

SERIES 'OCCUPATIONAL ASTHMA'
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Medicolegal and compensation aspects of occupational asthma

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ABSTRACT: The medicolegal aspects (primary prevention, secondary prevention or surveillance) and the system of compensation (tertiary prevention) for occupational asthma are reviewed in this article.

Due to the significant medical, medicolegal, social and financial consequences, it is of the utmost importance that the diagnosis of occupational asthma be proved by objective means, whenever feasible. Compensation for temporary and permanent disability/impairment should be offered to workers. Attempts to retrain subjects rapidly and efficiently are preferable, as occupational asthma generally affects young workers. The evaluation of permanent asthma and the awarding of relative permanent disability compensation should be effected 2 yrs after exposure to the causative agent has ended, as asthma generally persists even after exposure to the causative agent ceases.

A tabulated review of prevailing medicolegal compensation systems in various countries is presented. Data on an evaluative assessment of the Quebec system of compensation are included.

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Work-related asthma is now the most common occupational respiratory ailment, with the number of cases outnumbering those of pneumoconiosis. The past 10 yrs have seen a shift in the number of cases of each condition, with the number of cases of pneumoconiosis decreasing and those of occupational asthma increasing. Books focusing specifically on occupational asthma have recently been published [1, 2], demonstrating the increasing medical concern and interest in the field.

Important issues to be addressed in occupational asthma are the medical and medicolegal aspects and, in particular, questions of compensation. How is occupational asthma defined from the medicolegal standpoint? How are affected individuals compensated? Has there been cost-effectiveness analysis of existing legislation? This article will also focus on other medicolegal aspects of the disease, such as evaluation of impairment/disability, prevention and surveillance.

Definitions

The definition of a disease or condition varies according to the purpose for which it is to be used. Epidemiological, clinical and medicolegal definitions can, therefore, differ, as was discussed by BECKLAKE [3]. An epidemiological definition of occupational asthma can be based on specific answers to a questionnaire, results of immunological testing, single or serial assessment of airway calibre (forced expiratory volume in one second

(FEV₁) or peak expiratory flow rates) or hyperresponsiveness, or the results of specific inhalation challenges. A combination of these tools based on a decision tree can lead to a more specific case definition [4, 5]. It has been difficult to establish the prevalence of occupational asthma because of differences in case definition, variability in the selected target populations, and differing environmental exposure conditions from one workplace to another.

Case definitions for clinical and medicolegal purposes have to be more precise because specific recommendations have to be made for that worker. The criteria required for establishing a clinical diagnosis of occupational asthma are more demanding and more restrictive than those for the purposes of screening in a workplace. Indeed, making a diagnosis of occupational asthma has considerable medical, personal, social and financial consequences. If someone with occupational asthma remains exposed to the offending agent, he/she can be left with permanent asthma, as was originally shown by CHAN-YEUNG [6], and confirmed by various researchers in different countries [7-12]. Recommending that a worker leave his/her job has significant consequences [13], and this specific point will be addressed in this chapter.

Occupational asthma is defined as "a disease characterized by variable airflow limitation and/or airway hyperresponsiveness due to causes and conditions attributable to a particular occupational environment and not to stimuli encountered outside the workplace" [14]. There are two types of occupational asthma: 1) that

appearing after a latency period - this is the usual type of occupational asthma; and 2) that without a latency period - this is irritant-induced asthma or so-called reactive airways dysfunction syndrome (RADS).

How should occupational asthma be confirmed?

It has been proposed that the medical and medicolegal diagnosis of occupational asthma be based on objective confirmation of its relationship to the workplace. There are pitfalls in medical questionnaires and clinical histories. Questionnaires are generally sensitive but lack specificity [15]. Exposure to an agent known to cause occupational asthma along with a compatible history, may be considered in some countries to be sufficient for confirming the diagnosis, although this approach has not been validated. Immunological assessment can show that someone has become "sensitized" to the specific occupational agent but does not prove that the target organ (the bronchi) have been affected. Furthermore, whilst immunological assessment can be performed for protein-derived high molecular weight agents, it is generally not feasible nor reliable for low molecular weight agents, which are a common cause of occupational asthma. Whenever possible, the diagnosis should, therefore, be based on objective confirmation of work-relatedness either by documenting changes in airway calibre and/or airway hyperresponsiveness during a period at work compared with a period away from work, and/or specific inhalation challenges by exposing subjects to the relevant agent in a hospital laboratory or at the workplace.

Specific inhalation challenges, when performed correctly, should still be regarded as the gold standard for confirming the diagnosis [16, 17] as serial measurement of peak expiratory flow rates (PEFR) has several pitfalls: the subject has to be honest and co-operative; PEFR recordings are less sensitive than FEV₁ in documenting airway calibre; there are no objective criteria for assessing PEFR recordings; also, compared with results of specific inhalation challenges, there are false negative and false positive tests. However, it should be kept in mind that the specific inhalation challenges originally proposed by PEPYS and HUTCHCROFT [18] in the 1970s can only be performed in specialized centres with the necessary facilities and experienced physicians.

