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Group Health Associates
Cincinnati, Ohio

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PREFACE

The Hazard Evaluations and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (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 (OSHA) 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.

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ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Nancy Clark Burton and Kenneth F. Martinez of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Gregory Burr. Analytical support was provided by P and K Laboratories, Cherry Valley, New Jersey. Desktop publishing was performed by David Butler. Review and preparation for printing were performed by Penny Arthur.

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Highlights of the NIOSH Health Hazard Evaluation

Evaluation of Indoor Air Quality at Group Health Associates

In August and December 2000, NIOSH representatives conducted a health hazard evaluation (HHE) at the Group Health Associates' Western Hills Office to look at indoor environmental quality (IEQ) issues. Workers reported headaches, nasal congestion, chronic coughing, pneumonia, and a variety of nonspecific illnesses, including breathing and skin problems.

What NIOSH Did

- **We checked the carbon dioxide (CO_2), temperature, and relative humidity levels. These tell how well the ventilation systems are working.**
- **We looked inside some of the ventilation systems and in areas where water damage had been reported.**
- **We looked for moisture in the walls.**
- **We collected three samples to look for fungal growth.**

What NIOSH Found

- **Humidity problems were found in the new building. High moisture readings were found in outside walls and where the two buildings were joined.**
- **Staff areas, the medical records department and some examination rooms were not receiving enough fresh air.**
- **Temperature levels were cooler than those recommended for summer.**
- **Widespread mold contamination was not found. One sample collected in a bathroom that had flooded showed a small amount of fungi.**
- **Cases of Chlamydia pneumonia were likely the result of person-to-person transmission through respiratory secretions.**

What Group Health Associates Managers Can Do

- **Correct ventilation problems including addition of outside air, and better humidity and temperature control.**
- **Identify and promptly correct any water leaks.**

What the Group Health Associates Employees Can Do

- **Quickly report any water leaks or water damage so repairs can be made.**
- **Report IEQ concerns to supervisors and see a physician if health problems persist.**
- **Remember to wash hands frequently.**

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report # 2000-0339-2852

Health Hazard Evaluation Report 2000-0339-2852
Group Health Associates
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SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation at the Group Health Associates' Western Hills facility in Cincinnati, Ohio. The request listed several instances of water incursion. Reported health problems among employees included headaches, nasal congestion, chronic coughing, three diagnosed cases of chlamydia pneumonia, and an increase in the number of nonspecific illnesses.

NIOSH investigators conducted an initial site visit to the office on August 23 and 24, 2000, and a follow-up visit to look at moisture issues on December 14, 2000. The August site visit included a limited ventilation system assessment, measurement of indoor environmental quality indicators (carbon dioxide [CO_2], temperature, and relative humidity), moisture measurements, and limited microbial sampling. The environmental evaluation identified problems with temperature and humidity regulation and air delivery. Temperatures ranging from 69°F to 73°F, and relative humidities ranging from 48% to 70% were recorded on the day of sampling. Elevated CO_2 concentrations (up to 1540 parts per million) were recorded in the examination rooms, waiting areas, and the Medical Records Department, indicating insufficient ventilation.

The ventilation systems' thermostats were located in the perimeter offices where solar load affected the office conditions. Excessive moisture was detected in interior and exterior walls which could be due to water incursion from overflowing toilets and poor humidity control in the building. The visual assessment did not reveal widespread microbial contamination. A sticky tape sample collected beside one of the toilet areas indicated fungal growth. The outside air damper for the original building heating, ventilating, and air-conditioning unit was closed, and there was no provision of outside air to the basement. The major water-incursion issues had been addressed before the initial NIOSH site visit.

NIOSH investigators recommend that problems with the regulation of temperature, humidity, and air delivery within the Group Health Associates' Western Hills facility be corrected. It is unclear if these issues were the cause of the reported health symptoms, many of which were non-specific, however, improving the indoor environmental quality should minimize work-related health complaints. The cases of Chlamydia pneumonia are likely caused by person-to-person transmission from respiratory secretions. The occurrence of these cases reinforces the need to practice good personal hygiene in the workplace.

Keywords: SIC 8011 (Offices and Clinics of Doctors of Medicine), indoor environmental quality, IEQ, medical office, ventilation, carbon dioxide, relative humidity, water incursion.

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INTRODUCTION

In June 2000, the National Institute for Occupational Safety and Health (NIOSH) received a management request for a health hazard evaluation (HHE) at the Group Health Associates' Western Hills facility in Cincinnati, Ohio. The HHE request listed several instances of water incursion and other indoor environmental quality (IEQ) problems including overflowing toilets, roof leaks, sewer gas odors, and possible mold growth where a pipe had burst. Reported health problems among employees included headaches, nasal congestion, chronic cough, three diagnosed cases of chlamydia pneumonia, and an increased number of nonspecific illnesses. In response, NIOSH personnel conducted an initial site visit to the office to evaluate indoor environmental quality conditions on August 23 and 24, 2000. A follow-up visit was completed on December 14, 2000.

BACKGROUND

The Group Health Associates' Western Hills medical office has approximately 80 employees. On average, the office serves 7,000 patients a month, with 350 to 400 patients on the busiest days. The facility has two sections. The original building was opened in 1988 and consists of one story built on a concrete slab. The new addition was completed in 1998 and has one floor and a basement. The patient areas are on the first floor, and the basement area of the new addition contains office space, medical records, the employee breakroom, conference room, and storage area. The physician offices are located on the perimeter of the first floor. All the carpeting and wall coverings were replaced in the original building in 1998 and 1999. Vinyl wallpaper is used extensively throughout the facility.

The original portion of the building is served by a 50-ton, roof-top, gas heating, ventilating, and air-conditioning (HVAC) unit. The ventilation system is a variable air volume system with common ceiling plenum returns. Pleated fiberglass pre-filters followed by 80% efficiency bag filters are used. The pre-filters are changed on a monthly basis. The dark room and laboratory have a separate ventilation system and dedicated exhausts. The thermostats are located in the perimeter offices. Maintenance staff set the thermostats throughout the clinic at 72 to 74°F.

