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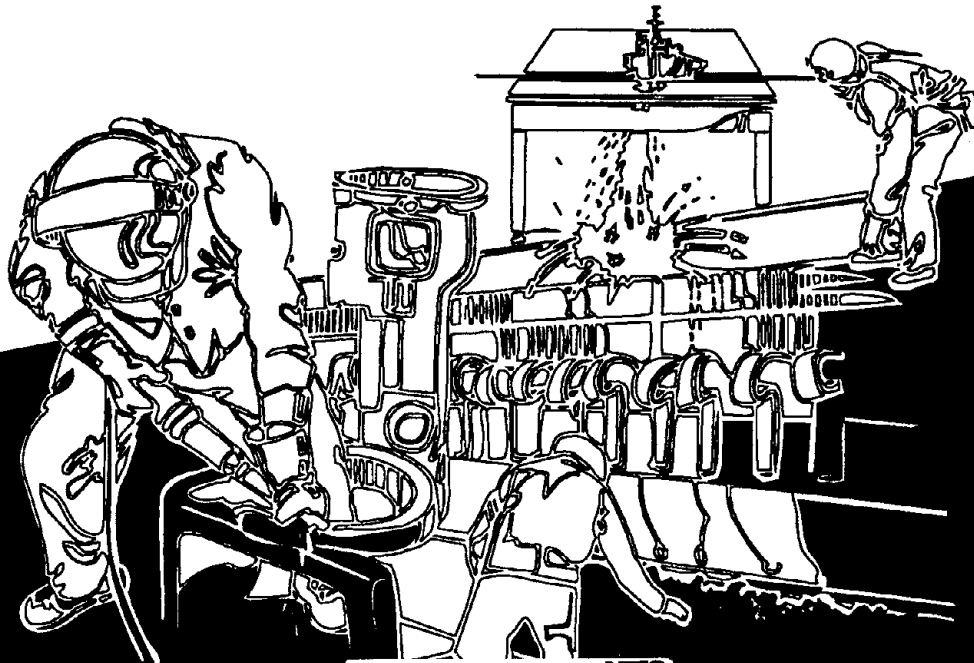AND PREVENTION

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NIOSH HEALTH HAZARD EVALUATION REPORT

HETA 98–0096-2737
Exempla St. Joseph Hospital
Denver, Colorado

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

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.

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Health Hazard Evaluation Report 98-0096-2737
Exempla St. Joseph Hospital
Denver, Colorado

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SUMMARY

On January 23, 1998, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request for a health hazard evaluation (HHE) at Exempla Health Care Facility/St. Joseph's Hospital in Denver, Colorado. The request stated that hospital employees experienced facial flushing, rhinitis, sneezing, itching and watery eyes, and fainting while at work. According to the request, the exposure thought to cause the employees' health problems was latex protein from powdered natural rubber latex (NRL) gloves.

The NIOSH investigation consisted of concurrent medical and industrial hygiene evaluations during the weeks of July 13–16, 1998, and August 3–6, 1998. Additional medical evaluations were completed November 9–13, 1998. The medical evaluation included a self-administered questionnaire and blood tests for total IgE and latex-specific IgE. The industrial hygiene evaluation consisted of air, surface, and bulk dust sampling to evaluate the presence of latex proteins within the hospital environment.

The overall prevalence of latex sensitization (defined by the presence of latex-specific IgE) was 6.2% (33/531). There was no statistically significant difference in the prevalence of latex sensitization between employees who wear latex gloves (6.1% or 16/248) and those who do not wear latex gloves (6.3% or 16/239) (p=0.9). There was also no statistically significant difference in the prevalence of latex sensitization between employees who reported current latex glove use or having worn at least one pair of latex gloves per day at another job or in training (i.e., ever having occupational latex glove use), with a prevalence of 6.3%, and those who reported never having occupational latex glove use, with a prevalence of 5.1% (p=0.6). Reporting of work–related hand dermatitis was more common among those who currently wore latex gloves (23.4%) than among those who did not (4.9%) (p < 0.01), as were rhinoconjunctivitis (16.3% and 7.9%, respectively, p < 0.01) and hand urticaria (9.9% and 2.1%, respectively, p < 0.01). There was no significant difference by latex glove use in the reporting of work–related asthma or general urticaria. There was no statistically significant association between any of these symptom complexes and latex sensitization, although hand urticaria and hand dermatitis were more prevalent in those who were sensitized.

