HETA 96-0012-2652
Brigham and Women's Hospital
Boston, Massachusetts

Melody M. Kawamoto, M.D., M.S.
Eric J. Esswein, M.S.P.H., C.I.H.
Kenneth M. Wallingford, M.S., C.I.H.
Karen A. Worthington, M.S., R.N.

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, technical and consultative assistance to Federal, State, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Melody M. Kawamoto, M.D., M.S., Eric J. Esswein, M.S.P.H., C.I.H., Kenneth M. Wallingford, M.S., C.I.H., and Karen A. Worthington, M.S., R.N. of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). E. Lee Petsonk, M.D., of the Division of Respiratory Disease Studies, also contributed to the report. Field assistance was provided by Lynne E. Pinkerton, M.D., M.P.H., Barbara L. Jenkins, and Jenise Brassell. Other assistance was provided by Toni Alterman, Ph.D., Bruce P. Bernard, M.D., M.P.H., Marian E. Coleman, Linda M. Goldenhar, Ph.D., James W. Grosch, Ph.D., Joseph J. Hurrell, Ph.D., Soo-Yee Lim, Ph.D., Leslie A. MacDonald, M.M.S., Patricia C. McGraw, Elaine Moore, Mitchell Singal, M.D., M.P.H., and Allison Tepper, Ph.D. Desktop publishing by Patricia C. McGraw.

 Single copies of this report will be available for a period of three years from the date of this report. To expedite your request, include a self-addressed mailing label along with your written request to:

NIOSH Publications Office
4676 Columbia Parkway
Cincinnati, Ohio 45226
800-356-4674

After this time, copies may be purchased from the National Technical Information Service (NTIS) at 5825 Port Royal Road, Springfield, Virginia 22161. Information regarding the NTIS stock number may be obtained from the NIOSH Publications Office at the Cincinnati address.

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Health Hazard Evaluation Report 96-0012-2652
Brigham and Women's Hospital
Boston, Massachusetts
September 1997

Melody M. Kawamoto, M.D., M.S.
Eric J. Esswein, M.S.P.H., C.I.H.
Kenneth M. Wallingford, M.S., C.I.H.
Karen A. Worthington, M.S., R.N.

EXECUTIVE SUMMARY

In 1995, the Massachusetts Nurses Association (MNA) asked the National Institute for Occupational Safety and Health (NIOSH) to conduct a health hazard evaluation at Brigham and Women's Hospital (BWH), a large teaching hospital in Boston, Massachusetts. MNA, which represents BWH staff nurses, reported that many BWH nurses had developed health problems such as skin and respiratory irritation, asthma, latex allergy, and sensitivity to chemicals. The nurses were concerned that these health problems were related to poor indoor air quality (IAQ) in the Patient Tower and in the Center for Women and Newborns (CWN, a new BWH building adjacent and connected to the Patient Tower). Some of the nurses hypothesized that, around March 1993, an event (e.g., a chemical spill or leak) happened within the Patient Tower, contaminating the indoor environment.

Poor IAQ had been documented in the Patient Tower since 1987, during a BWH investigation of a small 1986-1987 cluster of adult epiglottitis and supraglottitis among employees on Patient Tower floor L1. During the 1987 investigation, L1 employees reported eye and upper respiratory irritant symptoms. Between 1988 and 1993, occupational and environmental health consultants documented sources of potential air contaminants and ventilation system deficiencies that could have contributed to poor IAQ on L1. Several investigators attributed L1 employees' health problems to poor IAQ. Beginning in 1993, similar problems on Patient Tower floor 12 triggered additional investigations.

Because of the complex nature of indoor environmental quality (IEQ) problems in general and the added complexities in a hospital undergoing major transitions (e.g., construction, renovation, merger, and reorganization) as well as the many changes in personnel and programs dealing with IEQ, we used a multifaceted approach to address the many issues raised by the request and during our investigation. Our activities included the following: (1) Reviews of reports of previous occupational and environmental health investigations. (2) Site assessment, including an industrial hygiene walk-through evaluation. (3) Interviews with current and former employees; BWH administrators, managers, and consultants; employees' health care providers; and employees and contractors responsible for BWH facilities. (4) Reviews of OSHA Logs and Summaries of Occupational Injuries and Illnesses, information from workers' compensation files, and logs of the BWH case-manager triage system. (5) Assessment of BWH return-to-work guidelines. (6) Assessment of BWH construction and renovation practices.

We found an overall consistency among previous investigators' observations about ventilation systems, workplace exposures, reported health problems, and organizational and communication issues. They

documented indoor and outdoor sources of potential air contaminants and major ventilation system deficiencies that could have contributed to poor IEQ in the Patient Tower. They reported that a large number of employees were experiencing health problems or discomfort in the workplace. However, in general, previous investigators noted that IEQ problems at BWH could not be explained by a single specific exposure event. For some BWH employees, symptoms were consistent with specific documented workplace exposures, such as latex or glutaraldehyde. For other employees, the relationship between symptoms and work exposure was less clear. Previous investigators reported that significant communication problems between management and employees probably led to misunderstandings and distrust, and contributed to IEQ problems. They also reported that significant organizational problems, such as the lack of consistency and coordination among BWH departments handling IEQ problems, probably hampered resolution of IEQ problems.

Our assessment of the IEQ problems that existed before our visit is consistent with those of previous investigators. Examination of the workers' compensation information showed that employees began making claims for IEQ-related illnesses before the spring of 1993, and that workers' compensation claimants worked in different areas of the hospital. This information does not support the hypothesis that a single exposure event in 1993 was responsible for the increased number of illnesses among employees. In addition, claimants had a variety of diagnoses, which suggests that the illnesses were not related to a single cause. Our examination of workers' compensation diagnoses confirmed previous investigators' findings that some employees had symptoms that could be directly related to specific workplace exposures, such as latex and glutaraldehyde. The workers' compensation data also confirmed that, for other employees, the relationship between a diagnosis and a specific air contaminant was less clear. These findings were also supported by information from our interviews with current and former employees. In our interviews with managers, staff, and consultants, we confirmed the organizational and communication problems reported by previous investigators.

By the time of our initial site visit, BWH had already started implementing aggressive programs to correct IEQ problems and to respond to employees' concerns. The more successful programs included the following: (1) Removal of environmental dust to control employees' exposures to natural rubber latex protein. (2) Removal, substitution, containment, or use of appropriate exhaust ventilation to limit exposures to substances that could affect employees' health. (3) Implementation of appropriate work practice policies and use of engineering controls to prevent air contaminants from construction and renovation projects from entering occupied areas. Programs to address employees' concerns, such as efforts to improve communication, were not as successful. Some programs raised additional employee concerns that probably exacerbated the IEQ problem. For example, the case-manager triage system for handling IEQ incidents raised employee concerns about the potential for conflict of interest on the part of examining physicians, and the possibility that confidentiality of their medical records was not being maintained.

In summary, our investigation documented that some BWH employees had health problems that could be explained by specific workplace exposures. Other employees, however, had diagnoses or symptoms that could be explained by a variety of factors, some of which could be work-related. Over the past two years, the number of workers' compensation claims for IEQ problems appears to have decreased. This decrease could be the result of major improvements to the ventilation systems and the control of sources of potential air contaminants. However, these measures to eliminate or reduce exposures to air contaminants in the work environment have not completely eliminated employee reports of problems. This suggests that air contaminants might not fully explain the IEQ problem, and that other contributing factors may be involved. The major organizational and communication shortcomings that we and others found at BWH probably contributed to misunderstandings about workplace hazards and employee illnesses. These shortcomings probably also contributed to anger, frustration, lack of trust, and worry among employees. The resultant lack

of meaningful dialogue and information exchange between employer and employees was not conducive to solving problems.

Issues related to workplace IEQ problems are complex and can be affected by many different factors. Factors such as ventilation systems and sources of air contaminants are tangible and, thus, more easily identified and corrected. BWH appears to have successfully addressed and corrected these tangible problems. On the other hand, intangible problems, such as those related to organization and communication, are less easily identified, and thereby, less easily addressed. We cannot provide specific prescriptions for organizational and communication problems because these issues are affected by a multitude of factors which are specific to each workplace and can change over time. However, resolving organizational and communication problems may be important to the resolution of IEQ problems. Therefore, addressing organizational and communication problems should be a priority. This is a difficult task that will require collaboration between employer and employees. Recognition of the multifaceted nature of the problems and clarification of issues and points of view are important to the process. All parties should recognize that short-term resolution is probably unrealistic, and that a long-term dynamic process may be necessary. The process would best be facilitated by a mutually agreed upon independent consultant who is familiar with organizational and communication issues.

KEYWORDS: Standard Industry Code (SIC) 8062, General Medical and Surgical Hospitals, hospital, latex, building, ventilation, construction, renovation, indoor environmental quality, indoor air quality, chemical sensitivity, organization, communication, return to work

TABLE OF CONTENTS

INTRODUCTION

The Request

In 1995, the Massachusetts Nurses Association (MNA) asked the National Institute for Occupational Safety and Health (NIOSH) to conduct a health hazard evaluation at Brigham and Women's Hospital (BWH) in Boston, Massachusetts. MNA, a representative of staff nurses, reported that many BWH nurses had developed health problems such as skin and respiratory irritation, asthma, latex allergy, and sensitivity to chemicals. The nurses were concerned that these health problems were related to poor indoor air quality (IAQ) in the Patient Tower and in the Center for Women and Newborns (CWN, a new BWH building adjacent and connected to the Patient Tower).

Some of the MNA nurses hypothesized that, around March 1993, an event (e.g., a chemical spill or leak) happened within the Patient Tower, contaminating the indoor environment. Because ventilation system deficiencies had been documented during previous investigations, they concluded that these deficiencies contributed to the development and persistence of poor IAQ throughout the building. They further concluded that poor IAQ could explain the development and persistence of illnesses among employees. MNA acknowledged that Federal, State, and private occupational and environmental health professionals had conducted multiple IAQ investigations, and that BWH had implemented extensive programs to improve IAQ (e.g., major engineering modifications to the ventilation systems and extensive cleaning of building interior surfaces). However, MNA reported that employees continued to experience health problems. Therefore, MNA nurses were concerned that IAQ problems had not been resolved and that they had not been provided with all the available information. For this reason, MNA asked NIOSH to "identify what happened in early 1993 that could have caused the illnesses experienced by BWH employees and explain why the illnesses have persisted."

MNA reported that over 200 employees were experiencing health problems that they attributed to poor IAQ, up to 100 employees had left the workplace because of these health problems, and approximately 80 employees had filed workers' compensation claims. MNA reported that some nurses became symptomatic during attempts to return to work. MNA stated that nurses who had left the workplace wanted to continue working in their chosen profession but were concerned that poor IAQ in the hospital would continue to affect their health. MNA therefore asked NIOSH to "develop and test guidelines for monitoring employees returning to work from the above illnesses."

MNA reported that employees continue to work in BWH buildings undergoing construction and renovation. The Patient Tower had undergone frequent and extensive renovations throughout its history. At the time of the request for a NIOSH evaluation, the Patient Tower was undergoing renovation and CWN was still undergoing construction. Although some of the recent renovation projects were related to improving ventilation, MNA considered contaminant sources from construction and renovation projects to be contributors to poor IAQ. Therefore, MNA asked NIOSH to "develop guidelines for the safety and health of employees during ongoing construction and renovation projects."

During the course of our investigation, MNA raised additional concerns, which included the following:

- Will previous ventilation system problems, such as the lack of exhaust ventilation for glutaraldehyde in the operating rooms, be documented?
- What was the source of ethylene oxide found in trace amounts on the 12th floor (of the Patient Tower), and how did it get there?
- Was the "deep-cleaning" program for

controlling latex exposures necessary and effective?
- Will reaccumulation of contaminants cause such deep-cleaning programs to be necessary in the future?
- Are current measures to control workplace exposures during renovations effective?
- What future routine inspections and preventive maintenance guidelines should be followed to prevent IAQ problems?
- Are the results of the BWH biological monitoring program for latex and glutaraldehyde really invalid as was reported by the BWH occupational health physician?
- Would nurses with valid work-related illnesses be denied workers' compensation?
- Who is responsible for medical treatment payments before workers' compensation claims are settled?

NIOSH Activities

The primary NIOSH investigators responsible for this health hazard evaluation included an occupational health physician, two industrial hygienists specializing in indoor environmental quality (IEQ), and an occupational health nurse. Because of the complexity of the request, we used a multifaceted approach to address the issues raised by MNA. Our activities included the following:

- Reviews of previous occupational and environmental health investigations
- Site assessment, including an industrial hygiene walk-through evaluation
- Interviews with—
  - Current and former employees
  - BWH administrators, managers, and consultants
  - Health care providers
  - Employees and contractors responsible for BWH facilities
- Reviews of—
  - The Occupational Safety and Health Administration (OSHA) Logs and Summaries of Occupational Injuries and Illnesses
  - Information from workers' compensation files
  - Logs of the BWH case-manager triage system
- Assessment of BWH return-to-work guidelines
- Assessment of BWH construction and renovation practices

In this report of our investigation, we present our findings and recommendations on the issues raised by MNA. When possible, we try to be specific in our recommendations. When we cannot be specific, we provide general guidelines based on occupational health principles.

BACKGROUND

The Hospital

BWH is a major teaching hospital in Boston, Massachusetts. It employs approximately 8,500 full-time employees, of which approximately 1,200 are staff nurses. It also employs a large number of part-time employees. Approximately two-thirds of the staff nurses at BWH were reported to be part-time employees.

The main complex of BWH is a series of interconnected buildings that occupy a city block. The Patient Tower and CWN are located at one end of this complex. BWH also maintains several buildings located in other parts of the city. The Patient Tower is a 16-story building with two lower levels. It was built and occupied since the early 1980s. Throughout its history, the building has undergone renovations that reflect medical, technological, and economic changes in health care and hospital practice. Construction on CWN began in the early 1990s and was still in progress at the start of this investigation. Several patient service units moved into CWN in late 1993. CWN was officially opened in 1994. Table 1 shows the departments occupying the Patient Tower, CWN, and several other BWH buildings during the 1990s.

Hospitals can have multiple organizational structures, which could be related to functional

units (e.g., medical specialty), job title, or labor-management relationships. At teaching hospitals, a structure related to the educational institution would be superimposed over these other structures. At BWH, staff nurses are in the Nursing Department. However, staff nurses are assigned to different units organized by medical specialty (e.g., Surgery, Labor and Delivery, and Cardiac Intensive Care). Staff nurses are also organized in a collective bargaining unit represented by MNA. None of the other BWH employees belong to labor organizations. During this health hazard evaluation, BWH and MNA were undergoing contract negotiations and IAQ issues were said to be on the agenda.

During this health hazard evaluation, BWH was undergoing a merger with another major teaching hospital. The merger was taking place at managerial levels and had not yet affected most hospital operations. However, BWH Employee Health Services and the Safety Department had already been reorganized into the Occupational Health Department (which was still undergoing reorganization) and Environmental Affairs. Changes in these departments had the potential to directly affect issues of employee health and workers' compensation.

Previous Investigations

Poor IAQ had been documented in the Patient Tower since 1987, during a BWH investigation of a small 1986-1987 cluster of adult epiglottitis and supraglottitis among employees on Patient Tower floor L1. During the 1987 investigation, no work-related cause for the cluster was identified, but L1 employees reported eye and upper respiratory irritant symptoms. Therefore, BWH focused its earliest investigations, internal committees, and corrective actions on the operating and recovery rooms, the labor and delivery area, and neonatal intensive care unit (NICU) on L1. Between 1988 and 1993, occupational and environmental health consultants documented indoor and outdoor sources of air contaminants and ventilation system deficiencies that could have contributed to poor IAQ on L1. Several investigators attributed L1 employees' health problems to poor IAQ. Beginning in 1993, similar problems on Patient Tower floor 12 triggered additional investigations, internal committees, and corrective actions. BWH also reorganized Employee Health Services and the Safety Department into the Occupational Health Department and Environmental Affairs. These new departments developed programs to address continuing IAQ problems. One such program was the effort to control employees' exposures to natural rubber latex proteins by removing or cleaning building materials that contained significant amounts of latex proteins in dusts. (Latex proteins are also called allergens because they can cause allergic reactions in sensitized individuals. In this report, we refer to natural rubber latex protein as latex proteins or latex allergens.)

Indoor Environmental Quality

At BWH, the term IAQ referred to problems in the work environment and health problems among workers. This was probably based on conclusions made by occupational and environmental health professionals who had investigated BWH before our involvement. Thus, BWH had used the term IAQ in names for committees, programs, and illness classifications. However, lack of agreement on terminology and definitions for these types of problems have existed in the scientific community for years. This lack of agreement in terminology reflects the lack of consensus about the scientific evidence for the association between poor IAQ and reported illnesses. Terms such as "sick-building syndrome" and "environmental illness" have been used to describe certain health conditions reported by occupants of non-industrial buildings.[1] A typical spectrum of reported symptoms includes headache, unusual fatigue, varying degrees of itching or burning eyes, skin irritation, nasal congestion, dry or irritated throat, and other respiratory irritation. These symptoms do not suggest any particular medical diagnosis. Nor can they be readily associated with any particular

causative agent. Usually, the workplace environment was implicated because workers reported that their symptoms lessened or resolved when they left the building. Although building occupants may attribute their health problems to poor IAQ, thus implying air contamination as the cause, scientists investigating these issues believe that multiple factors may contribute to reports of health problems.[2,3] These factors include ventilation system problems, exposures to multiple chemicals, increased concentrations of airborne dusts, microbiological contamination, and factors that affect comfort, such as odors, temperature, humidity, lighting, and noise.[4,5,6,7,8,9] In some studies, occupant perceptions of the indoor environment were more closely related to the occurrence of symptoms than any measured indoor contaminant or condition.[10,11,12] Other studies have shown relationships between psychological, social, and organizational factors in the workplace and the occurrence of symptoms and discomfort.[13,14,15] Thus, the term IEQ would more accurately describe these factors than the term IAQ.

NIOSH investigators have conducted more than 1,300 IEQ evaluations of non-industrial workplaces. During these evaluations, they have found a spectrum of problems, similar to those described by other researchers. They include poor air quality due to ventilation system deficiencies, overcrowding, tobacco smoke, microbiological contamination, outside air pollutants, or volatile organic chemicals from sources inside the building, such as office furnishings, office machines, or structural components of the building; discomfort related to improper temperature and relative humidity, poor lighting, unacceptable noise levels, or poor ergonomic conditions; and job-related psychosocial stressors. As found by other researchers, most of the reported health effects could not be directly linked to indoor environmental problems.

Less often, a health problem is found to be related to something specific in the building environment. These conditions have been called "building-related illnesses."[2] Examples include allergic rhinitis, allergic asthma, and hypersensitivity pneumonitis, all of which can be caused by certain microorganisms or organic materials; Legionnaires' disease and Pontiac fever, which are caused by *Legionella* bacteria; carbon monoxide poisoning related to vehicle exhaust or inadequately ventilated fuel-burning appliances, such as kerosene heaters; and reactions to corrosion inhibitors in boiler steam used for humidification or released unintentionally.

NIOSH, OSHA, and the American Conference of Governmental Industrial Hygienists have published regulatory standards or recommended limits for occupational exposures.[16,17,18] With few exceptions, pollutant concentrations observed in non-industrial indoor environments fall well below these published occupational exposure limits. Although standards specifically addressing non-industrial indoor environments do not exist, the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) has published recommended building ventilation design criteria and thermal comfort guidelines.[19,20] The ACGIH has also developed a manual of guidelines for approaching investigations of building-related complaints that might be caused by airborne living organisms or their effluents.[21]

Except for strong or unusual sources, or specific contaminants known to cause specific building-related illnesses, measurements for indoor environmental contaminants have rarely been helpful in determining the cause of symptoms and health conditions among occupants of non-industrial buildings. The low concentrations of airborne particles and mixtures of organic materials typically found in such workplaces are difficult to interpret with respect to potential health effects.

The complexity of IEQ issues and unanswered scientific research questions probably contribute to the controversy about IEQ. For these reasons, all the questions about cause and effect raised by MNA cannot be easily answered.

METHODS

Because of the complex nature of IEQ problems in general and the added complexities in a hospital undergoing major transitions (e.g., construction, renovation, merger, and reorganization) as well as the many changes in personnel and programs dealing with IEQ, we used a multifaceted approach to address the many issues raised by the request and during our investigation. Our activities, which are described more fully in this section, included the following:

- Reviews of reports of previous occupational and environmental health investigations
- Site assessment, including an industrial hygiene walk-through evaluation
- Interviews with—
  - Current and former employees
  - BWH administrators, managers, and consultants
  - Health care providers
  - Employees and contractors responsible for BWH facilities
- Reviews of—
  - OSHA Logs and Summaries of Occupational Injuries and Illnesses
  - Information from workers' compensation files
  - Logs of the BWH case-manager triage system
- Assessment of BWH return-to-work guidelines
- Assessment of BWH construction and renovation practices

We use the term IAQ only when it was used by others, such as BWH, MNA, consulting occupational and environmental health professionals, and physicians. As previously discussed (Background), the term IAQ does not reflect the complexity of the sources of problems within buildings. Therefore, we use the broader term, IEQ, which includes all the factors in a building's environment that could affect occupants' health.

We include a glossary of terms and abbreviations in Appendix A.

Previous Investigations

Since 1987, a number of occupational and environmental health professionals, including physicians, industrial hygienists, epidemiologists, and environmental engineers, conducted investigations to address the concerns of BWH employees. Investigators included BWH personnel and consultants, an MNA consultant, and Federal and State occupational safety and health personnel. We abstracted conclusions and recommendations from reports and reviews of these investigations (Appendix B). These abstracts include the earliest investigations, which occurred in the lower levels of the Patient Tower. We also reviewed activities and issues about Patient Tower floor 12, which was the focus of many investigations, evaluations, meetings, programs, and clean-up efforts. We reviewed information from these documents, along with information from other sources, to address issues and concerns and to answer questions raised by MNA and staff nurses. We also used the information to create a chronology of events related to IEQ at BWH (Figure 1).

NIOSH Site Assessment

As early as 1987, previous investigations at BWH had identified a number of problems involving the building's ventilation systems. Several investigators' reports had noted the generation and release of contaminants from sources within and outside the building. These contaminants were identified as known contributors to a variety of IEQ issues. We were therefore interested in determining the current status of these previously identified problem sources, such as the potential for entrainment of outdoor air pollutants, the current condition of building ventilation systems, and the status of previously identified inadequately vented local exhaust systems. We made our first site visit to BWH on March 5-7, 1996. At that time, we conducted a site assessment, which included a walk-through evaluation of the Patient Tower and CWN

buildings. We were accompanied by the BWH Director of Environmental Affairs, the BWH Director of Indoor Air Quality, MNA representatives, the BWH Director of Nursing, and the BWH Vice President of Nursing.

Our objectives during the walk-through evaluation included the following:

- Familiarize ourselves with the layout of the building
- Evaluate the condition of the ventilation systems including—
  - Building make-up air intakes and building exhausts
  - Centrally-located heating, ventilating, and air conditioning (HVAC) systems
  - Unitary HVAC systems
- Visually inspect any construction and renovation activities in progress
- Visually inspect any engineering controls installed for controlling sources of air contaminants
- Evaluate the presence of any sources of air contaminants within the building
- Evaluate the general condition of the building and nursing work areas

We began the walk-through evaluation on floor fourteen of the Patient Tower. This floor had a typical configuration in terms of floor and patient bed layout and ventilation system for the patient service and core areas. We surveyed the patient care areas, the nursing station and the core area for this floor. We proceeded to floors that MNA had identified as problem areas (L1, 8, and 12) and also stopped on other floors selected by MNA and BWH for comparison. We inspected renovation areas on the 9th floor to observe construction and renovation practices and visually assess measures to control construction dusts. We visually inspected unitary HVAC systems (induction units) in randomly selected patient rooms. We continued through the mezzanine between the 6th and 7th floors where a number of central HVAC systems were located. Air handling units AC-1-AC-4 in this area serve the patient rooms and air handling units AC-5 and AC-6 serve the core areas of the building. In the L1 operating rooms, we visually inspected ducting intended for exhausting effluents from the Exomat machines and Steris sterilizers. We also toured several CWN floors and the helipad construction site on CWN (where the BWH Director of Environmental Affairs pointed out the location of proposed controls for jet exhaust).

NIOSH Interviews

We conducted interviews with individuals who were familiar with health and safety concerns at BWH. The individuals we interviewed included current and former employees, health care providers who had examined BWH employees, BWH administrators, managers, and consultants, and BWH staff and contractors responsible for BWH facilities. We describe our interview methods below.

Employee Interviews

On-site interviews

We conducted employee interviews at the workplace on June 15-16, 1996. Our purpose was to determine the current status of IEQ problems at BWH and to gain insight into current health problems among all employees. We selected building floors on the basis of frequency of reported problems. We asked MNA and BWH to identify floors with the highest frequency of symptom reports and floors with the lowest frequency of reports. Patient Tower L1, 8, and 12, and CWN 5 were identified as high-reporting floors, while Patient Tower floors 6, 7, and 14 were identified as low-reporting floors. Three NIOSH occupational health professionals conducted 75 on-site employee interviews over one-and-a-half days. On each of these floors, we interviewed employees randomly selected from daily staffing schedules which had been stratified by job title. The interviews were voluntary and were conducted in private rooms on the floors

where employees worked. Because BWH provided "floats" to cover nurses being interviewed, interviews were not constrained by the urgent need for an employee to perform work duties. The interview focused on the employee's health and how the employee related his or her health condition to the work environment, observations of changes in the work environment, and individual concerns. Table 2 shows the distribution of interviewed employees by job title and floor.

Off-site interviews

MNA provided us with lists of 264 employees who were reported to have health problems related to IAQ; 177 (67%) of the 264 were nurses and 103 (58%) of the 177 were not currently working. MNA was able to provide telephone numbers for most of the 177 nurses listed, but only a few for the 87 non-nursing employees. Our attempts to find additional non-nursing employee's telephone numbers were only partially successful.

Because of time constraints, we were unable to interview all employees on the MNA lists. To assure that employees from each floor were represented, we categorized employees by floor, then selected a random sample from each floor. We telephoned selected employees to ask for their voluntary participation in face-to-face interviews outside the workplace. On July 17 and 19, 1996, three NIOSH occupational health professionals conducted the interviews at a location outside the workplace that was convenient to both working employees and inactive employees. A total of 33 employees participated in these interviews. Participants completed a short questionnaire on specific health and work issues just before the interview. The 30- to 45-minute interview primarily focused on the employee's concerns about personal health and what the employee considered work-related hazards. Three additional employees were interviewed by telephone at a later date. Table 3 shows the demographic characteristics of the interviewed employees.

The employees we interviewed outside the workplace cannot be considered a representative sample of the workforce because they were known to have health problems that they attributed to their workplace and were mostly staff nurses. Therefore, we cannot assume that the experiences of these employees reflect the experiences of other employees. However, we felt that understanding and addressing their concerns was an important aspect of our investigation.

Other Interviews

After reviewing the numerous reports of occupational and environmental health investigations at BWH before our involvement, we had questions that would have been best answered by these earlier investigators and by health care providers who had evaluated BWH employees. Therefore, in addition to the employee interviews, we conducted interviews with numerous individuals, including—

- BWH and MNA representatives
- BWH managers and supervisors
- Health care providers of BWH employees, including specialists in allergy, otolaryngology (ear, nose, throat), pulmonology (lungs), cardiology (heart), neurology (nervous system), and infectious diseases, as well as in occupational health
- Occupational health professionals, including occupational epidemiologists and industrial hygienists, who had previously conducted investigations at BWH
- Management consultants who BWH retained to assist with issues related to IEQ

During these interviews, we asked for background information that might not have been included in the documents available to us. We also asked for clarification about issues raised in the documents we reviewed. These issues included rationale for medical diagnoses, organizational structure and function, and communications. We also asked questions raised by MNA and staff nurses about BWH programs and previous investigations.

These included questions about whether ethylene oxide was found in air samples from Patient Tower floor 12 and about the interpretation of results from a BWH biological monitoring program for latex and glutaraldehyde exposures.

Review of Health Records

We collected information from BWH, MNA, and other sources to document the types of illnesses reported and when and where they had occurred. We primarily looked at the following information sources:

- OSHA Logs and Summaries of Occupational Injuries and Illnesses
- Logs of IAQ incidents reported to the case-manager triage system set up by BWH
- Workers' compensation claims

We also attempted to obtain information from the BWH Occupational Health Department database. However, we did not use information from this source because the data was not easily retrievable in a useful format.