The new addition is served by seven roof-top HVAC variable air volume units, one of which is devoted to the pharmacy. The roof-top HVAC units have insulation-lined return ducts. All of the units are set to run on a continuous basis with the outside air dampers open when the building is occupied. The basement area is served by two gas furnaces (Carrier Weathermaker 9200) with air-conditioning coil units. No outside air source could be located for the basement area. The HVAC units and furnaces use American Air Filter Am-Air® Intercept-treated fiberglass filters with 30% efficiency. Intercept™ is an antimicrobial oil. The filters are changed on a monthly basis. Electric space heaters are used in the cashier area during the winter to compensate for the unconditioned air that enters the building when the outside doors are used.

METHODS

Carbon Dioxide (CO_2), Temperature, and Relative Humidity (RH)

During the August 2000, site visit, continuous CO_2, temperature, and RH measurements were made at six stationary locations during the workday between approximately 7:30 a.m. and 4:30 p.m. These locations were the pediatric reception area, Medical Records in the basement, adult medicine reception area, Pediatrics Examination Room D, Internal Medicine Examination Room A, and Podiatry/Dermatology Examination Room C. Spot checks were done throughout the day in nine locations-the pediatric reception area, pediatric nurses' station, four individual doctor offices, pediatric triage, internal medicine nurses' station, and adult medicine reception area-and outside the main entrance. The measurements were made using Q-Trak™ Model 8550 IAQ Monitors (TSI

Incorporated, Saint Paul, Minnesota). These portable, battery-operated instruments monitor CO_2 via non-dispersive infrared absorption with a range of 0-5000 parts per million (ppm) with a sensitivity of ±50 ppm. These meters also directly evaluate dry bulb temperature (range 32°F to 122°F) and RH (range 5% to 95%). Instrument calibration was done prior to use.

Ventilation System Assessment

During the August 2000 site visit, a visual inspection was made of the large HVAC unit for the original building and three of the HVAC units for the new addition.

Microbial Assessment of Tape Samples

Three sticky tape samples were collected for microscopic analysis. Samples were collected from the interior linings of Air Handler #7 and Air Handler #10, which serve the new addition, and from the intersection of the floor and wall next to the toilet in the adult medicine patient bathroom.

Moisture Measurements

Areas of suspected water damage (exterior walls) were probed with a moisture meter to qualitatively assess residual amounts of water. A Delmhorst Instrument Company (Towaco, New Jersey) Moisture Tester, Model BD-9 and a Tramex Moisture Encounter meter were used for this qualitative assessment. These instruments provide direct readings for moisture content in the range of 8-50% on wood. A reference scale is used for comparative readings on other nonwoody materials.

EVALUATION CRITERIA

Indoor Environmental Quality

Scientists investigating indoor environmental problems believe that there are multiple factors contributing to building-related occupant complaints.[1,2] Among these factors are imprecisely defined characteristics of HVAC systems, cumulative effects of exposure to low concentrations of multiple chemical pollutants, odors, elevated concentrations of particulate matter, microbiological contamination, and physical factors such as thermal comfort, lighting, and noise.[1,2,3] Reports are not conclusive as to whether increases of outdoor air above currently recommended amounts are beneficial.[4] However, rates lower than these amounts appear to increase the rates of complaints and symptoms in some studies.[5] Design, maintenance, and operation of HVAC systems are critical to their proper functioning and provision of healthy and thermally comfortable indoor environments. Indoor environmental pollutants can arise from either indoor or outdoor sources.[6]

NIOSH, the Occupational Safety and Health Administration (OSHA), and the American Conference of Governmental Industrial Hygienists (ACGIH®) have published regulatory standards or recommended limits for occupational exposures.[7,8,9] With few exceptions, pollutant concentrations observed in indoor work environments fall well below these published occupational standards or recommended exposure limits. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has published recommended building ventilation and thermal comfort guidelines.[10,11] The ACGIH has also developed a manual of guidelines for approaching investigations of building-related symptoms that might be caused by airborne living organisms or their effluents.[12] Measuring ventilation and comfort indicators such as CO_2, temperature, and RH is useful in the early stages of an investigation in providing information relative to the proper functioning and control of HVAC systems.

Carbon Dioxide

CO_2 is a normal constituent of exhaled breath and, if monitored, can be used as a screening technique to evaluate whether adequate quantities of outside air are being introduced into an occupied space. ASHRAE's most recently published ventilation

standard, ASHRAE 62-1999, Ventilation for Acceptable Indoor Air Quality, recommends outdoor air supply rates of 30 cubic feet per minute per person (cfm/person) for operating rooms, 25 cfm/person for patient rooms, 20 cfm/person for offices, and 15 cfm/person for reception areas, recovery rooms, classrooms, libraries, auditoriums, and corridors.[10] Maintaining the recommended ASHRAE outdoor air supply rates when the outdoor air is of good quality, and there are no significant indoor emission sources, should provide for acceptable indoor air quality.

Indoor CO_2 concentrations are normally higher than the generally constant ambient CO_2 concentration (range 300-350 ppm). CO_2 concentration is used as an indicator of the adequacy of outside air supplied to occupied areas. When indoor CO_2 concentrations exceed 800 ppm in areas where the only known source is exhaled breath, inadequate ventilation is suspected.[13] Elevated CO_2 concentrations suggest that other indoor contaminants may also be increased. It is important to note that CO_2 is not an effective indicator of ventilation adequacy if the ventilated area is not occupied at its usual level.

Temperature and Relative Humidity

Temperature and RH measurements are often collected as part of an indoor environmental quality investigation because these parameters affect the perception of comfort in an indoor environment. The perception of thermal comfort is related to one's metabolic heat production, the transfer of heat to the environment, physiological adjustments, and body temperature.[14] Heat transfer from the body to the environment is influenced by factors such as temperature, humidity, air movement, personal activities, and clothing. The American National Standards Institute (ANSI)/ASHRAE Standard 55-1992 specifies conditions in which 80% or more of the occupants would be expected to find the environment thermally acceptable.[11] Assuming slow air movement and 50% RH, the operative temperatures recommended by ASHRAE range from 68 to 74°F in the winter, and from 73 to 79°F in the summer. The difference between the two is largely due to seasonal clothing selection. ASHRAE also recommends that RH be maintained between 30 and 60% RH.[11] Excessive humidities can support the growth of microorganisms, some of which may be pathogenic or allergenic.

