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Review article

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Sick building syndrome–a wolf in sheep's clothing*

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Objective: Reading this article will acquaint the reader with possible outcomes associated with the diagnosis of "sick building syndrome." The definition, epidemiology, and precipitating events of this symptom complex are distinguished from other defined building-related illnesses.

Data source: The author's experience with many patients presenting with. this diagnostic label and selected studies on indoor pollution and "sick building syndrome" are carefully reviewed.

Study selection: Pertinent scientific investigations on "sick building syndrome" and previously published reviews on this arid related subjects that met the educational objectives were critically reviewed.

Results: "Sick building syndrome" is a pseudodiagnosis composed of nonspecific. transient symptoms without proven biologic markers. Its application in the clinical setting invites frequent subsequent linkage to other similar vague diagnoses associated with chronic debility and lack of therapeutic intervention.

Conclusion: The reader is encouraged to avoid the use of this term in favor of a Simpler, descriptive diagnosis (eg, transient office-related annoyance and/or irritation) or if this seems inadequate, adoption of the diagnostic label of "idiopathic building intolerance."

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INTRODUCTION

There is an increasing awareness that poor indoor air quality may generate a variety of deleterious effects on human health.[1] In recent years this has become a major public health concern. This is not surprising when one considers that we spend a majority of our time traveling or working in a succession of indoor microenvironments.[2] Although buildings are intended to provide relatively safe and comfortable environments for individuals to live and work, it has become apparent that they do not always achieve. this goal. Although there are no governmental health standards specifically applicable to commercial. buildings, the federal government either directly or indirectly regulates many products associated with indoor pollution.[3] There are voluntary guidelines within the Environmental Protection Agency's Building Air Quality guide[4] in Europe, the World Health Organization has also developed indoor air quality guidelines?[5]

Although the first modern building-associated illnesses were recognized prior to 1960. it was not until after the Arab oil embargo of 1973 that complaints of physical discomfort with associated irritant symptoms were reported with increasing frequency in the medical literature. Much of the interest and research began in Scandinavian countries and the United Kingdom in the late 1970s.[6] In 1983 at a World Health Organization meeting in Geneva. a new symptom complex "sick building syndrome" was initially coined? The complaints of afflicted office workers included dryness of the skin and mucous membranes, mental fatigue, headaches, general pruritus, and airway infections.[8] Most involved buildings were of a commercial nature and had in common the fact that they were heavily populated, carpeted, and either infrequently or poorly cleaned.[9]

In the previous decade there has been increasing debate about the symptom complex of "sick building syndrome." The growing dissatisfaction with the term originates from the total absence of consistent case definition of the "syndrome," the lack of biologic markers for most symptoms, or even groups of symptoms, and failure to find consistent associations between "sick building syndrome" symptoms and any building contaminant(s) across a large number of buildings studied.[10,11] It has been argued that utilization of this term has not improved our understanding of the occurrence of these symptoms. and further, that to label an entire building as "sick" or "healthy" has no scientific foundation.[11] Unfortunately, the media have often contributed to the problem by linking any building-associated complaint under this misleading and sometimes disquieting term.[12] In the United States expanding litigation has sought to link "sick building syndrome" with an equally controversial and unscientific symptom complex of "multiple

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Table 1. Definition of Terms Frequently Employed In Office Building-Related Health Problems

- Problem building
  An office building where worker complaints of ill health are more common than might be reasonably expected.
- Building-related illness
  An office building in which one or more workers develop an accepted, well-defined illness for which a specific cause is found. The cause is clearly related to the building, eg, hypersensitivity pneumonitis, humidifier fever, Legionnaire's pneumonitis, etc.
- Sick building syndrome
  An office building in which an ill-defined illness develops in one or more workers. The illness demonstrates great variability among the workers and no causative agent is apparent or found despite significant evaluation
- Tight building syndrome
  Generally used to designate an engineering or architectural flaw as the cause for either a building-related illness or a sick building syndrome.
- Crisis building
  Sick building where repeated industrial hygiene surveys have failed to localize a cause for ill-defined symptoms that precipitates a crisis of concern in the involved employees. Such buildings are frequently evacuated.

(Adapted from Bardana EJ. Building-related illness in occupational asthma, Eds: Bardana EJ, Montanaro A, O'Hollaren MT. Philadelphia: Hanley & Belfus, 1992:237-54).

chemical sensitivity."[13,14] This review will focus on the available scientific information on "sick building syndrome" and proposes an approach to the evaluation of nonspecific building-associated complaints for clinicians confronted with this problem.

TERMINOLOGY

Although air pollution in the setting of heavy industry has been well recognized for many centuries, indoor air quality issues in large commercial buildings and their worker occupants are relatively new developments in medicine.[15] The terminology that has arisen in this area has become somewhat confusing. The author's definitions of commonly employed terms are summarized in Table 1.[16] It should be pointed out that there continues to be some disagreement as to the use and application of these labels. In evaluating problem buildings, investigators have identified a variety of building-related illnesses that are clearly attributable to the building?." These include such diagnoses as hypersensitivity pneumonitis, humidifier fever, building-related asthma, toxic pneumonitis or organic dust toxic syndrome, a variety of infectious syndromes (eg, Legionnaire's disease, Pontiac fever, Q-fever, tuberculosis), building-related dermatitis and ocular symptoms and rare intoxication syndromes, eg, misuse of pesticides or other intoxicants.[16-18] These building-related illnesses have clinical case definitions and can be diagnosed by objectively measurable signs of illness. There is little controversy related to these illnesses and they will not be dealt with further in this review.