OSHA Logs

OSHA regulations [29 CFR 1904][22] require employers to record work-related injuries or illnesses on OSHA logs. Recordable illnesses are those "which result in fatalities, . . . lost workday cases, . . . [or] nonfatal cases without lost workdays which result in transfer to another job or termination of employment, or require medical treatment (other than first aid), or involve loss of consciousness or restriction of work or motion. This category also includes any diagnosed occupational illnesses which are reported to the employer but are not classified as fatalities or lost workdays." The forms ask for date of illness, employee's name, job title, department, and brief description of illness. Illnesses are classified into the following categories:

- Occupational skin disease or disorder
- Dust disease of lungs
- Respiratory conditions due to toxic agents
- Poisoning (systemic effects of toxic materials)
- Disorders due to physical agents
- Disorders associated with repeated trauma
- All other occupational illnesses

BWH provided us with OSHA logs from January 1991 through November 1995. We reviewed the logs for illnesses that might have been related to poor IEQ. According to BWH, employees who claimed IAQ-related illnesses could have been listed in any of the recordable illness categories except disorders associated with repeated trauma. Because the OSHA logs did not distinguish IEQ-related from IEQ-unrelated illnesses, we included all recorded illnesses except disorders associated with repeated trauma. We understood that this could result in an overestimate of the numbers of employees claiming IAQ-related illness.

We looked at illness classifications by year and, to the extent possible, by job classification or work area. In a large workplace such as BWH, some departments (e.g., Nursing and Environmental Services) are located in more than one work area (e.g., different floors or pods). In addition, some job titles (e.g., staff nurse) didn't differentiate work in different departments (e.g., Nursing, Blood Donor, Labor and Delivery). Therefore, classifications by department or job title were not particularly useful until BWH began entering floors and pods on the logs in 1995. Even then, floor numbers were not consistently used. Some work areas were identified by building name, floor, and pod. Others were identified by department name.

IAQ Encounter Logs

On July 10, 1995, BWH initiated a case-manager triage system to handle a possible increase in volume of reported IEQ incidents upon the reopening of Patient Tower floor 12 after extensive cleaning to remove potential sources of employees' exposures to latex allergens. Employees from other floors also had the option

of entering this triage system. Nurse practitioners staffing the system kept logs of their encounters with employees. For each encounter, case managers recorded the date of encounter, employee's name, work area (e.g., floor and pod), symptoms, what was done during the encounter, and where the employee was sent after the encounter. In late August 1995, case managers began recording the employee's job title and previous contact with the triage system. In September 1995, case managers began coding reported symptoms. They grouped symptoms into the following categories:

- Lightheadedness or dizziness
- Difficulty concentrating
- Visual changes
- Headache
- Eye irritation
- Throat irritation
- Ear, nose, or throat symptoms, sinus pressure or pain
- Chest tightness
- Difficulty taking a full breath or shortness of breath
- Palpitations
- Cough or wheezing
- Nausea
- Itching
- Rash or hives
- Fatigue
- Flushing or diaphoresis (sweating)
- Tingling or numbness
- Other

BWH provided us with copies of IAQ encounter logs dating from July 10, 1995, when the system began, through March 31, 1996. We compared these logs with the OSHA logs, and looked at the numbers of encounters by month and work area. Further analysis was of limited value because the triage system was implemented more than two years after the MNA-identified onset of IEQ problems at BWH. In addition, the logs did not include all employees claiming to have problems related to poor IAQ. Some employees bypassed the triage system and reported directly to the BWH Occupational Health Department or to health care providers outside BWH. The abridged logs that BWH provided to MNA were of little use to us because they excluded information about non-nurses.

Workers' Compensation Claims

Of all available information sources, workers' compensation records held the most complete and relevant information—specifically, diagnosis, but also job title, work area, date of onset of illness, physician making the diagnosis, and work status (Table 4). Although workers' compensation diagnoses were not readily available in computerized form, diagnoses were more easily retrievable than from other sources. All employees who reported health problems might not have filed workers' compensation claims, but those filing claims were likely to be the most seriously ill employees. We felt that examining the characteristics and health outcomes of these claimants might give us some insight into the nature of their problems.

BWH provided us with lists of workers' compensation claims that had been identified as possibly IEQ-related. These included all illness (i.e., non-injury) claims, except those related to repeated trauma. From January 1991 through March 1993, 241 employees filed 253 claims. Because the original lists did not include diagnoses, this information was abstracted from workers' compensation records (which could have contained notes from the BWH Emergency Department, Employee Health Services, or Occupational Health Department), and letters and reports from non-BWH examiners. A BWH Occupational Health Department employee and a NIOSH employee abstracted diagnoses and type of examiners (e.g., claimant's physician, insurer's examiner, impartial examiner). When multiple diagnoses were present, all diagnoses were abstracted. When a final diagnosis was not readily available, the records were reviewed for relevant findings and impressions. A NIOSH occupational physician was available to answer abstracters'

questions about diagnoses. The NIOSH physician also checked abstracts of randomly selected records for accuracy. For 32 of the 241 claimants, BWH also provided reports by physicians who had been appointed by the workers' compensation board to determine whether a claimant's case was related to work. The NIOSH physician abstracted diagnoses from these reports.

Examiners

We had six possible sources for claimants' diagnoses.

- Claimant's physician or personal medical doctor (PMD)
- Physician retained by the BWH workers' compensation insurance carrier (in Massachusetts, called an independent medical examiner [IME])
- Physician or nurse practitioner in BWH Employee Health Services or Occupational Health Department
- Physician in the BWH Emergency Department
- Physician appointed by the workers' compensation board (in Massachusetts, called an impartial medical examiner [IMP])
- A local hospital (not affiliated with BWH), where many claimants had been evaluated

No diagnoses were found for 50 (21%) claimants. The rest of the claimants had diagnoses from one to five examiners. For the 96 (40%) claimants with more than one source of diagnoses, examiners did not necessarily agree on the claimant's diagnoses, diagnostic certainty, or severity of condition. We therefore evaluated diagnostic consistency among examiners by looking for agreement on individual diagnoses by type of examiner—specifically, between the PMD and the IME for 59 claimants, then between the PMD and the IMP for 27 claimants (Table 5). Agreement between PMDs and IMEs was lower (69%) than between PMDs and IMPs (81%).

We also evaluated diagnostic consistency among examiners by looking for agreement among frequencies of diagnoses by type of examiners (Table 6). Almost all diagnostic groups evaluated were reported by all types of examiners. One exception was the absence of diagnoses of chemical sensitivity by IMEs for the 95 claimants they examined. Another was the absence of a determination of "unrelated to work" by the examiners from BWH departments and from the local hospital unaffiliated with BWH for the 135 claimants they examined (grouped as "Other" in Table 6).

Diagnoses

The NIOSH physician's review of a random sample of records and reports indicated that diagnostic criteria, when available, were not necessarily consistent from one examiner to the next, even among a single type of examiner. Generally, diagnostic criteria were not discussed in the records. Therefore, diagnoses were simply abstracted as recorded. For our analyses, we combined diagnoses into the categories described in Table 7. Because we were unable to establish the validity of abstracted diagnoses, we included any diagnosis found in a claimant's records. Because we were also unable to establish diagnostic certainty, we did not differentiate among possible, probable, or confirmed diagnoses.

Because latex is a known occupational health problem among hospital workers[23] and latex allergens had been found during environmental sampling at BWH, we looked at job classifications, other diagnoses, and current work status for claimants with diagnoses of latex allergy. We looked at other diagnoses and current work status for claimants with diagnoses of asthma because of its potential severity and impact on ability to work. We also looked at other diagnoses and current work status for claimants with building- or IAQ-related diagnoses or diagnoses of chemical sensitivity because of the

controversy about these types of diagnoses.

Time

We reviewed the 32 impartial medical examiner reports for lag times between the reported date of symptom onset and the date of illness recorded on the workers' compensation claim, and between this date of illness and the claimant's last work date. The median lag time from the reported date of symptom onset to the recorded date of illness on the claim was 7.5 months, with a range from none (5 claimants) to approximately 4 or 5 years (2 claimants). The longer lag times appeared to be related to early onset of mild symptoms, which claimants had not initially attributed to work. In those cases, the recorded dates of illness appeared to be related to episodes of acute worsening. The shorter lag times appeared to be related to the acute onset of more severe symptoms. For 16 (53%) of the 30 claimants no longer working at BWH, the recorded date of illness and the last work date were the same. For the remaining 14 claimants, last work date was from 1 to 15 months after the recorded date of illness. We also compared lag times between reported date of onset of symptoms and recorded date of illness for claimants whom we interviewed during off-site employee interviews on July 17-18, 1996. Lag times ranged from none to two years.

The differences in lag times from onset of symptoms to recorded date of illness indicated that we would not lose much information by categorizing dates of illnesses into quarter years. This categorization is consistent with the way some interviewed employees had reported the time of symptom onset (i.e., season rather than date).

Job titles

Almost two thirds (152, 63%) of the claimants were staff nurses (Table 8). The other claimants worked in 30 different job titles. For this report, we categorized the job titles into the following job function categories:

- Clinical service providers
- Technicians
- Secretaries or receptionists in clinical service areas
- Office employees
- Employees who work in multiple areas

Work areas

For this report, we used work area information provided by BWH. Because of departmental moves from one floor to another or moves by individual employees, some claimants might have worked in more than one area. The work areas provided by BWH appeared to be the claimants' last work area. For the analyses, we grouped work areas with fewer than 15 claimants into floors or buildings (Table 9). We combined Patient Tower floors 3 and 4 because they were functionally related (i.e., obstetrics) and employees assigned to these floors could have worked on either floor.

Analysis and interpretation

We also compared OSHA log entries with workers' compensation information to estimate the percentage of employees on the OSHA logs who had filed workers' compensation claims. Then we performed descriptive analyses to look at the distribution of diagnostic categories within and across work areas, and also over time. We did not statistically analyze the workers' compensation information for relationships between exposures and health outcomes because claimants did not constitute a representative sample of the workforce and reported exposures were not always documented or documentable. In addition, person-time at risk by work area (denominators necessary for statistical analysis) were difficult to determine for the following reasons:

- Staffing in each work area varies from day to day, depending on patient care load
- Some employees reporting health problems had been removed or reassigned
- Some departments moved because of

construction and renovation
- Schedules for staff nurses vary considerably, from a minimum of 2 days per month to over 40 hours per week

Return to Work

The BWH occupational health physician provided us with copies of the return-to-work decision tree and clinical guidelines for evaluation of occupational illnesses that she had developed. The occupational physician on our evaluation team reviewed it for general principles, and an occupational pulmonary physician at NIOSH reviewed it specifically for its application to employees with work-related asthma and latex allergy. We also interviewed several physicians, including the BWH occupational health physician, about their rationale in making return-to-work decisions. Return to work guidelines are presented in Appendix C.

Construction and Renovation

When BWH employees began attributing some IEQ problems to hospital construction and renovation projects, BWH began modifying standard operating procedures for construction and renovation projects at the hospital to reduce employee reports of problems. Because of these modifications, we could not independently evaluate previous conditions and practices. Therefore, we focused our evaluation on current construction and renovation practices.

We observed construction and renovation projects, reviewed standard operating procedures for construction and renovation projects, and informally interviewed selected hospital employees about construction and renovation practices. During our March 1996 site visit, we observed three currently active construction and renovation projects—the NICU renovation project on Patient Tower floor L-1, the "sleep study" area construction project on Patient Tower floor 9, and the helipad construction project on the CWN roof.

We reviewed standard operating procedures for several of the most recent construction and renovation projects, including those prepared for the helipad project. We also informally interviewed employees from management, nursing, engineering, maintenance, housekeeping, and health and safety, and others involved with construction and renovation activities.

Reference criteria that we prepared for our evaluation of hospital construction and renovation practices are presented in Appendix D. This Appendix also contains good practice guidelines for maintaining acceptable IEQ during construction and renovation projects.

FINDINGS

Previous Investigations

From 1987 to 1996, at least nine investigators (including in-house BWH staff, private occupational and environmental health consultants, and Federal and State occupational health and safety investigators) conducted or reviewed IEQ studies or surveys at BWH (Appendix B). Collectively, these efforts document a history of problems related to health and comfort in specific areas at BWH. In 1987, BWH employees in Patient Tower L1 (where the operating rooms, recovery room, NICU, and radiology and anesthesiology departments were located) reported eye and upper respiratory irritation. From 1988 through 1992, investigators found air contaminant sources and ventilation system deficiencies that could have contributed to IEQ problems on L1. In 1992, employees from the NICU, labor and delivery, and recovery room on L1 were still reporting health problems such as eye irritation and upper and lower respiratory symptoms. Subsequent investigations included an

extensive engineering study of the building's air-handling systems, pressurization differentials in areas of the hospital, and exhaust ventilation systems; and an in-depth industrial hygiene monitoring investigation to identify and characterize releases and exposures to gaseous and particulate air pollutants.

Over the years, investigators have identified a variety of contaminants that could have explained some of the health problems reported by employees. These included environmental tobacco smoke, radiographic developers, waste anesthetic gases, solvents, formaldehyde, glutaraldehyde, latex allergens, and dusts from construction and renovation activities. Investigators also implicated inadequate dilution ventilation (insufficient "fresh" outside air) and entrainment of outdoor pollutants (e.g., volatile organic chemicals and combustion gases) into the building as factors contributing to poor IEQ. They also identified low relative humidity as a possible cause for some employees' discomfort and upper respiratory irritant symptoms. Each report included recommendations to remediate identified problems and improve workplace conditions. However, the reports indicated that BWH had not implemented recommendations for major changes to the ventilation and exhaust systems before mid-1993.

Among the reports we reviewed, we found no evidence to support the hypothesis that the dramatic increase in symptoms among Patient Tower employees in 1993 might have been related to a single or specific event, such as a significant release of a specific or unusual air contaminant. Rather, previous investigators documented multiple problems that could have contributed to employees' health problems. These included major deficiencies in the ventilation systems (e.g., the lack of dilution ventilation, inadequate control of contaminant sources, and re-entrainment of exhausted air back into the building), the potential for several specific exposures (e.g., latex, glutaraldehyde, and waste anesthetic gases), and poor communications with employees about IEQ issues.

Latex

Among the more than 30 reports and letters that we reviewed, many addressed the subject of BWH remediation efforts to control employees' exposures to latex allergens. These efforts included what BWH called "deep cleaning," which included the removal of building materials confirmed to be contaminated by significant amounts of latex allergen-containing dusts. Where removal was impractical or impossible, surfaces were extensively cleaned and vacuumed.

Airborne concentrations of latex allergens in occupied areas monitored by an environmental health and engineering consultant were relatively low. However, contamination of air or surfaces by latex allergens in settled dusts on above- and below-ceiling surfaces was a possibility. Therefore, BWH elected to remove these reservoirs of latex allergens. The scope of work provided to contractors and BWH Environmental Services for implementing the program included the following procedures:

- Initial containment of areas to be cleaned, one pod at a time.
- Removal and disposal of suspended ceiling tiles.
- Replacement of all suspended ceiling panels with new panels.
- Vacuuming and inspection of ventilation ductwork.
- Vacuuming and wet wiping of all above-ceiling surfaces using a high efficiency particulate air (HEPA) vacuum.
- Washing of ceiling gridwork with a trisodium phosphate cleaner.
- Removal of all draperies, trash, and waste from floors.
- Cleaning of furniture and washing of all surfaces, including cabinets, wardrobes, counters, shelves and ledges in each area.

Deep cleaning work began in the fall of 1993 and

continued through 1995. One contractor cleaned Patient Tower floors L1 and L2 (including the operating and recovery rooms) from September through November 1993. Another cleaned pod D of Patient Tower floor 12 in April 1994. A third contractor cleaned other areas of the Patient Tower in August 1995.

The rationale for deep cleaning on Patient Tower floor 12 was documented by results of environmental sampling for latex allergens performed on April 14 and 15, 1995, before deep cleaning, by an environmental health and engineering consultant. Surface sampling was conducted to identify potential sources of employees' exposures to latex allergens in occupied areas. Latex allergens were found in surface samples of above- and below-ceiling environmental dust collected from all 12th floor pods. Latex allergen concentrations in nine above-ceiling surface dust samples ranged from 122,687 nanograms per gram (ng/gm) to 364,034 ng/gm. Latex allergen concentrations in ten below-ceiling surface dust samples collected on the same days ranged from 26,132 ng/gm to 119,221 ng/gm. Two outside reviewers noted this to be a "troubling finding" and recommended cleaning these surfaces.

After deep cleaning, air sampling was conducted to see whether latex allergens had been disseminated. Area air sampling in all 12th floor pods on April 28, 1995, and May 15-22, 1995, showed concentrations of airborne latex allergens ranging from less than 2 nanograms per cubic meter (ng/m^3) (the minimum detectable concentration) to 2.8 ng/m^3. Area air sampling in occupied areas of Patient Tower floor 8 on August 12 and 21, 1995, showed latex allergen concentrations ranging from 2.2 to 5.2 ng/m^3. No occupational health standards or exposure criteria for latex allergen levels in indoor or outdoor air exist currently. BWH uses an in-house action level of 10 ng/m^3.

Subsequent results of on-going surface dust sampling have continued to show latex allergen concentrations at or below the limits of detection for the analytical methods used. For example, all but 1 of 21 above-ceiling surface samples from Patient Tower floors 4-10 and 12-16 collected in June 1996 showed no detectable concentrations of latex allergens. The only sample with a detectable concentration (from pod D of Patient Tower floor 7) showed a latex allergen concentration of 0.15 ng/cm^2. On June 10, 1997, above-ceiling surface sampling was conducted on Patient Tower floor 12 (in the pod A corridor and in pod B) to assess the effectiveness of BWH programs to eliminate sources of employees' exposures to latex allergens. The June 1997 results showed no detectable above-ceiling latex allergens.

NIOSH Site Assessment

During the walk-through evaluation of the hospital in March 1996, we visited a number of locations. In the Patient Tower M1 area (between floors 6 and 7), where air handlers for floors 2 through 16 are located, the mechanical space was clean and well-kept. The air handlers use ducted returns, and the mechanical space was not used as a return air plenum. The outdoor air intake was dry and visually free of debris or microbiological contamination. All the pre-filters and final filters were in place and oriented correctly with respect to air flow. The mechanical space on SL-1 was orderly and clean. Plexiglas enclosures completely surrounded the wastewater pre-treatment equipment to prevent airborne release of water treatment chemicals into the mechanical room environment. This was important because this mechanical space was used as a return plenum. The outdoor air intake plenum for SL-1 is located in a large area below street level. Some areas inside the plenum were damp, but no microbiological contamination was evident. Sump pumps had been installed in low-lying areas to remove any storm water which might accumulate. In two locations of the outdoor air intake plenum area, we found leaves, paper, and debris. We notified the contractor responsible for on-going environmental remediation, and the debris was reportedly removed the following day.

From a general housekeeping perspective, the hospital was clean and orderly. We were informed that BWH had made aggressive efforts to reduce employees' exposures to latex allergens in the hospital, such as implementing an aggressive program to remove environmental dust containing latex allergens throughout 1995 and changing to low-allergen latex gloves in 1994. Powder-free, hypoallergenic latex gloves were available for staff to use throughout the patient care areas of the hospital we visited. BWH also implemented other policies to reduce other sources of employees' exposures to latex allergens, such as prohibiting latex balloons in the hospital.

On one of the Patient Tower floors, we saw a BWH employee using a portable containment booth that was developed for work above the suspended ceiling in areas that had not yet been cleaned. We inspected the booth and observed the employee's work practices. Use of the booth and proper work practice appear to be an effective combination of equipment and technique to prevent disturbed dusts above the ceiling from entering occupied areas. Based on the sampling results of June 1996, in which latex allergens were detected in only 1 of 21 surface dust samples, the Director of Environmental Affairs suggested (in a letter to the BWH Environmental Steering Committee dated September 3, 1996) that use of the portable containment booth would not be necessary in all areas of the Patient Tower, such as the unoccupied core area and surrounding hallways. As a preventative action, he stated that containment would still be required when removing suspended ceiling panels within occupied areas.

Patient Tower floor 9 areas undergoing renovation were under negative pressure according to magnehelic gauges installed outside the doors of areas being renovated. HEPA filtration units were used to maintain negative pressure and contain dusts released during construction and renovation.

On Patient Tower floor 12, additional ductwork and ventilation diffusers had been installed to provide better air mixing and distribution. Thermostats, previously located behind video monitors on the wall, had been relocated to the centers of nursing stations to more accurately monitor the occupied environment and provide more constant temperature control. Variable air volume (VAV) reheat coils had been installed in pods A through D and minimum stops for the dampers on these boxes were adjusted to prevent the VAV boxes from closing completely.

On Patient Tower floor L1, the operating room area was confirmed to be operating under positive pressure, as confirmed by the magnehelic gauges installed outside the operating rooms. New exhaust ductwork for the radiographic developer had been installed on the Exomat machines. The hood which formerly exhausted glutaraldehyde directly into the plenum above the operating rooms was no longer in service. Glutaraldehyde was no longer used in the area, and a new slot hood and exhaust system was being designed for later use. The Steris sterilizers now have a dedicated exhaust ventilation system. The chemical storage cabinets were also exhausted separately. We noted the use of portable HEPA filtration/charcoal adsorption units in the recovery area. BWH Environmental Affairs had installed these units as an additional control for any fugitive waste anesthetic gases exhaled by patients

NIOSH Interviews

Employee Interviews

On-site interviews

Health experience

About half (53%) of the 75 randomly selected employees interviewed in the workplace reported health problems that they attributed to poor building air quality (Table 10). The difference in prevalences between the high reporting floors (55%) and the low reporting floors (50%) was not statistically significant ($p>0.01$). Most of the

reported health problems from both low- and high-reporting floors were nonspecific symptoms (e.g., upper respiratory irritation, headache, dizziness) that could be related to any of a number of causes or aggravating factors. There were no statistically significant differences ($p>0.01$) between the high-reporting floors and the low-reporting floors in the percentage of people reporting each problem.

Employee observations about the hospital's response

Many interviewed employees on both high- and low-reporting floors recognized that BWH had done much to improve building air quality. They were aware of the environmental notification-and-response systems, the decreased usage of chemicals in the workplace, the switch to non-powdered gloves, the ban on balloons, and the ban on mixing medications on patient floors. They felt that BWH Engineering Services had been responsive to their concerns and noted that "air flow" in problem areas had improved. Employees, especially those on low-reporting floors, expressed the opinion that BWH had done everything that could have been done.

However, a number of employees felt that BWH did not begin addressing their problems until doctors were affected or until MNA increased pressure for administrative action. They also criticized BWH Employee Health Services and the Occupational Health Department for inconsistency of care, lack of follow-up, and poor treatment of employees reporting problems. Many expressed a lack of confidence that they would ever be told the cause(s) of their problems.

Employee concerns and expectations

Interviewed employees from low- and high-reporting floors expressed similar concerns and expectations. Their concerns included—

- The possibility of effects on their future health caused by past or current building air quality problems.
- The lack of knowledge about the cause(s)of the problem. For example, if the source has not yet been identified, how can employees be certain that it doesn't exist any more?
- Uncertainty about whether the problem will continue or recur with on-going building construction and renovation.
- The lack of job security for employees reporting health problems related to poor IAQ.
- Inconsistency in how compensation cases are handled.
- The ability of the ventilation systems to provide uncontaminated and adequate "fresh" outdoor air to work areas where employees have no control over air supply. For example, employees could not open windows to let in outside air.

Their expectations included—

- Questions about building air quality should be answered. For example, what was the problem? What was done to correct it? Will past and current air quality problems affect employees' health in the future? Were the results of blood tests for exposures to latex and glutaraldehyde valid?
- Employees should be able to control the air supply intake and be allowed to open windows.
- The environment should be fragrance-free.
- The environment should be latex-free.
- Air quality and employee health should continue to be monitored.

Off-site interviews

Health experience

Employees interviewed outside the workplace reported a variety of health problems (Table 11) that were similar to problems reported during the workplace interviews (Table 10). Generally, employees who no longer worked at BWH reported more severe or more persistent problems. They described the negative impact of their illnesses on their lives. Some had severely limited their daily activities, including activities with

family and friends, because of symptoms they experienced in environments they could not control. Several reported respiratory distress at home that, on occasion, required emergency medical care. Therefore, many avoided exposures that could trigger symptoms, such as allergens and many chemicals, including fragrances. Some had changed their diet and started taking dietary supplements. Some, especially asthmatics or those with asthma-like symptoms, were on medicines to control their symptoms. Most were currently under the care of health care providers, such as internists, pulmonologists, allergists, and physicians specializing in the environmental illnesses.

Several employees described a pattern of illness that they attributed to workplace exposures. Early symptoms included headache, cough, shortness of breath or wheezing. Later, these symptoms were accompanied by rash or hives and heart palpitations. Symptoms appeared during work and disappeared only after leaving the workplace. Eventually, symptoms took longer to resolve, sometimes requiring a long weekend or longer vacations. Initially, symptoms began only at work. But later, some interviewees reported that they experienced the same symptoms outside the workplace.

Employee observations about the hospital's response

Most of the employees interviewed outside of the workplace felt that BWH should have responded to their health problems and concerns about IAQ much earlier. They believed that BWH did not provide satisfactory information to employees. They also reported inconsistent handling of their problems by BWH Employee Health Services and, later, by the BWH Occupational Health Department. They recognized the amount of attention and money given to the construction and renovation of buildings, but felt that BWH ignored employees experiencing problems. Employees, especially those who had been with BWH for many years, expressed a sense of abandonment by their employer. They consistently reported problems in dealing with the BWH personnel and workers' compensation systems. Problems included terminations, the lack of availability of accommodation on return to work, difficulties in obtaining medical records, the ambiguous status of some workers' compensation claims, and the inconsistency of workers' compensation decisions. Some employees were pursuing vocational rehabilitation and retraining to find work outside the hospital setting. However, many wanted to continue working at BWH and felt that BWH should have done more to place them in other jobs within the hospital.

Employee concerns and expectations

Although employees interviewed outside the workplace had concerns and expectations similar to those of employees interviewed in the workplace, their concerns were graver and expectations more immediate. Their concerns included—

- The loss of health and the possibility of effects on their future health caused by past or current building air quality problems. Some interviewed employees were particularly concerned about cancer.
- The loss of career and the ability to earn a living in the future.
- The lack of knowledge about the cause of the problem. Can it be identified? If not, how can they be sure that the work environment is really safe?
- The health of employees who are still working and of hospital patients being treated in the building.

Their expectations included—

- BWH should acknowledge the existence of health problems related to poor IAQ.
- Affected workers should be able to report problems without fear of repercussions.

- BWH should provide alternate employment opportunities for affected employees who want to continue working. Employees should be allowed to open windows for "fresh" air.
- The environment should be perfume- and fragrance-free.

Other Interviews

During our interviews with other individuals (i.e., occupational and environmental health professionals, health care providers, management consultants, and BWH managers, supervisors, health care providers), we obtained information about the BWH response to the IEQ problem, BWH occupational health services, diagnoses given to employees, and organizational and communications issues affecting IEQ at BWH.

BWH response

Several health care providers, occupational health professionals, and management consultants were familiar with BWH activities to improve IEQ. They noted and commended the following BWH efforts:

- Improvements made over the years in response to employee reports of problems, such as—
  - Engineering changes to the ventilation systems
  - Extensive cleaning to remove latex allergens
  - Procedures to control emissions from construction and renovation sites
- Consulting with occupational health specialists
- Development of systems to respond to reported problems
- Off-site meetings to accommodate employees who continued to have problems upon entering the workplace

A few described BWH efforts as "extraordinary" and "admirable." However, they noted that the following factors contributed to the lack of success of these efforts:

- Lack of clear leadership at BWH, such as—
  - Lack of consistency in policy, decisions, and communications related to IEQ within and among departments and also from one administrative level to the next
  - Lack of clear plan for resolving IEQ issues
  - Ambiguous roles and relationships and conflicts within and among complex, cross-functional departments
  - Poorly integrated occupational health and environmental health services
- Changes in policy and administrative response when organizational structure and personnel changed
- Lack of recognition of potential conflicts of interest

According to our interview sources, BWH responded only after "after years of complaints," and consultants retained to solve the IEQ problems faced "administrative obstacles." Such administrative responses were felt to contribute to the creation and prolongation of an atmosphere of "incredibly bad feelings," such as—

- "Mistrust," "anger," "frustration," "suspicion," feelings of being "victimized," "panic," and "fear" on the part of employees
- "Extremely poor employee-employer relations" and a "politicized" atmosphere
- Potential for rumors spreading though the "grapevine"

Occupational health services

Several interview sources who were familiar with BWH reported that, when problems began, the BWH Employee Health Services and the Emergency Department were not prepared to handle occupational illnesses. Workers' compensation payments and leaves of absence were allowed until the problems could be better evaluated. Initially, only part-time occupational physicians were retained to examine employees

who reported IEQ-related health problems. By 1995, a full-time and two additional part-time occupational health physicians and several part-time nurse practitioners were also seeing employees seeking medical attention at BWH. Employees were also seeking medical attention from health care providers outside BWH. Interview sources reported the following types of clinically related problems—

- Poor communications among health care providers, especially between BWH physicians and employees' personal physicians
- Fragmented health care
- Differences of opinions among occupational health physicians evaluating employees for BWH
- Poorly documented clinical assessments
- Differences between occupational health recommendations and administrative decisions

Diagnoses

Each of the 20 health care providers that we interviewed had evaluated from 1 to over 50 BWH employees. These health care providers included eight physicians and nurse practitioners working at BWH Employee Health Services or the BWH Occupational Health Department, and two contract physicians seeing employees through the case-manager triage system. The other health care providers saw BWH employees as physician-referred or self-referred patients. Several physicians reported that they had documented objective abnormalities consistent with diagnoses such as asthma, reactive airways, or latex allergy. However, they also saw employees with nonspecific findings such as headaches, fatigue, upper respiratory symptoms, and palpitations, which they could not consistently attribute to workplace exposures. Several consulting specialists reported that they had found no or few objective findings related to their specialty. A few physicians stated that some employees appeared to have continued problems despite the lack of objective findings. These specialists generally deferred to other specialists for diagnoses. A few physicians stated that some clinically astute patients appeared to be overly concerned about symptoms of no or little clinical significance, and that these patients were generally not receptive to discussing the discrepancy between the level of concern and the significance of the symptoms.