Microorganisms

Microorganisms (including fungi and bacteria) are normal inhabitants of the environment. The saprophytic varieties (those utilizing non-living organic matter as a food source) inhabit soil, vegetation, water, or any reservoir that can provide an adequate supply of a nutrient substrate. Under the appropriate conditions (optimum temperature, pH, and with sufficient moisture and available nutrients) saprophytic microorganism populations can be amplified. Through various mechanisms, these organisms can then be disseminated as individual cells or with soil or dust particles or water droplets. In the outdoor environment, the levels of microbial aerosols will vary according to the geographic location, climatic conditions, and surrounding activity. In a "normal" indoor environment, where there is no unusual source of microorganisms, the level of microorganisms may vary somewhat as a function of the cleanliness of the HVAC system and the numbers and activity level of the occupants. Generally, the indoor levels are expected to be below the outdoor levels (depending on HVAC system filter efficiency).[15,16]

Some individuals manifest increased immunologic responses to antigenic agents encountered in the environment. These responses and the subsequent expression of allergic disease is based, partly, on a genetic predisposition.[17] Allergic diseases which have been reported to be associated with exposures in indoor environments include allergic rhinitis (nasal allergy), allergic asthma, allergic bronchopulmonary aspergillosis (ABPA), and extrinsic allergic alveolitis (hypersensitivity pneumonitis).[15] Allergic respiratory diseases resulting from exposures to microbial agents have been documented in agricultural, biotechnology, office, and home environments.[18,19,20,21,22,23,24,25]

Acceptable levels of airborne microorganisms or their mycotoxins have not been established. Relationships between health effects and environmental microorganisms must be determined through the combined contributions of medical, epidemiologic, and environmental evaluation. The current strategy for on-site evaluation involves a comprehensive inspection of problem areas to identify sources of microbial contamination and routes of dissemination. In those locations where contamination is visibly evident or suspected, bulk samples may be collected to identify the predominant species. However, associating health effects with airborne microbial contaminants can be difficult.

RESULTS

Carbon Dioxide (CO_2), Temperature, and Relative Humidity (RH)

Figures 1 to 3 show the spot measurements (rounded to the nearest whole number) of temperature, RH, and CO_2. The measurements were collected between 8:00 a.m. and 4:30 p.m. As shown in Figure 1, temperatures ranged from 71 to 72°F inside and 72 to 74°F outside. It was cloudy all day. The temperatures were below the ASHRAE guidelines for the summer season. The relative humidities, presented in Figure 2, varied from 44 to 70% inside. The relative humidity outdoors was 86% in the morning and 76% in the late afternoon. The relative humidity was higher in the new area, exceeding the recommended ASHRAE guideline of 30 to 60%. The CO_2 levels are shown in Figure 3. The levels ranged from 470 to 1260 ppm inside, and 350 to 390 ppm outside. The highest concentrations of CO_2 were measured in the new addition, exceeding the NIOSH 800 ppm guideline in the pediatric waiting area, the pediatric nursing station, one of the pediatrician's offices, and the Pediatric Triage area.

The pediatric waiting area is part of the new addition. The pattern of CO_2, temperature, and RH results shown in Figure 4 is consistent with the HVAC unit cycling on and off. The CO_2 levels rose throughout the day and exceeded the NIOSH 800 ppm guideline from mid-morning though the end of the day. The temperatures were between 69 and 73°F and were outside the recommended ASHRAE temperature guidelines for summer of 73 to 79°F, for most of the day. The relative humidity levels ranged from 48 to 70%, frequently exceeding the 30 to 60 % ASHRAE guideline.

Figure 5 shows the CO_2, temperature, and relative humidity measurements for the medical records area in the basement. The CO_2 levels rose throughout the day and exceeded the NIOSH 800 ppm guideline by 9:00 a.m. Temperatures and relative humidities ranged from 71 to 73.3°F and from 50 to 57.5%, respectively. It was colder than the recommended ASHRAE guideline, but the relative humidity readings were within acceptable limits.

Figure 6 presents the measurements for the adult medicine reception area in the original building. The CO_2 measurements ranged from 480 to 1000 ppm which exceeded the NIOSH 800 ppm guideline. The temperature ranged from 71.2 to 73.5°F, and the relative humidity ranged from 44 to 58%. Temperature readings were on the low end of the recommended ASHRAE guideline and the relative humidity readings were within acceptable limits.

Figures 7 to 9 show the data collected in pediatric, internal medicine, and podiatry/dermatology examination rooms. During the day, 7 patients were seen in the pediatrics examination room, 11 were seen in the internal medicine examination room, and 33 were seen in the podiatry/dermatology examination room. The pediatrics area is located in the new addition. The CO_2 levels ranged from 600 to 1540 ppm, the temperature ranged from 69.8 to 70°F, and the relative humidity was between 49.8 and 70%. The other two examination rooms were in the

original building. Temperature and relative humidity were better controlled in the original building; however, the internal medicine examination room was still colder than recommended for this time of year. The CO_2 levels in both rooms did exceed the current NIOSH guideline of 800 ppm. The podiatry/dermatology examination room showed a steady increase in CO_2 and temperature throughout the day.

Ventilation System Assessment

The outside air dampers were closed in the 50-ton unit, which resulted in no supply of outside air through the mechanical system. The outside air dampers were open for the three small HVAC units that were examined. The units were well-maintained. The condensate pans were clean with no standing water. The perimeter offices which contained the thermostats for all of the ventilation units were receiving a large amount of sunlight.

Moisture Measurements

Several high moisture readings were detected on vinyl-covered interior and exterior walls during the August site visit. Moisture was detected in the basement exterior wall in the employee break room where the pediatric waiting room toilet had overflowed, along the exterior windows on the first floor, the storage room wall in the basement, the pediatric nurses' station interior wall, and the interior wall where the two buildings joined in the back hallway. The high moisture readings were not found during the December site visit.