Atopy (history of allergic rhinitis, asthma, or atopic dermatitis) was significantly associated with latex sensitization; 81.3% of those with latex sensitization were atopic, compared to 59.5% of those who were not sensitized (p=0.02). Twenty-four percent of those with latex sensitization reported no Type I allergic symptoms, i.e., urticaria, rhinoconjunctivitis, or asthma, either at work or home, while 62% reported no work–related Type I symptoms.

A total of 23 area air samples for NRL allergen were collected in clinical (16) and non–clinical (7) areas of the hospital. Five of the seven samples collected in the non–clinical areas had no detectable NRL protein. One sample,

collected in inpatient admitting, had a concentration between the limit of detection (LOD) and the limit of quantitation (LOQ), that is, a trace concentration. One sample, collected in the medical records area, had a quantifiable concentration, 0.26 nanograms per cubic meter (ng/m^3). Sixteen air samples were collected in clinical areas of the hospital. Nine of 16 samples (from a variety of clinical areas) had NRL protein concentrations ranging from 0.41 to 3.33 ng/m^3. Four samples contained trace concentrations, and three samples had no detectable NRL protein.

Nineteen surface dust samples were collected from ceiling tiles and air handling unit (AHU) plenums. Ten samples were collected from clinical areas and nine from non–clinical areas. In the non–clinical areas, no NRL was detected in seven of the samples, one had a trace amount, and one sample from an AHU serving the inpatient admitting had 368 nanograms of NRL per 100 square centimeters ($ng/100\ cm^2$). In the clinical areas, 7 of 10 surface dust samples had no detectable NRL protein. One sample collected from the back of a ceiling tile in the labor and delivery (L&D) suite 242 had 118 $ng/100\ cm^2$, and two surface samples collected inside AHUs contained 1,022 and 3,952 $ng/100\ cm^2$.

Two filter dust samples were collected from AHUs serving non–clinical areas of the hospital; neither had detectable NRL protein. Five samples of filter dust collected from AHUs serving clinical areas of the hospital had NRL protein concentrations ranging from 4,433 ng/gram of dust (ng/gm), from an AHU which serves the emergency department (ED), to 83,682 ng/gm, from an AHU which served the labor and delivery areas.

We found that levels of airborne, surface, and filter dust latex proteins were higher in the work areas of the employees who were not sensitized to latex than those who were sensitized.

We found that neither current nor past occupational use of latex gloves was associated with latex sensitization in this study population. Latex glove use, however, was associated with reporting of work-related rhinoconjunctivitis, hand urticaria, and hand dermatitis. Airborne natural rubber latex protein levels were very low, but there was a significant amount of latex protein on filters in the ventilation system. Exposure to filter dust could present risks to individuals who change AHU filters (e.g., maintenance workers), or to other workers if NRL proteins were to be released into the hospital environment. Recommendations include the use of nonlatex gloves for those who do not encounter infectious materials, and the use of low–protein, powder–free latex gloves for those who do encounter infectious materials; education for employees about latex allergy; and re–assessment of prevention strategies if a worker is diagnosed with latex allergy.

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INTRODUCTION

On January 23, 1998, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request for a health hazard evaluation (HHE) at Exempla Health Care Facility/St. Joseph's Hospital in Denver, Colorado. The request stated that hospital employees experienced facial flushing, rhinitis, sneezing, itching and watery eyes, and fainting while at work. According to the request, the exposure thought to cause the employees' health problems was latex protein from powdered natural rubber latex (NRL) gloves.

The NIOSH investigation consisted of concurrent medical and industrial hygiene evaluations during the weeks of July 13–16, 1998, and August 3–6, 1998. Additional medical evaluations were completed November 9–13, 1998. The medical evaluation included a self-administered questionnaire, serum tests for total IgE and latex-specific IgE, and skin patch testing for rubber additives. The industrial hygiene evaluation consisted of air, surface, and bulk dust sampling to evaluate the presence of latex proteins within the hospital environment.