Organization and communication

These other interview sources confirmed and clarified the organizational and communication problems alluded to in a 1988 letter from occupational health consultants and reported since 1993 by other investigators. Their comments included the following:

- Complex and sometimes ambiguous relationships between departments as well as between upper administrative levels
- Communication breakdowns between departments, between administrative levels, and between management and employees
- Lack of administrative commitment to occupational safety and health
- Reliance on experts to solve the problems without management's understanding of the issues
- Lack of dialogue over major issues of concern
- Lack of clarity in communication leading to misunderstandings
- Distrust of official communication, leading to reliance on the grapevine for information
- Inconsistencies between policy and practice, leading to disputes among employees as well as between employees and supervisors
- Unresolved employee concerns about IEQ
- Employees' lack of understanding about the technical issues involved in managing IEQ effectively

Review of Health Records

OSHA Logs

From 1991 through 1995, the yearly numbers of injuries and illnesses recorded on the OSHA logs

doubled (Table 12). Most of the increase can be attributed to illnesses (not including repeated trauma), which increased from 36 in 1991, to 84 in 1992, and to 287 in 1993. Although the numbers of recorded illnesses decreased slightly in 1994, the 11-month total for 1995 was almost 10 times the number recorded in 1991. The distribution of types of illnesses changed from year to year, especially from 1993 through 1995. From 1991 through 1993, notable increases occurred in the OSHA categories for skin, lungs or respiratory, and "all other occupational illnesses." In 1993, BWH began recording illnesses that employees were attributing to poor IAQ under the OSHA classification for all other occupational illnesses. These illnesses were noted as "multiple multiple" or "multiple nonclassifiable." These notations indicated conditions that affected multiple body parts or showed multiple manifestations and, thus, did not fit into the more specific OSHA illness classifications. They quickly emerged as the predominant type of recorded illnesses at BWH (308 entries over 11 months in 1995). (In Table 12, these illnesses are classified as "All other, not classified.") These notational changes occurred at about the same time as major administrative and personnel changes in the BWH departments responsible for the OSHA logs (Employee Health Services and the Occupational Health Department).

IAQ Encounter Logs

From the onset of the case-manager triage system for IAQ incidents in July 1995 through March 1996, case managers logged over 400 employee encounters. The numbers of encounters paralleled the numbers of occupational illnesses recorded on the OSHA logs (Table 13). On each floor, the numbers of encounters changed from month to month and, among floors, the patterns of encounters differed (Table 14).

Workers' Compensation Claims

Comparison of the recorded illnesses on the OSHA logs and workers' compensation claims showed incomplete overlap (Table 15). Most dates of illnesses for workers' compensation claims were the same as the dates recorded on the OSHA logs. For seven individuals, the dates were more than a year apart. Of the 967 illnesses recorded on the OSHA logs that might have been IEQ-related, approximately 20% resulted in workers' compensation claims. Approximately 25% of the 253 workers' compensation claims that might have been IEQ-related were not recorded on the OSHA logs.

Table 16 shows the number of workers' compensation claims by work area and date of illness. From January 1991 through March 1996, most (201, 79%) of the claims were filed by employees from the Patient Tower, with 130 (51%) from floors 3 through 16, and 71 (28%) from lower level floors L1 and L2. The seven claims made for 1991 and 1992 were from various Patient Tower floors, including the lower levels. The number of claims for 1993 increased to 101. During the first three quarters of 1993, most (43, 69%) of 62 of the claims were made by employees from the lower levels. The numbers of claims from the lower levels peaked at 15 and 21 during the second and third quarters of 1993, then fell to 2 during the next quarter. Thereafter, the number of quarterly claims from the lower levels ranged from one to six. By the end of 1993, when claims from the lower levels had tapered off, claims from other areas, including other buildings, began increasing. The highest number of quarterly claims (20 to 56) were filed from the second quarter of 1993 through the second quarter of 1994. Quarterly claims decreased to three for each of the next two quarters, but increased again in 1995. However, the number of quarterly claims throughout 1995 was never as high as in 1993 and 1994.

The highest numbers of claims came from Patient Tower lower levels (specifically L1) and floors 8 and 12. However, the patterns for dates of illness differed among work areas. Claims from the lower levels peaked before claims from floors 8 and 12.

The first claim from the 8th floor was for the second quarter of 1992. Quarterly numbers thereafter ranged from 0 to 5, except for a single peak of 15 during the first quarter of 1994. The first claims from the 12th floor were for the fourth quarter of 1992. Quarterly numbers thereafter ranged from 0 through 9. Claims from Patient Tower floors 3 and 4 and from CWN began during the third quarter of 1993. All units from Patient Tower floors 3 and 4 and some units from the lower levels began moving into CWN in late 1993. CWN was officially opened in 1994. Some claims by CWN employees for dates of illness before CWN was officially open might have been related to health conditions that began in previous work areas.

Diagnoses

Table 17 shows the number of claims by diagnosis and date of illness. The only workers' compensation claim for 1991 that was possibly related to IEQ was diagnosed as unrelated to work. Of the six claims filed for 1992, two claimants had a diagnosis of latex allergy. One of these two claimants also had a diagnosis of asthma. No diagnoses were available for the four other claims. Beginning in 1993, the number of claims within each diagnostic category peaked in the first quarter of 1994, then rapidly decreased over the next two quarters. Almost all work areas were represented for each of the diagnostic categories. (Tables E-1 to E-9 in Appendix E show the numbers of claims for each diagnostic category by work area and date of illness. Tables E-10 to E-16 in Appendix E show the same information for each work area.)

Latex allergy

Forty-two (17%) of the 241 workers' compensation claimants had a diagnosis of latex allergy (Table 18). Table 19 shows the diagnostic certainty and agreement among workers' compensation examiners making the diagnoses. Diagnostic criteria, however, varied by examiner. Some diagnoses were based on clinical suspicion related to a history of symptoms upon exposure to latex products (e.g., balloons, nursing nipples, or gloves). Other diagnoses were confirmed by laboratory tests, such as a positive radioallergosorbent test (RAST) for immunoglobulin E to latex allergens. Examiners did not necessarily rule out latex allergy when the RAST was negative, since the test is known to give false negative results. We made the assumption that some diagnoses of "possible latex allergy" meant that the history was consistent with latex allergy, but the diagnosis was not confirmed by laboratory tests.

For 31 (74%) of the 42 claims with a diagnosis of latex allergy, illnesses occurred during three quarters beginning in the fourth quarter of 1993 (Table 18). Before and after this time period, no more than three claimants per quarter had a diagnosis of latex allergy. Claimants with a diagnosis of latex allergy were from all work areas. However, among clinical service providers, secretaries and receptionists in clinical service areas, and technicians, 17% to 23% of all claims identified as possibly related to IEQ had a diagnosis of latex allergy (Table 20). On the other hand, claimants from office areas, where latex exposure would not be expected, had no diagnoses of latex allergy. Although employees from the BWH Engineering Services and Environmental Services departments work in many areas, including clinical service areas, none of the workers' compensation claimants from these departments had a diagnosis of latex allergy.

Table 21 shows other types of diagnoses that were also given to claimants with a diagnosis of latex allergy. Most (74%) of the 42 claimants with a diagnosis of latex allergy also had a diagnosis of reactive airways (including asthma). Reactive airways is one of the health outcomes that may be caused by latex allergy.[24] However, from the available information, we could not determine the relationship between a claimant's latex allergy

and reactive airways.

Table 22 shows the current work status of the 42 claimants with a diagnosis of latex allergy. Fourteen (33%) were actively employed at BWH in 1996, 22 (52%) were on leaves of absence, and 6 (14%) were terminated employees. Of the 31 claimants with asthma as well as latex allergy, 9 (29%) were active employees, 16 (52%) were on leave of absence, and 6 (19%) were terminated employees.

Reactive airways and asthma

One third (80) of the 241 workers' compensation claimants had a diagnosis of reactive airways or asthma (Table 23). As with diagnoses of latex allergy, diagnostic criteria varied by examiner. Some diagnoses were based on clinical suspicion related to a history of symptoms of wheezing and chest tightness. Other diagnoses were confirmed by outpatient peak flow monitoring or laboratory tests, such as a positive methacholine inhalation challenge test. Examiners did not necessarily rule out reactive airways when the objective tests were negative. We made the assumption that some diagnoses of "possible" reactive airways or asthma meant that the history was consistent with reactive airways, but the diagnosis was not confirmed by objective tests.

Possible triggering exposures could not be determined reliably from the available diagnoses. However, some claimants' diagnoses were attributed to inhaled irritants, such as quaternary ammonium cleaning compounds or airborne particulates. Other claimants' diagnoses were attributed to pre-existing or non-work-related allergies, some of which had been confirmed by skin-prick testing. No possible triggering exposures were noted for other claimants. More than half (47) of the 80 claimants with a diagnosis of reactive airways also had a diagnosis of some allergy (Table 24). This number includes the 31 claimants with a diagnosis of latex allergy.

One-third (26) of the 80 claimants with a diagnosis of reactive airways were actively employed at BWH in 1996. Approximately one-half (41) were on leave of absence and 13 (16%) were terminated employees.

Diagnoses attributed to the building, poor IAQ, or chemical sensitivity

Seventy (29%) of the 241 claimants had been given a diagnosis that attributed the claimant's illness to the building, poor IAQ, or chemical sensitivity (Table 25). As with diagnoses of latex allergy and reactive airways, diagnostic criteria varied by examiner. But unlike health conditions related to latex allergy and reactive airways, health conditions attributed to "sick buildings" poor "indoor air quality," and "multiple chemical sensitivity" have not been consistently defined. Most of the medical community does not recognize the diagnostic tests used by some medical practitioners who specialize in these conditions.[25,26,27]

Fifty-eight (83%) of the 70 claimants with these diagnoses also had another diagnosis that could have explained symptoms that had been attributed to the building, poor IAQ, or chemical sensitivity (Table 26). Fifty-four (93%) of these 58 claimants had another diagnosis that described a specific health outcome (e.g., an upper or lower respiratory condition). Twenty-five (36%) had another diagnosis that described a possible cause for the symptoms (e.g., an allergy).

Of the 70 claimants with diagnoses in this category, 22 (31%) were actively employed at BWH in 1996, 34 (49%) were on leaves of absence, and 14 (20%) were terminated employees.

Upper respiratory conditions

Although 70 (29%) of the 241 workers' compensation claimants had a diagnosis of an upper respiratory condition, we examined these diagnoses only in relationship to latex allergy, reactive airways, and diagnoses attributed to the

building, poor IAQ, or chemical sensitivity (presented earlier in this section). From the available information, we could not determine the relationship between a claimant's workplace exposures and upper respiratory conditions. Upper respiratory conditions are commonly found in the general population. They are typically nonspecific and could be related to any of a number of causes or aggravating factors, such as upper respiratory infections and allergies.

Work status

We looked at work status to determine how health problems were affecting claimants' ability to work. Of all 241 workers' compensation claimants, 105 (44%) were active employees, 83 (34%) were on leaves of absence, and 53 (22%) were terminated employees. Employees on leaves of absence were not considered terminated. We were not able to determine whether a termination was voluntary or involuntary.

Return to Work

The return-to-work decision tree developed by the BWH occupational health physician takes different scenarios (e.g., recurrence of symptoms, assessment by a physician, and objective findings) into consideration. It also relies on administrative controls (i.e., removing an employee from the workplace) to protect affected employees. The clinical guidelines noted the need for workplace assessment and removal of sources of triggering exposures. However, this was not reflected in the return-to-work decision tree.

Several of our interview sources, physicians as well as employees, had expressed concern that some employees with occupational asthma had been given inhalers and returned to the same workplace environmental conditions that triggered asthma symptoms. They also reported that supervisors and administrators did not consistently accept or follow physicians' return-to-work recommendations.

Construction and Renovation

The current construction and renovation practices that we observed during our walk-through included isolation of occupied areas. According to our interview sources, management oversight practices included following standard operating procedures, and responding quickly to unexpected problems. However, during our interviews with hospital staff selected because of their knowledge and experience with these projects, several indicated some concern that a few of the construction and renovation projects were "rushed." Employees believed that this reduced the likelihood of prior input from appropriate hospital staff and generally created a management environment more prone to mistakes that could adversely impact hospital IEQ.

Additional Concerns

Ventilation Systems

MNA nurses had asked whether we would document previous ventilation system problems, such as the lack of exhaust ventilation for glutaraldehyde in the operating rooms. We found that reports of previous investigators had already documented ventilation system deficiencies. Specific instances of these problems, such as the lack of appropriate exhaust ventilation for glutaraldehyde on Patient Tower L1, were also verbally confirmed by the BWH Director of Environmental Affairs.

Exposures

MNA nurses also asked us to determine the source of the reported trace amounts of ethylene oxide on Patient Tower floor 12, and how it got there. When questioned about this, the BWH Director of Environmental Affairs stated that he was not aware that ethylene oxide was found during 12th floor sampling. Among the 12th floor environmental sampling results that we reviewed, ethylene oxide was not detected at the analytical

limit of detection (Appendix B).

Some BWH employees expressed concern about exposures to perfumes, medications, quaternary ammonium cleansers, and formaldehyde in hand creams. According to managerial and supervisory interview sources at BWH, the hospital has attempted to control these types of exposures as much as possible. For example, earlier cleansers had been substituted with less irritant ones, and housekeeping practices, such as spraying of cleansers, had been discontinued. Several employees reported that they had been asked not to use perfumed personal products while at work.

Biological Monitoring Program

MNA nurses asked whether the results of the BWH biological monitoring program for latex and glutaraldehyde were really invalid as was reported by the BWH occupational health physician. According to the BWH occupational health physician, her predecessors had collected blood specimens during the summer of 1993, in an attempt to find a screening test for latex and glutaraldehyde exposures. She confirmed MNA nurses' reports that not all of the collected specimens were analyzed. She reported that further specimens were not analyzed for glutaraldehyde because the assay did not appear to be reliable or valid. For example, analyses of duplicate samples gave different results, no control specimens (i.e., blanks or specimens from individuals known to have no exposure, which could be used for comparison) were analyzed at the same time, and the assay's clinical relevance had not been established. This information was confirmed verbally by the BWH occupational health physician who had collected the blood specimens and confirmed in writing in a report of another BWH occupational health physician who was interested in the research potential of such an assay (Appendix B). Individuals whose specimens were analyzed received their results without interpretation, since no interpretation was available. The BWH occupational physician stated that she discarded the remaining specimens because they were not going to be analyzed.

Workers' Compensation

MNA nurses raised concerns about employees who had filed workers' compensation claims still awaiting decisions, especially those who were on leaves of absence without pay. They asked whether nurses with valid work-related illnesses would be denied workers' compensation. They also asked who was responsible for medical treatment payments before the claims were settled. This concern arose because some employees had no income and no health insurance. They were thus unable to pay for medical care for conditions that they believe are related to work. During our meetings with BWH and MNA representatives and in the employee interviews, we stated that NIOSH is not involved in the workers' compensation system. We informed them that we would summarize the workers' compensation information we collected but would not examine individual claims. Thus, we did not evaluate the validity of individual diagnoses or merits of individual cases.

Medical Records

MNA nurses expressed concern about the confidentiality of their medical records. We confirmed that BWH Employee Health Services had routine access to employees' hospital records because this unit had provided primary medical care services to employees. This practice did not change when the unit first began seeing employees with claims of work-related illnesses. After the department was reorganized into the BWH Occupational Health Department, the newly retained occupational health physician ended this practice and began requiring written authorization for release of medical information before obtaining such records. Records for the case-manager triage system for IAQ incidents were kept in locked files in the office of the Vice President of Nursing.

Conflict of Interest

MNA and several staff nurses asked us to clarify the relationship between BWH and the part-time occupational health physicians and nurse case managers, whose services had been retained by the BWH Environmental Health and Engineering consultant, who was also the BWH Director of Environmental Affairs. MNA and the nurses were specifically concerned about conflicts of interest on the part of health care providers who were retained by an agent of BWH. We therefore raised these issues with these health care providers, the EH&E consultant who had arranged their services, and the nursing administrators and managers with whom they interacted. All maintained that the relationship was indirect and, thus, did not interfere with clinical objectivity.

DISCUSSION

During the three years between March 1993 and the time of our initial site visit in March 1996, BWH had made significant changes to the Patient Tower. These changes included engineering improvements to the ventilation systems and extensive cleaning on floors reporting problems. BWH had also implemented programs to prevent contaminants from construction and renovation projects from entering occupied areas. Therefore, any on-site assessment in 1996 could not have confirmed employee reports of earlier problems. We informed BWH and MNA of this limitation before our first site visit. We were, however, able to review existing reports of previous investigations for documentation of earlier problems reported by employees.

What Happened in 1993?

The MNA request asked, "What happened in early 1993 that could have caused the illnesses experienced by BWH employees and explain why the illnesses have persisted." This question implies several hypotheses—that employees' health problems could be related to a single, specific exposure or event, that large numbers of building occupants were affected, and that the exposure or event took place in 1993.

No Single Exposure

We did not find evidence to support the hypothesis that employees' health problems are related to a single specific exposure. Our assessment is based on information from various sources. Previous occupational and environmental investigators documented a history of problems that could have affected IEQ in the BWH Patient Tower. These problems were related to multiple factors, not to a single type of exposure (Appendix B). Examples of factors contributing to poor IEQ included ventilation system deficiencies, potential for exposures to specific air contaminants (e.g., latex, glutaraldehyde, and waste anesthetic gases), and potential for exposures to a mixture of air contaminants from construction and renovation activities. In addition, the variety of workers' compensation diagnoses does not support a single-cause hypothesis. Approximately 20% of workers' compensation claimants' health problems could be explained by latex or glutaraldehyde allergy. Although these problems might be considered related to poor IEQ, they do not account for all health problems that employees attribute to poor IEQ. Finally, during our walk-through evaluation of the Patient Tower and CWN and employee interviews, employees in different work areas reported a variety of problems that could have contributed to poor IEQ.

Furthermore, if a single exposure or event was responsible for employees' health problems, employees in other job categories working in the same areas as staff nurses would have had an equal chance to be affected. Staff nurses accounted for almost two-thirds of the workers' compensation claimants making IEQ claims, but do not make up two-thirds of the workforce.

No Single Event

We also did not find evidence to support the hypothesis that employees' health problems are related to a single event, such as a chemical leak or spill, in early 1993. Previous occupational and environmental investigations documented a history of problems beginning in the 1980s (Figure 1 and Appendix B). Although 42% of the 241 workers' compensation claims identified as possibly related to IEQ were filed in 1993, six IEQ-related claims were filed in 1992. Three of these 1992 claims were filed by employees from Patient Tower L1, which had been investigated by BWH consultants in 1988 for similar health problems.

Ventilation Systems

Some staff nurses expressed concerns that previous ventilation system problems, now corrected, had not been documented. Our review of reports of previous investigators showed that earlier problems had been documented since the 1980s (Figure 1 and Appendix B). Specific ventilation system deficiencies, such as the lack of exhaust ventilation for glutaraldehyde used on Patient Tower floor L1, were also confirmed by the BWH Director of Environmental Affairs. Although the hospital was reportedly slow to correct ventilation system deficiencies, major improvements had already been made or were in progress at the time of our site visit.

Ethylene Oxide

We found no documentation to confirm reports of trace amounts of ethylene oxide on Patient Tower floor 12. All 12th floor environmental sampling results for ethylene oxide that were available to us showed no detectable concentrations at the analytic limit of detection (Appendix B). A possible explanation for the lack of confirmatory documentation is that reports showing trace concentrations of ethylene oxide on the 12th floor were not available for our review. An alternative explanation is that the results we reviewed were misinterpreted. The laboratory reports that we reviewed presented nondetectable results as "less than [the limit of detection]." Because a numerical analytic limit of detection was provided, this might have been misinterpreted as a trace concentration.

Latex

Latex allergy is an important occupational health problem in hospitals.[23,24] Thus, we were not surprised that environmental monitoring by BWH consultants showed latex allergens on surfaces of occupied areas where latex products had been used, and that some workers' compensation claimants had diagnoses of latex allergy. The latex-contaminated surfaces were probably the result of years of release of latex protein from latex products, such as powdered latex gloves. Therefore, work exposures could explain the development of latex allergy and the occurrence of allergic reactions (e.g., conjunctivitis, rhinitis, urticaria, angioedema, and asthma) among sensitized employees upon exposure.[24]

Among workers' compensation claimants from clinical areas, where latex exposure would be expected, the proportion of claimants with diagnoses of latex allergy ranged from 17% to 23%. No workers' compensation claimants from office areas had a diagnosis of latex allergy. We would not have expected office area workers to have significant exposures to latex. Some diagnoses were made with laboratory (e.g., RAST) or clinical (e.g., skin-prick test, clinical challenge test) confirmation. However, objective tests can sometimes be falsely negative. Therefore, latex allergy might have been undiagnosed in some individuals. We also knew of at least one employee with a diagnosis of latex allergy who had not filed a workers' compensation claim. Therefore, latex allergy among BWH employees might be under reported as well as under diagnosed.

Some claimants with latex allergy also had

diagnoses of other potentially serious conditions, such as asthma or angioedema. Others with latex allergy had diagnoses of milder conditions, such as rhinitis. Although conditions such as asthma, angioedema, and rhinitis may be related to latex allergy, the relationship is sometimes unclear, such as for claimants with other allergies. This could explain some of the differences of opinion among medical examiners over the cause of an individual's diagnosis.

Area air sampling on Patient Tower floor 12 in April 1995, before deep cleaning was performed, showed relatively low concentrations of airborne latex allergens (Appendix B). Despite these results, BWH elected to remove potential sources of future airborne exposure. The presence of latex allergens in environmental dust implies a potential exposure hazard, but the risk for exposure depends on activities or conditions that would disturb the dust. Routine facility maintenance activities, such as removing suspended ceiling panels to reach above-ceiling spaces, could disturb settled dusts and cause them to become airborne. Therefore, we consider the removal and cleaning program to control employees' exposures to latex allergens to be a prudent and appropriate course of action.

The procedures for deep cleaning and renovations at BWH, as outlined in the scope of work (listed in the findings section of this report), are essentially the same as asbestos abatement procedures, which have rigorous requirements to contain dust and control worker exposures. A recent survey of 105 acute-care hospitals in Washington State to determine which measures hospitals are using to control employees' exposures to latex allergens found that 76 % of reporting hospitals had switched to powder-free latex gloves, 61% had switched to non-latex gloves, and only 4% had reported cleaning surfaces specifically to remove dust containing latex allergens.[28] Thus, the BWH deep-cleaning program is relatively aggressive. In combination with the BWH-wide policy on the use of powder-free and low-allergen latex gloves as well as non-latex gloves, the potential for future latex allergen exposures at BWH should be minimal. Therefore, the continued use of the portable containment booth may not be necessary even within occupied areas, provided that all supply and return ventilation are ducted, the plenum is not negatively pressurized with respect to occupied areas, and routine surveillance with surface sampling continues to show no evidence of latex allergens.

The success of the combined cleaning program and policy on latex products to control employees' exposures to latex allergens was confirmed in 1996 and 1997 by BWH environmental sampling of surfaces in occupied areas. The reduction of exposure could explain the decrease in workers' compensation diagnoses of latex allergy. An alternative explanation for the decrease is that susceptible employees had left the workplace, thus decreasing the numbers at risk. In the future, development of new onset latex allergy and recurrent allergic reactions among sensitized individuals would be expected to be low because of the measures taken to prevent exposures.

Other Diagnoses

Glutaraldehyde allergy was diagnosed among 5 of the 241 workers' compensation claimants. Sources of exposure were found on Patient Tower floor L1, where glutaraldehyde was used. Glutaraldehyde exposures outside work would have been unlikely. Therefore, glutaraldehyde allergy among exposed employees would clearly be work-related.

Work-relatedness was less clear for other workers' compensation diagnoses. These include diagnoses of sinusitis, rhinitis, asthma, and various skin conditions, all of which have many possible causes. Objective tests may be able to confirm medical conditions, but not necessarily their causes. Symptoms for many of these conditions could be triggered by different types of exposures, such as irritants in the workplace (e.g., hospital cleaning solutions and airborne

contaminants from construction or renovation projects). Therefore, individualized evaluations would be necessary to determine a relationship to work. This could explain some of the differences of opinion among medical examiners over the cause of an individual's diagnosis.

For diagnoses such as sick building syndrome and chemical sensitivity, work-relatedness is typically based on the patient's history of a relationship between symptoms and the workplace. With these diagnoses, no generally accepted diagnostic criteria exist, and objective tests are not necessarily helpful in making a diagnosis. This explains the differences of opinion among medical examiners over these types of diagnoses.

More Than the Air

Hospitals have more potential for exposures to hazardous substances (e.g., chemical sterilants, anesthetic gases, and certain medicines) than office buildings. In fact, some specific sources of potential exposures to air contaminants were documented at BWH and could explain some employees' health problems. These include latex and glutaraldehyde, which might have caused symptoms of allergy, including asthma, among susceptible individuals. Other not so specific exposures, such as airborne irritants and dusts, could explain some employees' upper and lower respiratory symptoms, including asthma. However, some aspects of the problems at BWH also resemble those of studies in which occupants' perceptions of the indoor environment were more closely related to the occurrence of symptoms than any measured indoor contaminant or condition.[10,11,12] This suggests that other factors, such as organizational factors in the workplace, might be affecting the comfort and health of BWH employees. Thus, at BWH, indoor *environmental* quality (IEQ) more accurately describes some issues than indoor *air* quality.

Another factor that might have contributed to the increase in reporting is increased employee awareness as IEQ problems were investigated. Since 1988, reports of previous investigators have documented indoor and outdoor sources of air contaminants. In May 1992, an occupational and environmental health consultant investigating Patient Tower floor L1 reported that air contaminants could have contributed to employees' health problems, which he identified as consistent with "sick building syndrome" (Appendix B). Workers' compensation claims from L1 increased from 3 in 1992 to 7, 14, and 21, respectively, for the first three quarters in 1993. The consultant also suggested that patients could be at risk. During our investigation, MNA nurses raised the same issue.

A study by an occupational epidemiologist in the spring of 1993 conducted in response to the increase in reports of symptoms among employees on L1 also found exposures that could explain some employees' health problems. However, he noted that administrative and communication problems contributed to employees' growing concerns. Similar problems had been noted by other investigators and consultants before and after 1993. These organizational and communication problems could have contributed to the increase in employee reports of IEQ problems.

Organization and Communication

According to our review of reports of previous investigations at BWH, US DOL/OSHA and Massachusetts DLI/DOH investigators noted that IEQ problems were exacerbated by poor communication between management and employees. The occupational health professionals and management consultants we interviewed also emphasized the role of organizational and communication issues in the persistence of the problem. As early as 1987, consultants had strongly advised BWH to address these issues to prevent increased problems.

During our interviews, we found significant discrepancies between BWH and employees with regard to knowledge and understanding of IEQ

issues. For example, communication and knowledge gaps probably contributed to employee misunderstandings about the biological monitoring program and possibly the question of ethylene oxide on Patient Tower floor 12. Perceptual gaps contributed to the inability of BWH management to understand why employees had significant concerns about the confidentiality of medical records, conflicts of interest on the part of contract physicians, and the fairness of workers' compensation policies and decisions. These discrepancies contributed to credibility gaps that probably exacerbated IEQ problems and hampered resolution of the problems. These discrepancies could explain why, despite major BWH efforts to improve ventilation systems, to control exposures to air contaminants, and to increase employee access to occupational health services, many employees appear to feel that they are not being heard and their needs are not being met.

Bureaucratic organizations, like BWH, are typically characterized by formalization and centralized decision-making authority. Organizational communication in such structures are often one-way, with information being sent down the chain of command from management to employees. Such communication systems are inherently subject to both communication loss and distortion, which can lead to considerable uncertainty about the meaning of messages. These types of communication problems, coupled with ongoing organizational changes at BWH, have led to rumors and numerous unresolved concerns that have negatively affected both the organization and the course and outcome of IEQ problems. Therefore, as many occupational and environmental health and management consultants to BWH have mentioned over the years, improving communication is of great importance.

Return to Work

The clinical guidelines for occupational illnesses developed by the BWH occupational health physician appear to be rational. In the patient's interest, a clinician is expected to advise an employee to avoid a workplace if that workplace would cause or aggravate the employee's illness. In both the employee's and the employer's interest, an occupational physician is expected to protect employees from risk of illness. However, the return-to-work decision tree does not appear to emphasize a preferred occupational health method for protecting employees—the removal or control of symptom-triggering exposures. Unlike the removal of affected employees from the workplace, this practice would allow an affected employee to return to work as well as protect other susceptible employees. However, a few highly sensitive employees with severe reactions to low concentrations of a triggering allergen may not be able to return to work despite measures to control exposures to that allergen.