On the other hand, there has been an increasing tendency to describe symptoms that appear or are perceived to be related to the air quality of a building, but which exhaustive studies fail to correlate with any identifiable problem in the building. It is this group of transient symptoms that has composed the symptom complex called "sick building syndrome" upon which this review will concentrate.

Even those who utilize the term "sick building syndrome" concede that all investigators and scientific journals discussing this issue have a great responsibility to define terminology clearly.[16,19] One of the critical issues often lost in distinguishing building-related illness such as Legionnaire's disease and "sick building syndrome" is that the former biologically defined infection may persist even after an afflicted individual is removed from the building, whereas the symptoms of "sick building syndrome" should quickly abate upon leaving the building." It is often this distinction that motivates a number of unconventional providers to seek linkage with other equally controversial diagnoses to justify the persistence of symptoms.[20] In doing this one loses even the ill-defined parameters of this transient symptom complex.

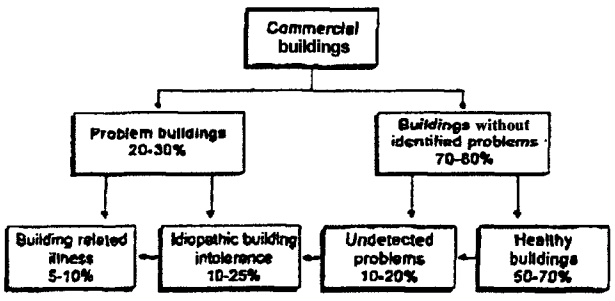

Figure 1. Schematic depiction of the dynamic continuum within commercial building stock focused on the degradation of building performance (adopted from reference #22, with permission).

EPIDEMIOLOGIC CONSIDERATIONS

The prevalence of "sick building syndrome" remains largely unknown. Case definition for this symptom complex remains very arbitrary since there are no biologic markers to define it precisely. It has been indicated that this is partly attributable to inadequate analytical methods, and partly related to the nonspecificity of many "sick building syndrome" symptoms.[19] Burge has observed that in the inves-

tigations conducted thus far there does not appear to be one group of "sick" buildings and a separate group of "unaffected buildings." Rather, there is a continuum of problems from one building to another.[21] In this respect, Woods has hypothesized a dynamic continuum within commercial building stock focused on the degradation of building performance (Fig 1).[22] Furthermore, most studies of this issue have utilized a self-report instrument, and there is neither a standard questionnaire nor a general consensus on the range of symptoms that are appropriate for inclusion.[23]

The National Institute of Occupational Safety and Health conducted numerous investigations over the past several decades. By 1991 over 600 indoor air quality studies had been performed as part of the health hazard program.[16,24] It has been estimated nearly a third of buildings world-wide have some problems with their heating, ventilation, and air conditioning system precipitating worker complaints. In 1989 the Honeywell Corporation conducted a random telephone survey of 600 of its office workers. Twenty percent perceived their work product hampered by poor indoor air quality.[25]

A number of large multi-building studies covering thousands of office workers have been conducted in North America, the United Kingdom, and Europe.[26–35] As indicated above, questionnaires were not standardized in these investigations making any comparisons problematic. As well, these studies depended on self-reported symptoms and subjective estimates of building conditions, ie, dry air, dusty conditions, fresh paint odor, etc.[36] The validity of these observations and absence of confirmation by objective measurements has been a source of significant criticism. The most common independent health factors identified in these large cross sectional studies of "sick building" workers are summarized in Table 2. There are no comparable data for these independent health factors in unaffected buildings. The Environmental Protection Agency's BASE program suggests, however, that symptom frequencies in a dozen buildings selected at random were often lower by a factor of two or more.[**] The only finding common to the multiple studies performed to dale wag the increased symptom rates reported by females.[26–35] Even this observation elicits debate because it may simply reflect workplace disparities, ie, lower pay scale, assignment of menial tasks, unattractive workspace, etc.[36]

Table 2, Independent Health Factors Identified by Respondents to Questionnaires Related to *"Sick Building* Syndrome"

- **Upper respiratory symptoms**
  - Rhinorrhea
  - Nasal congestion
  - Sneezing
  - Sinus congestion
- **Throat symptoms**
  - Soreness
  - Hoarseness
  - Dryness
- **Lower respiratory symptoms**
  - Cough
  - Wheezing
  - Dyspnea
  - Chest tightness
- **Ocular/cutaneous *symptoms***
  - Dryness
  - Itch
  - Tearing
  - Blurred vision
  - Soreness/burning
  - Problems with contact lenses
- General
  - Fatigue/drowsiness
  - Chills/fever
  - Nausea
- **Musculoskeletal**
  - Myalgia
  - Cervical spasm
  - Lumbosacral spasm/pain
  - Numbness in hands/wrists
  - Polyarthralgia
- Neurologic
  - Headache
  - Reduced memory
  - Difficulty in concentrating
  - Depression
  - Tension/nervousness

Modified and *adapted* from references #32 and #35, with permission.