The tests are not without risks, although improvement in methodology through careful environmental and physiological monitoring can diminish these risks and greatly improve interpretation of the results [19–21]. It should also be taken into consideration that false positive tests (if the asthma is unstable or in the instance of exposure to high concentrations), and false negative tests (if the subject has not been exposed to the offending agent for a while) do occur.

Types of compensation

As was recently discussed [22], there are three distinct elements in the classification of disabled persons: impairment, disability and handicap. Impairment refers to

functional abnormality resulting from a medical condition that may be temporary or permanent and may preclude gainful employment; disability is a term that reflects the total effect of impairment on a patient's life; finally, handicap is used to describe the total effect of disease on the subject's life. The latter can be assessed by quality-of-life questionnaires, such as one recently proposed [23], but is rarely incorporated into medical or medicolegal assessments of occupational asthma.

In the context of occupational asthma, provisions for temporary and permanent disability should be considered, as was presented during a recent workshop [24]. Handicap is generally not an element of the assessment for compensation. Evaluation should be made on two occasions: 1) evaluation of temporary impairment/disability should be carried out at the time of diagnosis; and 2) evaluation of permanent impairment/disability should be carried out 2 yrs after the subject has been removed from exposure.

Temporary impairment/disability

Once the diagnosis is confirmed, the subject should be considered as 100% impaired on a permanent basis in terms of the job that caused the illness as well as other jobs entailing exposure to the same causative agent. It is important that the subject should not be exposed, as further exposure will increase the risk of deterioration in asthma [25]. In a subject with occupational asthma, the threshold level of exposure for developing symptoms, airway obstruction and/or hyperresponsiveness is very much lower than that required for "sensitization". Subjects may react to a minute amount of the causative agent, which precludes any further exposure to the product. Several alternatives should be considered, as is discussed below (Example: cost and effectiveness of the Quebec system of compensation). Financial compensation should be offered in every instance where there is a loss of earning power.

All follow-up studies have shown that the majority (60–90%) of subjects fail to recover several years after exposure ends. Most of them will be left with bronchial hyperresponsiveness even if lung function tests are normal, and they often require either bronchodilators alone or in combination with an anti-inflammatory preparation [6–12, 26].

Permanent disability/impairment

The following factors need to be considered in assessing permanent impairment.

Timing of the evaluation. It is important to assess subjects when their asthma is under reasonable control as defined by recent guidelines for managing asthma [27–29]. Stability is generally determined by the following clinical and functional criteria: 1) absence of nocturnal awakenings due to asthma; 2) need for an inhaled beta₂ adrenergic agent <2 times-day⁻¹; and 3) daily variability

in PEFR <20%. In some subjects, it may be difficult to achieve this stability, but, in general, it is feasible. Assessment of permanent impairment/disability should take place 2 yrs after exposure to the offending agent ends; this recommendation is based on the fact that there is a plateau of improvement in spirometry and bronchial responsiveness at that point, at least in the case of one offending agent, snow-crab [12].

Parameters to be considered. Most existing scales for determining impairment/disability in occupational lung diseases were designed for pneumoconiosis and other diseases that lead to a restrictive breathing defect, abnormalities of gas exchange, and alterations in mechanical parenchymal properties. Several scales have been proposed. One of the most widely-used was the one proposed by the American Medical Association [30]. A case has been made that these guidelines are not satisfactory for asthma [31] for various reasons, including those listed in table 1. A scaling system that incorporates the level of bronchial obstruction, the level of bronchial responsiveness and the need for medication was introduced into Quebec legislation in 1984 and has been used ever since [32]. More recently, a committee was

appointed by the American Thoracic Society, and their report proposed a scaling system that includes the same variables (table 2). There should be provisions for periodic reassessment if the subject and/or his/her physician feels that the clinical and functional status has deteriorated.

Compensation in various countries

Table 3 gives a listing of compensation aspects for some countries. Most compensation systems are administered by national agencies. However, in the United States, disputes are usually settled through litigation in an adversarial setting. Evidence from witnesses is presented. Once a claim is accepted, complete medical care is provided and medical expenses are paid either by the privately-insured employer or the state compensation fund for workers who qualify under various programmes [33]. Elsewhere, employers are usually responsible for compensating the affected employees through a general insurance system. Occupational asthma is generally accepted as a disease for which compensation should be awarded.

The diagnosis is made by the national agency after

Table 1. – Comparison of criteria used for impairment/disability for occupational asthma and pneumoconiosis

	Occupational asthma	Pneumoconiosis
Type of functional impairment		Obstructive-Restrictive (±some obstructive component) Stable
Functional tests	Labile Spirometry (before and after bronchodilators) Nonspecific bronchial responsiveness	Lung volumes Gas exchange Parenchymal mechanical properties Spirometry
Effects of drugs on functional and clinical impairment/disability	Yes	No
Behaviour of impairment/disability	Recovery or stability	Stability or deterioration

Table 2. – American Thoracic Society (ATS) guidelines for assessing impairment/disability in asthma and occupational asthma