Return-to-work practices for different individuals may not appear consistent because each individual's situation may be unique. Therefore, individual assessments are necessary and return-to-work decisions could very well differ. Problems could arise when physicians disagree about a particular individual, when return-to-work decisions depend more on which physician makes the decision than on the affected employees' medical needs, or when supervisors and administrators do not consistently follow return-to-work recommendations. Possible resulting problems include aggravation of a work-related illness or the appearance of unfairness.

Construction and Renovation

Based on our evaluation, the current construction and renovation practices utilized at the hospital appear to be sufficient to ensure adequate IEQ. Our observations indicated that isolation of occupied areas and work practices of construction and renovation employees were appropriate. Management oversight to ensure that standard operating procedures are followed appeared to be appropriate, and any problems arising from the dynamic construction and renovation processes appeared to be handled quickly and effectively.

However, employee concerns that rushing through projects without prior input from appropriate hospital staff may contribute to IEQ problems are valid.

Additional Concerns

Open Windows for Air

Employees frequently asked for hospital windows that could be opened to let in "fresh" or outside air. They felt that this would improve the indoor environment. However, such a practice would have a significant negative impact on the indoor environment. Essentially, opening hospital windows would not improve the indoor environment at all, and would most likely worsen the indoor environment. Hospital ventilation systems and controls are technologically sophisticated and are designed and operated to perform a variety of very important functions that critically affect the quality of the indoor environment. Each of these systems brings in an appropriate volume of outdoor air which is filtered, heated or cooled and dehumidified or humidified as required, then supplied through ventilating ducts and diffusers to occupied areas. In addition, the volume of supply and exhaust air for each of these systems is adjusted, or balanced, to provide appropriate pressure relationships between adjacent occupied areas. This allows the isolation, when appropriate, of an individual occupied area from other occupied areas. Such isolation is particularly critical in a hospital, where a wide variety of activities occur. Opening windows would allow uncontrolled amounts of unfiltered and unconditioned air to enter occupied areas of the hospital, bringing with it any outdoor contaminants and odors. It would also disrupt the designed pressure relationships necessary for maintaining isolation between adjacent occupied areas. Therefore, hospital windows should not be opened in an attempt to improve the indoor environment.

Future Health Outcomes

Employees consistently raised concerns about the possibility of effects on their future health caused by past or current building air quality problems. Unfortunately, we cannot predict future health for a number of reasons. Health care providers, workers' compensation examiners, and other occupational health consultants did not establish a single cause for health problems among employees. Thus no single type of diagnosis can be predicted. In addition, individual outcomes among patients with the same diagnosis may be different, often for reasons that science and medicine cannot explain.

Some employees had diagnoses, such as asthma, that could have serious clinical outcomes. Such a diagnosis could seriously affect an employee's work and career. MNA and employees reported that some employees with serious diagnoses that could be work-related had been denied workers' compensation and were terminated. We did not examine individual workers' compensation decisions to confirm this. However, we found that some employees who had diagnoses of latex allergy and asthma were terminated employees. Thus, aside from their medical conditions, economic pressures resulting from lack of income and health insurance and a sense of unfairness could affect the future health of these individuals.

Risk for Future Illnesses

Employees also raised concerns about the risk for future illnesses among building occupants, including both patients and employees. Our evaluation found several major programs already in place to improve the work and patient environment at BWH. These included—

- Engineering improvements to the ventilation systems

- Measures to ensure adequate IEQ during construction and renovation activities
- The deep cleaning program, which probably reduced reservoirs of other contaminants as well as latex allergens
- Programs to systematically identify, control, and prevent problem exposures, such as latex allergens and cleaning solutions

Many of the occupational health professionals we interviewed had positive comments about the extent of work done to improve the physical work environment. These improvements would be expected to reduce certain exposures and thus decrease the risk of illnesses attributable to those exposures.

CONCLUSIONS

Previous Investigations

Although we did not find complete agreement among previous occupational and environmental health investigators, we found an overall consistency of reported observations about the building, IEQ, and employees' health problems. Previous investigators noted that IEQ problems at BWH could not be explained by a single, specific exposure event. Their observations support conclusions that can be categorized into the following issues: ventilation systems and exposures, health problems, and organization and communication.

Ventilation Systems and Exposures

- In the past, the BWH Patient Tower building had many major ventilation system deficiencies, which contributed to poor IEQ and could explain some employees' health problems.
- The BWH Patient Tower had a long history of major renovations, which could have contributed to poor IEQ if air contaminants had not been adequately controlled.
- In the past, indoor and outdoor sources of potential air contaminants (e.g., latex, glutaraldehyde, volatile organic chemicals, combustion gases, and re-entrained exhausted air) were documented and, in some cases, contributed to poor IEQ.

Health Problems

- A large number of Patient Tower employees were reported to be experiencing health problems or discomfort in the workplace.
- For some BWH employees, symptoms were related to diagnoses consistent with specific, documented workplace exposures (e.g., latex and glutaraldehyde).
- For other employees, symptoms were not specific to any particular work-related diagnosis, and the relationship between symptoms and work exposures was less clear.

Organization and Communication

- Significant communication problems between management and employees probably led to misunderstandings and distrust, and contributed to IEQ problems.
- Significant organizational problems, such as the lack of consistency and coordination among BWH departments handling IEQ problems, adversely affected the resolution of IEQ problems at BWH.

NIOSH Evaluation

Our observations were consistent with those of previous investigators. Our additional observations support conclusions that can be categorized into the following issues: BWH programs, employee concerns, and organization

and communication.

BWH Programs

- Based on BWH environmental monitoring results and the decrease in workers' compensation claims with diagnoses of latex allergy, BWH programs to remove environmental dusts and control employees' exposures to latex allergens appear to be successful.
- BWH has implemented removal, substitution, containment, or use of appropriate exhaust ventilation to limit exposures to substances that could affect employees' health. These programs and practices are consistent with the principles of occupational health.
- BWH has also implemented appropriate work practice policies and use of engineering controls to prevent air contaminants from construction and renovation projects from entering occupied areas.

Employee Concerns

Despite aggressive efforts to address IEQ issues, such as extensive cleaning programs and major ventilation system improvements, employees continue to have many unresolved concerns.

- Employees expressed feelings of outrage related to a perception that they had been treated unfairly.
- Employees with health problems expressed concerns about the possibility of effects on their future health caused by past or current building air quality problems, and how their health problems would affect their future.
- Employees expressed feelings of frustration related to a perception that their questions have not been answered and their concerns have not been not addressed.
- Some programs raised additional employee concerns. For example,
  - The case-manager triage system for handling IEQ incidents raised employee concerns about the potential for conflict of interest on the part of examining physicians.
  - Employees were concerned that the confidentiality of their medical records was not being maintained.

Organization and Communication

- BWH has implemented a variety of methods, such as newsletter updates, staff or committee meetings, and electronic mail messages, to communicate to employees.
- These communication efforts have not been particularly successful.
- On-going plans for major organizational changes, such as a merger and reorganization on the institutional level, as well as reorganization of departments handling IEQ issues at BWH, could affect IEQ issues as well as communication with employees.

Summary

In summary, our investigation documented that some BWH employees had health problems that could be explained by specific workplace exposures. Other employees, however, had diagnoses or symptoms that could be explained by a variety of factors, some of which could be work-related. Over the past two years, the number of workers' compensation claims for IEQ problems appears to have decreased. This decrease could be the result of major improvements to the ventilation systems and the control of sources of potential air contaminants. However, these measures to eliminate or reduce exposures to air contaminants in the work environment have not completely eliminated employee reports of problems. This suggests that air contaminants might not fully explain the IEQ problem, and that other contributing factors may be involved. The major organizational and communication shortcomings that we and others found at BWH probably contributed to misunderstandings about workplace hazards and employee illnesses. These shortcomings probably also contributed to anger, frustration, lack of trust, and worry among

employees. The resultant lack of meaningful dialogue and information exchange between employer and employees was not conducive to solving problems.

Issues related to workplace IEQ problems are complex and can be affected by many different factors. Factors such as ventilation systems and sources of air contaminants are tangible and, thus, more easily identified and corrected. BWH appears to have successfully addressed and corrected these tangible problems. On the other hand, intangible problems, such as those related to organization and communication, are less easily identified, and thereby, less easily addressed.

RECOMMENDATIONS

IEQ

- Continue to control any air contaminants from construction and renovation projects that could contribute to poor IEQ.
- Continue programs to reduce other workplace exposures to substances that could affect employees' health.
- Periodically inspect and maintain ventilation systems to insure proper functioning and effectiveness in providing good air quality to occupied areas.
- Continue environmental surveillance activities to periodically monitor potential for latex exposure.
- Conduct appropriate assessments to evaluate new or continued reports of IEQ problems.
- Ensure that hospital staff who are responsible for building systems that would be affected by construction and renovation projects be provided ample opportunity to provide input during the construction and renovation project planning process. (See Appendix D for other guidelines for construction and renovation projects.)

Return to Work

- Include exposure assessment and exposure control in the return-to-work decision tree.
- Assure that supervisors and administrators treat employees returning to work fairly and consistently.
- Establish effective lines of communication among the BWH Occupational Health Department, the employee's health care provider, the employee's supervisor, and the employee returning to work. (See Appendix C for other return-to-work guidelines).

Organization and Communication

We cannot provide specific prescriptions for organizational and communication problems because these issues are affected by a multitude of factors which are specific to each workplace and can change over time. However, resolving organizational and communication problems may be important to the resolution of IEQ problems. Therefore, addressing organizational and communication problems should be a priority. This is a difficult task that will require collaboration between employer and employees. Recognition of the multifaceted nature of the problems and clarification of issues and points of view are important to the process. All parties should recognize that short-term resolution is probably unrealistic, and that a long-term dynamic process may be necessary. The process would best be facilitated by a mutually agreed upon independent consultant who is familiar with organizational andcommunication issues.We also recommend the following:

- Improve the coordination of occupational health and environmental health services. In addition to clarifying the roles and responsibilities of each department, relationships among all departments involved in maintaining a safe and healthy workplace should be clarified.
- Assure that employees have sufficient information to understand the important factors that affect IEQ. These factors include patient-care, engineering, and administrative constraints that could affect solutions to building-related problems, as well as the purpose and function of ventilation systems and methods to control sources of potential exposures. Because of the complexity of IEQ issues and because many scientific research questions about IEQ have not yet been answered, an educational program may be necessary before meaningful dialogue between BWH and employees can take place.
- Address employee concerns, such as—
  - Workers' compensation processes and decisions
  - Confidentiality of medical records and conflicts of interest
  - Inability to open windows
  - The possibility of future health problems related to past or current building air quality problems.
- Anticipate and prepare for any disruptions to occupational health services and programs or changes in policy during reorganization.

REFERENCES

1. Hodgson, MJ [1989]. Clinical diagnosis and management of building-related illness and the sick-building syndrome. Occupational Medicine: State of the Art Reviews 4(4):593-606.

2. Kreiss K [1989]. The epidemiology of building-related complaints and illness. Occupational Medicine: State of the Art Reviews 4(4):575-592.

3. Norbäck D, Michel I, Widstrom J [1990]. IAQ and personal factors related to the sick building syndrome. Scan J Work Environ Health 16:121-128.

4. Morey PR, Shattuck DE [1989]. Role of ventilation in the causation of building-associated illnesses. Occupational Medicine: State of the Art Reviews 4(4):625-642.

5. Mendell MJ, Smith AH [1990]. Consistent pattern of elevated symptoms in air-conditioned office buildings: A reanalysis of epidemiologic studies. Am J Public Health 80(10):1193-1199.

6. Molhave L, Bach B, Pedersen OF [1986]. Human reactions during controlled exposures to low concentrations of organic gases and vapours known as normal indoor air pollutants. Environ Int 12:167-175.

7. Fanger PO [1989]. The new comfort equation for IAQ. ASHRAE J 31(10):33-38.

8. Burge HA [1989]. Indoor air and infectious disease. Occupational Medicine: State of the Art Reviews 4(4):713-722.

9. Robertson AS, McInnes M, Glass D, Dalton G, Burge PS [1989]. Building sickness, are symptoms related to the office lighting? Ann Occup Hyg 33(1):47-59.

10. Wallace LA, Nelson CJ, Dunteman G [1991]. Workplace characteristics associated with health and comfort concerns in three office buildings in Washington, D.C. In: Geshwiler M, Montgomery L, and Moran M, eds. Healthy buildings. Proceedings of the ASHRAE/ICBRSD conference IAQ '91. Atlanta, GA. The American Society of

Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

11. Haghighat F, Donnini G, D'Addario R [1992]. Relationship between occupant discomfort as perceived and as measured objectively. Indoor Environ 1:112-118.

12. NIOSH [1991]. Hazard evaluation and technical assistance report: Library of Congress Madison Building, Washington, D.C. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH Report No. HETA 88-364-2104 - Vol. III.

13. Skov P, Valbjørn O, Pedersen BV [1989]. Influence of personal characteristics, job-related factors, and psychosocial factors on the sick building syndrome. Scand J Work Environ Health 15:286-295.

14. Boxer PA [1990]. IAQ: A psychosocial perspective. J Occup Med 32(5):425-428.

15. Baker DB [1989]. Social and organizational factors in office building-associated illness. Occupational Medicine: State of the Art Reviews 4(4):607-624.

16. CDC [1992]. NIOSH recommendations for occupational safety and health: Compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 92-100.

17. Code of Federal Regulations [1989]. OSHA Table Z-1-A. 29 CFR 1910.1000. Washington, DC: U.S. Government Printing Office, Federal Register.

18. ACGIH [1995]. 1995-1996 Threshold limit values for chemical substances and physical agents and biological exposure indices. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

19. ASHRAE [1989]. Ventilation for acceptable IAQ. Atlanta, GA: American Society of Heating, Refrigerating, and Air-conditioning Engineers. ASHRAE Standard 62-1989.

20. ASHRAE [1992]. Thermal environmental conditions for human occupancy. Atlanta, GA: American Society for Heating, Refrigerating, and Air-conditioning Engineers. ANSI/ASHRAE Standard 55-1992.

21. ACGIH [1989]. Guidelines for the assessment of bioaerosols in the indoor environment. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

22. OSHA, Code of Federal Regulations [1989]. Recording and Reporting Occupational Injuries and Illnesses, 29 CFR 1904. Washington, DC: U.S. Government Printing Office, Federal Register.

23. Hunt LW, Fransway AF, Reed CE, Miller LK, Jones RT, Swanson MC, Yunginger JW [1995]. An epidemic of occupational allergy to latex involving health care workers. JOEM 37:1204-1209.

24. NIOSH [1997]. NIOSH alert: Preventing allergic reactions to natural

rubber latex in the workplace. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 97-135.

25. American Academy of Allergy and Immunology [1986]. Position statements: Clinical ecology. J Allergy Clin Immunol 78(2):269-271.

26. American College of Physicians [1989]. Position paper: Clinical ecology. Annals of Internal Medicine 111(2):168-178.

27. American Medical Association Council of Scientific Affairs [1992]. Council report: Clinical ecology. JAMA 268(24):3465-3467.

28. Washington State Department of Labor and Industries, Safety and Health Assessment & Research for Prevention (SHARP) Program [1997]. Personal communication about the SHARP Latex Allergy Awareness and Needs Assessment Survey in acute care hospitals in Washington state, May 1996-May 1997.

Table 1
Departments within Work Areas
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

Work Area	Floors	Department	
Patient Tower	Lower Levels L1 and L2	Operating Rooms (OR) Recovery (PACU) OR Central Processing OR Central Supply Labor and Delivery[a] Neonatal Intensive Care[a]	Day Surgery Research Organ Bank Clinical Engineering Catheterization Laboratory Central Services
	3, 4	Obstetrics[a]	
	8	Cardiac Intermediate, Special, and Intensive Care Surgical Intensive Care	
	12	Medical and Surgical Cardiac Stepdown	Coronary Intensive Care
	5 6 7 9 10 14 15 16	Obstetrics, Gynecology, Antenatal Surgical Oncology, Gynecology, Neurology General Surgery, Special Care, Surgical Intensive Care, Burn Clinical, Medical Intermediate, Medical Intensive Care, Bone Marrow Transplant Medicine, Hematology and Oncology Renal Transplant, Rheumatology, Orthopedics, Medical Rheumatology, Orthopedics Physical Therapy, Orthopedics	
	Multiple	Engineering, Environmental Services	
Center for Women and Newborns	5 6 7, 8, 9	Labor and Delivery Newborn Intensive Care Antenatal, Postpartum, Nursery	
Other buildings		Ambulatory Clinics Blood Donor Hematology, Oncology Radiation Oncology Obstetrics, Gynecology Family Planning Occupational Health	Laboratories Radiology Medical Records Tumor Registry Finance Communications Reservations

[a]Departments were relocated to the Center for Women and Newborns beginning in 1993-1994.

Table 2
Employees Interviewed On-Site[a] by Job Title and Work Area, July 15-16, 1996
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

		"High-reporting" floors				"Low-reporting" floors			
		8[b]	**12[b]**	**OR[c]**	**CWN 5[d]**	**6[b]**	**7[b]**	**14[b]**	**Total**
Job titles	Staff nurse	7 / 26[e]	8 / 20	5 / 64	4 / 16	8 / 12	7 / 20	4 / 9	43 / 167 (26%)
	Nursing assistant[f]	2 / 6	1 / 3	0 / 21	2 / 3	1 / 1	1 / 4	0 / 1	7 / 39 (18%)
	Technician	0 / 0	0 / 0	3 / 23	1 / 3	0 / 0	0 / 0	0 / 0	4 / 26 (15%)
	Nurse in charge[g]			1 / 3	1 / 2			1 / 3	3 / 8 (38%)
	Unit secretary[h]	2 / 4	2 / 4	1 / 5	2 / 2	2 / 4	2 / 3	1 / 4	12 / 26 (46%)
	Housekeeper[i]	2	1		1		1		5
	Dietary[j]		1						1
Total interviews by floor		13 / 38 34%	13 / 31 42%	10 / 116 7%	11 / 27 41%	11 / 17 65%	11 / 28 39%	6 / 17 35%	
Total by reporting category		47				28			75

[a]The numbers in this table do not include employees who were interviewed for background information, such as the nurse managers from each of the interviewed floors and engineering department employees.
[b]Patient Tower floor.
[c]Operating Room on Patient Tower floor L1.
[d]Center for Women and Newborns, 5th floor
[e]Denominators are estimated numbers of employees working on the floor at the time of the interviews. Exact numbers were difficult to determine because different employees had different, (some overlapping), shift schedules (such as 7 a.m. to 3 p.m., 7 a.m. to 7 p.m., or 3 p.m. to 11 p.m.).
[f]Licensed practical nurses, patient care assistants, and unit service assistants.
[g]Nurses in charge were not identified on all daily staffing schedules.
[h]Or unit coordinator.
[i]Employees were selected because of availability rather than by random sampling. In some cases, housekeepers were not regularly assigned to a floor. Up to 4 housekeepers were assigned to a Patient Tower floor on the days of the interviews. However, none or only one might have been on the floor at any particular time.

[j]Three dietary employees were assigned to the 12th floor, but only one was available for interview.

Table 3
Characteristics of Employees Interviewed Outside the Workplace, July 17-18, 1996[a]
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

		Patient Tower floors				All other areas[c]
		3-4[b]	8	12	L1	
Number interviewed		3	3	8	7	15
Ages (years) of employees interviewed		38-43	33-43	33-51	35-56	33-54
Gender	Female Male	3	3	8	5 2	14 1
Job titles	Staff nurse LPN Technician Physician	3	3	6 1	3 1 1 1	10 1
	Unit secretary Unit coordinator Supervisor			 1	1	 1
	Housekeeper Engineering					1 1
Currently working at BWH	Yes No Not reported	3	2 1	8	2 4 1	6 9

[a]Includes 3 telephone interviews conducted on later dates.
[b]Units from these floors moved to the Center for Women and Newborns (CWN), a new building adjacent to the patient towers, in 1993-1994.
[c]Includes other BWH buildings, such as CWN, as well as other Patient Tower floors.

Table 4
Comparison of Information Sources for Health Outcomes
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	Workers' compensation	OSHA logs	IAQ logs	BWH OHD[a] database[b]
Information since—	1991[c]	1991[c]	July 1995	Fall 1993
Name	+	+	+	+
Job title	+	+/–	+/–	+
Work area	+	+/–	+	+
Date of illness	+	+	+/–	+/–
Symptom	+/–	–	+/–	+
Diagnoses	+/–	–	–	+/–
Work status	+	–	–	+
Inclusion criteria	If claim filed	If recognized as recordable[d]	If reported by employee	If reported to OHD

[a]Occupational Health Department.
[b]Information from this database was not easily retrievable in a useful format.
[c]Records before 1991 were available, but not reviewed. The MNA request reported that problems related to indoor air quality began in the spring of 1993. Records from 1991 and 1992 were reviewed to establish a baseline.
[d]". . . [A]ny occupational injuries or illnesses which result in fatalities, . . . lost workday cases, . . . [or] nonfatal cases without lost workdays which result in transfer to another job or termination of employment, or require medical treatment (other than first aid) or involve loss of consciousness or restriction of work or motion. This category also includes any diagnosed occupational illnesses which are reported to the employer but are not classified as fatalities or lost workdays." [29 CFR 1904]

Table 5
Diagnostic Consistency Between Claimants' Physicians and Other Examiners
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

Type of examiners	Number claimants	Diagnoses	Number claimants	Percent
Claimant's physician (PMD[a]) *and* Insurer's examiner (IME[b])	59	Similar[c]	10	69%
		Similar but PMD > IME[d]	20	
		Similar but PMD < IME[e]	11	
		Different	18	31%
Claimant's physician (PMD) *and* Examiner appointed by the workers' compensation board (IMP[f])	27	Similar[c]	2	81%
		Similar but PMD > IMP[d]	10	
		Similar but PMD < IMP[e]	10	
		Different	5	19%

[a]Personal medical doctor.
[b]Independent medical examiner.
[c]Apparent agreement on diagnosis, diagnostic certainty, and severity of condition.
[d]PMD indicated a greater diagnostic certainty or greater severity of condition than the IME or IMP.
[e]IME or IMP indicated a greater diagnostic certainty or greater severity of condition than the PMD.
[f]Impartial medical examiner.

Table 6
Diagnostic Consistency Among Examiners by Type of Diagnosis and Type of Examiner
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

Diagnostic categories[a]	**Any examiner** number (%)	**PMD** number (%)	**IME** number (%)	**IMP** number (%)	**Other**[b] number (%)
Upper respiratory	70 (37)[c]	11 (14)	13 (14)	5 (16)	39 (29)
Reactive airways	80 (42)	25 (32)	36 (38)	18 (56)	39 (29)
Other lower respiratory	38 (20)	7 (9)	2 (2)	5 (16)	28 (21)
Urticaria or angioedema	28 (15)	7 (9)	7 (7)	8 (25)	14 (10)
Rash or other skin condition	29 (15)	4 (5)	8 (8)	3 (9)	16 (12)
Latex allergy	42 (22)	15 (19)	21 (22)	10 (31)	12 (9)
Any allergies[d]	83 (43)	27 (35)	37 (39)	20 (63)	31 (23)
Related to					
Building or IAQ[e]	54 (28)	14 (18)	5 (5)	4 (13)	42 (31)
Chemical sensitivity[a]	31 (16)	21 (27)	0	10 (31)	5 (4)
Either of the above	70 (37)	30 (39)	5 (5)	11 (34)	43 (32)
Other diagnoses					
Headache	8	4	1		4
Syncope or presyncope	9		1		9
Heart findings	10	2	1		8
Other lung conditions	3	2	1		1
Neurobehavioral	10	3	8	3	3
Unrelated to work	11	1	8	2	0
Total seen by type of examiner	191	77	95	32	135

[a]Diagnoses were listed without regard to work-relatedness. See Table 7 for diagnoses included in these categories.
[b]BWH Occupational Health Department saw 93 individuals, BWH Emergency Department saw 7, and the local hospital not affiliated with BWH saw 50. Some individuals were seen by more than one of these examiners.
[c]Percent of total seen by type of examiner. For example, 37% of the 191 claimants seen by any examiner had diagnoses of upper respiratory conditions. Column totals exceed 100% because some claimants could have had more than one diagnosis.
[d]Includes latex and glutaraldehyde allergies
[e]Indoor air quality.

Table 7
Diagnostic Categories Used in Analyses of Worker's Compensation Information
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

Diagnostic category	**Diagnoses in medical records**
Upper respiratory	Rhinitis, sinusitis, upper respiratory symptoms
Reactive airways	Asthma and possible asthma, reactive airways, airways obstruction, wheezing
Other lower respiratory	Bronchitis, lower respiratory irritation, chest tightness, shortness of breath, cough, laryngitis (*does not include* lung conditions listed in "Other diagnoses" of this table)
Urticaria or angioedema	Angioedema, urticaria, hives
Rash or other skin condition	Dermatitis (allergic, atopic, or irritant), rash, erythema (redness)
Latex allergy	Confirmed or possible
Glutaraldehyde allergy	Confirmed or possible
Any allergies	Allergies to specified allergens (such as to latex and glutaraldehyde) as well as nonspecified allergies (such as urticaria and allergic rhinitis)
Related to building or poor IAQ	Building-related, indoor air quality, sick building
Chemical sensitivity	Chemical sensitivity, environmental sensitivity, multiple chemical sensitivity
Other diagnoses Headache Syncope or presyncope Heart findings Other lung conditions Neurobehavioral	 Headache, migraine headache Dizziness, lightheadedness, presyncope, syncope Palpitations, tachycardia, cardiac dysrhythmia Bronchiectasis, chronic obstructive lung disease, pneumonia Anxiety, conversion reaction, depression, fear, Munchausen's syndrome, panic disorder, stress

Table 8
Number of Workers' Compensation Claimants by Job Title and Job Function Category
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

Job function category	Number claimants	Job title	Number claimants
Clinical service providers	180	Physician	1
		Coordinator	3
		Nurse in charge	7
		Staff nurse[a]	152
		Licensed practical nurse	7
		Patient care assistant	7
		Nursing co-op	3
Technicians	23	Anesthesia technician	1
		Clinical engineer	1
		Instrument technician	1
		Inventory control	3
		Medical technician	1
		OR[b] supply clerk	1
		Pharmacy co-op	1
		Processing technician	2
		Surgical technician	10
		Technician	2
Secretaries or receptionists in clinical service areas	22	Secretary	21
		Receptionist	1
Office employees	11	Benefits assistant	1
		Console operator	1
		Financial specialist	1
		Medical records analyst	1
		Medical records assistant	2
		Practice assistant	1
		Registrar	2
		Supervisor	2
Employees in multiple areas	5	Housekeeper	4
		Carpenter	1
Total			241

[a]Eligible for membership in the Massachusetts Nurses Association; all others not eligible.
[b]Operating room.

Table 9
Number of Workers' Compensation Claimants by Work Area
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

Work area category	Number claimants	Work areas included	Number claimants
Patient Tower lower levels	69	L1 L1 and L2 L2	64 2 3
Patient Tower floors 3-4	19	3rd floor 4th floor	8 11
Patient Tower floor 8	28	8 AB 8 C 8 D	20 4 4
Patient Tower floor 12	32	12 ABC 12 ABCD 12 D	14 1 17
Patient Tower other floors	42	5th, 6th, and 7th floors 9th floor 10th floor 11th floor 15th and 16th floor Other floors (including multi-floor assignments)	9 9 5 7 4 8
Center for Women and Newborns	23	5th and 7th floor 8th floor 9th floor	3 8 12
Other buildings	28	Buildings on same city block Amory Ambulatory Services Buildings (ASB) ASB I (L1, L2, Pike, 3) ASB II (1, L1) Peter Bent Brigham (PBB-A, PBB-MC) Off-site buildings Boylston, Longwood, Neville	 1 4 12 7 4

Table 10
Health Problems Reported During Confidential Employee Interviews at the Workplace, July 15-16, 1996
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

		"High-reporting" floors				"Low-reporting" floors			
		8	**12**	**OR[a]**	**CWN 5[b]**	**6**	**7**	**14**	**Total**
Number interviewed		13	13	10	11	11	11	6	75
Health problem attributed to poor IAQ[c]		6	7	6	7	7	5	2	40
Previous problem, but now resolved				1					1
Problem, but not attributed to poor IAQ		3		1		2		1	7
No health problems		4	6	2	4	2	6	3	27
Types of reported problems and number reporting problem	Headache	1	2				1	1	
	Dizziness	2	2			1		1	
	Fatigue			1					
	Upper respiratory	1		5	4	2	2	1	
	Throat tightness		1		1	2			
	Cough or wheezing	1			1	2			
	Shortness of breath	2		2		2		1	
	Chest tightness	1	1		1			1	
	Heart palpitations	2					1		
	Rash or hives	3	2	2		4	2		
	Itchiness	1		1		2			
	Latex allergy		3	3		2			

[a]Operating room.
[b]Center for Women and Newborns, 5th floor.