ECONOMIC REPERCUSQONS

Although symptoms related to indoor pollution may seem trivial, it is associated with a disproportionate expenditure of both financial and manpower resources. The economic impact of this problem can easily be overlooked in the absence of a clear understanding of bow widespread the problem is. The numhcr of incriminated buildings and their occupants is estimated to be substantial. In the United States, Woods has estimated these numbers to hc between 800.000 and 1,200,000 commercial buildings with between 30 to 70 million exposed occupants.[37] For example, if approximately half of Environmental Protection Agency's employees reported headache fur the previous week with a duration of two days, this corresponds to 5,000 headaches/wk among 5000 employees, or a quarter of a million headaches per year. If the cost of a headache is estimated to vary between $1.50 and $8.00,[38] then the cost of building-related headaches to the Environmental Protection Agency as an organization could be valued at between $375.000 and $2 million.[36] If one adds the cost of workers' compensation actions and, in some instances, litigation against architects, building managers, employers and landlords, the cost of this problem can reach astronomic proportions.[3,14]

PRECIPITATJNG FACTORS IN "SICK BUILDJNG SYNDROME"

My own experience as well as that of other investigators in the area of "sick building syndrome" indicates there are three major reasons associated with the onset of complaints in building occupants. They are (1) rapid new buildinp occupancy, (2) building renovation, and (3) water or moisture incursion with subsequent microbial contamination. The most common precipitator is associated with the initiation of extensive office building renovation that is conducted during normal work hours with incomplete isolation of the construction area, and with little or no adjustment of the ventilation rate. Painting, sheetrocking, plastering, and carpeting result in a variety of chemi-

cal emissions that may adversely impact nearby employees. Airborne particulate and volatile chemical contaminants are the most frequently reported contaminants in buildings undergoing renovation.[22,39] Volatile organic compounds in indoor air arise from a wide variety of building materials, cleaners, office products and machines, paints and furnishings. Examples of typical volatile organic compounds found in office buildings include xylene, chloroform, ethylbenzene, chlorobenzene, styrene, and trichloroethylene. Volatile organic compounds frequently have annoying odors and their presence in the setting of significant renovation or new building occupancy is estimated at 70% to 80%.

Several reviews and a number of investigations have incriminated volatile organic compounds in office buildings as a cause of annoyance and/or irritation to the eyes and mucous membrane of the respiratory tract.[40–46] It is not yet scientifically known whether exposure to low level concentrations of volatile organic compounds has any significant adverse health effects. It is clear that certain odors are atrributable to volatile organic compounds; however, whether or not they cause or contribute to the nonspecific symptoms outlined in Table 2 has yet to be established.[45] Levels of volatile organic compounds in the indoor environment are almost always well below threshold limit value standards published by the American Conference of Governmental Indusrrial Hygienists. It is almost impossible to calculate the cumulative effect of total. volatile organic compounds when one considers the potential synergistic effect of airborne particulate and other possible pollutants.[49] Where ventilation rates meet or exceed the requirements of the American Conference of Governmental Industrial Hygienists standard 62-1989, the total volatile organic compounds are usually less than 1 mg/m^3 and concentrations of individual volatile organic compouads are well below (less than 1%) any recognized occupational exposure standard.[45]

In addition to building renovation, rapid new building occupancy is equally likely to induce annoyance and/or irritative complaints in exposed workers. The reasons are very similar to those noted above with building renovation, The same contamination with dusts and volatile organic compounds occurs when newly constructed buildings are not left to "air out" and meticulously cleaned prior to occupancy.

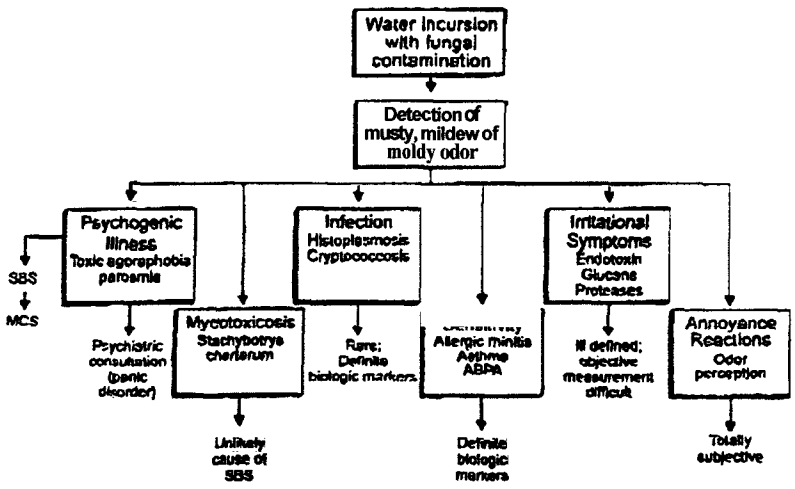

Figure 2. Potential clinical sequelae associated with fungal contamination of a building. SBS = sick building syndrome. MCS = multiple chemical sensitivity. and ABPA = allergic bronchopulmonary aspergillosis.