Tape Samples

The tape samples collected for Air Handler #7 and Air Handler #10 showed mostly dust and skin flakes. A few loose fungal spores were observed, but there was no obvious sign of fungal growth. The tape sample collected in the adult medicine bathroom showed a few fungal spores and hyphae of unknown identity. A trace of spores, hyphae, and conidiophores of *Acremonium* were seen which suggests some fungal growth had occurred. *Acremonium* species are fungi that are commonly isolated from plant debris and soil.

Water Incursion Issues

The water incursion problems reported in the HHE request had been addressed before the initial site visit. The roof was replaced in 1999. The leaks at the connection point between the two additions were repaired. A sewer pipe that was not connected during the construction of the new addition was identified as a source of sewer odor and was repaired. There are occasionally clogged toilets in the pediatric waiting area that result in leakage into the employee break room. A water vacuum is reportedly used to clean up the water, and the area is cleaned with a 10% chlorine bleach solution. One toilet in the adult medicine area has also overflowed frequently. To correct overflowing toilets in the basement, a grinder pump system was installed to handle bulk material before it is pumped up to the main sewer line. There was a sewer odor in the basement which was eliminated by caulking all of the openings in the grinder pump system. There has been some leakage around the windows that has been repaired. Condensate from freezing coils and leaking condenser pans for the fan coil units in the new addition has occasionally leaked into the work areas. Stained ceiling tiles are replaced when identified.

DISCUSSION

Spot measurements collected for CO_2 indicate that 4 of the 10 area locations had concentrations above the NIOSH guideline of 800 ppm indicating that further evaluation of the ventilation system is warranted. These locations are in the new addition and include the waiting area, the nurses' station, the pediatrician's office, and Pediatric Triage. The highest concentrations were found in the nurses' station and Pediatric Triage. Each location, except the pediatrician's office, is a patient servicing area and has the potential to be occupied by numerous visitors. The elevated CO_2

concentrations suggest an inadequate supply of outdoor air to these occupied spaces. The continuous monitoring results show a similar pattern of elevated CO_2 concentrations. These locations include the pediatric waiting area, medical records, the adult reception area, Internal Medicine Room A, and Pediatric Room C. There was a steady increase in the CO_2 concentration as the workday progressed, further illustrating the inadequacy of the outdoor air supply to dilute contaminants generated by individuals or office processes.

Two small package ventilation systems were observed in a small room in the basement. These units serve all areas in the basement. Upon inspection, neither system appeared to have the capacity to introduce outside air. This offers a plausible explanation for the elevated CO_2 concentrations in the medical records room after 9:00 a.m. Visual inspection of the large HVAC unit serving the old section showed that the outside air damper was closed, preventing the introduction of outside air to that portion of the building. The small HVAC units had the capacity to bring in outside air, but we were not able to get information on outside air flow rates for comparison with ASHRAE guidelines.

The peak relative humidity levels in the pediatric waiting area and Pediatrics Room D were above the ASHRAE recommended maximum of 60%. The RH levels in the medical records area were within the ASHRAE guidelines. Measurements collected in the adult reception area, Internal Medicine Room A, and Podiatry Room D reveal relatively stable temperature and RH values throughout the work day.

The temperature measurements in both sections were cooler than the ASHRAE guideline of 73 to 79°F recommended for the summer season. This can result in individuals feeling uncomfortable.

Although the major water incursion issues at the connection seam between the two buildings had reportedly been addressed, high moisture content readings (100% on the relative scale) were found in the hallway closest to the back wall, and along the corridor adjacent to the stairwell near the front. Other locations with high readings include peripheral walls in the adult medicine waiting area, the physician offices in the new section, the break room in the basement, and interior walls in the pediatric nurses station, the pharmacy area, and the basement conference room/storage room. Moisture in peripheral walls is likely the result of moisture penetration through the building envelope. Interior wall readings with relatively high moisture content were found next to bathrooms and are likely related to past flooding events.

The control of moisture incursion, nutritional substrates, and/or temperatures to appropriate levels in the indoor environment will decrease the ability of microorganisms to proliferate. Under normal circumstances, gypsum wallboard that has been impacted by water through flooding or vapor migration will release the moisture over time. The application of vinyl wall cover to gypsum wallboard surfaces significantly retards moisture release. The accumulation of water behind the vinyl wall cover combined with the abundance of nutrient materials (i.e., cellulose) promotes an environment suitable for the amplification of microbiological reservoirs.[26,27] The existence of significant microbiological reservoirs as a result of mold contamination behind vinyl wall covering and on gypsum wallboard has been suggested to result in adverse health symptoms in building occupants.[28,29]

According to the HHE request, chlamydia pneumonia was diagnosed among three staff members. It is caused by the bacterium, *Chlamydia pneumoniae*. The exact mode of transmission is unknown but appears to be person-to-person though respiratory secretions and, unlikely to be related to water-damaged materials.[30] All ages are at risk for developing the disease but it is most common among school age children. It is common to have reinfection throughout a lifetime.[30]

CONCLUSIONS

The environmental evaluation of this facility found problems with the regulation of RH, temperature, and air delivery. Additionally, the small ventilation units located in the basement were installed

without provision to introduce outdoor air to the occupied space.

There was no visible indication of widespread microbial contamination. However, environmental conditions were present that could promote the growth of fungal reservoirs-RH measurements consistently above 60%, and the use of vinyl wall cover on peripheral walls which could act as vapor barriers. It is unlikely that the reported cases of chlamydia pneumonia are related to environmental conditions at the facility. It is recommended that the ventilation problems be corrected to minimize health complaints among the employees and to prevent moisture-related problems.