Score	0	1	2	3	4	
FEV ₁ % pred	≥80	70–79	60–69	50–59	≤50	
Reversibility of airway obstruction or degree of bronchial responsiveness						
Reversibility % change in FEV ₁	≤10	10–19	20–29	≥30		
PC ₂₀ mg·ml ⁻¹	≥8	2–8	0.25–2	≤0.25		
Medication need						
Bronchodilators	None	Occasional (not daily)	Daily	Daily		
Cromolyn	None	Occasional course (1–3·yr ⁻¹)	Daily	–		
Inhaled steroid	None	Occasional course (1–3·yr ⁻¹)	Low dose daily	High dose daily	High dose daily	
Systemic steroid	None	None	None	Occasional (course 1–3·yr ⁻¹)	Daily	
Summary impairment/disability rating class						
Class	0	I	II	III	IV	V
Total score	0	1–3	4–6	7–9	10–11	Asthma not controlled

FEV₁: forced expiratory volume in one second; PC₂₀: provocative concentration of histamine or methacholine producing a 20% fall in FEV₁.

Table 3. – Review of systems of compensation for occupational asthma in various countries

	Who administers?	Who pays?	Is occupational asthma compensated?	Who examines cases?	How is the diagnosis made?	No. of cases (yr)	Permanent disability allocated?
Australia	Cases handled by court	Private insurers	Yes	Specialist	Multiple means	?	Yes
Belgium	National agency	Employers	Yes	Board of specialists	Multiple means	?	Yes
Brazil	National agency	Employers (15 days) +government (afterwards)	Yes	Physician designated by the national agency	Multiple means	?	Yes
Bulgaria	National agency	Employers	Yes	Board of specialists	Multiple means	?	Yes
Canada	Provincial agencies	Employers	Yes	Variable (provinces)	Variable (provinces)	~100 (Quebec)	Yes (Quebec) Variable (others)
Finland	National agency	Employers	Yes	Chest physician	Multiple means	352 (1991)	Yes
France	Regional agency	Employers	Yes	Social Security practitioners	Multiple means	456 (1985)	Yes
Italy	National agency	Employers	Yes	Decision made with specific expertise	Clinical	? up to 550 in 1989	Yes
New Zealand	National	Employers	Yes	Agency physician and claimant's physician	Variable	?	Yes
Norway	National agency and private insurance	Employers +private insurers	Yes	Claimant's physician	Multiple means	52 (1991)	Yes
Romania	National agency	Employers	Yes	Board of specialists	Multiple means	?	Yes
South Africa	National agency	Employers +private insurers	Yes	Medical advisory panels (to come)	Clinical	?	Provisions not necessarily applied
South Korea	National agency	Employers	Yes	Specialists	Multiple means	?	No
Spain	Governmental agency	Employers	Yes	Board of specialists	Multiple means	146 (1990)	Yes
The Netherlands	No specific system	Employers +employees	No official acceptance	Board of chest physicians	Multiple means	? (under-reporting)	No
United Kingdom	Governmental agency	General taxation	Yes	Career specialists for assessing occupational diseases	Variable	293 cases examined (year 1991)	Yes ("prescribed disease provisions")
United States	No-fault insurance system	Employers	Yes	Variable (states)	Variable (states)	?	?

Other countries to come: Japan, other Scandinavian countries, Greece, Eastern Europe?, Russia?

consultation with experts or boards of experts. Various means are used. Some countries still rely on lists of accepted causative agents and a compatible history, but most have provisions, if the diagnosis is doubtful, whereby objective tests (immunological tests, assessment of airway calibre and airway hyperresponsiveness, serial monitoring of PEFR, specific inhalation tests) are carried out. Most countries do not keep figures on the number of cases of occupational asthma accepted for compensation. Even when permanent disability has been determined, there is no scaling system and no exact timing for rating the degree of permanent impairment/disability.

In France, workers with occupational diseases have been compensated since 1919. Two official lists exist, one for farmers and one for general employers. There is a table for each work-related disease, which includes a list of symptoms, an indication of workplaces where subjects may be exposed and the minimum exposure. Compensation is awarded only if the symptoms and workplace are listed in the table. If a claimant develops a disease within the scope of an approved schedule, there is a good chance that compensation will be awarded. Recently, however, the way occupational asthma is recognized has been changing. Claims are sent by the workers themselves to the local social security office. They are accompanied by a medical certificate indicating the type of occupational disease and the observed manifestations listed in the table. The social security office then carries out a medical and technical investigation. The consulting physician employed by the social security office makes a decision to accept or reject the claim. If it is accepted, a decision will also be made on an income-replacement indemnity. If there is any doubt, the physician can ask for a consultation with a pneumologist or specialist working at a centre for occupational diseases. If the case is rejected, the worker can also ask for a specialized medical assessment. The criteria currently used for determining permanent disability indemnities are based on the severity of the dyspnoea, chest radiograph and baseline airway calibre. The percentage of impairment is based on a flowchart. Assessment is undertaken if asthma is judged to be stable. If a worker has a proven occupational disease that is not listed, for which he/she cannot be compensated, he/she has to make a claim through a judicial procedure. This is a rare occurrence, due to the complexity of the legal process. The listing system does not recognize all occupational diseases because they cannot be updated at regular intervals [34].