In instances where emissions from construction materials are nor the initial trigger of symptoms, the next most commonly encountered problem is related either to a poorly maintained structure, or one that was poorly or defectively constructed with resultant intrusion of water and contamination with microbial and fungal growth. This may be more problematic in certain geographic locations where warmer temperatures and high relative humidity result in condensation problems in air conditioned structures. In general. older buildings are more susceptible to moisture problems than newer buildings. Obvious fungal growth usually precipitates health concerns among office occupants. This results in the typical "moldy" or "mildew" odor that accompanies such contamination. However. there is a paucity of scientific information upon which building engineers. industrial hygienists and involved clinicians can make sound judgements. There are no generally accepted numerical guidelines that specify "safe" exposure limits. More importantly, there are no established standards as to what airborne levels constitute a definite health hazard. Similarly. there are no environmental criteria for deciding whether a measured airborne level of fungi or bacteria is a risk factor for bypersensitivity pneumonitis or other defined respiratory disorders." Analytical results of air sampling for microorganisms are useful in identifying indoor sites where fungi may be accumulating and amplifying. The same analytical results cannot, however, be used to predict or invoke adverse health effects.

CLINICAL SEQUELAE ASSOCIATED WITH MICROBIAL OVERGROWTH

There are a variety of clinical Outcomes that may be associated with microbial growth in a building (Fig 2).

Annoyance Reactions

Annoyance reactions occur in individuals who possess a heightened sense of olfactory awareness. Odor perception involves the most fundamental of

senses. From a phylogenetic standpoint, it may be the oldest of the perceptual systems and is known to k~- volve the limbic system of the brain which is the seat of emotions in humans and other animals.[51] The ability to tolerate a variety of non-irritating, but undesirable odors, is dependent on a variety of genetic and acquired factors that affect olfaction. These factors may include the presence of allergic or nonallergic rhinitis, infectious sinusitis, nasal and paranasal polyposis, tobacco use, and nasal instillation of over-the-counter, prescription and illicit drugs, among others. The perception of an undesirable odor is one of the principal heralding complaints in instances of "sick buildiag syndrome." Frequently, a strong emotional response is voiced by occupants, and often, the complaints may continue despite remediation of the source. As well, the emotional response of occupants *often* seems out of proportion to the identified problem.[51] This often becomes a difficult issue to solve, and a costly experience for the building owner or manager.[52,53] The source of repugnant odors in "sick building syndrome" is frequently associated with the "mildew" or "musty" odor of *fungal growth* which represents fungal-specific volatile organic compounds.

Irritational Symptoms

Although conventional wisdom has attributed the transient, nonspecific irritation of mucous membranes or respiratory tract to volatile organic compounds in *office* buildings, there is a paucity of scientific data substantiating this assertion.[45,54] It is possible that other factors relating to total particulates, relative humidity, and temperature may play a role in these nonspecific symptoms.

In the absence of specific chemicals or mixtures of chemicals, it has been suggested that indoor microbial contamination could account for a portion of the observed symptoms.[55–59] Indoor air contains a variety of bacterial and fungal species.[58,59] Certain cell wall constituents, particularly bacterial endotoxin, glucans, and othw proteases have been observed to possess both inflammatory and adjuvant properties.[60–62] In this respect, it is of interest that Michel and associates recently demonstrated that subjects sensitized to housedust mite develop severe asthma when simultaneously exposed to housedust containing high concentrations of endotoxin.[63] This supports the theory *that* mite allergy (*or* other allergens) act as an initiating environmental factor, whereas endotoxin acts as a triggering mechanism for increasing the seventy of the basic disease.

At the present time there are very limited scientific data related to the detection of endotoxin, glucans, or other microbial constituents in office settings. A great deal more work will be required before their roles, if any, can be determined with any accuracy in building-related illness.[62]

Sensitization

Sensitization is a highly unlikely mechanism to explain symptoms in most cases of "sick building syndrome." The symptom complex of sick building syndrome often develops acutely in individuals who have none of the hallmarks of allergic disease. As well, there are relatively few chemicals with the capacity of inducing de novo immune hypersensitivity. Although significant levels of dust and microorganisms have been found in public buildings,[64,65] it is more likely that these constituents contribute to symptomatology by either mechanical irritation, or by reactivity with volatile organic compounds associated with microorganisms, than by de novo sensitization.[66]

In addition to IgE-specific mechanisms, hypersensitivity pneumonitis may result from Exposure to moderately heavy concentrations of microorganisms.[66] The true incidence of *building-related hypersensitivity* pneumonitis is not known. There is a paucity of scientific data related to the actual dose of bacterial or fungal antigen required for either sensitization or development of overt symptoms. I cannot overemphasize that the mere presence of an airborne microbial contaminant cannot be directly identified with a disease process in an occupant unless there is additional evidence linking an immunologic response to a specific building contaminant (as opposed to an alternative exposure, eg, home, bam, vehicle, dc).