[c]Indoor air quality.

Table 11
Health Problems Reported During Employee Interviews
Outside the Workplace, July 17-18, 1996[a]
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

Health problems that employees associated with poor indoor air quality		Patient Tower floors				All other areas[c]
		3-4[b]	8	12	L1	
Head	Headache	1[d]	1	4	3	1
	Difficulty concentrating			1		
	Eye irritation				2	
Upper respiratory	Ear, nose, sinus, throat	2	1	3	3	2
	Throat tightness	1		1		1
Chest	Asthma	1	1	5	4	3
	Chest tightness	1	1	2	1	
	Shortness of breath	1	1	4	4	1
	Palpitations	1		1	1	1
Skin	Flushing		1			
	Sweating		1			
	Rash or hives	1	1	4	1	5
	Itching		1			
Other	Latex allergy			3		4
	Other allergy					5
	Chemical sensitivity			4		4

[a]Includes 3 telephone interviews conducted on later dates.
[b]Units from these floors moved to the Center for Women and Newborns (CWN) in 1993-1994.
[c]Includes other BWH buildings, such as CWN, as well as other floors in the Patient Tower.
[d]Number of employees reporting problem

Table 12
Summaries of Numbers of Illnesses Recorded on the BWH OSHA Logs, 1991-1995[a]
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991	1992	1993	1994	1995[b]
Skin	10	28	68	49	35
Lungs, dust		7	68	44	
Respiratory, toxic agents	3	8	15	1	
Systemic, toxic agents	7	7	16		
Physical agents		2			
All other					
Infectious	15	23	10	15	2
Irritant		2	28		
Loss of consciousness	1		2		
Stress		1			
Not classified[c]		6	80	41	308
Not classified, no injury					1
Total illnesses	36	84	287	150	346
Total injuries and illnesses	412	531	824	506	823
Percent illnesses	8.7%	15.8%	34.8%	29.6%	42.0%

[a]Numbers are based on the NIOSH review of the logs. Illnesses related to repeated trauma were not included. Differences between the numbers in this table and numbers reported on BWH summaries could be related to classification differences. Totals in this table include all multiple listings for individuals who were recorded more than once.

[b]Excludes December logs, which were not reviewed.

[c]Described on the OSHA logs as "multiple multiple" or "multiple nonclassifiable," indicating that the condition affected multiple body parts or showed multiple manifestations and, thus, did not fit into the more specific OSHA classifications.

Table 13
Comparison of Numbers of Illnesses Recorded on the BWH OSHA Logs[a] and Incidents Recorded on the BWH Indoor Air Quality Logs[b]
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	OSHA logs	IAQ logs		OSHA logs	IAQ logs
July 10-31, 1995	13	13	November 1995	32	37
August 1995	65	79	January 1996	15	21
September 1995	69	66	February 1996	37	51
October 1995	32	24	March 1996	12[c]	71[d]

[a]Excludes illnesses related to repeated trauma. OSHA logs for December 1995 were not reviewed.
[b]Employee encounters with the nurse case-manager triage system for IAQ incidents.
[c]15 days reviewed
[d]31 days reviewed

Table 14
Number of Incidents Recorded on BWH
Indoor Air Quality Logs by Work Area and Month
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

		1995						1996		
Building	**Floor[a]**	**Jul[b]**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**
Patient Tower	6								15	3
	8		47	9	7	7	7	2	2	7
	10		14	11		4	2			1
	12	13	15	15		1	5	4		2
Center for Women and Newborns	5			1		5	46	4	5	1
	9			2	1		3	3	8	6

[a]Floors with lower frequencies of reported incidents are not included in this table.
[b]The triage system began on July 10.

Table 15
Workers' Compensation Claims and Recorded Illnesses[a] on the OSHA Logs
January 1991 - March 1996
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

Workers' compensation claims	OSHA logs		Total
	Yes	No	
Yes	180[b]	61	241[b]
No	787[c]		
Total	967[c]		

[a]Excludes illnesses related to repeated trauma.
[b]Number of workers' compensation claimants. For this row, each claimant was counted only once, even if a claimant could have been listed more than once on the OSHA logs.
[c]An estimate because (1) the OSHA logs for December 1995 and the latter half of March 1995 were not reviewed and numbers from those dates were not included, and (2) individuals with more than one recorded illness on the OSHA logs were counted each time they were listed.

Table 16
Workers' Compensation Claims by Work Area and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[a]				1992				1993				1994				1995				96	
Work area	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Patient Tower L1-L2					1		2		7	15	21	2	6	5	1	1	2	2	3	2	1	71
Patient Tower 3-4	1										1	13	2	3								20
Patient Tower 8										1		2	15	1			2	3	5	2		31
Patient Tower 12												3	7	9			5	5	2	1		32
Patient Tower, all other[b]						1	1	1	1	1	4	6	12	6	2		1	6	2	3		47
CWN[c]											2	6	8	4		2				1		23
Other BWH buildings										3	6	7	6	2			1	1	1	1	1	29
Total claims by quarter[d]	1				1	1	3	1	8	20	34	39	56	30	3	3	11	17	13	10	2	253

[a]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.
[b]Floors 5-7, 9-11, 14-16.
[c]Center for Women and Newborns, a new building. Units from patient tower floors 3-4 and some units from the lower levels (e.g., labor and delivery, neonatal intensive care unit) were relocated to CWN in 1993-1994. Some of the early claims by CWN employees might be related to conditions that began before the move to CWN.
[d]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category.

Table 17
Workers' Compensation Claims by Diagnosis and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[a]				1992				1993				1994				1995				96	
Diagnostic category[b]	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Upper respiratory									1	7	12	13	18	5	1	1	4	3	4	1		70
Reactive airways							1		2	6	6	17	18	12		2	4	7	1	3	1	80
Other lower respiratory										2	7	6	15	4				1	3			38
Urticaria or angioedema										2	1	4	6	5			2	3	2	3		28
Skin										2	3	5	10	3	1			4	1			29
Latex allergy					1		1		1	1	1	12	12	7			3	2	1			42
Glutaraldehyde allergy									1			1	2	1								5
Any allergies[c]					1		1		2	5	3	16	21	13			4	10	4	2	1	83
Building or IAQ[d]									1	4	6	5	19	9		1	4	3	2			54
Chemical sensitivity									1	3	3	4	7	7			3	2	1			31
Either									1	5	8	9	22	13		1	5	4	2			70
Unrelated to work	1										1	3	1	1			2	2				11
No diagnoses in records						1	2	1	5	8	9	4	11	6			1	1	6	6	1	62
Total claims by quarter[e]	1				1	1	3	1	8	20	34	39	56	30	3	3	11	17	13	10	2	253

[a]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.
[b]See Table 7 for the diagnoses included in these categories.
[c]Includes latex and glutaraldehyde allergies.
[d]Diagnoses attributed to the building or poor indoor air quality.
[e]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category.

Table 18
Workers' Compensation Diagnoses of Latex Allergy by Work Area and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[a]				1992				1993				1994				1995				96	
Work area	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Patient Tower L1-L2					1				1		1	1		3			1					8
Patient Tower 3-4												3	2									5
Patient Tower 8												1					1					2
Patient Tower 12													2				1	1				4
Patient Tower, all other							1			1		3	6	2				1				14
CWN[b]												1	2	1								4
Other BWH buildings												3		1					1			5
Total claims by quarter[c]	0	0	0	0	1	0	1	0	1	1	1	12	12	7	0	0	3	2	1	0	0	42

[a]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.

[b]Center for Women and Newborns, a new building. Units from Patient Tower floors 3-4 and some units from the lower levels (e.g., labor and delivery, neonatal intensive care) were relocated to CWN in 1993-1994.

[c]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category.

Table 19
Diagnostic Certainty and Agreement Among Workers' Compensation Examiners
for 42 Claimants with Diagnoses of Latex Allergy
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

Number of examiners making diagnosis	Diagnostic certainty		
	Yes only	Yes and possible	Possible only
One	21		7
More than one	9	5	
Total	30	5	7

Table 20
Claims with Diagnoses of Latex Allergy Compared with All Workers' Compensation Claims Identified as Possibly Related to Poor Indoor Air Quality[a] by Work Area and Job Category
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	Clinical service providers		Clinical service secretaries or receptionists		Technicians		Office employees		Environmental services or engineering	
Work area	**Latex**	**All[a]**	**Latex**	**All**	**Latex**	**All**	**Latex**	**All**	**Latex**	**All**
Patient Tower floor										6[b]
L1-L2	4	46	1	5	3	20				
3-4	5	20								
8	2	28		3						
12	4	32								
All other	12	37	2	2		1		1		
Center for Women and Newborns	3	21	1	2						
Other buildings	3	7	1	10	1	2		10		
Totals	33	191	5	22	4	23	0	11	0	6
Percent latex allergy among all claims[a,c]	17.3%		22.7%		17.4%		0%		0%	

[a]All claims identified as possibly related to poor indoor air quality, including those with a diagnosis of latex allergy.
[b]Multiple work areas, including all tower and lower level floors.
[c]Crude estimate because diagnoses were not available for 21% of claimants.

Table 21
Concurrent Diagnoses for 42 Workers' Compensation Claimants with a Diagnosis of Latex Allergy[a]
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

Diagnostic category[a]	Latex allergy		Total within diagnostic category
	Yes	No	
Upper respiratory	12	58	70
Reactive airways	31	49	80
Other lower respiratory	7	31	38
Urticaria or angioedema	7	21	28
Rash or other skin condition	10	19	29
Building or IAQ[b] or chemical sensitivity	10	60	70
None of the above diagnoses[c]	5		

[a]Because of the difference of opinions among medical examiners, possible diagnoses were combined with confirmed diagnoses. See Table 7 for diagnoses included in the diagnostic categories.
[b]Diagnoses attributed to the building or poor indoor air quality.
[c]5 of the 42 claimants with a diagnosis of latex allergy did not have diagnoses in the categories listed above. Therefore, the number of claimants with latex allergy who also experienced problems within those diagnostic categories may be underestimated.

Table 22
Current Work Status of 42 Workers' Compensation Claimants with a Diagnosis of Latex Allergy
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

Diagnoses	Work status at BWH			Total
	Active	Leave of absence	Terminated	
Latex allergy *and* reactive airways[a]	9 (29%)	16 (52%)	6 (19%)	31
Latex allergy *without* reactive airways	5 (45%)	6 (55%)	0	11
Latex allergy	14 (33%)	22 (52%)	6 (14%)	42

[a]Includes asthma. See Table 7 for diagnoses included in the diagnostic categories.

Table 23
Workers' Compensation Diagnoses of Reactive Airways[a] by Work Area and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Work Area	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Patient Tower L1-L2									2	4	2	1	2	4		1		1		1	1	19
Patient Tower 3-4											1	7	2	1								11
Patient Tower 8												1	6				2	3		1		13
Patient Tower 12												1	4	3			2	1		1		12
Patient Tower, all other							1			1	1	2	3	2				2				12
CWN[c]											1	2	1	1		1						6
Other BWH buildings										1	1	3		1					1			7
Total claims by quarter[d]	0	0	0	0	0	0	1	0	2	6	6	17	18	12	0	2	4	7	1	3	1	80

[a]Includes asthma. See Table 7 for diagnoses included in this diagnostic category.

[b]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.

[c]Center for Women and Newborns, a new building. Units from Patient Tower floors 3-4 and some units from the lower levels (e.g., labor and delivery, neonatal intensive care) were reclocated to CWN in 1993-1994.

[d]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category.

Table 24
Allergies Among 80 Workers' Compensation Claimants
with Diagnoses of Reactive Airways
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

Diagnoses	Latex allergy	No latex allergy	Total
Any allergies[a]	31	16	47 (59%)
No allergies	–	33	33 (41%)
Total	31	49	80 (100%)

[a]Includes latex allergy.

Table 25
Workers' Compensation Claim Diagnoses Attributed to the Building orPoor Indoor Air Quality or Chemical Sensitivity
by Work Area and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Work area	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Patient Tower L1-L2									1	3	5		4	3				1	1			18
Patient Tower 3-4											1	4		1								6
Patient Tower 8												1	6	1								8
Patient Tower 12												1	4	4			4	3				16
Patient Tower, all other											1		3	3								7
CWN[c]												1	3	1		1						6
Other BWH buildings										2	1	2	2				1		1			9
Total by quarter[d]	0	0	0	0	0	0	0	0	1	5	8	9	22	13	0	1	5	4	2	0	0	70

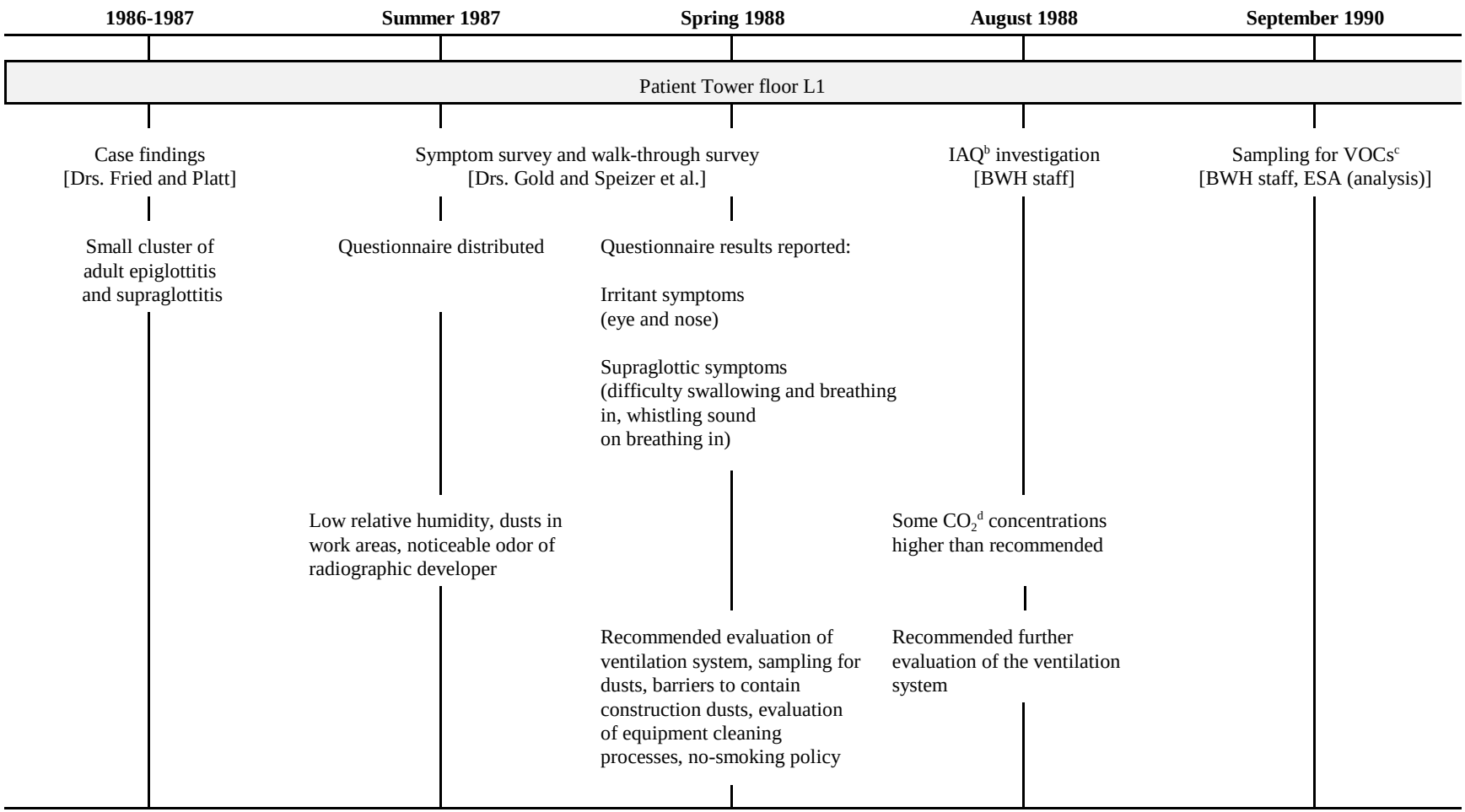
[a]See Table 7 for diagnoses included in this diagnostic category.
[b]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.
[c]Center for Women and Newborns, a new building. Units from Patient Tower floors 3-4 and some units from the lower levels (e.g., labor and delivery, neonatal intensive care) were reclocated to CWN in 1993-1994.
[d]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category.

Table 26
Concurrent Diagnoses for 70 Workers' Compensation Claimants with a Diagnosis Attributed to the Building, Poor Indoor Air Quality, or Chemical Sensitivity[a]
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

Diagnostic category[a]	Diagnosis attributed to the building, IAQ,[b] or chemical sensitivity		Total within diagnostic category
	Yes[c]	No	
Upper respiratory	31	39	70
Reactive airways	25	55	80
Other lower respiratory	18	20	38
Urticaria or angioedema	10	18	28
Rash or other skin condition	11	18	29
Latex allergy	10	32	42
Glutaraldehyde allergy	3	2	5
Any allergies[d]	25	69	83
None of the above diagnoses	13		

[a]Because of the differences of opinions among medical examiners, possible diagnoses were combined with confirmed diagnoses. See Table 7 for diagnoses included in the diagnostic categories.
[b]Indoor air quality.
[c]Claimants might have had diagnoses in more than one category.
[d]Includes latex and glutaraldehyde allergies.

Figure 1. Chronology of Events at Brigham and Women's Hospital[a]

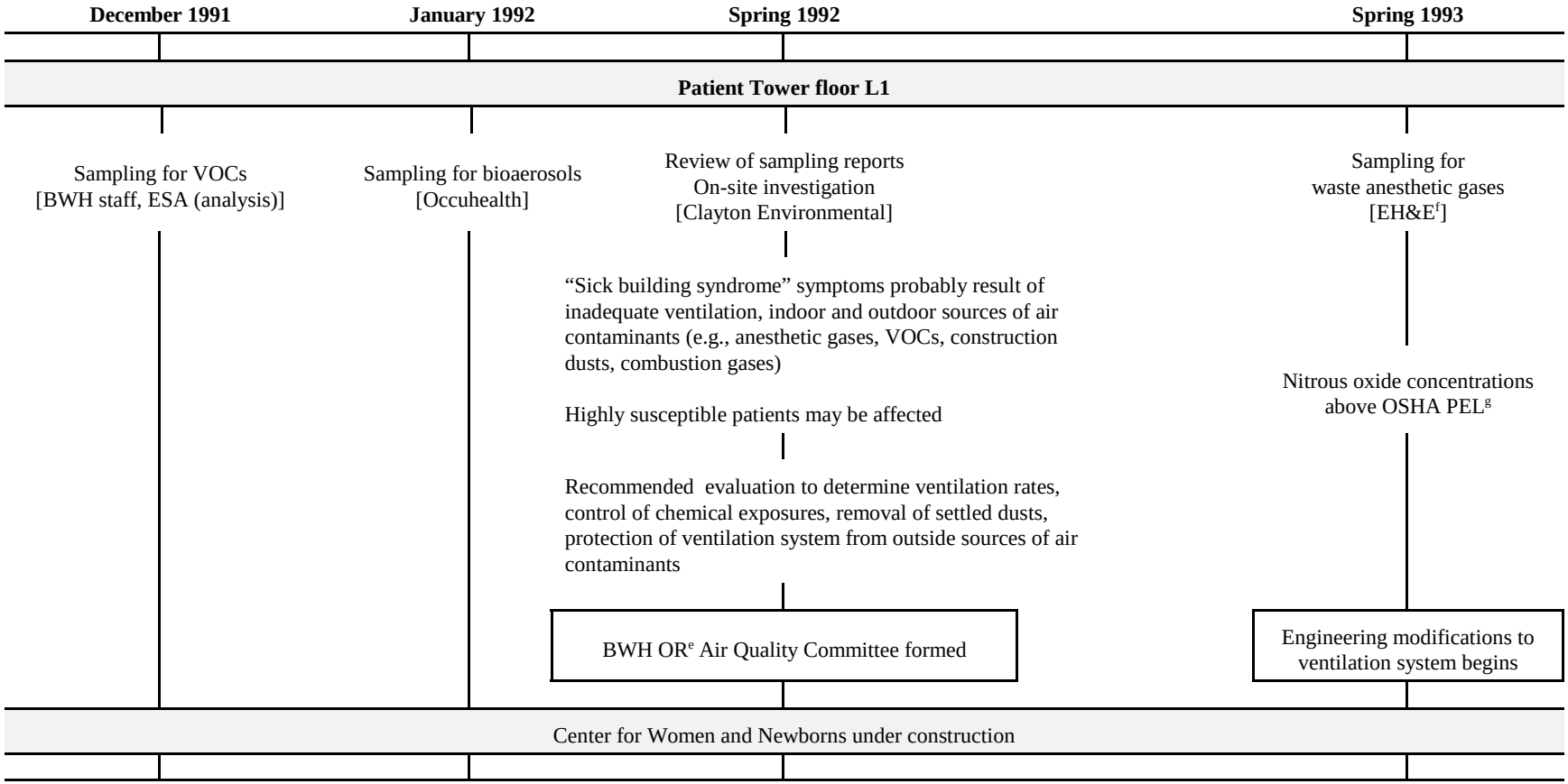


[a]Abstracted from reports of previous investigators. See abstracts of documents reviewed by NIOSH investigators (Appendix B) for details. Intervals marked on the time line are not constant. Because of overlapping events, some events may not be in exact chronological order. Investigators' findings, conclusions, and recommendations are summarized. BWH activities are in boxes.
[b]Indoor air quality.
[c]Volatile organic chemicals.

[d]Carbon dioxide, an indicator of inadequate ventilation.

Continued on next page.

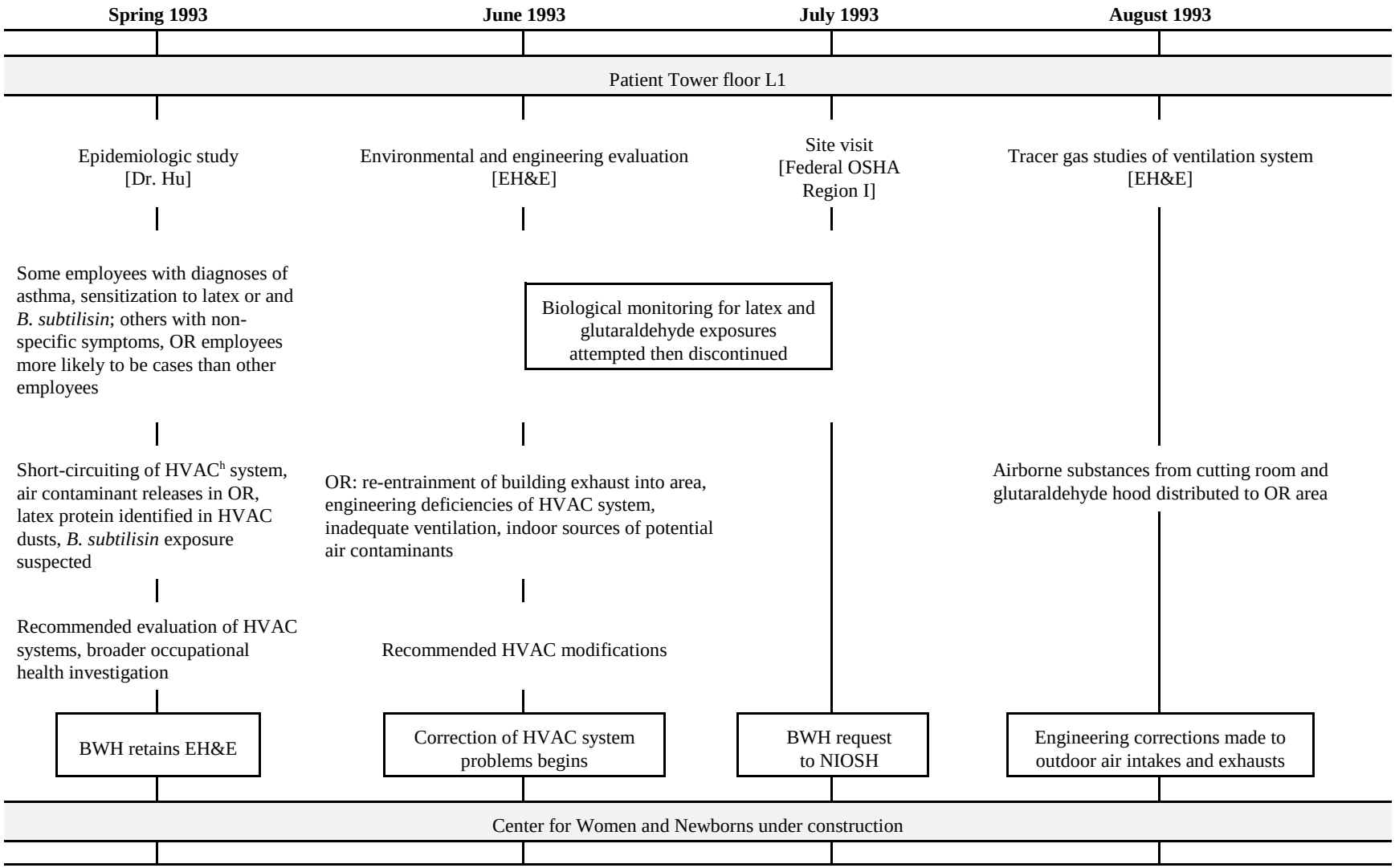
Figure 1. Chronology of Events at Brigham and Women's Hospital (continued)



[e]Operating room area on L1.
[f]Environmental Health and Engineering, Inc., a consultant to BWH.
[g]Permissible exposure limit.

Continued on next page.

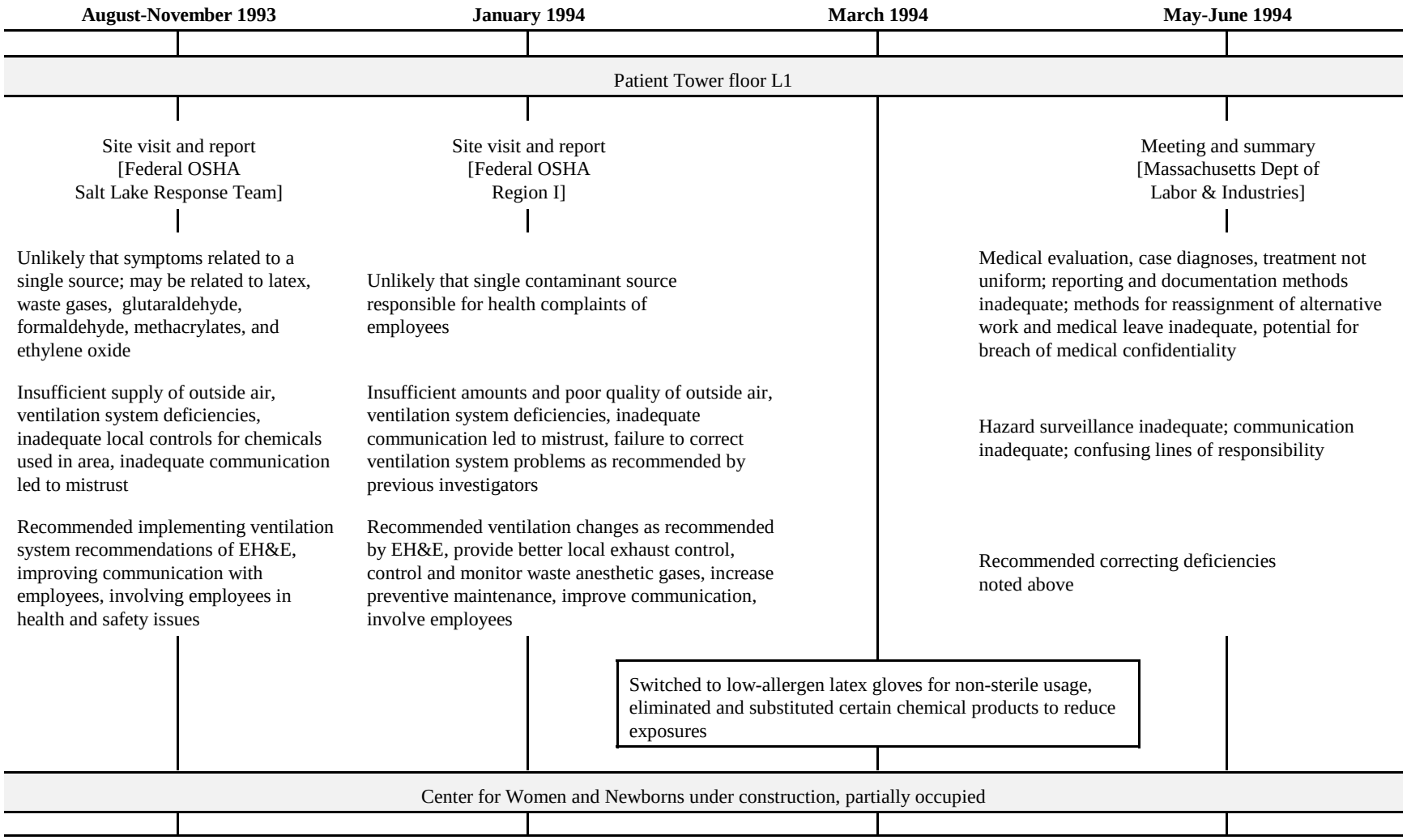
Figure 1. Chronology of Events at Brigham and Women's Hospital (continued)



[h]Heating, ventilation, and air conditioning.