Example: cost and effectiveness of the Quebec system of compensation

Description of the Quebec medicolegal system related to occupational lung diseases

In Quebec, a worker is compensated for occupational asthma if he/she is exposed to a product that is specific to the workplace and does not increase pre-existing asthma through a nonspecific (irritant) mechanism (excluding reactive airways dysfunction syndrome [35],

which is compensated in its own right). The diagnosis of occupational asthma must be confirmed through objective means (specific inhalation challenges and/or serial functional assessment at work and away from work). Compensation for occupational asthma covers two time frames: 1) workers are offered temporary disability compensation, including assistance in finding a new job with the same employer or one where they are no longer exposed to the causal agent, retraining for a new job, or early retirement if claimants are over 55 yrs of age. In all cases, financial compensation (90% of net salary) is offered if there is a loss of earning power; and 2) workers are offered compensation for permanent impairment/disability 2 yrs after cessation of work, with a possibility of a review if requested.

The way in which claims are made and handled is illustrated in figure 1. Claims made by workers and/or physicians are first sent to the regional office of the Workers' Compensation Board (WCB). They are then handled by the central office of the WCB. Claims for respiratory ailments are first referred by the Medical Department of the WCB to a medical committee of three chest physicians from four of the university hospitals in Quebec that have facilities for investigating this type of condition (experienced physicians, trained technicians, challenge rooms, etc.). If the claim is related to occupational asthma, the medical committee refers the claimant to specialists working at three university hospitals. To be accepted for compensation, cases of occupational asthma usually have to have been investigated by objective means. This includes specific inhalation challenges, sometimes combined with serial monitoring of PEFR at work and away from work. The chairpersons of the four medical committees then meet to approve or reject decisions made by the first medical committee (2nd decision). The WCB is bound by the final diagnosis made by the second committee. In cases of dispute, a medicolegal court makes the final decision.

Two types of compensation are awarded. The first provides an income replacement indemnity and rehabilitation. A worker who is unable to do his/her job because of occupational asthma gets an income replacement indemnity, generally for 1 or 2 yrs, but theoretically the duration is unlimited. It covers a maximum of 90% of previous net annual income. If the worker is over 55 yrs of age, the income replacement indemnity is applicable until his or her retirement. The second type is a permanent disability indemnity. The amount depends on the worker's age and the percentage of impairment.

The criteria currently used to determine the permanent disability rating are the degree of bronchial obstruction, the level of baseline bronchial hyperresponsiveness and the need for medication, as these factors reflect the severity of the asthma. Table 4 shows the criteria which are used. The percentage of impairment is determined according to these criteria. The assessment is performed 2 yrs after the subject has been removed from the workplace. The case can be reassessed anytime thereafter if the claimant or his (her) physician thinks that the condition has worsened.