Respiratory Infections

Respiratory infections with common pathogens such as viruses (eg, influenza, measles, common colds) and bacteria (eg, Legionnaire's disease, Q fever, tuberculosis) are certainly transmissible by indoor air and have been reported in office buildings.[67–69] Only a few fungal species, however, can cause infections in otherwise healthy individuals (eg, *Coccidioides immitis*, *Histoplasma capsulatum*, *Cryptococcus neoformans*). These *are* common to soil and the last two also occur in bird droppings that may contaminate air intake systems of buildings.[69] Other fungal infections usually occur in the setting of patients wirb significant defects in cell-mediated immunity," and have been reported in association with faulty heating, ventilation and air conditioning systems,[71–73] eg, disseminated aspergillosis.

Toxicosis

Toxicosis results from chemical toxins that are generated by viable organisms. The irritant responses to endotoxin and glucans have been discussed above. Endotoxin has also been associated with the development of "organic dust toxic syndrome." The severity of symptoms in this condition appears to correlate with the number of grim-negative bacteria or endotoxin in the environment.[74] Symptom generally commence four to eight hours after exposure and include malaise, myalgia~dyspnea, cough, headache, and nausea. It differs from hypersensitivity pneumonitis in that no prior sensitization is required, chest radiograph is generally normal, and chronic sequelae do not occur." Symptoms usually subside in hours and tolerance *often* develops despite continued exposure. The latter may be lost over weekends or vacations with reappearance upon

re-exposure, ie, "Monday morning misery." This condition has been referred to under a variety of labels including humidifier fever. grain fever. toxic dust syndrome, etc.[69]

Mycotoxicosis as a potential cause of "sick building syndrome.' remains essentially undocumented. It would be a consideration only in instances of florid contamination. Recently there has been increased concern about homes water-damaged as a result of flooding. This would rarely be a problem in a commercial building setting.

Stachybotrys chartarum (atra) and its toxic metabolites (satratoxins) have been linked to life-threatening pulmonary hemorrhage in a cluster of ten infants in Cleveland.[76] All ten were hospitalized and pulmonary hemorrhages recurred in five infants shortly after discharge from hospital. Informal surveillance for pulmonary hemorrhage by the Centers for Disease Control and Prevention following the Cleveland report uncovered an additional 32 cases in Ohio and 47 cases among infants in the rest of the country.[77] Unfortunately, in the latter reports investigators were unable to do any confirmatory studies. There appears to be a synergistic effect between exposure to *S. chartarum* and the presence of tobacco smoke.[78,79] Thus far all reported cases io humans have occurred in infants less than 1 year of age.[79]

Although there have been reports of Stachybotrys-induced disease in farm workers handling heavily contaminated hay, the absence of appropriate confirmatory studies makes the linkage tenuous.[80] Similar concerns surround the report by Croft et al regarding a Chicago family with a hemorrhagic alveolitis presumed to be related to trichothecene toxicosis.[81] Johanning et al reponed on the results of a questionnaire survey among 53 New York office workers who were exposed to fungal contaminants as a result of water incursion from a faulty storm drain.[82] Although these authors conclude that workers' symptoms and subtle immunologic changes in the complainants were the result of exposure to toxigenic *S. chartarum* and other fungi, there is no direct scientific evidence substantiating this assertion. There are no confumed cases of Stachybotrys-induced hemorrhagic alveolitis *in* adults.[79] It has been speculated that infants are more susceptible because their lungs are developing rapidly.[79] This usually occurs in the setting of very significant water damage. It is highly doubtful that *this* organism plays a significant role in the induction of what has been characterized as "sick building syndrome." Aflatoxin from *Aspergillus flavus is* a mycotoxin associated with increased cancer risk, but an unlikely participant in the nonspecific symptoms associated with "sick building syndromc."

Mass Psychogenic Illness

Psychogenic and social factors play a significant role in the cvofution of many cases of "sick building syndrome." There are insufficient scientific data to state how often this occurs. The origin of *the* problem develops from an initial lack of scientific information, dissemination of misinformation, or providers who unequivocally diagnose an evolving pathologic state that has not been scientifically demonstrated.[83] Frequently. the media add to the confusion. Unfortunately, the use of "sick building syndrome" as a surrogate €or a bonafide diagnosis contributes little to clarify the clinical situation. With the suggestion of "dangerous" microbial aerosols in the workplace. patients understandably become concerned about their long-term health. Inappropriate belief systems may become entrenched in situations where office-workers are frustrated in their attempts to correct a perceived problem and ignored by their employers and physicians.[16]