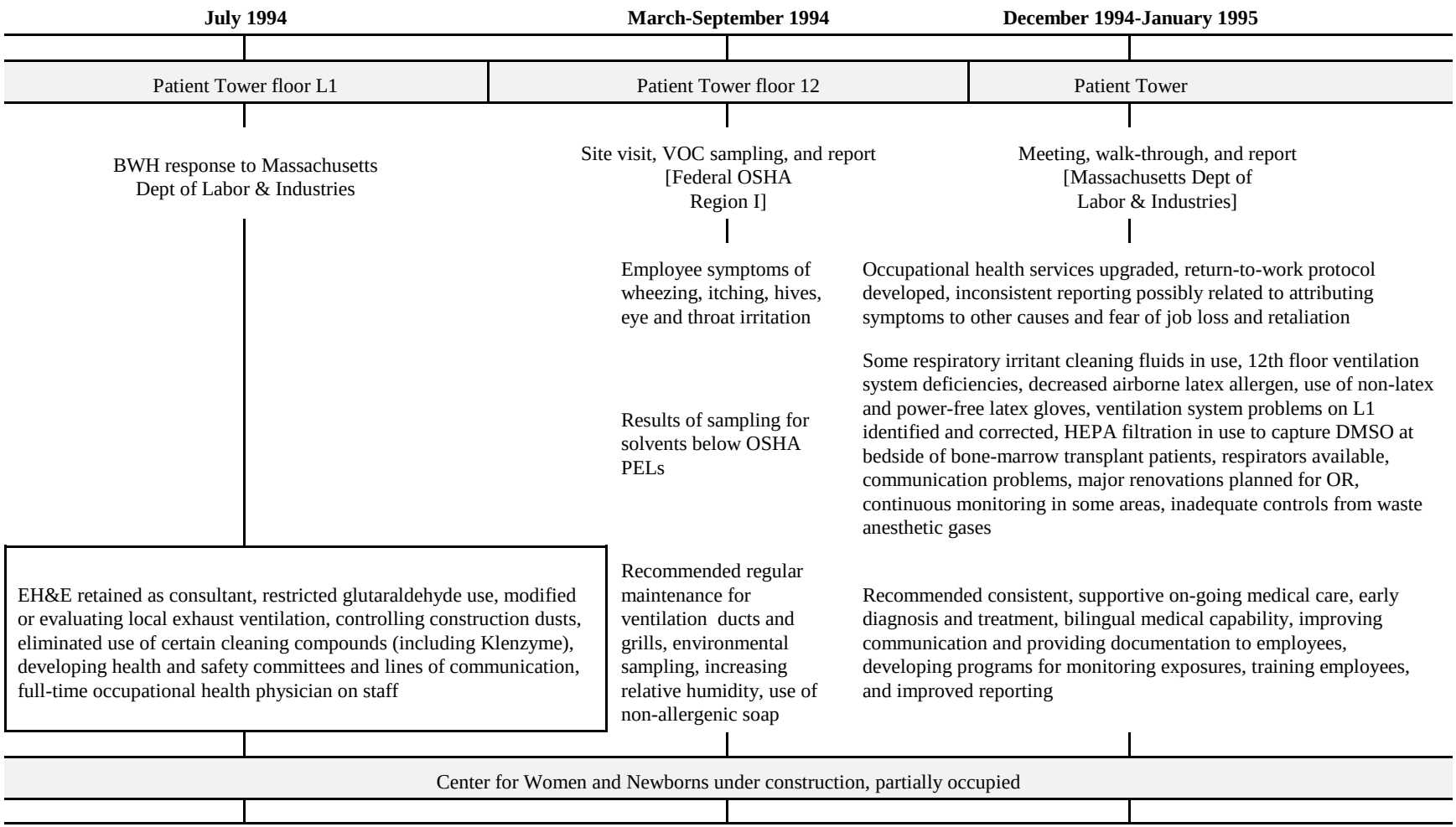
Continued on next page.

Figure 1. Chronology of Events at Brigham and Women's Hospital (continued)



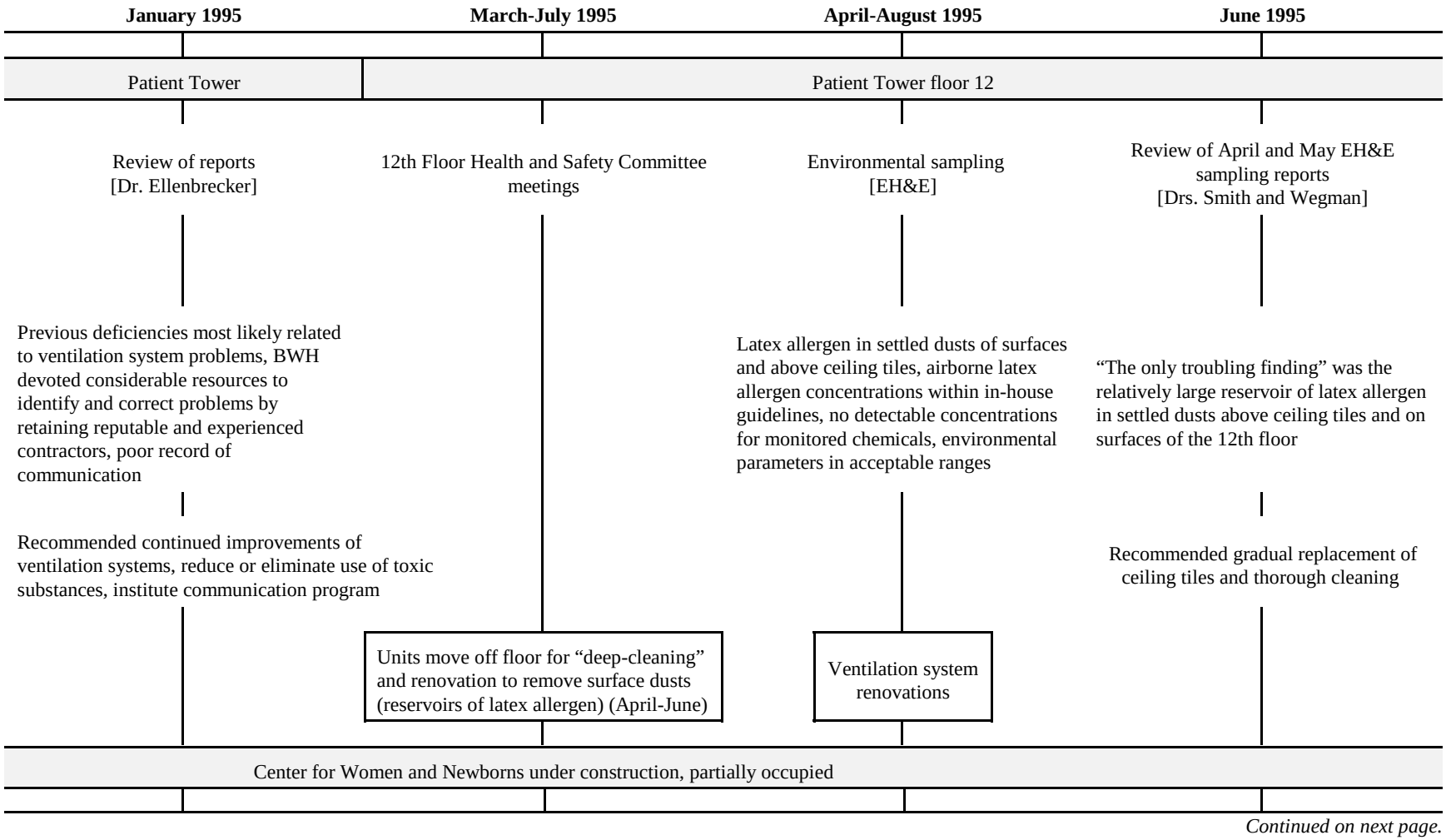
Continued on next page.

Figure 1. Chronology of Events at Brigham and Women's Hospital (continued)



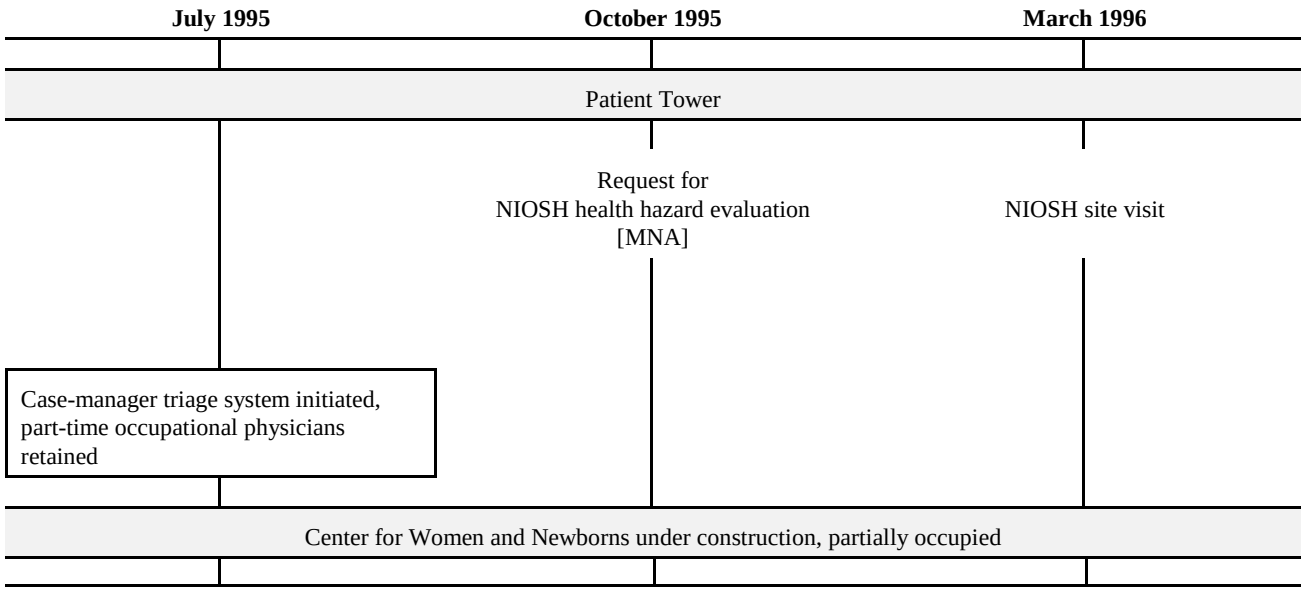
Continued on next page.

Figure 1. Chronology of Events at Brigham and Women's Hospital (continued)



Continued on next page.

Figure 1. Chronology of Events at Brigham and Women's Hospital (continued)



APPENDIX A

GLOSSARY

Definitions of words, terms, and abbreviations used in this report.
Italicized words or terms are defined in the glossary.

active employee Currently working employee; employee not on leave of absence or terminated.
accommodation Any change in the work environment or in the way things are usually done that would allow an individual with known physical or mental limitations to work; includes job restructuring, modifying work schedules, or reassignment to a vacant position.
acute Short-term, as in acute exposure. Of rapid onset, as in acute medical condition. Not *chronic*.
allergen Substance that causes an allergic reaction in a sensitized individual. Examples include pollens, molds, animal (e.g., cat, dog, horse) proteins, *latex* proteins. See *sensitization.*
antigen *Allergen.*
BWH Brigham and Women's Hospital, the subject of this health hazard evaluation. Areas included in the investigation were the *Patient Tower* and *Center for Women and Newborns (CWN).*
building-related illness In the literature, specific condition (such as hypersensitivity pneumonitis, humidifier fever, asthma, allergic rhinitis, infections, reactions to chemicals) that can be directly attributed to a specific building exposure (such as specific molds, bacteria, *allergens*, or chemicals). Not *sick building syndrome*. In this investigation, a determination made by some medical examiners when no specific illness and no specific exposure causing the *symptoms* could be identified, but the symptoms or discomfort appeared to be related to being in the building. Substitute term for *sick building syndrome*. *Non-specific symptoms* attributed to poor *indoor air quality* or *indoor environmental quality*.
bronchiectasis Lung condition characterized by abnormal widening of the smaller airways.
CWN Center for Women and Newborns, the *BWH* building adjacent and connected to the *Patient Tower*, under construction since the early 1990s and occupied in stages beginning in late 1993 by staff who previously worked in *Patient Tower* floors L1, 3, and 4. CWN was included in this NIOSH health hazard evaluation. The upper floors were still under construction at the time of the NIOSH site visit in March 1996.
case managers Nurse practitioners contracted through *EH&E* to staff the reporting and referral system established in July 1995 in response to the large numbers of reported *indoor air quality* episodes that began to overwhelm the capacity of the *BWH Occupational Health Department.*
cardiac dysrhythmia Irregular heart beat.
chronic Long-term, as in chronic exposure. Long lasting, as in chronic medical condition. Not *acute*.
chronic obstructive lung disease Lung condition characterized by an abnormal increased retention of air by the lungs caused by airway obstruction. Frequently related to smoking tobacco, less frequently related to an inherited condition. Also referred to as chronic obstruction pulmonary disease (COPD) or emphysema.
claimant In workers' compensation, employee who files a claim of work-related illness or injury.
clinical diagnosis Diagnosis made by a medical examiner that is based on the strength of the available clinical evidence (e.g., consistency of the history and examination findings with the diagnosis, and the ruling out of other possible diagnoses); i.e., diagnosis not necessarily *confirmed* by laboratory or other *objective* tests.

cluster Occurrence of a number of illnesses or other events that seem to be more than would be expected for a particular place within a relatively short time interval.

collective bargaining unit Employees who are eligible for membership in a labor organization that represents employees in labor-management relations (such as contract negotiations, grievances, and arbitration).

confirmed diagnosis Diagnosis confirmed by laboratory or other *objective* tests. See also *clinical diagnosis.*

contract physicians Occupational health physicians contracted through *EH&E* to provide an alternative to *BWH Occupational Health Department* services in July 1995, in anticipation of a large number of reports related to reoccupation of Patient Tower floor 12.

conversion reaction Transformation of an emotion into a physical condition.

date of illness For *OSHA logs*, date of initial diagnosis, or, if absent from work before diagnosed, first day of absence attributable to the illness. For workers' compensation, date of onset of illness, which could be one of a number of dates, such as date of initial symptoms, date symptoms became acute or severe, or date of diagnosis.

diagnosis of exclusion Diagnosis made by a medical examiner that is made only after all other possible diagnoses have been ruled out. Usually made for a condition in which the diagnosis is not necessarily *confirmed* or excluded by laboratory or other *objective* tests. See also *clinical diagnosis.*

disability An individual's inability to meet personal, social, work, or other demands; a disability may be considered *work-related* if shown to be caused or aggravated by work or conditions at work.

EH&E Environmental Health and Engineering, Inc., an environmental health and engineering consultant to *BWH*.

encounter logs See *IAQ encounter logs.*

Emergency Department *BWH* department providing the hospital's emergency medical services. Employees were referred to the Emergency Department if their health problems were acute, severe, or occurred when the *BWH Employee Health Services* or *Occupational Health Department* was closed.

Employee Health Services *BWH* department providing general medical services to employees. When *indoor air quality* problems arose, part-time occupational health physicians provided occupational health services. In the summer of 1995, this department was reorganized into the *Occupational Health Department*, which no longer provides general medical services.

Environmental Affairs BWH department providing environmental health and engineering services, including environmental monitoring and recommendations for control of environmental exposures to prevent work-related injuries and illnesses.

Environmental Engineering *BWH* department providing building and ventilation maintenance services.

Environmental Services *BWH* department providing housekeeping services.

float Employee (e.g., staff nurse) assigned to fill temporary gaps in staffing.

HEPA High efficiency particulate air, as in HEPA filter.

HVAC Heating, ventilation, and air conditioning.

IAQ Indoor air quality. *BWH* and *MNA* used this term to refer to problems attributed to poor indoor air quality.

IAQ encounter logs Logs documenting employee encounters about *IAQ* issues with the nurse case-manager triage system set up by *BWH* in July 1995 in response to an anticipated large number of reported problems related to reoccupation of Patient Tower floor 12.

IEQ Indoor environmental quality. NIOSH uses this term to refer to problems and issues that others sometimes call *IAQ*-related, because the problems are not necessarily related to air quality.

illness Disease, vis-à-vis *injury*. See also *occupational illness.*

inactive employee Employee not currently working at *BWH,* i.e., on leave of absence or terminated.

independent medical examiner (IME) In Massachusetts, a physician retained by the employer's workers' compensation insurance carrier to make a determination on whether a claimant's case is related to work.

impartial medical examiner (IMP) In Massachusetts, a physician appointed by the workers' compensation board to review a workers' compensation case.

injury Damage or trauma, vis-à-vis *illness.*

lower levels (L1 and L2) Lower levels 1 and 2 under the *Patient Tower*.

latex Natural product from the rubber tree, which contains proteins that can cause allergic reactions in sensitized individuals. The proteins causing allergic reactions are called *allergens* or *antigens*.

MNA Massachusetts Nurses Association, the official representative for the *collective bargaining unit* of staff nurses at *BWH*.

migraine headache Headache related to widening of blood vessels, usually on one side of the head. May be associated with dizziness, nausea, vomiting, abnormal sensitivity to light, or seeing flickering or flashing lights.

multiple chemical sensitivity Term used to described a disorder in which *symptoms* in multiple organ systems of the body recur on exposure to many unrelated chemicals at doses far below those known to cause harmful effects in the general population.

Munchausen's syndrome Attention-seeking behavior through the use of self-induced conditions that resemble critical conditions requiring medical or surgical attention.

NIOSH National Institute for Occupational Safety and Health, institute of the Centers for Disease Control and Prevention, US Department of Health and Human Services, provider of health hazard evaluations at the request of employers, employees, or employee representatives.

nonspecific symptoms *Symptoms* that may be related to any of a number of causes or aggravating factors, thus making the true cause difficult to identify. For example, the symptoms described in *sick building syndrome*.

OSHA logs The Occupational Safety and Health Administration (OSHA) Logs and Summaries of Occupational Injuries and Illnesses, mandated by OSHA. See also, *recordable illness*.

objective Physical examination findings or test results observed by an examiner. Not *subjective*.

occupant Individual occupying an indoor area, such as a building or area within a building. At workplaces, employee assigned to a particular area.

Occupational Health Department *BWH* department providing occupational health services, including workers' compensation as well as acute care for work-related injuries and illnesses. Reorganized from *Employee Health Services* in 1995.

occupational illness For *OSHA Form 200,* any abnormal condition or disorder caused by exposure to environmental factors associated with employment, vis-à-vis *occupational injury*. Includes *acute* and *chronic* illnesses and diseases which may be caused by inhalation, absorption, ingestion, or direct contact.

occupational injury For *OSHA Form 200,* any injury (such as a cut, fracture, or sprain) resulting from a work accident or exposure involving a single incident in the work environment. See also *occupational illness.*

occupied area Area in which building *occupants* are generally located; includes work areas to which employees are assigned; does not include areas with intermittent traffic, e.g., corridors or storage areas.

PMD Personal medical doctor; for workers' compensation, *claimant*'s physician.

palpitations Sensation of increased force and rate of heart beat with or without irregular rhythm.

panic disorder Condition of intense anxiety or fear that may cause an affected individual to not be able to act, behave, function, or work normally.
pathological Not normal, diseased, not *physiological*.
Patient Tower 16-story *BWH* building with a floor plan in a cloverleaf pattern. One of the two buildings of concern in this *NIOSH* health hazard evaluation.
person-time For a population being studied, sum of all individuals' amounts of exposure time; person-time at risk is necessary to determine how often a *symptom* or disease is occurring in an exposed population.
physiological Normal, not *pathological*.
plenum Space between a suspended ceiling and its structural ceiling.
pneumonia Inflammation of the lungs, usually related to an infectious disease (e.g., bacterial or viral).
pod One of the four sections of a cloverleaf-shaped floor in the *Patient Tower* of *BWH*. Each pod is designated by a letter from "A" through "D."
RAST Radioallergosorbent test that measures immunoglobulin (Ig) E levels in the serum for specific *allergens*, such as some (but not all) *latex* proteins; elevated IgE indicates sensitization to the allergen. For *latex*, helpful if positive, but a negative result does not rule out *latex* allergy.
recordable illness On the *OSHA logs*, "any occupational . . . illnesses which result in fatalities, . . . lost workday cases, . . . [or] nonfatal cases without lost workdays which result in transfer to another job or termination of employment, or require medical treatment (other than first aid) or involve loss of consciousness or restriction of work or motion. This category also includes any diagnosed occupational illnesses which are reported to the employer but are not classified as fatalities or lost workdays." [29 CFR 1904]
sensitivity The state of being sensitive, may or may not be immunologically mediated.
sensitization Immunization, the initiation of an immunologically mediated response to an *allergen*. A sensitized individual may have a clinical response (allergic reaction) on re-exposure to the triggering allergen.
sick building syndrome Poorly defined term (thus of questionable usefulness) used to describe situations in which building occupants experience *acute symptoms* or discomfort that are attributed to poor indoor environmental conditions. Frequently reported symptoms include eye, nose, and throat irritation; headache; fatigue; respiratory symptoms; skin dryness, itching, or redness. Odors are also frequently reported. The term is used when no specific illnesses and no specific exposures causing the symptoms could be identified. See also *building-related illness*.
staff nurse Nonsupervisory registered nurses who make up the MNA *collective bargaining unit.*
stress Reaction to abnormal external states or forces that can disturb normal functioning.
subjective *Symptom* (such as headache) perceived by the individual experiencing it and not necessarily evident to an examiner. Not *objective*.
symptom Condition perceived to be abnormal by the individual experiencing it
syncope Fainting.
syndrome An aggregation of *symptoms* and *objective* findings associated with a particular disease process. Together, the symptoms and objective findings constitute a characteristic picture of that disease.
tachycardia Fast heart rate.
teaching hospital Hospital in which health professionals (such as medical students, resident physicians, and student nurses) are trained.
triage Screening system to prioritize patients' needs for the most efficient use of health care resources.
unit Work area within the hospital, e.g., surgical intensive care unit, coronary care unit, labor and delivery.
VOC Volatile organic chemicals, such as solvents.

work-related Related to activities or conditions at work. For example, a *disability* may be considered work-related if shown to be caused or aggravated by work or conditions at work.

References

Last J [1995]. A dictionary of epidemiologic terms. 3rd ed. New York: Oxford University Press.

EPA, NIOSH [1991]. Building air quality: A guide for building owners and facility managers. Washington, DC: U.S. Environmental Protection Agency.

OSHA, Code of Federal Regulations [1989]. Recording and Reporting Occupational Injuries and Illnesses, 29 CFR 1904. Washington, DC: U.S. Government Printing Office, Federal Register.

Stedman medical dictionary [1976]. Baltimore, MD: The Williams and Wilkins Company.

Webster's II new Riverside University dictionary [1984]. Boston, MA: Houghton Mifflin Co.

APPENDIX B

Abstracts of Documents Reviewed by NIOSH Investigators

We reviewed all of the documents provided to us. We abstracted documents pertaining to previous occupational and environmental health investigations and BWH activities in response to IEQ issues. We provide these abstracts to add details to the findings that we summarized in our report.

Date: March 4, 1988
Document: Letter
From: Diane Gold, M.D., M.P.H., (BWH Environmental/Occupational Health Center) and Frank Speizer, M.D. (Director, BWH Environmental/Occupational Health Center)
To: President, BWH

Re: Investigation for an environmental cause of the cluster of adult epiglottitis and supraglottitis observed on Patient Tower L1 in 1986-1987 by Dr. Marvin Fried (otolaryngologist) and Dr. Richard Platt (epidemiologist), and of the persistent complaints of irritant symptoms (eye irritation, runny nose, sneezing) reported among L1 employees in 1987.

Activities: Walk-through survey and questionnaire on Patient Tower L1, August-September 1987

Comment: "We have not yet received feedback from administration on the first draft of this report. It is essential that we give some form of feedback to our employees soon, or we will lose our credibility as effective hospital epidemiologists and, in addition, will lose cooperation in any further surveys which might be appropriate and necessary."

Date: May 23, 1988
Document: Cover letter and report (draft number 2)
From: A. Bauchner, R.N.C., M.S., D. Gold, M.D., M.P.H. (BWH Occupational and Environmental Health Center), Kristians Veinbergs (Asst. Vice President, BWH Administrative Services), and Frank E. Speizer, M.D. (Director, BWH Occupational and Environmental Health Center)
To: "Colleagues"

Re: Employee survey on Patient Tower L1, August 1987 (See letter of March 4, 1988)

Findings: Symptoms might be separated into two categories: irritant symptoms (eye irritation, runny nose, sneezing) and "supraglottic" symptoms (difficulty swallowing, difficulty breathing in, and whistling sound on breathing in).
Re: Irritant symptoms
- More irritant symptoms than expected.
- Past history of low humidity in some areas.
- Visible dust in many places.
- Odor of products used to develop x-ray film in some areas.

Re: Supraglottic symptoms
- More supraglottic symptoms than expected, but "not necessarily specific to supraglottic disease."
- No new cases reported by Dr. Fried (otolaryngologist) since the small cluster reported in 1986-1987.
- "Nothing more can be done to elucidate the [cause] of the cases [of adult epiglottitis and suproglottitis] which occurred. . . ."

Recommendations:
- Reduce employee exposure to passive smoke (implemented at time of report).
- Evaluate humidity and correct as necessary.
- Confirm amounts of make-up air supplied to occupied work areas.
- Evaluate problems with dust.
- Use barriers to separate construction areas from work areas.
- Evaluate x-ray film processing area and ensure proper exhaust ventilation.
- Evaluate ventilation systems for each area if there is a question of an irritant substance being circulated through the ventilation system.

Date: August 25, 1988
Document: Letter and analytical reports
From: Travon P. Zomback, M.P.H. (BWH Safety Department)
To: D. Gold, M.D., M.P.H. (BWH Occupational and Environmental Health Clinic)

Re: Follow up of recommendations for evaluating humidity on Patient Tower L1

Activities: Indoor air measurements for temperature, relative humidity, carbon dioxide, and air supply on Patient Tower L1, August 1-19, 1988

Conclusions: Observed concentrations of carbon dioxide ranged from acceptable (i.e., similar to outdoor air) to concentrations that cause doubt about the adequacy of the ventilation system (i.e., concentration of 900 parts per million, which is higher than the Massachusetts Department of Labor and Industry recommended maximum of 600 parts per million). Air flow was less than blue-print specifications. The Labor and Delivery area was not receiving any outside air until the temperature control unit was adjusted to allow a specified minimum amount of supplied air. Temperature and relative humidity were within their acceptable ranges.

Recommendations: Air changes per hour and air flow need to be evaluated and adjusted to meet changing needs related to spatial changes and the increase in number of occupants. These include evaluation of outside air ventilation rates, recalibrating variable volume boxes to achieve a set amount of supplied air into work areas, evaluate for obstructions in the ventilation systems, distribution of air supply, and remeasuring during colder weather.

Comment: "The information presented is only the tip of an iceberg and hopefully will promote further investigation into the operation of the ventilation system."

Date: May 20, 1992
Document: Letter
From: Philip R. Morey, Ph.D., CIH**.** Clayton Environmental Consultants (consultant to BWH)
To: Mr. George Weinert, Director, BWH Occupational Safety and Health

Re: Investigation of IAQ problems on Patient Tower L1(NICU, Labor and Delivery, Recovery), April 1992

Activities:
- Review of previous reports about IAQ investigations at BWH.
  - ESA Laboratories, Inc., report of volatile organic compound (VOCs) samples received from BWH on September 28, 1990, and December 13, 1991.
  - Occuhealth, Inc., report dated January 5, 1992, of bioaerosol sampling it performed.
  - BWH IAQ survey data of NICU.
- On-site investigation.

Findings:
- Concentrations of VOCs "sufficient to elicit sick building syndrome complaints such as eye, nose, throat, and skin irritation, headache, fatigue, mild neurotoxic symptoms, and odors."
- The limit of detection and guidelines used for bioaerosol sampling were not appropriate for health care facilities.
- Certain patients (e.g., infants in the NICU and immunosuppressed patients) may experience pronounced and severe health effects related to these types of exposures.
- The outdoor air intake for the ventilation system servicing L1 is located close to the exhaust for L1, adjacent to a large construction site, and approximately 70 feet from a temporary exhaust outlet for an adjoining laboratory and outpatient services building.
- The outdoor air intake areaway contained construction dusts and debris, and fungal colonies were observed in a few areas.

Conclusions:
- "Sick building syndrome" symptoms experienced by L1 employees were probably the result of a combination of factors, such as outdoor sources of VOCs and combustion gases, the low air supply, and indoor sources of VOCs and anesthetic agents.
- Highly susceptible patients exposed to indoor air contaminants for long periods of time may be affected.