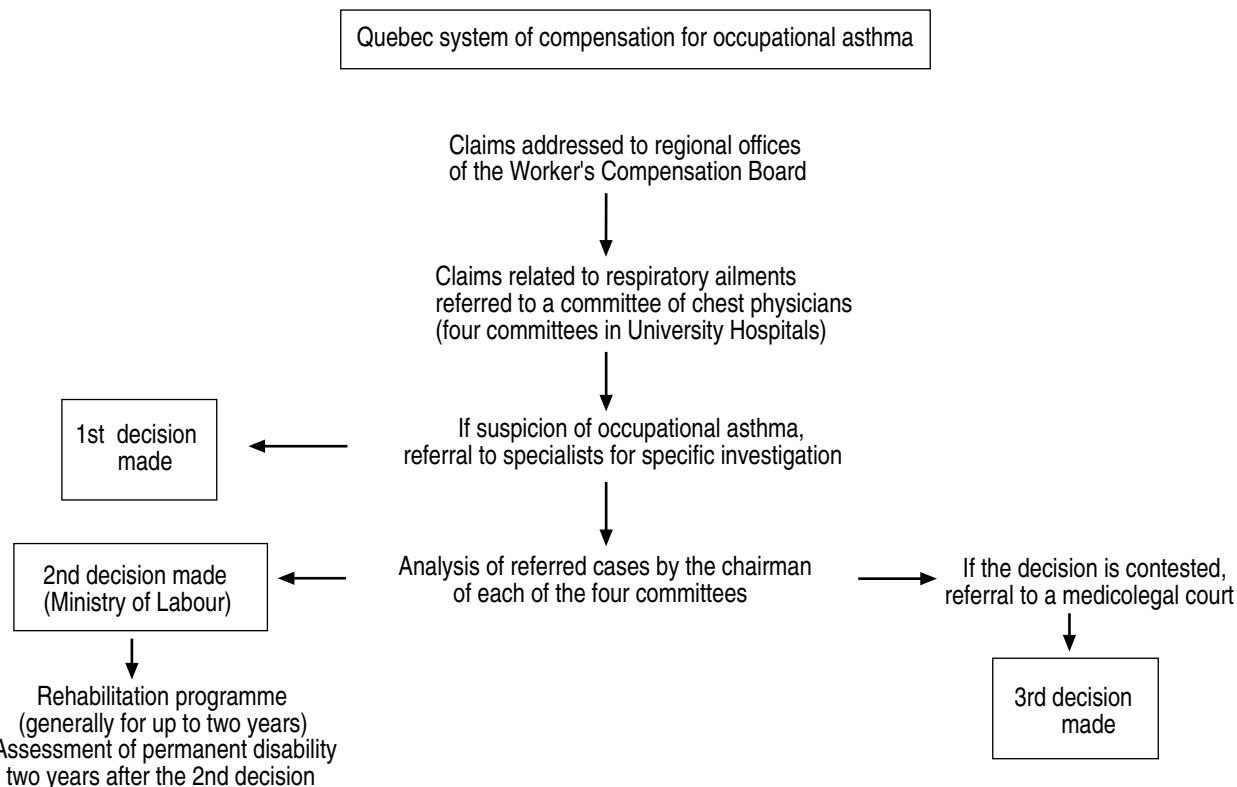


Fig. 1. – See text for description of the flowchart.

Table 4. – Quebec system of compensation for occupational asthma: criteria used to determine permanent disability

Class	Level of bronchial obstruction*	Level of bronchial responsiveness†	Need for medication	Percentage disability
1	0	0	None	0
2A	0	1	None	5
2B	0	1	BDT if needed	8
2C	0	1	BDT regularly	10
2D	0	2	None	10
2E	0	2	BDT reg or if needed	13
2F	0	3	BDT reg or if needed	15
3A	1	1	BDT reg or if needed	18
3B	1	2	BDT reg or if needed	20
3C	1	3	BDT reg or if needed	25
4A	2	1–2	BDT reg or if needed	28
4B	2	3	BDT reg or if needed	33
5A	3	1–2	BDT reg or if needed	50
5B	3	3	BDT reg or if needed	60
6	4	1–2–3	BDT reg or if needed	100
			Group with oral steroids and with or without inhaled steroids To be added: Inhaled steroids	3
			Oral steroids	10

*: level of bronchial obstruction (FEV_1 and/or FEV_1/FVC) determined at least 8 h after inhaled β_2 -adrenergic agent and 48 h after oral theophylline, as follows: 0 = >85% pred; 1 = 71–85% pred; 2 = 56–70% pred; 3 = 40–55% pred; and 4 = <40% pred.

†: level of bronchial hyperresponsiveness determined as follows: 0 = $PC_{20} >16 \text{ mg}\cdot\text{ml}^{-1}$; 1 = $PC_{20} 2\text{--}16 \text{ mg}\cdot\text{ml}^{-1}$; 2 = $PC_{20} 0.25\text{--}2 \text{ mg}\cdot\text{ml}^{-1}$; 3 = $PC_{20} \leq 0.25 \text{ mg}\cdot\text{ml}^{-1}$. PC_{20} assessed by the method of Cockcroft and co-workers (*Clin Allergy* 1977; 7: 235–243). BDT: bronchodilator therapy; PC_{20} : provocative concentration producing a 20% fall in FEV_1 ; reg: regularly (daily).

Assessment of the outcome in terms of cost and efficiency

We recently had an opportunity to assess the cost and effectiveness of the Quebec system of compensation for occupational asthma. Results of these studies were detailed in two articles that are to be published [36, 37]. Briefly, 134 subjects out of 211, (participation rate 64%) with a diagnosis of occupational asthma who were compensated by the Workers' Compensation Board (WCB) in 1986, 1987 and 1988 were included in the study (table 5). A control group of 91 subjects without occupational asthma seen in 1990 at the asthma clinics of two tertiary care hospitals, was paired for asthma severity (baseline FEV₁ value±10%, similar need for medication, *i.e.* bronchodilators only as opposed to bronchodilators combined with regular anti-inflammatory preparations), and, when possible, a similar level of bronchial hyperresponsiveness. The reason for including a control group matched for asthma severity was to provide a means for comparing the quality-of-life of the two groups. The following information was obtained: 1) anthropometric data (sex, height and age); 2) medical data on persistent asthma symptoms, need for medication, smoking habits,

medications, means used for confirming the diagnosis, atopic status, nature of causative agent; 3) functional status - baseline spirometry and bronchial responsiveness at the time of the diagnosis and the follow-up; 4) quality-of-life determined by means of a questionnaire including relevant open and closed questions in four different domains - symptoms associated with asthma, limitation of activities, emotional dysfunction and response to environmental stimuli, on a seven-point scale from one (none or never) to seven (marked or always); and 5) administrative data were obtained from the records of the WCB, including: date of claim, decision rendered (see below), start date of rehabilitation programmes, permanent disability allocation, entry into a new job or new workplace. The costs of the temporary rehabilitation programme and permanent disability compensation were also recorded.

