

## CASE STUDY

[In each issue **IAQU** presents a case study on an investigation of indoor air problems in a particular building. The editorial staff relies on information provided by the environmental consultants involved in the investigation. **IAQU** presents a variety of approaches to investigation and mitigation implemented by consultants with a broad range of experience, philosophies, and expertise. Inclusion of a particular case study in the newsletter does not imply **IAQU**'s endorsement of the investigative procedures, analysis, or mitigation techniques employed in the case. **IAQU** invites readers to submit comments, suggestions, and questions concerning any case. At the discretion of the editors, correspondence may be presented in a future issue.]

### School Fainting Episodes Blamed on Mass Psychogenic Illness

When IAQ investigations fail to find environmental causes for occupant symptoms, some people are quick to point the finger at the occupants themselves and label such phenomena as "mass psychogenic illness."

We have reported cases in the past where building managers tried to tell occupants that the symptoms were "all in their heads," and later paid a dear price when it turned out that the causes were environmental, and occupants suffered acute and, in some cases, chronic effects from building problems.

This case involves a high school in Fairfax, Virginia, USA, at which students in 1990-1991 experienced an outbreak of symptoms that turned out to be mass psychogenic illness. Three separate IAQ investigations by county authorities and an independent consultant detected no evidence of environmental causes.

It was only after an extensive epidemiological study of the students at the school that researchers determined that the outbreak could only have been from psychogenic causes. Following that study, the episodes ceased.

#### Building Description

The school involved is a 300,000-square-foot, two-story masonry structure with interior finishes of brick and concrete masonry block walls and dropped acoustical tile ceilings. It opened in 1966 and, at the time of the IAQ problems, housed 2,200 students in grades 9 through 12, as well as about 200 employees.

School facilities include classrooms, offices, corridors, mechanical spaces, and specialty use areas typically found in high schools.

The building underwent a major renovation in the spring of 1989 to provide upgraded mechanical and electrical systems, including new lighting and fire alarm systems. The US

\$8-million-dollar project also completely renovated the auditorium and added new finishes, such as floor surfaces, ceilings, and paint inside and out, as well as a new roof.

#### HVAC System Description

Most offices and classrooms have individual ventilating units below an outside window. Operating at a constant fan speed, the units draw air from an intake at the base of the outside wall. The air circulates in the room only, but some transfers to the corridor.

Thermostats in each room control the temperature, and windows open to provide additional temperature control and ventilation.

Interior classrooms receive ventilation air from ceiling vents ducted from rooftop makeup air units, while individual fan-coil units (FCU) supply circulation and temperature control. Return air vents exhaust air out of the building.

Large common spaces have separate constant air volume (CAV) rooftop air handling units, and special use areas, such as kitchens and laboratories, have exhaust hoods to vent air directly from the building.

Corridors have no air supply and receive air indirectly from classrooms and other areas.

#### History of Symptoms

In February 1990, while renovations were still underway, a student fainted in the school. By March 1991, this student had experienced an additional 32 incidents, most of which occurred in the building.

Four other students, all female, began experiencing multiple fainting spells. One student reported 14 episodes in a five-month period. Other students began to report near-fainting episodes.

When a student suffered an episode, school authorities would call the nearby rescue squad,

which usually arrived in less than five minutes. Emergency services recorded 63 calls in the five months between September 1990 and February 1991. In almost every case, emergency workers reported that the student was alert and conscious when the squad arrived.

Rescue squad records show that of the 63 calls, 17 were for hyperventilation, 15 for unconfirmed "seizures," and the rest for fainting episodes. All involved female students, four of whom accounted for 29% of the calls. Emergency workers also noted that they often received additional calls once they had arrived on the scene.

### Investigation History

When the fainting episodes began, Mark LaCroix, an environmental health specialist for the Fairfax County Public Schools, conducted an IAQ investigation. This study detected no toxins in the environment and only a few instances of elevated carbon dioxide (CO<sub>2</sub>) levels in some classrooms, indicating suboptimal ventilation. However, these classrooms were well within building codes and LaCroix could make no plausible link between environmental conditions and the fainting spells.