In my experience analyzing instances of "Sick building syndrome" there Frequently is an evolution to chronic complaints from wbat originated as transient building-related symptoms. Frqucnrly. the spectrum of odors or irritants precipitating symptoms expands without plausible rationale. There are no physiologic reasons for this transition. but it must be recognized that when this occurs, the symptom complex no longer represents what bas been traditionally referred to as "sick building syndrome." In this respect, some patients may find the theories of clinical ecology comforting and useful, and as a matter of course are also labeled as having "%"-tiple chemical sensitivity." At this point they have acquired two pseudodiagnostic labels defined only by nonspecific symptoms and confounded by a confusing nomenclature and considerable scientific controversy. Hence, the adage of this review . . ."a wolf in sheep's clothing." In effect, many individuals who follow in this transition can be said to suffer a form of toxic agoraphobia usually triggered by an odor or the perception of an exposure, ie. a form of cacosmia or parosmia. Kurt believes this symptom complex is analogous to the manifestations of panic disorder as defined by DSM-IV-R.[84] This belief is supported by two recent investigations.[85,86]

ASSOCIATION OF "SICK BUILDING SYNDROME" WITH OTHER CONTROVERSIAL DIAGNOSES

Traditionally the symptom complex of "sick building syndrome" has implied the development of transient annoyance and/or irritational symptom that are temporally related to a building or a specific area of a building. The key issue lending credibility to this "diagnosis" has always been the striking temporality of symptoms within the building. Symptoms regress upon exiting the building and resume upon returning. The obvious solution Io any such patient bas been to change the work station to an alternative site. In those affected patients where such solutions appear to be elusive, there is a gradual evolution to a permanence of symptoms beyond the envelope of the building. The reason for this subtle transformation is not always evident. Because many of these patients become engaged in one form or another of legal action (eg, Workers' Compensation, Americans with Disabiliries

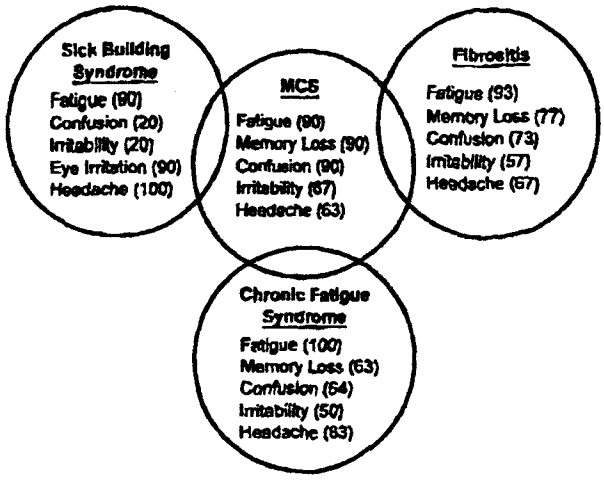

Figure 3. Similarity of core symptoms in four controversial disorders frequently associated with one another (adapted and modified from references #12, 18, and 87, used with permission). MCS = multiple chemical sensitivity.

Act, Fair Housing Amendments Act, Toxic Tort Litigation, etc), the concept of a self-limited symptom complex is never as forbearing as a condition that has permanence and is all encompassing.[3,14] Accordingly, one occasionally observes a tendency to link "sick building syndrome" with the development of other chronic disorders, many of which suffer a similar paucity of biologic markers and an absence of an effective therapeutic intervention.[13] Disability among such patients is considerable.

"Multiple chemical sensitivity" is frequently invoked as the natural outcome of "sick building syndrome." The latter serves as the environmental trigger for "multiple chemical sensitivity."[20] Core symptoms of these proported symptom complexes are similar, ie, skin and/or mucous membrane irritation, headache, fatigue, myalgias, cognitive impairment, etc[12,68,87] (Fig 3). Symptoms are not the result of tissue damage that can be observed or measured by physical examination or laboratory studies.[88-90] Once the transition is established, the patient feels justified in the expression of chronic symptoms for which there is little hope of any effective therapeutic intervention.[91-93] Previous studies of patients with "multiple chemical sensitivity" have observed that 69% to 86% claimed total disability.[91,92]

In selected patients with "sick building syndrome" or "multiple chemical sensitivity" there is a further proclivity to associate with other ill-defined, chronic disorders with overlapping symptoms. These include chronic fatigue syndrome and fibromyalgia.[87] It has been proposed that chronic fatigue syndrome and fibromyalgia are similar, if not identical disorders.[94,95] All these conditions share a preponderance of female patients with similar mean ages at presentation, marital status, educational level, employment rate, and duration of illness (Fig 3).[86-93] Recently, there have also been claims associating the "chemical" basis of "multiple chemical sensitivity" with the induction of porphyria.[96] This purported association is based principally on results from a single reference laboratory utilizing a fundamentally flawed assay for erythrocyte coproporphyrin oxidase.[96]

Based on these observations, the clinician should be extremely cautious about accepting or applying "sick building syndrome" as a bunafide diagnosis. This frequently triggers a diagnostic domino effect leading to an unintended clinical outcome. Just as a recent panel of The World Health Organization has recommended a new name, "idiopathic environmental intolerance," to stress the fact that environmental chemicals have not been proven to cause "multiple chemical sensitivity" symptoms, I would submit that a better name for "sick, building syndrome" would be "idiopathic building intolerance" to remove any illusion of a bonafide illness.