RECOMMENDATIONS

1. The outside air intake for the large HVAC unit for the original building should be opened. The ASHRAE Applications Handbook recommends at least 2 air changes of outdoor air per hour for examination rooms (6 total air changes per hour [ACH] for a ventilation rate) and 5 air changes of outdoor air per hour for operating rooms on a recirculating system (25 ACH for a total ventilation rate).[31]

2. Outside air provisions need to be made for the basement area. ASHRAE standard 62-1999 recommends outdoor air ventilation rates for offices of 20 cfm outdoor air/person.[10]

3. The thermostats controlling the HVAC units for the new addition should remain in the "on" fan mode whenever the building is occupied so that there is a constant supply of air to the offices and examination rooms. ASHRAE standard 62-1999 recommends outdoor air ventilation rates for patient rooms of 25 cfm outdoor air/person.[10]

4. Working with a certified ventilation engineer, changes should be undertaken for the new building addition ventilation system to correct the humidity problems. There are commercially available hybrid fan-coil units that continuously dehumidify outdoor air even when the room temperature is less than the thermostat setting.[32]

5. The temperature control points should be set to meet current ASHRAE guidelines of 73 to 79°F for summer.[11]

6. Vinyl wall cover should not be used on outside walls. If the walls get wet, water vapor trapped under the wall cover cannot escape easily, a condition which can lead to microbial growth.

7. Sources of excessive moisture or leaks that may cause water damage to office building interior or furnishings should be identified and promptly eliminated. Information on the remediation of fungi in indoor environments is available from the U.S. Environmental Protection Agency document "Mold Remediation in Schools and Commercial Buildings" and the ACGIH book "Bioaerosols: Assessment and Control." [12,33]

8. Employees who continue to experience health problems should see a physician.

9. To reduce the risk of workplace transmission of infectious agents, the importance of personal hygiene, including hand-washing, should continue to be emphasized during employee training.

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Figure 1 - Temperature Measurements
HETA 2000-0339