The fainting episodes continued after this investigation, and a county sanitarian supervisor conducted a second evaluation of the building. Also, county health officials undertook a medical evaluation of the fainting episodes, but were unable to find a plausible organic etiology.

In March 1991, following increased concern over the faintings, county officials elected to hire an independent environmental firm to conduct a third study of the school.

Parental and official concern increased on April 23, 1991, when a student died. Initial autopsy results failed to determine the cause of death. A parent-teacher meeting early in May discussed the growing problem and, despite reports from investigators that no environmental causes existed for the episodes, many parents reported more faintings and near-faintings among students.

On the following day, the medical examiner reported that the deceased student had died from an overdose of a prescribed medication.

In May 1991, epidemiologists conducted a survey of all students at the school in an effort to determine a probable cause of the fainting episodes.

### Investigation Results

#### *First Study*

The initial study by the school department looked at temperature, relative humidity, particulates, carbon dioxide, airborne fungi, formaldehyde, and total hydrocarbons.

CO<sub>2</sub> levels ranged from 400-1,200 parts per million (ppm). In rooms with elevated levels — those above the ASHRAE recommended maximum of 1,000 ppm — further tests showed that the O/A supply rate was above 15 cubic feet per minute (cfm), which is called for by the same standard.

The investigator concluded that the high CO<sub>2</sub> levels came from stratification caused by room occupants closing the fins on the ventilators or turning off the blower.

Airborne fungal levels were less than half of the outdoor count and well below the level considered acceptable by the American Conference of Government Industrial Hygienists (ACGIH). Formaldehyde and hydrocarbon measurements also showed nothing to indicate unusual sources of chemical pollutants within the building.

#### *Second Study*

The Fairfax County Health Department conducted the second investigation. In addition to a visual inspection of building systems, the investigators also measured temperature, relative humidity, and CO<sub>2</sub> levels.

They also considered possible contaminant sources from outside the school building, such as combustion or vehicle exhaust, but found no significant potential for contamination. They then investigated custodial supplies and found them to be consistent with materials used in all other county schools, and determined that no custodial activities could be causing the fainting episodes.

Investigators also obtained material safety data sheets (MSDSs) for construction materials used in the building renovation to identify potential contaminant sources. Then, they collected air samples for 36 volatile organic compounds (VOCs), as well as formaldehyde and pentachlorophenol (PCP), a component of one of the carpet adhesives used.

VOC samples were analyzed by gas chromatography-flame ionization detection (GC-FID). Formaldehyde samples came from passive monitors

set up in selected areas of the school. Results from the study appear in Table 6.

Investigators found no significant concentrations of VOCs, formaldehyde levels well below ASHRAE guidelines, and PCP levels at the limit of detection.

This study concluded that no chemical contaminants existed in concentrations sufficient to cause adverse health effects among faculty or students. Investigators recommended measures to deal with elevated CO<sub>2</sub> levels, but felt these were not responsible for the fainting episodes.

### Third Study

Edward Light, Pathway Diagnostics, Reston, Virginia, conducted the third and final IAQ investigation. The strategy in this study was to review building records, interview key individuals, investigate health complaints, evaluate mechanical systems, conduct a visual inspection and air sampling.

The air sampling consisted of tests for temperature, relative humidity, CO<sub>2</sub>, and carbon monoxide. Sampling also included suspended respirable particulates, combustible gases, and VOCs. The investigators also tested bulk carpet samples for potential VOCs.

This investigation found higher CO<sub>2</sub> levels than previous studies, but still found the highest levels in those rooms where occupants had changed ventilator settings. Further studies found the building to be at negative pressure relative to the outside, which meant it was drawing in air. The building is designed to be at positive pressure relative to the outside.