The mean age of the subjects was approximately 40 yrs, and 42% were under 40 yrs of age. The principal causal agents were isocyanates. At the time of the follow-up, airway calibre was normal in most instances, but the vast majority of subjects still demonstrated bronchial hyperresponsiveness (table 5). Compared

Table 5. - The Quebec system of compensation for occupational asthma: compensated cases 1986-1988; baseline anthropometric, clinical and functional results of study participants and nonparticipants

	Participants	Nonparticipants
n	134	77
Regions*		
Montreal and region	43 (32)	26 (37)
Quebec City and region	48 (32)	12 (17)
Others	48 (36)	33 (46)
Sex M/F	102/32 (76/24)	54/23 (70/30)
Age in 1990 yrs	44±12	41±13
Causative agents		
Snow crab	12 (9)	13 (17)
Isocyanates	42 (31)	14 (18)
Flour	18 (13)	7 (9)
Red cedar	14 (11)	9 (12)
Others	48 (36)	34 (44)
Treatment		
None	22 (16)	21 (30)
BDT alone	69 (52)	33 (46)
BDT + corticosteroids	43 (32)	17 (24)
Atopy [§]	81 (60)	39 (63)
FEV ₁ % pred [†]	89±19	86±20
With value <80% pred	35 (26)	21 (30)
With value >80% pred	98 (74)	50 (70)
FEV ₁ /FVC % pred [†]	88±11	89±13
With value <85% pred	40 (33)	19 (29)
With value >85% pred	81 (67)	47 (71)
PC ₂₀ mg·ml ^{-1†}	2.1±4.7	1.9±1.6
With value:		
0.03-0.125	6 (5)	2 (3)
0.125-1	27 (22)	15 (24)
1-8	61 (49)	27 (43)
8-16	22 (17)	10 (16)
>16	9 (7)	9 (14)

Data presented in parenthesis are percentages. Treatment FEV₁, FEV₁/FVC and PC₂₀ were those at the time of follow-up. †: mean±SD; *: distinction was made between the two main metropolitan areas and the remainder of the province; §: at least, one positive immediate reaction to a battery of 15 common inhalant allergens (nine nonparticipant subjects did not undergo skin testing). No statistical difference between the two groups for any of the variables, except for region (proportionally more subjects participated in the Quebec City region than in the two other regions; chi-squared = 5.5; p=0.02). Information missing for some items. Thus, n values may not equal 134 for participants/77 for nonparticipants. For abbreviations see legend to table 4.

Table 6. — The Quebec system of compensation for occupational asthma: compensated cases 1986–1988; anthropometric clinical, functional and quality-of-life results of subjects with occupational asthma and control subjects

	Total group	Paired groups	
		Occupational Asthma subjects	Control Subjects
Number	134	91	91
Sex M/F %	76/24	69/31	69/31
Age in 1990 yrs	44±12	45±12	43±13
FEV ₁ % pred	91±20	91±19	87±18
PC ₂₀ mg·ml ⁻¹	3.5±4.9	3.5±4.6	2.5±4.9
Medications n (%)			
None	24 (18)	18 (20)	11 (12)
BDT only	67 (50)	47 (52)	38 (43)
BDT + anti-inflammatory	43 (32)	26 (28)	40 (45)
Severity of asthma†	18.7±14.3	18.0±14.7	19.5±12.4
Number of limited activities‡	6.4±5.7	6.5±6.0	4.1±3.7

		←***→	
Other limited activities‡	0.3±0.6	0.3±0.6	0.1±0.4

		←***→	
Asthma symptoms§	3.0±1.5	2.9±1.5	2.4±1.0

		←***→	
Limitation of activities§	3.3±1.6	3.2±1.6	2.7±1.4

		←***→	
Emotional dysfunction§	2.7±1.5	2.6±1.3	2.0±0.9

		←***→	
Environmental stimuli§	2.7±1.5	2.6±1.4	2.2±1.1

		←***→	
Total§	2.9±1.4	2.8±1.3	2.3±1.0

		←***→	

BDT: bronchodilator therapy (inhaled beta₂-adrenergic agent and/or theophylline derivative). †: based on disability scale (see table 4); ‡: in the quality-of-life questionnaire, 29 different activities were suggested to subjects and the others were given by subjects in an open fashion; §: quality of life assessments based on a scale from one to seven (increasing symptoms and/or frequency); *: p<0.05; **: p<0.01; ***: p<0.001 for the between-group comparisons by t-test. Information missing for some items. Thus, n values may not equal 134 for participants/77 for nonparticipants. For further abbreviations see legend to table 4.

to the assessment at diagnosis, there was no significant improvement in FEV₁ (mean±SD values of 91±20% predicted and 90±17% pred; t=1.09, p>0.05) but the provocative concentration producing a 20% fall in FEV₁ (PC₂₀) improved significantly from 2.5 to 3.5 mg·ml⁻¹ (t=2.5; p<0.01). The asthma severity score and percentage of impairment listed in table 4 remained unchanged at 19%.

The quality-of-life data is shown in table 6. The quality-of-life questionnaire showed that the activities of occupational asthma subjects were more limited than those of the control subjects. In all four domains of the quality-of-life questionnaire, as well as overall, occupational asthma subjects scored slightly below the middle of the scale, the mean score being 2.9 on a scale from one (best) to seven (worst). Their scores were statistically higher than those of the control group.