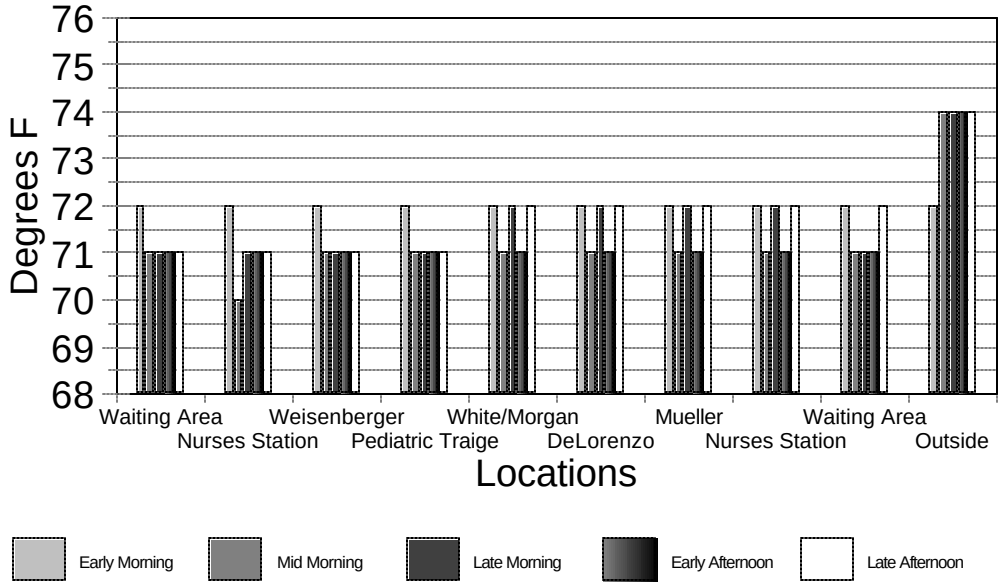


Figure 2 - Relative Humidity
HETA 2000-0339

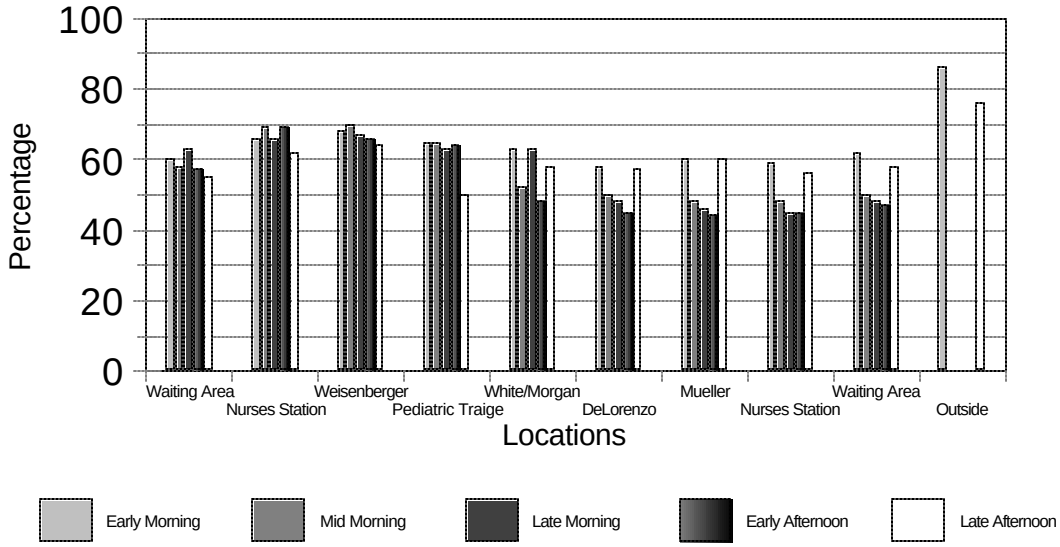


Figure 3 - Carbon Dioxide
HETA 2000-0339

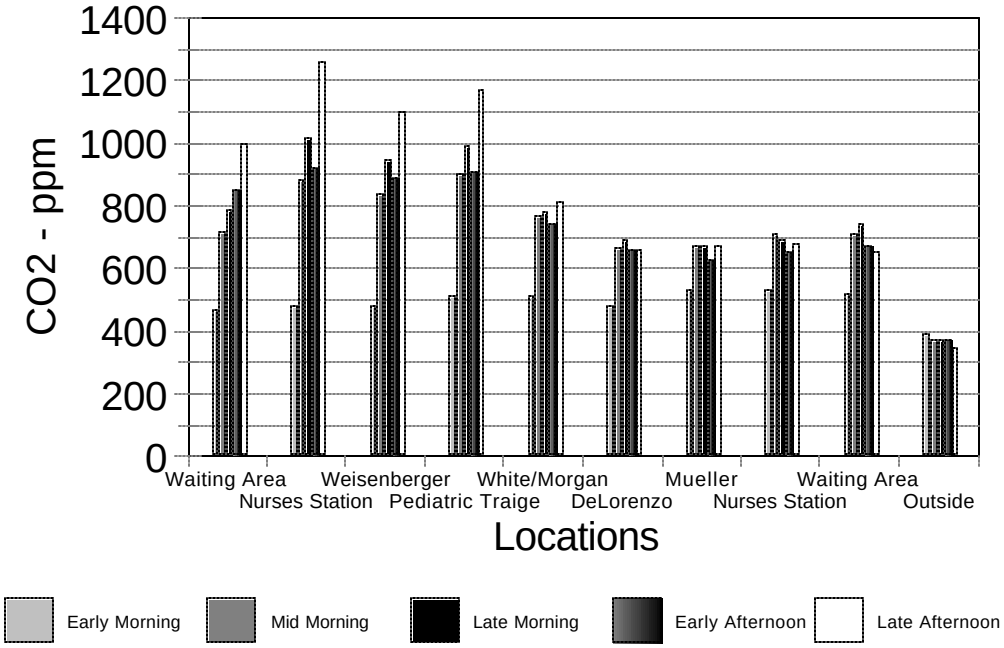


Figure 4 - Indoor Environmental Quality Measurements

Pediatric Waiting Area

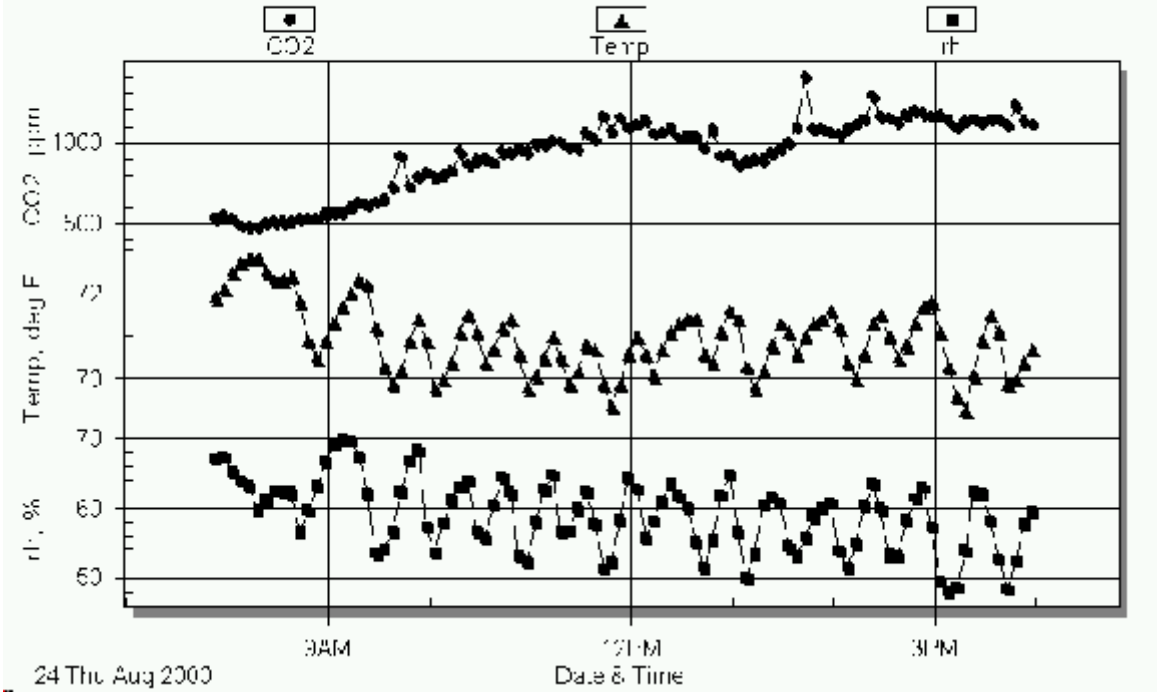


Figure 5 - Indoor Environmental Quality Measurements