APPROACH TO PATENTS WITH IDIOPATHIC BUILDING INTOLERANCE

Building-associated illness often presents a major diagnostic challenge to the clinician. The patient often arrives with deeply entrenched perceptions regarding the absolute Linkage of their symptoms to poor air quality in their work environment. Three major pitfalls arise in the evaluation of possible attribution of any symptom complex to a particular workplace, domicile or product. These are (1) failure to recognize an explanatory preexisting medical disorder, (2) failure to diagnose an underlying condition masquerading as "sick building syndrome," and (3) inappropriate patient advocacy in the absence of credible scientific substantiation. In evaluating any patient with such problems I recommend a stratified approach beginning with a comprehensive history and physical examination to eliminate the first two pitfalls. In obtaining the medical history, it is essential that attention be given to the details of the patients' workplace and non-workplace exposures. Frequently, one sees a reasonably complete description of the workplace and its exposures without similar attention to the home, avocations, social habits, recreational activities, type of vehicle driven, etc. Supplementation of the medical history with an extensive questionnaire that can be checked at the time of examination can be extremely useful.[97] As well, the examiner must make every effort to obtain as many previous medical records as is possible.

Laboratory tests for biologic markers of building exposures are seldom helpful, except in the case of environ-

mental tobacco smoke. More commonly than not, laboratory studies are more likely to assist in the elucidation of alternative disease processes. The clinician should consider selecting relatively high yield, low cost tests (eg, complete blood count, chemistry screen, screening computerized tomography of sinuses, selected allergy skin testing, pulmonary function studies, etc) before proceeding to more expensive evaluations less likely to yield useful information (eg, autoimmune serology, airborne bacterial/mold determinations, toxicology screens, lymphocyte surface marker studies, etc).[98]

The appropriate use of consultants can prove invaluable in the assessment of building-associated symptoms. For example, collaboration with an otolaryngologist to assess symptoms relating to upper airway obstruction or voice disorders such as hoarseness, laryngitis or persistent throat pain ascribed to poor air quality may lead to an alternative diagnosis. eg, vocal cord dysfunction. Similarly, referral to a dermatologist or psychiatrist can prove invaluable in shedding light on associated cutaneous or cognitive problems.

The initial process of evaluation should focus on the differential diagnostic process, It is imperative to consider the common medical and psychologic conditions that may present as perceived toxicity or hypersensitivity caused by indoor pollution. Five general groups of disorders have been identified in patients who present with building-related illness (Table 3).

Upon completion of this initial phase of differential diagnosis, the second step relates to developing an assessment of the most likely cause for the patient's complaints. In this respect, collaboration with a knowledgeable industrial hygienist or building engineer is invaluable. When possible and practical, the clinician should always take the opportunity to visit and inspect the building. A number of excellent protocols have been developed as guidelines in the investigation of indoor air quality. All of these protocols share a flexible approach and emphasize general observations over actual measurements of pollutants.[22,99,100] The major building-related issues that should be addressed can be divided into five major categories: (1) building age and design: (2) outdoor air quality; (3) heating, ventilation and air conditioning design and maintenance; (4) renovation; and (5) management philosophy.[22,25,39,97]

The third and final step involves the distillation of available data into a scientifically based, easily understood description of the likely pathogenic process. The author frequently relies on the paradigm of annoyance reactions, transient irritation, sensitization, infection, toxicosis, or psychogenic illness described above (Fig 2). A careful attempt is made to explain the medical implications of these various alternatives to the patient lucidly. At times several alternative mechanisms may apply. The often used pseudodiagnosis of "sick building syndrome" is avoided entirely with the hope that the patient will be reassured, and armed with a scientific medical perspective, proceed to cope with the issues at hand without adverse impact on their psychologic stability, their employment, or their career. In this respect, the physician owes each patient his or her advocacy, but this patronage must always be tempered by the overriding responsibility to scientific veracity.

In summary, "sick building syndrome" is a pseudodiagnosis composed of nonspecific, transient symptoms without known biologic markers. Its application in the clinical setting invites frequent subsequent linkage to other similar vague diagnoses associated with chronic debility and lack of effective therapeutic interventions, eg, "multiple chemical sensitivity," fibromyalgia, chronic fatigue syndrome, among others. Hence, the thrust of this review is to encourage the reader to avoid use of this term in favor of a simpler, descriptive diagnosis (eg, transient annoyance and/or irritation) or if this is not appealing, adopt the diagnostic label of "idiopathic building intolerance" instead.

Table 3. Diagnostic Groupings of Medical Conditions Commonly Confused with Toxicity or Hypersensitivity to Indoor Pollution

infectious diseases
Acute/chronic sinusitis
Pharyngitis
Tonsillitis
Bronchitis
Allergic/inflammatory disorders
Allergic rhinitis
Bronchial asthma
Contact dermatitis
Idiopathic urticaria/angioedema
Hypersensitivity pneumonitis
Organic toxic dust syndrome
Nonallergic respiratory disorders
Chronic serous *otitis* media
Eustachian tube dysfunction
Nasal/paranasal polyposis
Vocal cord polyps/nodules
Gastroesophageal reflux
Rhinitis medicamentosa
Vocal cord dysfunction
Metabolic/toxic conditions
Thyroid dysfunction
Diabetes *mellitus*
Recreational drug abuse
Rheumatic disorders
Pharmaceutical side effects
Psychiatric disorders
Generalized anxiety states
Panic disorder/toxic agoraphobia
Somatization disorder

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CME Examination
No 007-009
Questions 1–20, Bardana EI. 1997;79:283–94.