- Dusts generated from outdoor construction areas (likely to contain *Aspergillus* spores), could affect patients with compromised immune systems.

Recommendations:
- Investigate low ventilation rates on L1 and increase air flow to comply with the recommendations provided.
- Control sources of air contamination and prevent future exposures.
  - Restrict use of solvents and chemicals.
  - Determine sources and control dispersion of anesthetic gases.
  - Remove settled dust from NICU with good housekeeping practices and use of a HEPA-filter vacuum cleaner.
  - Continue efforts to protect the HVAC system's outside air inlet.
  - Clean the make-up air intakes routinely with HEPA vacuum. Remove dirt from inlets to the ventilation system's air-handling units.
  - Replace water-stained, fungus-covered fiberboard from ceiling of the fan room of the air-handling unit (AC1N). Prevent future water damage.
- Protect patients with compromised immune systems from dusts generated during interior renovation and exterior construction.

Date: June 16, 1993
Document: Draft report
From: Howard Hu, M.D., M.P.H., Sc.D., BWH Employee Health Services, BWH Occupational and Environmental Medicine Service, Harvard Medical School, Harvard School of Public Health
To: Robert Murray, Senior Vice President, BWH

Re: Investigation of symptoms of employees working in BWH operating rooms. Report covered period April 1, 1992 - June 1, 1993.

Activities:
- Interviews with BWH operating room, Employee Health Services, Environmental Services, Engineering, and Emergency Department staff.
- Interviews with physicians responsible for employee health at other area hospitals.
- Review of written summaries of clinical examinations and interviews from BWH Employee Health Services and BWH Occupational and Environmental Health Center.
- Rough epidemiological study comparing rates of symptoms (e.g., nonspecific, upper or lower respiratory, eye, and skin) among operating room versus non-operating room employees.
- Review of written documents of previous IAQ investigations, including industrial hygiene sampling data.
- Review of Material Safety Data Sheets for products used in the operating rooms.
- Review of comments by operating room employees at two informational meetings.
- Review of the relevant scientific and public health literature.

Conclusions:
- Marked increase in work-related health complaints among BWH operating room employees compared to other employees from March 1993 through May 1993.

- No differences between operating room and other employees with regard to skin problems, which are possibly related to latex glove use.
- Ventilation system suspected as a primary factor in causation of health symptoms in the operating rooms.
- A case definition was lacking. Complaints considered work-related were broad and quite non-specific. Some symptoms could have been caused by exposures related to air contaminants with sources in the hospital. However, non-specific symptoms, such as headache, fatigue, dizziness, nasal congestion, eye irritation, and hair loss were more difficult to explain.
- Sub-population of employees developed "sensitization, i.e., the triggering of an immunological response to a specific antigen. The most debilitating form of this response has been asthma." Some employees were suspected to have new onset of asthma.
- Sub-population of employees "experiencing problems consistent with 'sick building syndrome'." Exposures to "low-level irritants and fungi/molds" might have contributed to the outbreak.
- "BWH has not been administratively prepared to deal with this type of crisis."
- Operating room employees are "anxious; some are angry. Communication has been slow, hampered by a lack of coordination and knowledge."
- Caveats: Potential for underestimating number of employees with symptoms, since results were based on reports to BWH Employee Health Services.

Recommendations:
- Perform a review of the operating room ventilation systems, retain an outside consultant to get third party perspectives.
- Ensure that ventilation systems provide adequate amounts of fresh air.
- Evaluate current and anticipated locations of HVAC outside air inlets.
- Additional epidemiological investigation suggested.
- Review chemical usage, especially use of any sensitizing agents.
- Aggressive efforts needed to identify sensitizing agent in question.
- Follow-up sensitized individuals, follow-up on case-by-case basis.

Date: July 21, 1993
Document: Letter, update on draft report dated June 16, 1993
From: Howard Hu, M.D., M.P.H., Sc.D.
To: BWH Operating Room Committee

Re: Review of status of BWH activities in response to problems in the operating rooms, July 1993

Conclusions:
- Symptoms are still being reported.
- Tracer gas studies by an environmental health and engineering consultant suggest that hood vapors enter two rooms of the operating room area.
- Sensitization to aldehydes may be occurring.
- Employees report "ongoing irritant/odor exposures from entrainment of motor vehicle exhaust fumes."

Status of activities:

- Self-administered symptom-reporting system being planned.
- BWH Employee Health Services clinicians briefed on adopting a unified approach to evaluating, managing, and advising operating room employees seeking medical attention.
- Advice of an occupational medicine specialist in obstetrics and gynecology sought about whether pregnancy-related transfers should be offered. Further discussion necessary.
- NIOSH consulted about a health hazard evaluation.
- Earlier findings of high prevalence of glutaraldehyde specific antibodies have not been reproduced. More specimens will not be sent to the laboratory. If the analytic problems are resolved, a Phase II epidemiologic study will be considered.
- A Phase II epidemiologic study using a questionnaire being finalized.
- Considering retaining a consultant.

Date: September 28, 1993
Document: Report (draft)
From: Environmental Health & Engineering, Inc. (EH&E), Newton, MA (Consultant to BWH)
To: Lisa Molodovsky, Office of General Council, BWH

Re: Indoor Air Quality Investigation of Patient Tower L1 (operating room suites) Summary Report

Activities:
- Engineering systems review of the ventilation systems, including use of tracer testing techniques.
- Continuous real-time monitoring of dew point, carbon dioxide, carbon monoxide, total aldehydes, total hydrocarbons, and sulfur hexafluoride.
- Air sampling for formaldehyde, glutaraldehyde, VOCs, anesthetic gases, and acid gases.

Conclusions:
- Redesign operating room ventilation systems to provide appropriate amounts of outside air, maintain appropriate pressure relationships (work accomplished or in progress)
- Total aldehydes: peak levels of 5.2 and 3.6 ppm, but chemicals used in the room may create positive interference.
- Carbon monoxide: measured at 2 and 3 times concurrent ambient levels, but level might have been influenced by anesthetic gases.
- Formaldehyde: generally less than 1% of the occupational standard (750 ppb), one sample detected 163 ppb.
- Glutaraldehyde: results ranged from 0.666 ppb to 6.6 ppb.
- VOCs: all below recommended values. Most prevalent were 1,1,1-TCE, toluene, ethyl benzene, xylene, isoflurane.
- Anesthetic gases: enflurane detectable only in trace quantities; isoflurane levels all below 25 ppb; nitrous oxide less than detectable limit except for one sample showing 13 ppm (from an operating room).
- Acid gases (air conc. at highest level detected): sulfuric acid: .076 mg/m^3; HCL: < 0.026; HF: < 0.027; nitric acid: < 0.026

Recommendations:
- Reconfigure the supply air shaft.

- Control source contaminants by substitution, reduction, and local exhaust ventilation.
- Training for individuals using chemicals, increase awareness of proper storage and handling to reduce fugitive emissions.
- Relocate general exhaust fans so that exhaust ducting is maintained under negative pressure when in building interior.
- Assure adequate maintenance of the supply fans.
- Maintain operating rooms under positive pressure by delivering constant supply air to the operating rooms.
- Expand "As-Built" drawing development to other operating rooms to identify deficiencies.
- Evaluate and institute controls to contain fume plumes with laser surgery.
- Repair, then evaluate Pathology Room slot hood.
- Commission all new and repaired ventilation control systems to insure performance prior to bringing them online.

Date: November 23, 1993
Document: Report
From: Kevin Cummins, MSPH, CIH, and Joan Shulsky. U.S. Department of Labor (US DOL), Occupational Health and Safety Administration (OSHA), Salt Lake Technical Center Report, Salt Lake City, Utah
To: BWH

Re: Evaluation of BWH operating rooms on Patient Tower L1, August 3-5, 1993

Activities:
- Review of previous reports by Dr. Howard Hu, Drs. Speizer and Gold, Clayton Environmental, and EH&E.
- Walk-through inspection.
- Physical assessment of ventilation system.
- Real-time monitoring for nitrous oxide during surgery.

Conclusions:
- Employees' reports of poor IAQ and symptoms were probably not related to a single source. Reasons for employee reports could have been related to a number of explanations, such as the following:
  - Latex allergy.
  - Anesthetic waste gases, including nitrous oxide.
  - Possible exposures to a number chemicals, such as glutaraldehyde, formaldehyde, methacrylates, and ethylene oxide.
  - Insufficient supply of outside air.
  - Deficiencies in the design, maintenance, and operation of the ventilation system, as was described by EH&E, the consulting firm retained by BWH to evaluate and correct building ventilation problems.
  - The ventilation system was also compromised by alterations during ongoing construction.
- Local controls for anesthetic gases and other chemicals (possible sources of air contamination) used in the operating rooms were inadequate.
- EH&E had identified ventilation system deficiencies and BWH was taking appropriate action to correct them.
- EH&E was in the process of identifying sources of potential air contamination.

- Inadequate communication between management and operating room employees, which resulted in a crisis of confidence and fostered an environment of mistrust.

Recommendations:
- Implement ventilation system alterations recommended by EH&E.
- Provide better communication to employees.
- Facilitate better employee involvement in health and safety matters.

Date: January 14, 1994
Document: Letter of Notification
From: Kipp Hartman, Area Director. US DOL/OSHA regional office, Braintree, MA.
To: BWH

Re: Inspections of workplace (Patient Tower L1 operating rooms?) on 7/21/93 to 1/5/94

Activities:
- Walk-though observation.
- Inspection of ventilation systems.
- Review of EH&E report.

Conclusions:
- OSHA perspective: unlikely that single contaminant or contaminant source is responsible for health complaints of operating room employees.
- Insufficient amounts, and poor quality of outside air related to deficiencies and design in the ventilation systems serving the operating rooms.
- Inadequate communication between management and operating room staff led to mistrust.
- Management failed to implement past recommendations for correcting ventilation system problems.
- Employee health concerns were exacerbated by management's failure to address potential employee layoffs.

Recommendations:
- Institute ventilation recommendations made by EH&E.
- Provide better local exhaust control.
- Attach plume control devices to electrocautery instruments in each operating room.

- Implement an anesthetic waste gas monitoring program, regularly test nitrous oxide fittings in operating rooms.
- Clear operating room access.
- Improve communication with operating room staff and involve employees in decision making.
- Increase preventive maintenance.
- Focus initial efforts on areas of increased symptom reporting.
- Continue joint committee involvement between various hospital groups.

Date: June 13, 1994
Document: Summary letter
From: Elise Pector Morse, MPH, CIH, and Maxine Garbo, MS, COHN, Commonwealth of Massachusetts, Department of Labor and Industries, Division of Occupational Hygiene
To: George Weinert, Director, Department of Environmental Safety, BWH

Re: Summary of May 2, 1994, meeting at BWH

Activities: Review of the ongoing occupational health problems at BWH reported since July 1993, as well as the OSHA findings and the steps BWH had taken to investigate and ameliorate the problems

Conclusions:
- Case diagnosis, medical evaluation, and treatment is not uniform.
- Documentation and reporting methods for symptoms and diseases are inadequate.
- Methods for reassignment, alternative work, and medical leave is inadequate.
- Access to employee medical findings by computer is a breach of medical confidentiality.
- Hazard surveillance is inadequate.
- Communications and the current communication plan are inadequate.
- Lines of responsibility are confusing.

Recommendations:
- Cases should be evaluated epidemiologically.
- Medical follow-up and surveillance should be done in a systematic manner.
- Hazard surveillance should be done.
- The Massachusetts law concerning reporting of occupational disease (105 CMR 300.000) should be followed.
- Improve methods of communication.
- Improve communications with operating staff and out-of-work employees.
- Outline methods for reassignments, alternative work, and medical leave.
- Improve medical confidentiality.
- Outline lines of responsibility.
- List OSHA and NIOSH contacts.
- Develop a task force or advisory board to oversee the reported problems.
- Distribute or publish the BWH experience with latex to enhance prevention methods locally and nationally.
- “Popularize” successful efforts at reducing glutaraldehyde.

Date: July 20, 1994
Document: Response Letter
From: George W. Weinert, CIH, BWH Director of Environmental Safety and Health
To: Elise Pector Morse, MPH, CIH, and Maxine Garbo, MS, COHN, Commonwealth of Massachusetts, Department of Labor and Industries, Division of Occupational Hygiene

Re: Response to correspondence from DLI/DOH dated June 13, 1994

- Reviewed actions by BWH
  - Retention of EH&E as consultants.
  - Virtually eliminate the use of glutaraldehyde in the operating rooms, restricted use elsewhere, or substitution with hydrogen peroxide.
  - Completely modify exhaust ventilation for ethylene oxide, exhaust dispersed from Patient Tower floor 16.
  - Current evaluation of the exhaust ventilation system for photographic developers.
  - Evaluation and modification of electrocautery operating knives and laser surgical systems.

- Comments in response to concerns.
  - New staff hired for Employee Health Services.
  - Systematic medical management program established.
  - Retrospective review of cases to categorize affected workers in progress.

- Programs to address employee exposures.
  - Latex: adopted in-house guidelines of 10 ng/m^3 as "trigger" for remediation. Non-sterile examination gloves changed to low allergen-content gloves in March 1994. Other sources of latex exposure (e.g., baby feeding nipples, catheter kits) identified.
  - Ethylene oxide: New ventilation system to control exposure designed and installed.
  - Mold and mildew: Cystoscopy room (where mold was identified) reconstructed. According to sampling for bioaerosols, mold and mildew does not seem to be a problem throughout the institution.
  - Construction Dust: Renovation and construction projects done under containment conditions and with negative-pressure air systems.
  - Ethanolamine: Use in floor cleaning compounds eliminated, substitution by less irritating products.
  - Glutaraldehyde: Elimination planned.
  - Klenzyme: Use eliminated.
  - Formaldehyde: Only rarely used, when used almost all concentrations reported below 0.1 ppm.

- OSHA logs are available for review.
- Communications
  - On-going process including involvement of 67 health and safety committees developed along departmental or functional lines.
  - Routine briefing meetings conducted weekly with OR Safety Committee and bimonthly with BWH Department of Nursing.

– BWH administration meets regularly with MNA.
– Several direct mailings sent to out-of-work employees.

- Alternate work: Plan being developed for medical leave and alternate work.

- Medical confidentiality: Medical records or telephone reports of employees' confidential medical findings available to the general hospital staff.

Coordination: Air quality concerns are handled by the Director of Air Quality Management, and medical concerns by the BWH occupational health physician.

Date: September 14, 1994
Document: Report
From: Kipp Hartman, Area Director, US DOL/OSHA regional office, Braintree, MA.
To: George Weinert, Director, Office of Environmental Safety, BWH

Re: Inspection (of Patient Tower 12D?), March 23, 1994

Activities: Industrial hygiene monitoring of registered nurses' personal-breathing-zone exposures to xylene, toluene, n-butyl alcohol, styrene, and formaldehyde.

Conclusions:
- Employees reported symptoms such as wheezing, itching, hives, and eye and throat irritation.
- Results of industrial hygiene sampling for solvents were below the OSHA permissible exposure limits. No citations were issued.

Recommendations:
- Develop a regular maintenance program for cleaning ducts and grills of the ventilation systems on Patient Tower 12, especially 12D. (This recommendation was for reducing exposures to allergenic particles that could be distributed into the environment, thus suggesting that latex allergen was a potential problem.)
- Perform sampling (including latex and total dust) on Patient Tower floors 4, 8, and 9. Share and adequately explain results to employees on 12D.
- Increase the relative humidity in the hospital.
- Substitute non-allergenic soap for chlorhexadiene soap on 12D.

Date: January 4, 1995
Document: Report
From: Elise Pector Morse, MPH, CIH, and Maxine Garbo, MS, COHN, Commonwealth of Massachusetts, Department of Labor and Industries, Division of Occupational Hygiene
To: BWH

Re: Meeting and walk-through conducted on December 9, 1994

Conclusions:

- Important improvements
  - Latex: Powdered latex gloves were being substituted with non-latex gloves where possible and low-latex, non-powdered gloves where latex was preferred. Air sampling documented drop in airborne latex allergen. The BWH occupational health physician reported no new cases of glove-related illness.
  - Employee Health Services: Staffing in the BWH Occupational Health Department was upgraded, employees were assigned to a health care provider for continuity of follow-up care. Non-working employees were assigned to case managers. The BWH occupational health physician saw employees who preferred not to enter the BWH building at an off-site clinic. All employees with work-related symptoms followed by the BWH occupational health physician.
  - Return-to-work protocol: The BWH occupational health physician had developed a protocol for clinicians evaluating affected employees. The protocol included procedures for returning affected employees to work.
  - Ventilation system: Problems with the ventilation system (such as the supply of outside air to the operating rooms) had been identified and corrected under the supervision of BWH's consultants. Plans had been made to warm the outside air supplied to the Patient Tower building.
  - DMSO: BWH's consultants adapted a HEPA air cleaner with charcoal filtration to capture DMSO at the bedside of bone-marrow transplant patients. Staff confirmed a lack of DMSO odor with use of the air cleaner. Further evaluation of the air cleaner's use, and the storage and replacement of filters was needed. Charcoal-impregnated disposable personal respirators (3M model 9913) were available if DMSO vapors could not be adequately controlled by the air cleaners.
  - Operating rooms: BWH had planned major renovations for pods E and F and ventilation improvements for the lobby and operating rooms. BWH's consultant was performing continual monitoring of some operating rooms.

- Ongoing concerns
  - Reporting: The lack of consistent reporting could be related to the practice of attributing employees' symptoms to other causes (i.e., not IAQ), and fear of job loss and retaliation.
  - Communication deficits: Differences in effectiveness of communications were noted. Nurses no longer working at BWH reported lack of information and feelings of isolation, whereas BWH nurse managers felt well informed. Written summaries of problems, occurrences of illnesses or symptom complexes, incidents of exposures, and controls have not been available to educate and inform employees or to ease their concerns.
  - Environmental Services: Several cleaning products in use were irritants and could trigger asthma.
  - Oversight of ventilation: The ventilation system on 12th floor, where many nurses experienced symptoms, was not operating properly. No report on the cause or resolution of this problem was provided.
  - Recovery Room: Controls for anesthetic gas recovery may be inadequate. Four cases of epiglottitis had been reported over past ten years.

- Problems similar to those reported at BWH had been reported in two other hospitals.

- **Recommendations:**
- Medical

  - Provide consistent and supportive (i.e., without fear of job loss or retaliation) on-going medical care to in-house and out-of-work staff.
  - Early diagnosis and treatment should be provided.
  - Bilingual services should be provided.
  - Records documenting the incidence and prevalence of symptoms and illnesses should be maintained.
  - Communication: Administration needs to communicate effectively with current and out-of-work employees.
  - The work atmosphere must not involve threatening conditions.
  - Problems and solutions should be documented and accessible to staff.

- Other
  - A system for the selection and use of products by BWH Environmental Services should be developed.
  - Ventilation should be monitored. Floor staff should be trained to check for proper ventilation operation.
  - Methods for reporting problems should be improved.
  - Anesthetic gases in the recovery room should be routinely monitored.
  - Massachusetts Department of Labor and Industries, Division of Occupational Hygiene should be kept informed about new occurrences of illnesses, changes in ventilation, changes in policy and product selection, and communication.

Date: January 22, 1995
Document: Report
From: Michael J. Ellenbrecker, Sc.D., CIH
To: MNA

Re: Reports of previous occupational health investigations at BWH

Activities: Reviewed documents included—
- Documents from EH&E, a consulting firm retained by BWH to advise them on matters of indoor air quality.
  - Indoor air quality investigation of Patient Tower L1 operating room suites, Executive Summary and Final Report, dated August 2, 1994.
  - Environmental measurements reference sheet, dated August 25, 1994.
  - Report on environmental assessment of BWH, dated August 1994.
- Report from the U.S. Department of Labor, OSHA, Salt Lake Health Response Team, dated November 1993.
- Draft report from Howard Hu, M.D., M.P.H., occupational health physician, consultant to BWH, dated June 1993.

Conclusions:

- Previous deficiencies most likely related to ventilation system problems with the supply and distribution of outside air within the hospital contributed to IAQ problems. Several sources of air contaminants were identified within the hospital.
- BWH devoted considerable resources to identify and resolve IAQ problems by retaining reputable and experienced contractors.
- BWH's consultants identified solutions for significant improvements in the work environment.
- BWH had a poor record of communicating with employees and their representatives. Employees were not made aware of, or were not able to understand, what was being done to improve conditions in the building. Despite significant progress in resolving identified deficiencies in the HVAC system, the lack of communication between staff and management resulted in an atmosphere of mistrust, exacerbated employee concerns about the work environment, and prevented MNA and BWH employees from assessing progress in the implementation of solutions.

Recommendations:
- Continue to make improvements and renovations of the hospital HVAC systems.
- Perform regular, systematic measurements of ambient carbon dioxide levels (to assess HVAC system performance).
- Continue to identify toxic substances that could be sources of air contamination; reduce or eliminate use of these substances.
- Institute a communications program (such as regular reports and meetings) to report improvements to BWH employees and MNA representatives.

Date: March through July 1995
Document: Minutes

Re: Patient Tower 12th Floor Health and Safety Committee meetings

- March 31, 1995: Comment: Trust needs to be developed so that continuity and follow up take place about health concerns. EH&E reviewed general work plan for 12th floor.
- April 3, 1995
- April 11, 1995: Entire floor to be shut down for renovation instead of only pod D. Extensive 12th floor investigative plan outlined.
- April 19, 1995: EH&E reviewed air sampling. Nurses reported that move to 11C over weekend went well, i.e., no symptoms reported. Findings of mechanical inspection of pod D reviewed.
- April 25, 1995: Move back to 12th floor reported to be going smoothly. Results of air sampling in Patient Tower from April 13 and 21 presented.
- May 2, 1995: Need for information hotline expressed. Issue raised about the need for an occupational health physician to evaluate employees or suggest tests to identify "variations from baselines."

- May 9, 1995: EH&E updated committee on progress on the 12th floor, photographs shown. Cleaning documented. Staff reported not to be pleased with article in the BWH Bulletin (newsletter for employees), because bulletin understated the issues.
- May 16, 1995: Feedback requested from nurses about type of medical support they prefer (such as on-site, on call, Emergency Department, or on-floor). Antibiotics reported to be delivered to floors unmixed.
- May 23, 1995: Feedback from nurses (see previous meeting) included need for consistent evaluation of affected individuals who had symptoms at work, desire for notification of results of "testing" on the 12th floor as compared with other floors, preference for in-service communication of information, and the need for a contingency plan in case of problems.
- June 6, 1995: EH&E reported that 12th floor cleaning completed. Review of EH&E documents by Drs. Wegman and Smith reported. Blood testing being done for latex allergy. Nurses asked about options for employees who cannot return to work. Nurses also asked, "Why has latex allergy has become an issue in recent years?" EH&E to prepare informational communication for employees.
- June 13, 1995: Concern raised that the process in the BWH Occupational Health Department was not working well, i.e., nurses having to wait to be seen. Need for developing hospital-wide system raised. Communication problems indicated. Questions: When odors noticed, "Why can't someone respond immediately to do an air test?" "How can we know the environment is controlled, safe?" EH&E offered to provide evacuated canisters for grabbing samples. Nurses raised concern that construction outside the building would cause indoor exposures.
- July 13, 1995: EH&E answered specific questions by staff about how temperature controls work, workers reporting symptoms during cleaning of the 12th floor, and the latex content of face masks used by nurses.
- July 18, 1995: EH&E reported that air monitoring was still ongoing and to be continued for three months. EH&E obtained information on non-latex gloves. Nurses requested another environmental update.
- Copy of single-page six-part form for a survey of 12th floor employees. The form asked about the type of information about the work (cleaning) on the 12th floor that the employee desired, how information should be distributed, preference for medical coverage for employees at work, the single greatest concern about returning to work on 12th floor (after cleaning), and other concerns.

Date: April 1995
Document: Reports
From: EH&E
To: BWH

Re: Miscellaneous environmental sampling on Patient Tower floor 12, April, May, July, and August 1995

Findings:
- Latex: results were not remarkable, except for a July 14 result of 17 ng/m^3 on pod 12D; all 9 other samples on pods A, B, C, and D during that month were less than 10 ng/mg^3 to not detectable. In August, all 9 samples were less than 5 ng/mg^3 to not detected.
- Glutaraldehyde not detectable.
- Ethylene oxide not detectable.

Date: April and May 1995
Document: Reports
From: EH&E
To: BWH

Re: Environmental performance data and facility/engineering improvements on Patient Tower floor 12

Activities: Evaluation of more than 10 environmental parameters, including chemicals and indoor conditions, such as temperature, relative humidity, and carbon dioxide (CO_2).

Conclusions:
- Airborne latex sample concentrations were below the BWH in-house guideline of 10 ng/m^3. In most cases, concentrations were less than 2 ng/m^3.
- Total aldehydes were less than 0.05 ppm, less than the BWH in-house guideline of 0.08 ppm.
- Airborne endotoxin was not detectable.
- Carbon dioxide was below 500 ppm (acceptable).
- Carbon monoxide was less than 5 ppm.

Date: June 12, 1995
Document: Letter
From: Thomas J. Smith, Ph.D., and David H. Wegman, M.D, Harvard University School of Public Health and University of Massachusetts, Lowell
To: John F. McCarthy, Sc.D., EH&E (a consulting firm retained by BWH)

Re: EH&E reports about evaluations on Patient Tower floor 12, April and May, 1995

Activities: Review of EH&E reports

Conclusions:
- EH&E had collected an extensive amount of information.
- "[N]o hazard [was found] from the items EH&E tested, assuming findings represent normal conditions/exposure situations."
- "The only troubling finding" was the relatively large reservoir of latex allergen in settled dusts above ceiling panels and on surfaces of the 12th floor of the Patient Tower.

Recommendation: Gradual replacement of ceiling panels and thorough cleaning, while acknowledging the costliness of this activity.

Date: June 13, 1995
Document: Memorandum
From: Michael Dykens, Comissioning Manager Associate, EH&E (mechanical engineer)

To: Kevin Coghlan, Technical Director, EH&E (industrial hygienist)

Re: Description of renovations of the mechanical system on Patient Tower floor 12

Conclusions:
- Pods A,B,C: additional air diffussers result in better mixing.
- Pods A,B,C and D: variable-air-volume (VAV) reheat coils installed to maintain ventilation flow by preventing the VAV box from closing down.
- Direct digital controls installed to better monitor and maintain ventilation system performance.
- Thermostats relocated in center of nursing stations to provide more accurate comfort control.
- Humidifiers on air-conditioning units of 12-1 and 12-2 were replaced.
- Performance measurements of ventilation systems in pods A-D were at or within 10% of design air volumes in April and May 1995.

Date: July 10, 1995
Document: Letter and miscellaneous guidelines, protocols, and forms
From: BWH Nursing Department
To: BWH staff nurses

Re: Patient Tower floor 12 symptom response plan, including—
- Data collection process for the IAQ triage system handled by nurse case managers, list of nurse case managers, encounter log form.
- BWH Occupational Health Department and Emergency Department triage criteria.
- Symptom checklist.

Date: August 21, 1995
Document: Scope of work
From: BWH Facility Planning & Construction
To: Contractor

Re: Typical floor cleaning on Patient Tower floor 12

- Description of surface and "deep cleaning"
  – HEPA vacuum.
  – Wet wiping all above-ceiling surfaces.
  – Wash ceiling grid with trisodium phosphate.
  – Vacuum and inspect ductwork"

- BWH Environmental Services responsible for routine cleaning to avoid visible dust buildup.
- Bio-medical Engineering responsible for vacuuming insides of electronic equipment.
- Information Systems responsible for HEPA vacuuming of computers, surrounding areas, and wiring.

- Nursing Department responsible for working with service departments to establish cleaning schedules and prepare areas for cleaning.
- Attachment: Computer-assisted design floorplan of 12th floor pods, with results of sampling for latex, microbials, ethylene oxide, formaldehyde, glutaraldehyde, particles, and VOCs.
- 1996 revision of BWH exposure control plan for hepatitis B virus, human immunodeficiency virus (HIV), and other blood-borne pathogens.

APPENDIX C

Return-to-Work Guidelines

Many elements must be considered in the development of any return-to-work policy. These elements include:

- The type of health effect and the degree of an employee's impairment.
- The degree to which specific work environment exposures and conditions are implicated in current health effects.
- The implications of subsequent work exposures on the employee's long term health and the potential for exacerbation of the condition.
- The capacity to control the relevant work environmental conditions through process and materials changes, engineering controls, administrative changes, and personal protection.
- The documentation that triggering exposures or working conditions in the proposed work environment for the affected worker have, in fact, been effectively controlled.
- The feasibility, usefulness, and actual capacity for ongoing monitoring of the worker's health after return to work.
- The extent to which the persisting impairments interfere with the employee's ability to effectively and safely perform the necessary job activities, after reasonable accommodation.
- Any potential effect of the employee's impairment on the health and safety of others.
- Legal requirements.