Medical Records

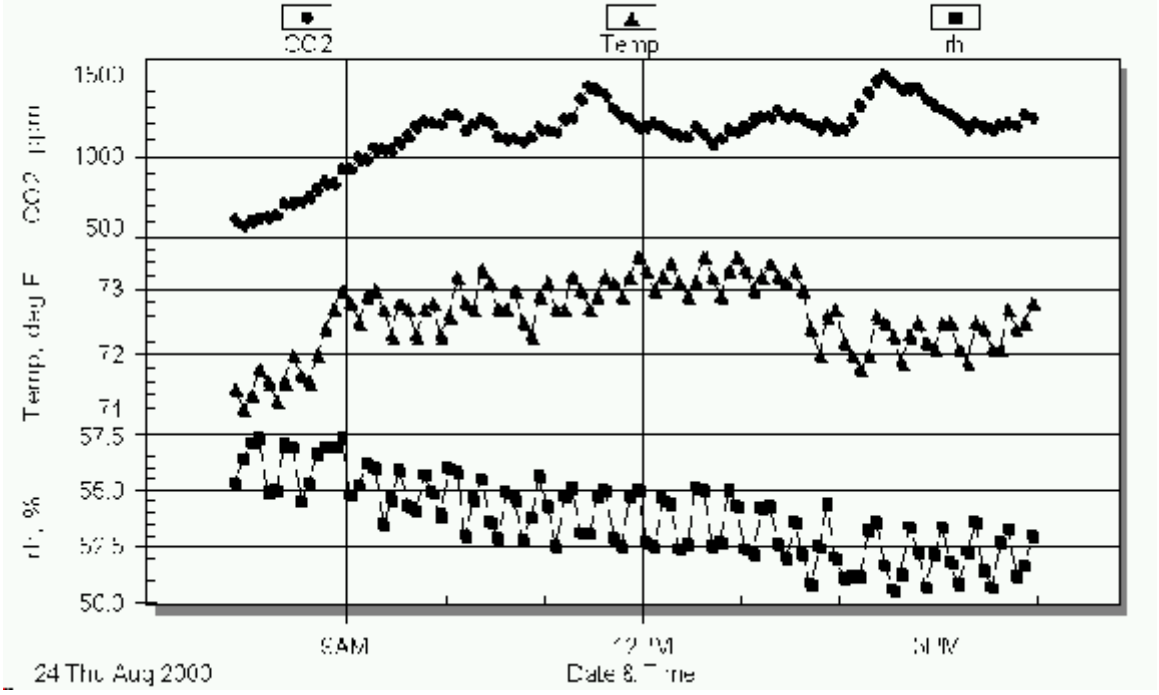


Figure 6 - Indoor Environmental Quality Measurements

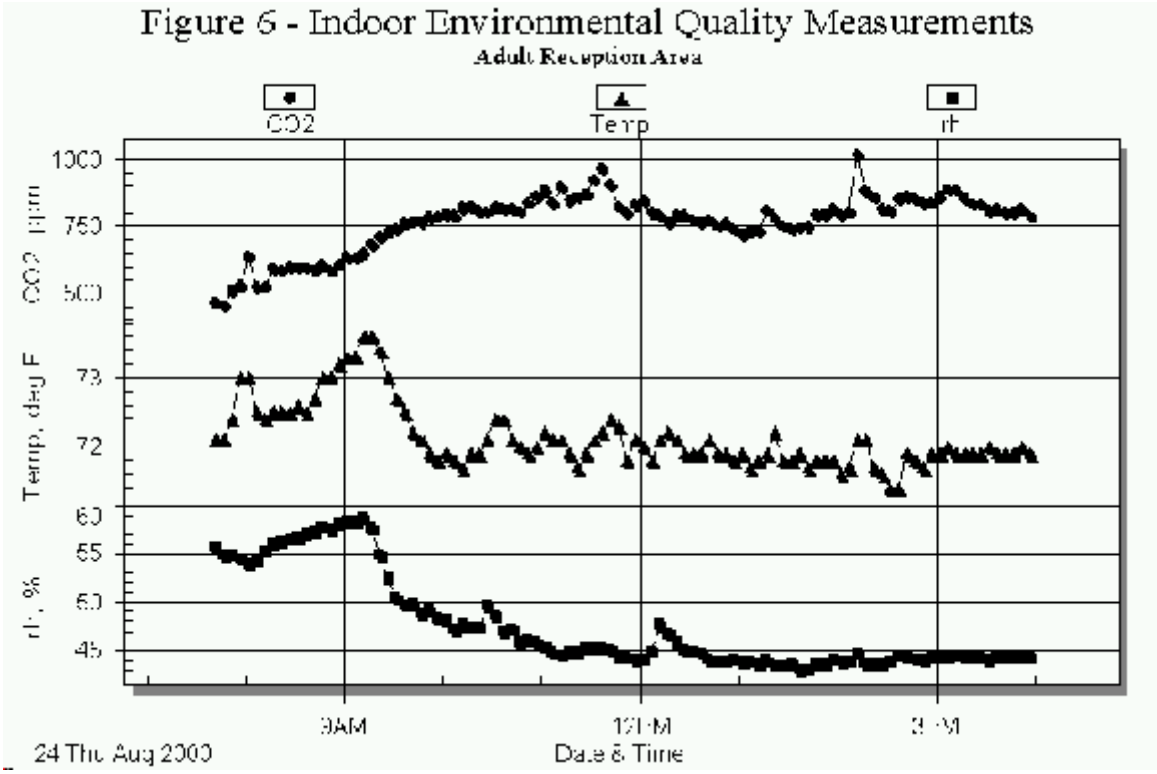


Figure 7 - Indoor Environmental Quality Measurements

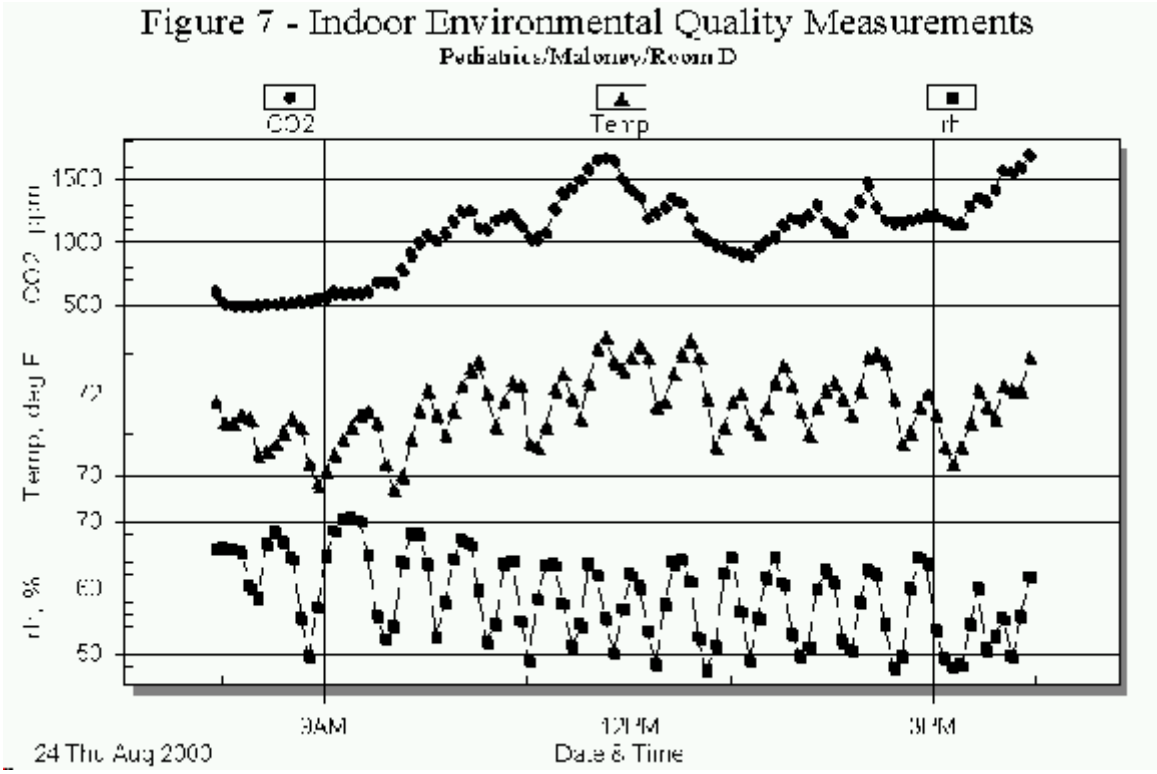


Figure 8 - Indoor Environmental Quality Measurements

Internal Medicine/Seltser/Room A