CME Test Questions

1. All the following diagnoses belong in the category of building-related illnesses except:
   A. Hypersensitivity pneumonitis
   B. Humidifier fever
   C. Tuberculosis
   D. Q fever
   E. Vocal cord dysfunction syndrome
2. A building where studies have failed to localize a cause for ill-defined symptoms in occupants with resultant fear and eventual evacuation is termed a:
   A. tight building.
   B. problem building.
   C. crisis building.
   D. troubled building.
3. The estimated number of commercial buildings with malfunctioning heating, ventilation and air conditioning systems is:
   A. 10%
   B. 25%
   C. 33%
   D. 50%
   E. 65%
4. The approximate number of affected building occupants who may be suffering adverse health effects due to poor indoor air quality is:
   A. 2 million.
   B. 5 million.
   C. 10 million.
   D. 20 million.
   E. 50 million.
5. All of the following are precipitators of "sick building syndrome" except:
   A. Preparation of food or beverages
   B. Occupancy of a new building before final completion
   C. Renovation of any commercial building during normal workshifts
   D. Water or moisture incursion
6. True statements related to indoor levels of volatile organic compounds in commercial buildings include all of the following except
   A. Associated with annoying odors
   B. Emanate from paints, carpet adhesives, plastering compounds. etc.
   C. Are usually well below TLV standards published by the American Conference of Governmental Industrial Hygienists
   D. Are usually less than 1% of any recognized occupational exposure standard
   E. Are definite respiratory irritants
7. Obvious mold growth in commercial ofice buildings is usually associated with all of the following except:
   A. Poor maintenance of the heating, ventilation. and air conditioning system
   B. Intrusion of water
   C. Typical "mildew" odor
   D. Health concems among building occupants
   E. Adverse health effects
8. All of the following conditions may impact how a building occupant responds to an undesirable odor except:
   A. Allergic rhinitis
   B. Chronic sinusitis
   C. Cigarette smoking
   D. Cocaine abuse

E. Migraine headaches

9. The source of the typical "mildew" or "moldy" odor emanating from fungal overgrowth is related to which constituents produced by fungi:
   A. Endotoxin
   B. Proteases
   C. Volatile organic compounds
   D. Glucans
   E. Mycotoxins
10. Fungal species associated with systemic infections in health individuals include all of the following except:
   A. *Coccidioides immitis*
   B. *Histoplasma capsulatum*
   C. *Penicillium notatum*
   D. *Cryptococcus neoformans*
11. Organic dust toxic syndrome is usually caused by which of the following:
   A. *Thermoactinomycetes vulgaris*
   B. Endotoxin
   C. *Candida albicans*
   D. *Aspergillus flavus*
   E. *Stachybotrys chartarum (atra)*
12. Aflatoxin is a carcinogenic mycotoxin derived from which of the following species?
   A. *Aureobasidium pullulans*
   B. *Alternaria tenuis*
   C. *Sitophilus granarius*
   D. *Aspergillus flavus*
   E. *Merulius lacrymans*
13. Building-related psychogenic illness has its inception in all of the following except:
   A. Preexisting atopic disease
   B. *The* lay media
   C. Misinformation
   D. Lack of information
   E. Uninformed, alarmist providers
14. *The* most significant trigger resulting in the development of toxic agoraphobia in sick building syndrome is:
   A. *An* upper respiratory infection
   B. Poor acoustical qualities
   C. Unacceptable room temperatures
   D. Perception of some malodor
   E. Inadequate illumination
15. Conditions frequently associated with "sick building Syndrome" include all of the following except:
   A. Multiple chemical sensitivity
   B. Chronic fatigue syndrome
   C. Fibromyalgia
   D. Porphyria
   E. Polymyalgia rheumatica
16. Three major pitfalls that should be considered before attribution of any symptom complex to a building include all of the following except:
   A. Age of the building
   B. Failure to recognize a preexisting medical disorder
   C. Failure to diagnose a condition masquerading as "sick building syndrome"
   D. Inappropriate patient advocacy
17. Historically, information about the patient's workplace is as important as information about which of the following:
   A. Private residence
   B. Motor vehicle driven
   C. Avocations
   D. Social habits
   E. All of the above
18. An example of a relatively high yield, low cost test in the evaluation of patients with building-related symptoms include:
   A. Complete blood count
   B. Computerized tomography screen of sinuses
   C. Pulmonary function studies
   D. Selected allergy skin tests
   E. All of the above
19. In evaluating building-retted complaints the clinician should make every attempt to:
   A. Compare prevalence of symptom in similar buildings
   B. Examine the rate of absenteeism in all occupants
   C. Make a visit to the building
   D. Perform allergy testing in all occupants
20. Which building-specific issue should be considered in evaluating the adequacy of any building:
   A. Building age and design
   B. Heating, ventilation and air conditioning design and maintenance
   C. Renovation
   D. Management philosophy
   E. All of the above