Asthma

As implied above, decisions regarding return-to-work for individuals with work-related asthma must be individualized for each employee and work environment. Factors that must be considered include (1) medical aspects (such as the extent of knowledge regarding the specific causative and exacerbating factors for the asthma, severity of airflow limitation and airway responsiveness; treatment costs, responses, and side-effects; as well as concurrent and complicating conditions), (2) emotional, social, and economic implications (for both the affected worker and his or her dependents), (3) preventive interventions and accommodations (the ability to eliminate, control, or modify work exposures to any specific allergen that has been identified and to nonspecific stimuli such as dusts, odors, exercise, temperature extremes, and the extent to which this has been accomplished), and (4) the available resources for, and actual success in, closely monitoring any changes in worker respiratory health after return to work.

If the asthma is felt to be allergy-induced (such as asthma associated with allergy to natural rubber latex proteins), reducing exposure to the allergen will only rarely result in complete resolution of symptoms. Exposures to extremely low concentrations of the causative agent may still result in symptoms, and require increasing intensity of treatment. The toxicity of long-term treatment with systemic corticosteroids is rarely, if ever, justified while even low-level exposures are continuing. Additionally, continuing symptomatic exposure to a specific occupational allergen frequently leads to persistent airway hyperresponsiveness and progressive impairment. In this setting, complete and permanent cessation of exposure to the specific agent is recommended. For pre-existing asthma triggered by workplace irritants or physical conditions, control of

the triggering work exposures or work environments, accompanied by effective close medical supervision, when available, may have a reasonable chance for success. Additionally, in contrast to allergy-induced occupational asthma, continued exposure to irritants has not been clearly associated with a worsening long-term prognosis. In either case, if an asthmatic employee returns to work, there should be a continuing assessment of the need for further environmental controls and accommodations.

Latex allergy

Return-to-work decisions for employees with latex allergy may need to consider several additional factors. Latex antigens are known to bind to starch powders used as lubricants on many surgical and examination gloves. The antigen/powder particles become airborne during donning and removal of gloves. Health care workers with latex allergy may develop symptoms after exposure to airborne powder from powdered latex gloves worn by co-workers, even if the affected individual uses only non-latex gloves. Symptoms may recur and persist until all workers in a unit use non-latex or powder-free latex gloves. Where powdered latex gloves have been used, antigens also have been shown to persist on environmental surfaces and in air handling systems. Although it is rarely the first manifestation of the condition, latex allergy occasionally progresses to systemic responses and anaphylaxis. Thus, return-to-work decisions for individuals with latex allergy need to carefully consider the evidence suggesting potential for systemic reactions (such as prior systemic responses, including urticaria or angioedema), and also the likelihood that the employee will enter areas with exposure to latex glove powders or significant residual environmental latex antigen contamination.[29] NIOSH recommendations[1] for workplaces include—

- Providing non-latex gloves for employees who have little potential for contact with infectious materials.
- Use of reduced latex protein, powder-free gloves when latex gloves are chosen to protect workers from infectious materials.
- Good housekeeping practices to remove latex-containing dust from the workplace.
- Educational programs and training materials about latex allergy
- Periodic screening of high risk workers for symptoms of latex allergy.
- Evaluation of prevention strategies whenever an employee is diagnosed with latex allergy.

References

1. NIOSH [1997]. NIOSH alert: Preventing allergic reactions to natural rubber latex in the workplace. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 97-135.

APPENDIX D

Good Practice Guidelines for Maintaining Acceptable IEQ During Construction and Renovation Projects

Introduction

The following good practice guidelines for maintaining adequate indoor environmental quality (IEQ) during construction and renovation projects were prepared to serve as objective criteria for our evaluation of the construction and renovation practices currently being utilized at BWH. They are also intended to be educational and informative. These guidelines were prepared from information contained in two reference documents along with our own experience. The two reference documents are "IAQ Guidelines for Occupied Buildings Under Construction," prepared and published by the Sheet Metal and Air-Conditioning Contractors' National Association, Inc,[1] and "Construction/ Renovation Influence on Indoor Air Quality" by Dr. Thomas Kuehn, an article published in the October 1996 issue of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) Journal.[2]

Background

Construction and renovation can adversely affect hospital occupants during the construction, renovation, demolition, repair, or reconfiguration activities through the release of airborne dusts, gases, organic vapors, and odors. Microbiological contaminants can also be released during construction and renovation activities. Two sources of contaminants, sources generated from inside the hospital and sources from activities outside the hospital, need to be considered. There are several important distinctions regarding exposures of construction workers versus exposures of non-construction workers (hospital occupants), and these differences are critically important in the development of management strategies to: (1) ensure awareness on the part of the construction contractors of the potential impact of construction and renovation activities on hospital occupants; (2) anticipate construction and renovation activities that may generate contaminants; and (3) implement controls to minimize or prevent exposures of both construction and renovation workers and hospital occupants. Foresight and planning are necessary prerequisites to prevent IEQ-related complaints during hospital construction and renovation. Even nuisance odors and non-toxic dusts from construction activities can be triggering factors, resulting in complaints from hospital occupants. These complaints can be due to actual symptoms resulting from exposures or to a perceived risk of exposures to unknown materials, which may or may not be an actual health hazard.

Effective maintenance of adequate IEQ during construction and renovation activities requires a collective effort and input from hospital managers, the general contractor, subcontractors, engineers, and hospital occupants. Input from heating, ventilating and air-conditioning (HVAC) professionals and architects is important to assess ventilation system performance when making design changes or implementing control measures. The ability and desire for effective communication between all parties is essential, especially

during rapidly changing circumstances, which are often a hallmark of construction- and renovation-related activities.

Guidelines for Initial Planning

The initial stages of any construction or renovation activity is the appropriate time to develop a site- and activity-specific plan to control contaminants that may affect construction or renovation workers and hospital occupants.

- Identify all key personnel (representatives from the hospital and the general contractor) responsible for addressing construction- or renovation-related activities and airborne contaminant control. Other personnel such as hospital staff, engineers, and subcontractors, should be involved as necessary.

- Develop a construction or renovation impact assessment describing anticipated work activities, along with their associated source contaminants, generation points, and areas potentially affected by the release of air contaminants.

- Develop a detailed budget for the contaminant control methods to be utilized.

Guidelines for Bid Specifications

Bid document specifications should be developed. In addition to general control measures, the bid document should include the particular control measures appropriate for the specific construction or renovation project being proposed. These bid specifications should be clearly written to reduce the likelihood of misinterpretation.

- Identify the specific controls needed for the construction or renovation project along with the appropriate performance metrics, and write specifications into the bid document accordingly.

- Require the general contractor to designate a representative to handle IEQ issues and establish appropriate channels of communication with subcontractors.

- Specify construction or renovation conditions that would require an emergency response (such as a contaminant release into an occupied area).

Guidelines for Control Options

Since a variety of methods are available for the control of both indoor- and outdoor-generated contaminants, the most effective and cost efficient strategies should be considered for implementation.

- Schedule construction or renovation work during periods of low building occupancy or low occupancy adjacent to the work areas, if possible.

- Isolate work areas from occupied areas using critical barriers, negative and positive pressurization, and high-efficiency particulate air (HEPA) filtration, as necessary, and minimize the number of building penetrations required for the construction or renovation activities.

- Negatively pressurize work areas and/or positively pressurize occupied areas to prevent migration of air contaminants from work areas to occupied areas.
- Modify HVAC operations as necessary during times of construction or renovation activities to ensure isolation of work areas from occupied areas. This could include increasing the HVAC outdoor air intake filtration efficiency and temporarily relocating the HVAC outdoor air intakes serving the occupied areas.
- Maintain an adequate unoccupied buffer zone around the work areas to allow for construction or renovation traffic and to ensure adequate IEQ. This could require temporarily relocating hospital occupants in the immediate vicinity of the work areas.

- Increase housekeeping activities in adjacent occupied areas during construction or renovation.

- To reduce the likelihood of contaminant generation, specify low-emitting materials for use in construction or renovation projects.

Guidelines to Protect HVAC Systems

Protect the HVAC system(s) serving the construction or renovation areas from damage or contamination.

- The HVAC system(s) serving the construction or renovation areas should be disabled, if possible.

- Isolate portions of the HVAC system where appropriate to prevent damage or contamination.

- Return air grilles should be blocked or sealed in construction or renovation areas.

- Upgrade filtration efficiency in the HVAC systems continuing in use during construction or renovation activities.

- Do not store construction materials or equipment in HVAC mechanical rooms.

Guidelines for Good Work Practices

Good work and housekeeping practices that minimize contaminant release and ensure adequate IEQ are essential to the success of any construction or renovation project.

- Use local exhaust ventilation with HEPA filtration where dust generation is anticipated. If local exhaust is not feasible, portable air cleaning devices could be used as appropriate.

- Use work practices and materials that result in little or no generation of airborne contaminants during construction or renovation activities (such as wet methods to suppress dust generation).

- Identify routes for construction or renovation traffic through unoccupied areas and away from building openings to occupied areas.

- Use HEPA vacuums and damp mop regularly to clean floors and ledges during construction or renovation activities.

- Bag and promptly remove off site all construction or renovation debris through demolition chutes on the exterior of building and/or through other dedicated perimeter wall penetrations.
- Locate dumpsters and salvage bins away from operating HVAC outdoor air intakes and exterior doors to occupied areas.

Guidelines to Implement Project Specifications

Effective implementation and management of the construction or renovation project is essential to maintain adequate IEQ for the hospital occupants.

- Ensure that the general contractor's IEQ designee is adequately trained and has the authority to immediately correct problems affecting IEQ as they arise.

- Hold regularly scheduled meetings between hospital representatives, the general contractor, subcontractors, and other personnel as appropriate to ensure the adequacy of IEQ.

- Monitor construction or renovation activities carefully so that all work conforms to the bid document specifications.

- Monitor the pressurization of both construction or renovation and occupied areas to ensure that the complete isolation of the work area is maintained.

- Monitor for airborne contaminants in the occupied areas as appropriate to ensure adequate IEQ.

Guidelines to Maintain Effective Communication

Ensure that effective communication exists between hospital occupants, the project manager, the general contractor, subcontractors, and other personnel as appropriate.

- Prior to the start of construction or renovation activities, communicate the scope of work and the precautions that will be used to control the release of contaminants.

- During the construction or renovation project, update hospital occupants regarding the project's progress and other pertinent information.

- Promptly respond to complaints from hospital occupants regarding construction-related IEQ issues and specify any situations requiring an emergency response.

Guidelines to Commission Work Area

- Use 100% outdoor air to ventilate the work areas before and during initial occupancy.
- Ensure the HVAC system(s) in the work areas are tested and balanced, preferably before occupancy.
- Monitor for airborne contaminants in the work areas to ensure adequate IEQ as necessary, during initial occupancy.

References

1. SMACNA [1995]. IAQ Guidelines for Occupied Buildings Under Construction. Chantilly, VA: Sheet Metal And Air Conditioning Contractors' National Association, Inc.
2. Kuehn, Thomas [1996]. Construction/Renovation Influence on Indoor Air Quality. ASHRAE Journal 38(10):22-29.

APPENDIX E

Workers' Compensation Claims by Diagnosis and by Work Area

Table E-1
Workers' Compensation Diagnoses of SINUSITIS, RHINITIS, or Other UPPER RESPIRATORY Conditions,[a]
by Work Area and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Work Area	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Patient Tower L1-L2									1	5	9		2		1		1		1	1		21
Patient Tower 3-4												3		1								4
Patient Tower 8													4					1	3			8
Patient Tower 12													4	2			3	2				11
Patient Tower, all other											1	4	3	1								9
CWN[c]											2	2	3	1		1						9
Other BWH buildings										2		4	2									8
Total claims by quarter[d]	0	0	0	0	0	0	0	0	1	7	12	13	18	5	1	1	4	3	4	1	0	70

[a]See Table 7 for the diagnoses included in this diagnostic category.
[b]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.
[c]Center for Women and Newborns, a new building. Units from Patient Tower floors 3-4 and some units from the lower levels (e.g., labor and delivery, neonatal intensive care) were reclocated to CWN in 1993-1994.
[d]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category.

Table E-2
Workers' Compensation Diagnoses of REACTIVE AIRWAYS,[a]
by Work Area and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Work Area	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Patient Tower L1-L2									2	4	2	1	2	4		1		1		1	1	19
Patient Tower 3-4											1	7	2	1								11
Patient Tower 8												1	6				2	3		1		13
Patient Tower 12												1	4	3			2	1		1		12
Patient Tower, all other							1			1	1	2	3	2				2				12
CWN[c]											1	2	1	1		1						6
Other BWH buildings										1	1	3		1					1			7
Total claims by quarter[d]	0	0	0	0	0	0	1	0	2	6	6	17	18	12	0	2	4	7	1	3	1	80

[a]Includes asthma. See Table 7 for the diagnoses included in this diagnostic category.

[b]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.

[c]Center for Women and Newborns, a new building. Units from Patient Tower floors 3-4 and some units from the lower levels (e.g., labor and delivery, neonatal intensive care) were reclocated to CWN in 1993-1994.

[d]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category.

Table E-3
Workers' Compensation Diagnoses of OTHER LOWER RESPIRATORY Conditions,[a]
by Work Area and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Work Area	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Patient Tower L1-L2										2	5		1									8
Patient Tower 3-4												3										3
Patient Tower 8													3						1			4
Patient Tower 12													3	2								5
Patient Tower, all other											1	1	2					1	1			6
CWN[c]											1	2	5	2								10
Other BWH buildings													1						1			2
Total claims by quarter[d]	0	0	0	0	0	0	0	0	0	2	7	6	15	4	0	0	0	1	3	0	0	38

[a]Does not include reactive airways and asthma. See Table 7 for the diagnoses included in this diagnostic category.
[b]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.
[c]Center for Women and Newborns, a new building. Units from Patient Tower floors 3-4 and some units from the lower levels (e.g., labor and delivery, neonatal intensive care) were reclocated to CWN in 1993-1994.
[d]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category.

Table E-4
Workers' Compensation Diagnoses of URTICARIA or ANGIOEDEMA,[a]
by Work Area and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Work Area	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Patient Tower L1-L2										2	1		1							1		5
Patient Tower 3-4																						0
Patient Tower 8												1	3				1		1			6
Patient Tower 12												1	1	3			1			1		7
Patient Tower, all other												1		2				3	1	1		8
CWN[c]												1										1
Other BWH buildings													1									1
Total by quarter[d]	0	0	0	0	0	0	0	0	0	2	1	4	6	5	0	0	2	3	2	3	0	28

[a]6 had a diagnosis of angioedema. 2 of them also had a diagnosis of urticaria or hives. 22 claimants had a diagnosis of urticaria or hives without angioedema. See Table 7 for the diagnoses included in this diagnostic category.

[b]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.

[c]Center for Women and Newborns, a new building. Units from Patient Tower floors 3-4 and some units from the lower levels (e.g., labor and delivery, neonatal intensive care) were reclocated to CWN in 1993-1994.

[d]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category.

Table E-5
Workers' Compensation Diagnoses of RASHES and Other SKIN DISORDERS,[a]
by Work Area and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Work Area	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Patient Tower L1-L2										1	1	1	1	2								6
Patient Tower 3-4											1		1									2
Patient Tower 8												1	2					2	1			6
Patient Tower 12												1	3	1								5
Patient Tower, all other											1	1	1		1			2				6
CWN[c]												1	1									2
Other BWH buildings										1			1									2
Total by quarter[d]	0	0	0	0	0	0	0	0	0	2	3	5	10	3	1	0	0	4	1	0	0	29

[a]Does not include hives and urticaria. See Table 7 for the diagnoses included in this diagnostic category.
[b]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.
[c]Center for Women and Newborns, a new building. Units from Patient Tower floors 3-4 and some units from the lower levels (e.g., labor and delivery, neonatal intensive care) were reclocated to CWN in 1993-1994.
[d]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category.

Table E-6
Workers' Compensation Diagnoses of LATEX ALLERGY,[a]
by Work Area and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Work Area	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Patient Tower L1-L2					1				1		1	1		3			1					8
Patient Tower 3-4												3	2									5
Patient Tower 8												1					1					2
Patient Tower 12													2				1	1				4
Patient Tower, all other							1			1		3	6	2				1				14
CWN[c]												1	2	1								4
Other BWH buildings												3		1					1			5
Total claims by quarter[d]	0	0	0	0	1	0	1	0	1	1	1	12	12	7	0	0	3	2	1	0	0	42

[a]See Table 7 for the diagnoses included in this diagnostic category.

[b]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.

[c]Center for Women and Newborns, a new building. Units from Patient Tower floors 3-4 and some units from the lower levels (e.g., labor and delivery, neonatal intensive care) were reclocated to CWN in 1993-1994.

[d]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category.

Table E-7
Workers' Compensation Diagnoses Attributed to the BUILDING or Poor INDOOR AIR QUALITY[a]
by Work Area and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Work Area	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Patient Tower L1-L2									1	2	4		3	1				1	1			13
Patient Towers 3-4												1		1								2
Patient Tower 8													5	1								6
Patient Tower 12												1	4	4			3	2				14
Patient Tower, all other											1		3	1								5
CWN[c]												1	2	1		1						5
Other BWH buildings										2	1	2	2				1		1			9
Total by quarter[d]	0	0	0	0	0	0	0	0	1	4	6	5	19	9	0	1	4	3	2	0	0	54

[a]See Table 7 for the diagnoses included in this diagnostic category.
[b]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.
[c]Center for Women and Newborns, a new building. Units from Patient Tower floors 3-4 and some units from the lower levels (e.g., labor and delivery, neonatal intensive care) were reclocated to CWN in 1993-1994.
[d]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category.

Table E-8
Workers' Compensation Diagnoses Attributed to CHEMICAL SENSITIVITY,[a]
by Work Area and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Work Area	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Patient Tower L1-L2									1	2	2		1	2								8
Patient Tower 3-4											1	3		1								5
Patient Tower 8												1	1									2
Patient Tower 12													3	2			3	2				10
Patient Tower, all other													1	2								3
CWN[c]													1									1
Other BWH buildings										1									1			2
Total by quarter[d]	0	0	0	0	0	0	0	0	1	3	3	4	7	7	0	0	3	2	1	0	0	31

[a]See Table 7 for the diagnoses included in this diagnostic category.

[b]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.

[c]Center for Women and Newborns, a new building. Units from Patient Tower floors 3-4 and some units from the lower levels (e.g., labor and delivery, neonatal intensive care) were reclocated to CWN in 1993-1994.

[d]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category. unted more than once within each diagnostic category.

Table E-9
Workers' Compensation Claims Attributed to the BUILDING, Poor INDOOR AIR QUALITY, or CHEMICAL SENSITIVITY,[a]
by Work Area and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Work Area	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Patient Tower L1-L2									1	3	5		4	3				1	1			18
Patient Tower 3-4											1	4		1								6
Patient Tower 8												1	6	1								8
Patient Tower 12												1	4	4			4	3				16
Patient Tower, all other											1		3	3								7
CWN[c]												1	3	1		1						6
Other BWH buildings										2	1	2	2				1		1			9
Total by quarter[d]	0	0	0	0	0	0	0	0	1	5	8	9	22	13	0	1	5	4	2	0	0	70

[a]See Table 7 for the diagnoses included in this diagnostic category.
[b]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.
[c]Center for Women and Newborns, a new building. Units from Patient Tower floors 3-4 and some units from the lower levels (e.g., labor and delivery, neonatal intensive care) were reclocated to CWN in 1993-1994.
[d]Totals for quarterly claims are not necessarily equal to column totals. Individuals with more than one diagnosis were listed in all appropriate diagnostic categories. All claims, including multiple claims by 10 individuals, were counted in the quarterly totals. However, no individual was counted more than once within each diagnostic category.

Table E-10
Workers' Compensation Claims from the PATIENT TOWER LOWER LEVELS, by Diagnosis and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Diagnostic category[a]	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Upper respiratory									1	5	9		2		1		1		1	1		21
Reactive airways[c]									2	4	2	1	2	4		1		1		1	1	19
Other lower respiratory										2	5		1									8
Urticaria or angioedema										2	1		1							1		5
Skin										1	1	1	1	2								6
Latex allergy					1				1		1	1		3			1					8
Glutaraldehyde allergy									1													1
Any allergy[d]					1				2	3	2	1	2	3			1	1		1	1	18
Building or IAQ[e]									1	2	4		3	1				1	1			13
Chemical sensitivity									1	2	2		1	2								8
Either									1	3	5		4	3				1	1			18
Unrelated to work																	1					1
No diagnoses in records							2		4	7	6	1	1						1			22
Total claims by quarter[f]					1		2		7	15	21	2	6	5	1	1	2	2	3	2	1	71

[a]See Table 7 for diagnoses included in these categories.
[b] Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.
[c]Includes asthma.
[d]Includes latex and glutaraldehyde allergy as well as seasonal and other allergies.
[e]Diagnoses attributed to the building or poor indoor air quality.

[f]Totals for quarterly claims are not necessarily equal to column totals. All claims, including multiple claims by an individual, were counted in the quarterly totals. Some individuals were listed in more than one diagnostic
category. However, no individual was counted more than once within each diagnostic category. Inconsistent diagnoses for an individual may be related to differences of opinion among medical examiners.

Table E-11
Workers' Compensation Claims from PATIENT TOWER FLOORS 3 and 4, by Diagnosis and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Diagnostic category[a]	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Upper respiratory												3		1								4
Reactive airways[c]											1	7	2	1								11
Other lower respiratory												3										3
Urticaria or angioedema																						0
Skin											1		1									2
Latex allergy												3	2									5
Glutaraldehyde allergy																						0
Any allergy[d]												3	2									5
Building or IAQ[e]											1		1									2
Chemical sensitivity											1	3		1								5
Either											1	4		1								6
Unrelated to work	1										1	3										5
No diagnoses in records														1								1
Total claims by quarter[f]	1										1	13	2	3								20

[a]See Table 7 for diagnoses included in these categories.

[b] Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.

[c]Includes asthma.

[d]Includes latex and glutaraldehyde allergy as well as seasonal and other allergies.

[e]Diagnoses attributed to the building or poor indoor air quality.

[f]Totals for quarterly claims are not necessarily equal to column totals. All claims, including multiple claims by an individual, were counted in the quarterly totals. Some individuals were listed in more than one diagnostic category. However, no individual was counted more than once within each diagnostic category. Inconsistent diagnoses for an individual may be related to differences of opinion among medical examiners.

Table E-12
Workers' Compensation Claims from PATIENT TOWER FLOOR 8, by Diagnosis and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Diagnostic category[a]	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Upper respiratory													4					1	3			8
Reactive airways[c]												1	6				2	3		1		13
Other lower respiratory													3						1			4
Urticaria or angioedema												1	3				1		1			6
Skin												1	2					2	1			6
Latex allergy												1					1					2
Glutaraldehyde allergy																						0
Any allergy[d]										1		1	5	1			1	2	1			12
Building or IAQ[e]													5	1								6
Chemical sensitivity													1	1								2
Either												1	6	1								8
Unrelated to work																	1					0
No diagnoses in records												1	4									5
Total claims by quarter[f]										1		2	15	1			2	3	5	2		31

[a]See Table 7 for diagnoses included in these categories.
[b] Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.
[c]Includes asthma.
[d]Includes latex and glutaraldehyde allergy as well as seasonal and other allergies.
[e]Diagnoses attributed to the building or poor indoor air quality.
[f]Totals for quarterly claims are not necessarily equal to column totals. All claims, including multiple claims by an individual, were counted in the quarterly totals. Some individuals were listed in more than one diagnostic category. However, no individual was counted more than once within each diagnostic category. Inconsistent diagnoses for an individual may be related to differences of opinion among medical examiners.

Table E-13
Workers' Compensation Claims from PATIENT TOWER FLOOR 12, by Diagnosis and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Diagnostic category[a]	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Upper respiratory													4	2			3	2				11
Reactive airways[c]												1	4	3			2	1		1		12
Other lower respiratory													3	2								5
Urticaria or angioedema												1	1	3			1			1		7
Skin												1	3	1								5
Latex allergy													2				1	1				4
Glutaraldehyde allergy																						0
Any allergy[d]												1	3	4			2	2				12
Building or IAQ[e]												1	4	4			3	2				14
Chemical sensitivity													3	2			3	2				10
Either												1	4	4			4	3				16
Unrelated to work													1				2	1				4
No diagnoses in records												1		3					2			6
Total claims by quarter[f]												3	7	9			5	5	2	1		32

[a]See Table 7 for diagnoses included in these categories.
[b] Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.
[c]Includes asthma.
[d]Includes latex and glutaraldehyde allergy as well as seasonal and other allergies.
[e]Diagnoses attributed to the building or poor indoor air quality.
[f]Totals for quarterly claims are not necessarily equal to column totals. All claims, including multiple claims by an individual, were counted in the quarterly totals.
Some individuals were listed in more than one diagnostic category. However, no individual was counted more than once within each diagnostic category.

Inconsistent diagnoses for an individual may be related to differences of opinion among medical examiners.

Table E-14
Workers' Compensation Claims from OTHER PATIENT TOWERS FLOORS, by Diagnosis and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Diagnostic category[a]	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Upper respiratory											1	4	3	1								9
Reactive airways[c]							1			1	1	2	3	2				2				12
Other lower respiratory											1	1	2					1	1			6
Urticaria or angioedema												1		2				3	1	1		8
Skin											1	1	1		1			2				6
Latex allergy							1			1		3	6	2				1				14
Glutaraldehyde allergy													1	1								2
Any allergy[d]							1			1		4	6	2				5	2	1		22
Building or IAQ[e]											1		3	1								5
Chemical sensitivity													1	2								3
Either											1		3	3								7
Unrelated to work														1								1
No diagnoses in records						1		1	1		1		4	2	1							11
Total claims by quarter[f]						1	1	1	1	1	4	6	12	6	2		1	6	2	3		47

[a]See Table 7 for diagnoses included in these categories.
[b] Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.
[c]Includes asthma.
[d]Includes latex and glutaraldehyde allergy as well as seasonal and other allergies.
[e]Diagnoses attributed to the building or poor indoor air quality.
[f]Totals for quarterly claims are not necessarily equal to column totals. All claims, including multiple claims by an individual, were counted in the quarterly totals.
Some individuals were listed in more than one diagnostic category. However, no individual was counted more than once within each diagnostic category.

Inconsistent diagnoses for an individual may be related to differences of opinion among medical examiners.

Table E-15
Workers' Compensation Claims from the CENTER FOR WOMEN AND NEWBORNS, by Diagnosis and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Diagnostic category[a]	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Upper respiratory											2	2	3	1		1						9
Reactive airways[c]											1	2	1	1		1						6
Other lower respiratory											1	2	5	2								10
Urticaria or angioedema												1										1
Skin												1	1									2
Latex allergy												1	2	1								4
Glutaraldehyde allergy													1									1
Any allergy[d]											1	3	2	2								8
Building or IAQ[e]												1	2	1		1						5
Chemical sensitivity													1									1
Either												1	3	1		1						6
Unrelated to work																						0
No diagnoses in records												1	3	1						1		6
Total claims by quarter[f]											2	6	8	4		2				1		23

[a]See Table 7 for diagnoses included in these categories.December.
[b] Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-
[c]Includes asthma.
[d]Includes latex and glutaraldehyde allergy as well as seasonal and other allergies.
[e]Diagnoses attributed to the building or poor indoor air quality.
[f]Totals for quarterly claims are not necessarily equal to column totals. All claims, including multiple claims by an individual, were counted in the quarterly totals.
Some individuals were listed in more than one diagnostic category. However, no individual was counted more than once within each diagnostic category.

Inconsistent diagnoses for an individual may be related to differences of opinion among medical examiners.

Table E-16
Workers' Compensation Claims from OTHER BWH BUILDINGS, by Diagnosis and Date of Illness
Brigham and Women's Hospital
Boston, Massachusetts
HETA 96-0012

	1991[b]				1992				1993				1994				1995				96	
Diagnostic category[a]	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**Totals**
Upper respiratory										2		4	2									8
Reactive airways[c]										1	1	3		1					1			7
Other lower respiratory													1						1			2
Urticaria or angioedema													1									1
Skin										1			1									2
Latex allergy												3		1					1			5
Glutaraldehyde allergy													1									1
Any allergy[d]												3	1	1					1			6
Building or IAQ[e]										2	1	2	2				1		1			9
Chemical sensitivity										1									1			2
Either										2	1	2	2				1		1			9
Unrelated to work																						0
No diagnoses in records										1	4		3	1				1		1		11
Total claims by quarter[f]										3	6	7	6	2			1	1	1	1	1	29

[a]See Table 7 for diagnoses included in these categories.
[b]Quarter I: January-March; Quarter II: April-June; Quarter III: July-September; Quarter IV: October-December.
[c]Includes asthma.
[d]Includes latex and glutaraldehyde allergy as well as seasonal and other allergies.
[e]Diagnoses attributed to the building or poor indoor air quality.
[f]Totals for quarterly claims are not necessarily equal to column totals. All claims, including multiple claims by an individual, were counted in the quarterly totals.
Some individuals were listed in more than one diagnostic category. However, no individual was counted more than once within each diagnostic category.

Inconsistent diagnoses for an individual may be related to differences of opinion among medical examiners.

29. NIOSH [1997]. NIOSH alert: Preventing allergic reactions to natural rubber latex in the workplace. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 97-135.