Figure 2 gives the details of the intervals between main events, *i.e.* onset of symptoms, claim, decision by the first and second committees, acceptance by the regional WCB office, the start of the rehabilitation pro-

gramme and return to work (when applicable). Subjects had been symptomatic for a mean of 4 months before submitting a claim. It took a mean of 8 months before the first decision was made (≤3 months in 30 cases; 3–6 months in 45; 6–12 months in 35; 1–2 yrs in 12; and ≥2 yrs in 12). This included the time required for referral to the first medical committee by the WCB administration and for the investigation by specific inhalation challenges and/or serial PEFR monitoring for periods at work and away from work. After the claim was accepted by the regional WCB office, less than 2 months were required before the rehabilitation programme began, and nearly 8 months before return to work was possible (if applicable).

Subjects were separated into six different groups by outcomes: another job with the same employer (Group 1); another job with a different employer without the need for a rehabilitation programme (Group 2); another job with a different employer with a rehabilitation programme (Group 3); retraining for a new job (Group 4); early retirement (Group 5); and unemployment

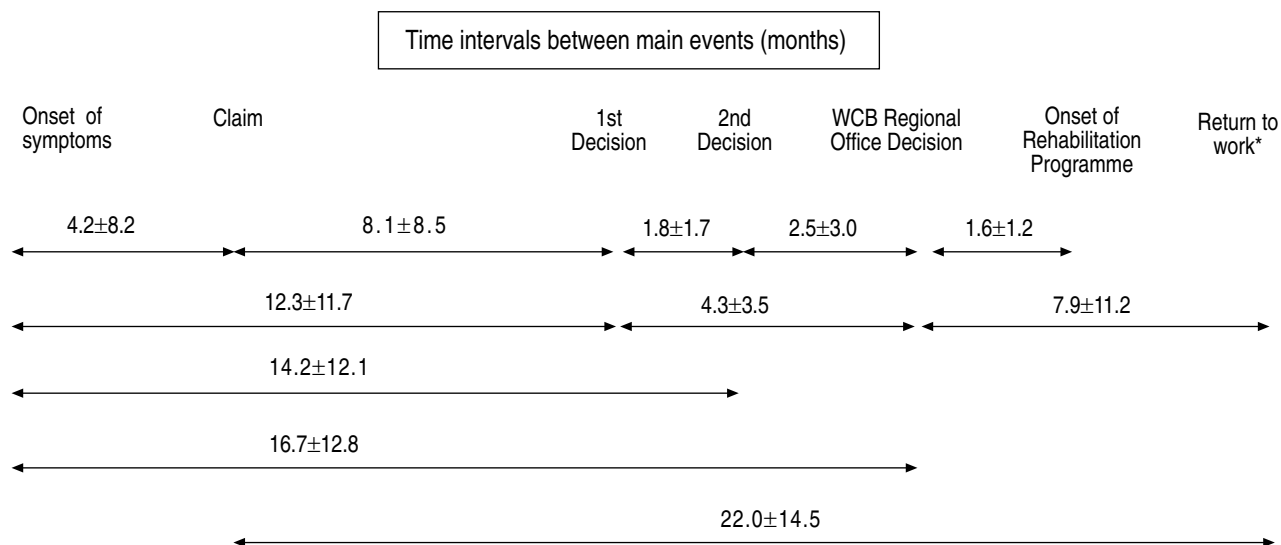


Fig. 2. – Mean±SD intervals are given between each event. See text for description. *: for those who returned to work. WCB: Worker's Compensation Board.

(Group 6). The mean combined cost for temporary and permanent disability/impairment was Can\$ 49,200 per subject. Groups 4, 5 and 6 generated significantly greater costs than Groups 1, 2 and 3 (table 7). Costs were related to the severity of asthma ($r=0.41$), and inversely related to level of schooling ($r=-0.31$). Asthma-related quality-of-life was significantly different for the six outcomes ($F=3.7$; $p=0.003$), due to the fact that subjects who were still unemployed had a significantly less satisfactory quality-of-life than subjects who had found another job with the same employer (mean scores of 3.8 and 2.3, respectively). Mean scores for Groups 1–6 were 2.3, 3.2, 3.3, 3.7, 3.3 and 3.8, respectively.

This study of subjects who received compensation for occupational asthma in Quebec in 1986, 1987 and 1988 shows that claimants are generally left with persistent asthma after exposure ends. Their quality-of-life is less satisfactory than that of control subjects, although the difference seems minor. Those remaining unemployed had the least satisfactory quality-of-life. In Quebec, the medicolegal process for examining claims and making a decision is still too long (8 months). Finding a job with the same employer without requiring retraining is associated with lower cost and better quality-of-life.

Surveillance and prevention

There are three types of prevention, as recently reviewed by VENABLES [38]. Primary prevention is concerned with the control of agents that cause occupational asthma. Lists of known causal agents should be regularly updated [39]. Lists of agents, at-risk occupations and relevant information on scientific evidence should be made available as a public service. This is now the case in France since the introduction of the telematic information service (Minitel) [40]. A service is also offered in the USA by the National Institute of Occupational

Safety and Health (NIOSH) [41], though it does not have the direct access of the French system. As regards occupational asthma due to exposure to high concentrations of irritants (reactive airways dysfunction syndrome) [35], employees and employers should be aware of the risk of chlorine, ammonia and various other chemicals in gaseous or aerosol form. There is some evidence of a dose-response relationship between level of exposure to agents causing occupational asthma with a latency period and the prevalence of occupational asthma [42, 43]. It is, therefore, important to advise employers and employees to avoid acute exposure to them.