Temperature and relative humidity readings showed the building to be generally within the comfort range for the majority of occupants. Temperatures ranged from 64°F to 74°F, with relative humidity between 57% and 70%.

The study also showed systems to be clean and well-maintained, with some minor problems. VOC sampling ruled out any offgassing of contaminants from new or old sources within the building. Sampling also found no evidence of CO, ozone, or combustible gases.

The investigation concluded that it had detected no airborne health hazards at the school and that the air quality was comparable to that found in many other school buildings. It also failed to detect any link between environmental factors and the fainting spells.

### Epidemiological Survey

Epidemiologists from the Virginia Department of Health began their investigation in March 1991. With the cooperation of two federal agencies, they prepared a questionnaire for all students at the school.

On May 31, faculty members administered the questionnaire to all students who were present. Several students who had been out of school because of fear of the fainting episodes were allowed to complete the questionnaire later that day at another location.

Health complaints at the school were categorized in three ways:

- Fainting: an individual who had fainted either at school or both at and away from school and had no history of fainting prior to January 1990.

Table 6— Air Sample Results from Second Investigation

Location	GC-FID Screen	Total Hydrocarbons (in mg/m <sup>3</sup> )	Formaldehyde (in ppm)	PCP (in mg/m <sup>3</sup> )
Main Office	ND	<0.44	0.02	<0.27
Gymnasium	ND	<0.44	—	—
Room 012	ND	<0.58	—	—
Room 029-B	ND	<0.56	<0.01	<0.027
Room 188	ND	<0.58	—	—
Room 201	—	—	—	<0.029
Room 208	ND	<0.042	0.01	—
Room 275	—	—	0.02	—
ND = None detected				

Source: Fairfax County Health Department

- **Lightheadedness:** an individual who had experienced lightheadedness or dizziness either at school or both at and away from school, without having similar symptoms before January 1990.
- **Headache:** an individual who had experienced more than two headaches each month, of which the majority occurred on weekdays.

## Results

Of the 2,152 students registered at the school, 1,918 returned questionnaires. After researchers eliminated those with multiple answers or contradictory answers, 1,887 remained in the study.

Approximately 21% of the students felt they experienced illness attributable to the building, while 46% did not. The remainder were unsure.

Less than 1% of the responders (17) met the definition for fainting. Of these, 16 were female and 15 were Caucasian. Investigators determined that cases did not differ from noncases in numerous important characteristics, although they were significantly more likely to report asthma, hyperventilation, and migraine headaches.

The study was unable to detect any difference in stress levels between the fainters and nonfainters over academic concerns, nor was there an association between self-perception and fainting.

Sixteen percent, or 289 students, met the definition for lightheadedness. Cases were generally similar in many characteristics to noncases. However, cases were more likely than noncases to be aware of other students suffering lightheadedness and were more likely to know someone who had fainted. Those reporting lightheadedness were also more likely to report other symptoms and to complain of inadequate air movement at the school.

Of the students who responded, 34% (616) met the definition for headache. Most (64%) were female and were more likely than noncases to be aware of others suffering symptoms. Cases were also more likely to report dissatisfaction with the school environment.

## Analysis

Epidemiologists concluded that environmental toxins generally do not affect a particular gender, age, or race. Yet the fainting episodes at the high school did affect a disproportionately high number of females.

Also, the researchers noted that if a toxin were involved, they should have expected to see a dose-response effect. However, there was no increase of symptoms in those who spent more time in the school than the others.

This, coupled with the other environmental studies, led them to rule out an environmental toxin and to form other hypotheses. One of these hypotheses was mass psychogenic illness.

Noting that this type of diagnosis is often one of exclusion — considered after all other causes have been ruled out — they did list a set of specific characteristics associated with this phenomenon:

- Preponderance of illness in girls or women;
- Occurrence in adolescents or pre-adolescents;
- Presence of hyperventilation or fainting;
- Absence of laboratory results or physical findings of an organic cause;
- Relapses of illness in the setting of the original outbreak;
- Benign morbidity, often with rapid spread followed by rapid remission of symptoms; and
- Evidence of unusual physical or psychological stress.