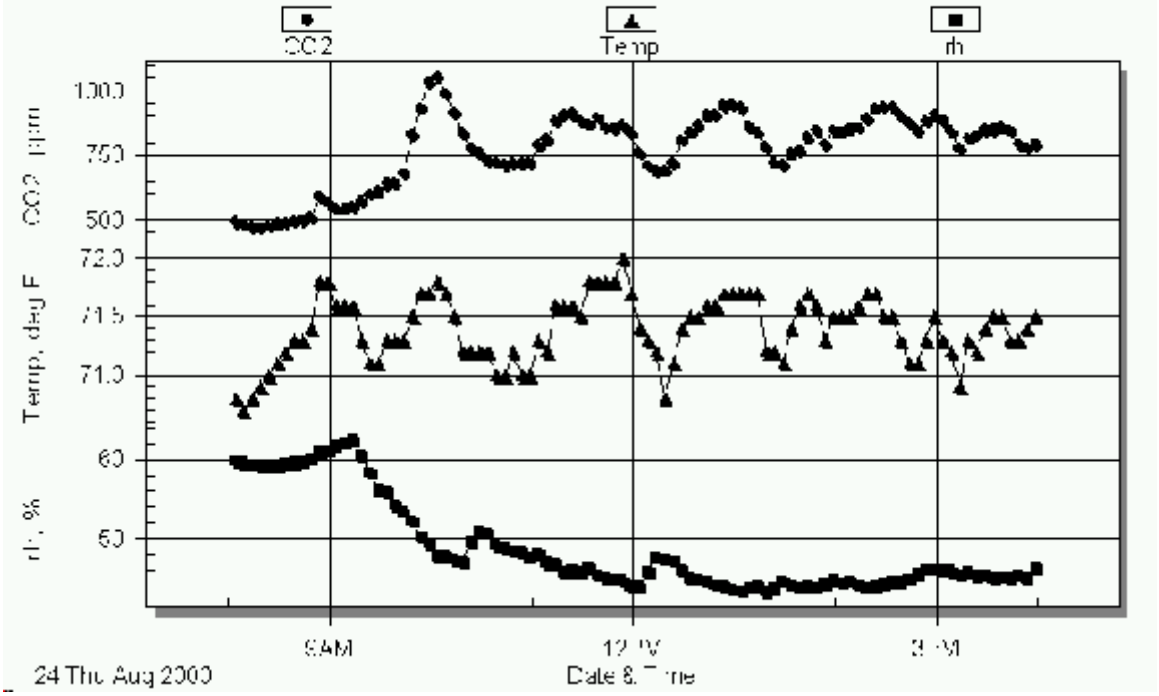
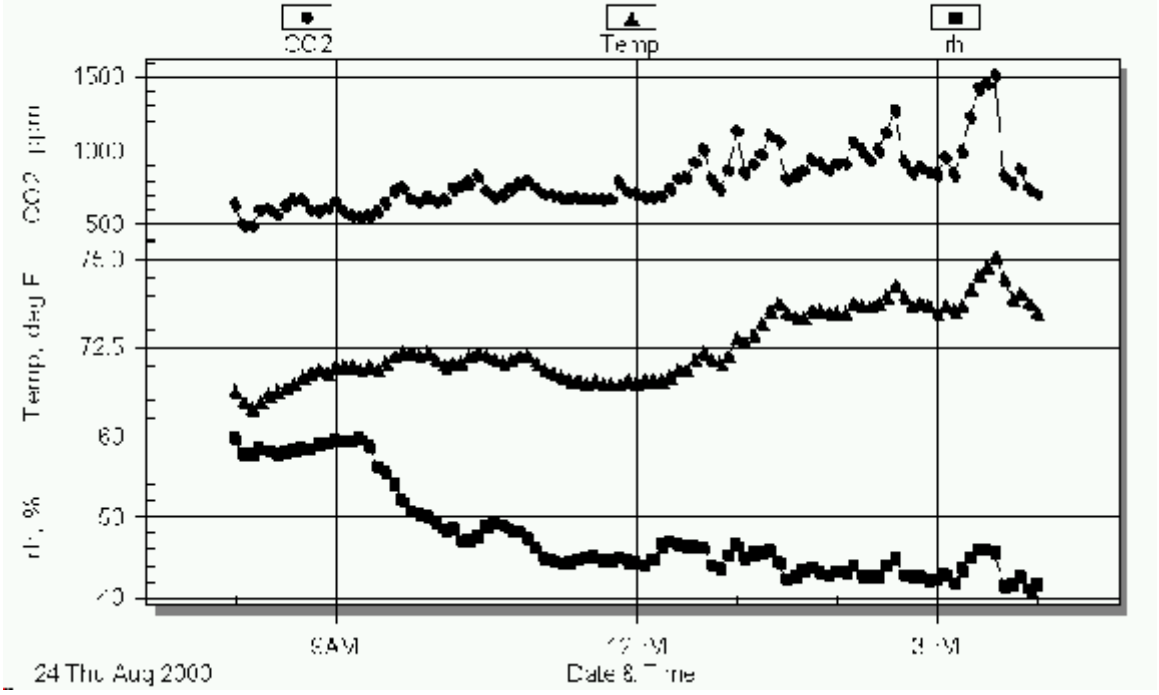


Figure 9 - Indoor Environmental Quality Measurements

Podiatry/Dermatology/Room C



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Call NIOSH at:
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or visit the NIOSH Web site at:
www.cdc.gov/niosh

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