Atopy is a marker of a predisposition to developing sensitization and occupational asthma to high molecular weight agents. However, the positive predictive value of atopy in developing occupational asthma has been found to be relevant in only one case in three among laboratory animal handlers at risk of developing rhinitis and/or asthma up to 5 yrs after the onset of exposure [44]. Some would argue that excluding atopic subjects from the workplace is not justified, as two thirds of potential workers will not develop occupational rhinitis or asthma, and would be excluded from employment needlessly.

Secondary prevention or surveillance implies detecting asthma at an early enough stage to make impairment unlikely [45]. In several retrospective studies, it has been shown that subjects with occupational asthma who remain exposed for a longer interval after the onset of symptoms are more likely to end up with permanent asthma and hyperresponsiveness [6–13, 26]. Efforts to detect asthma at an early stage, therefore, seem justified in order to avoid permanent sequelae. There is no universally accepted way of screening for occupational asthma. It has been shown that cross-shift assessment of spirometry is not satisfactory [46, 47]. Immunological testing can be used for high molecular weight agents because in most instances the mechanism is

Table 7. – The Quebec system of compensation for occupational asthma: compensated cases 1986–1988; costs for temporary and permanent disability indemnities in Can\$ according to social outcome, asthma severity, region and education

	n (%)	Temporary indemnities	Permanent disability indemnities*	Total cost
Social outcome†				
1	42 (31)	12 400±14 800	20 800±16 900	27 300±23 400
2	30 (22)	18 500±17 000	34 000±64 000	41 400±56 800
3	18 (14)	27 600±16 100	13 300±5 200	44 100±15 700
4	11 (8)§	500±22 100	12 900±7 500	68 800±22 000
5	22 (17)	56 600±41 200	47 540±64 500	85 600±59 100
6	11 (8)§	600±20 600	26 500±21 700	70 400±35 600
Asthma severity§				
0–15%	70 (53)	31 400±28 000	37 700±64 500	51 800±52 500
16–30%	44 (33)	25 600±29 400	20 000±15 600	42 600±36 500
≥30%	19 (14)	44 700±30 700	29 000±23 200	73 200±36 200
Region**				
Montreal	43 (32)	30 700±30 800	19 400±21 800	44 400±34 800
Quebec City	43 (32)	33 300±30 300	34 500±54 200	57 400±54 600
Others	48 (36)	25 000±25 300	29 100±48 600	46 200±44 900
Education**				
Primary	38 (31)	35 000±34 000	31 300±52 600	57 500±52 300
Secondary	66 (54)	27 600±26 400	31 700±47 100	48 300±46 800
College + University	18 (15)	23 200±28 600	13 600±8 500	37 500±32 400

*: permanent disability indemnities were allocated in 56 subjects, which explains why total cost may be lower than the sum of the two indemnities; total cost includes temporary and permanent disability indemnities as well as medical and hospital costs; †: Group 1: another job, same employer; Group 2: another job, different employer, no rehabilitation; Group 3: another job, different employer, rehabilitation; Group 4: retraining; Group 5: early retirement; Group 6: unemployed; all significantly different costs for temporary indemnities ($F=16.5$; $p<0.001$; all significant contrasts except for comparisons Groups 4–5–6, Groups 1–2 and Groups 2–3) but not for permanent disability indemnities ($F=0.8$; NS). §: all significantly different costs for temporary indemnities ($F=3.9$; $p=0.02$; significant contrasts between 16–30% and >30% severity grades); **: no significant differences in costs.

immunoglobulin G (IgE)-dependent. However, positive tests simply reflect sensitization and do not prove that the target organ, the bronchi, is involved. In the case of high molecular weight agents for which skin testing can reveal evidence of specific IgE sensitization, we have proposed the use of questionnaires and assessment of nonspecific bronchial responsiveness [48]. Skin testing cannot be performed for low molecular weight agents, as the mechanism is generally not IgE-mediated. A combination of questionnaires and bronchial responsiveness tests have to be relied on instead. It is our experience that a positive questionnaire coupled with significant bronchial hyperresponsiveness is more likely to be specific than one or other of the tools alone [49].

The key to tertiary prevention is offering medical care to affected workers. It is of the utmost importance that the worker has no further exposure to the causal agent, as *COTÉ et al.* [25] have shown that continued exposure results in deterioration.

Conclusions

We have reviewed the medicolegal aspects and compensation for occupational asthma in several countries, as well as presenting the results of a recent study on the cost and effectiveness of the Quebec system of compensation as an example. We conclude that:

1. Temporary and permanent impairment/disability compensation based on the degree of bronchial obstruction, airway hyperresponsiveness and need for medica-

tion should be awarded to subjects with occupational asthma.
2. The diagnosis of occupational asthma should be confirmed by objective means because of the significant medical, social and financial consequences.
3. There is a need to obtain data on the cost and effectiveness of medicolegal systems in order to improve the handling of occupational asthma cases.

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