels of an irritant and in whom persistent symptoms and, sometimes, sustained increased nasal airway resistance are observed despite avoidance of the irritant.[19,24,25]

*Chronic irritant.* This subcategory may include subjects exposed to irritants in different forms (e.g. fumes, dust, vapours and gases) and of different types (e.g. chlorine, ammonia, glutaraldehyde and wood dust) that cause chronic nasal symptoms. In contrast to RUDS, the characteristic of this subtype of occupational rhinitis is the insidious, progressive development of rhinitis symptoms without a history of acute exposure. There are a number of cases of exposure that have been associated with chronic nasal symptoms but in which the specific offending agent could not be identified. In these cases, symptoms may be due not only to a single irritant agent but to a mixture of several irritants. For example, such exposure can take place in offices using photocopiers and/or laser printers[26,27] and also in offices with air-conditioning systems.

*Corrosive.* Although a nasal septal perforation has always been considered as a plausible outcome of exposure to metals such as chromium, nickel, copper and arsenic, subjects with such a nasal problem have never been categorized (to the best of our knowledge) as having a type of rhinitis. The sub-category 'corrosive occupational rhinitis' intends to cover those cases of occupational rhinitis secondary to exposure to corrosive chemicals, which develop nasal ulceration and/or nasal septum perforation.[26,28] We consider that the development of a nasal septal perforation of occupational origin entails a history of rhinitis that could be classified as chronic due to an insidious and gradual development of symptoms (e.g. nasal obstruction, dryness, formation of crusts and bleeding) with progression to ulceration and, in many cases, ultimately to perforation of the nasal septum. This category can be considered a chronic form of irritant-induced occupational rhinitis, but we propose to categorize it as a distinct form to take into account its specific clinical feature.

## Conclusions

The appropriate diagnosis and management of occupational rhinitis should rely on both a workable definition and a well structured classification of this respiratory disorder. In this paper, we propose new elements for discussion regarding the definition and classification of occupational rhinitis. These borrow from the widely accepted definition and classification of occupational asthma. They also endorse the proposals of the 'united airways disease' model, which presents both rhinitis and asthma as two clinical manifestations of a single disorder involving allergic and non-allergic mechanisms. The link between rhinitis and asthma is recognized and well established in the general population. There is evidence that supports its presence in the workplace as well.

The present classification as we propose it is not exempt from limitations. It can be challenged and improved by new evidence of pathogenic mechanisms. We acknowledge that the pathogenic mechanisms of irritant-induced occupational rhinitis have been less investigated and are currently the object of research and discussion. In addition, some nasal symptoms are found in both occupational rhinitis categories and other nasal pathologies and can create diagnostic difficulties. Likewise, the characteristics of work-aggravated rhinitis and rhinitis-like conditions should be the subject of future research.

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