These are not criteria that must all be met, but merely guidelines to aid in identifying outbreaks. The researchers decided that the fainting episodes at the high school met enough of the characteristics to be classified as mass psychogenic illness.

With the end of the school year, the fainting episodes ceased and since 1991 there have been no more such outbreaks at the school.

## Discussion

Mass psychogenic illness is often a fall-back adopted by people unable to easily find a cause for illness in a building. However, thanks to extensive IAQ investigations and dogged epidemiological work, this seems to be a clear-cut case of the phenomenon.

One thing that may have led to the continuation of the outbreak was the fact that fainting episodes were treated as medical emergencies. School officials summoned rescue squads, which almost always found the victims conscious and alert. However, the scenario that unfolded may have sparked the other faintings. Some observers who were on the scene told **IAQU** that it was not

unusual, on some occasions, to see numerous ambulances lined up outside the school building.

Extensive media coverage may have heightened anxiety over the situation and could have possibly led to the episodes spreading to other students.

The situation was also most likely exacerbated by the parents' and students' uncertainty over the environmental situation at the school, despite the inability of investigators to find an

environmental cause. Perhaps better risk communication at the very beginning, along with a more measured response to individual incidents, would have alleviated this aspect.

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## NEWS AND ANALYSIS

### OSHA Prepares for Hearings on Proposed IAQ Regulation

The US Occupational Safety and Health Administration (OSHA) is gearing up for what are expected to be lengthy hearings this summer on the agency's proposed rule to govern IAQ in the nonindustrial workplace (see *IAQU*, April 1994).

The informal hearings will begin July 12 and are currently scheduled to run through July 26, although that could be extended if enough witnesses want to testify. Prospective witnesses have until June 20 to file their notice to appear, while others wishing to comment have until June 29 to submit their remarks.

Many organizations and trade groups are in the process of preparing their remarks. A spokesperson at the Building Owners and Manager's Association (BOMA) told *IAQU* in late April that the organization was "putting the finishing touches" on that group's response.

Thomas McChesney, BOMA president, has criticized OSHA's approach for falling short in efforts to prevent IAQ problems, while putting too much emphasis on a regulatory approach and record-keeping requirements. BOMA, which represents the commercial real estate industry, fears that its members will feel the brunt of the proposal.

Even before the OSHA proposal, BOMA had urged a total ban on smoking in the workplace as a way to eliminate at least one source of indoor air pollution. However, even in supporting that initiative, BOMA stressed that the burden of compliance shouldn't fall on the building managers.

The OSHA regulation, as written, places the onus of IAQ compliance on the employers, but BOMA feels that the burden inevitably will be shifted to building owners and managers be-

cause most of the activities involved in ensuring adequate IAQ fall within that domain.

#### *History*

OSHA's action in proposing the rule came from a longtime effort, spurred mainly by anti-smoking groups, asking the agency to limit smoking in the workplace.

In 1987, three public interest groups petitioned OSHA to issue an emergency temporary standard to prohibit smoking in most indoor workplaces. In September 1989, OSHA denied that petition, claiming that the data didn't support such an action.

The following month, Action on Smoking and Health (ASH) filed a suit in the US Court of Appeals for review of the denial. In May 1991, the court denied the appeal.

In September 1991, OSHA issued a request for information (RFI) on indoor air quality problems in an effort to determine what was necessary in the way of IAQ regulations. The agency asked for comments on:

- Health effects attributable to poor IAQ;
- Ventilation systems performance;
- Exposure assessment; and
- Abatement methods.

Following the RFI, OSHA received more than 1,200 replies, comprising some 17,000 pages. OSHA reports that about 75% of the respondents indicated support for IAQ regulations. Of those, 21% were explicitly in favor of a regulation on environmental tobacco smoke (ETS), more than 41% favored overall IAQ regulation, and approximately 13% favored a combined regulation.