Participants were notified by letter of their own test results during November and December of 1998. Management and employees were notified of preliminary findings and recommendations on February 26, 1999.

BACKGROUND

NRL is contained in the milky fluid from the *Hevea brasiliensis* tree. It contains a variety of proteins capable of inducing an allergic reaction. Routes of exposure include dermal, mucosal, percutaneous, and inhalation. Latex proteins are reported to be adsorbed onto cornstarch particles.[1] United States Pharmacopoeia (USP) absorbable dusting powder (cornstarch) is used to powder sterile and non-sterile

NRL gloves to aid in glove donning. NRL proteins alone or glove powder containing NRL proteins can become airborne and represent a health hazard for health care workers. Glove powder present in environmental dusts also can pose a hazard.

There are three main types of reactions to latex-containing objects; irritant contact dermatitis, allergic contact dermatitis, and immediate hypersensitivity.[2] Irritant contact dermatitis is the most common reaction in latex glove wearers. It is not an immune-mediated reaction and can occur with occlusive gloves of any material. It typically presents over time as dry, cracked, red, and itchy skin. It can be caused by moisture and friction under the gloves, frequent hand washing, and dermal exposure to soaps and other chemicals.

Allergic contact dermatitis is a Type IV, delayed hypersensitivity reaction. It is T-cell mediated. Allergic contact dermatitis related to exposure to chemicals used in manufacturing latex gloves has been recognized for years. Accelerators and antioxidants, including thiurams, carbamates, thiourea derivatives, benzothiazole derivatives, and amine derivatives, are the main allergens in rubber products that can induce allergic contact dermatitis.[3,4] Allergic contact dermatitis is diagnosed by skin patch testing. Several cases have recently been reported of allergic contact dermatitis due to NRL itself, not the additives.[5,6,7] One study reports that 6% of glove users with hand dermatitis had positive patch tests to natural rubber latex, often in the absence of contact urticaria.[8] Another study reported positive patch test reactions to latex in 1.2% of contact dermatitis patients.[7]

Sensitization is the development of antigen-specific antibodies. This occurs after an initial exposure to the offending antigen. Subsequent re-exposure to the same antigen results in production of antigen-specific antibodies.[9] It is common to be sensitized to a substance but not have clinical symptoms of allergy. For example, about 60% of positive skin prick test results do not reflect symptomatic food allergy.[10] One-third[11] to

one–half[12] of patients with positive skin prick test results to latex are asymptomatic. Immediate hypersensitivity is a Type I, IgE–mediated reaction. It was first reported in the English literature in 1979, when Nutter described a case of contact urticaria in a housewife who wore rubber gloves.[13] Type I hypersensitivity reactions may manifest as urticaria, asthma, allergic rhinoconjunctivitis, and anaphylaxis.[14] Persons thought to be at risk of developing latex allergy include health care workers, latex product manufacturing workers, children with spina bifida, and persons who have had multiple surgeries. Atopy (history of allergic rhinitis, asthma, or atopic dermatitis) is also a risk factor, as is allergy to cross–reacting foods, such as banana, kiwi, avocado, and chestnut.[14] The estimated prevalence of sensitization to latex, manifested by either a positive skin prick test or the presence of antibodies to latex in serum, among health care workers ranges from 2.9% to 22%,[15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30] with most studies reporting prevalence rates in the range of 5–15%. The prevalence of latex–specific IgE is reported to be from 6.4%[31] to 7.7%[32] in blood donors, and ranges from 0.12% to 20% in a variety of occupationally unexposed populations, such as adults attending health screening or allergy clinics, children admitted for allergy testing, or in the general population.[30,33,34,35,36,37,38,39,40]

Diagnosis of Type I allergic conditions is most commonly accomplished with skin prick testing (SPT) with specific antigens.[9] However, no SPT eluate has been approved by the Food and Drug Administration (FDA) for use in the United States. While SPT is traditionally considered more sensitive, the radioallergosorbent test (RAST) has been shown to be highly sensitive (94%) and specific (96%).[41] Four serum tests for the detection of latex–specific IgE have been approved and are currently in use. These are the Pharmacia CAP™, Immunolite™, HY–TEC™, and the Alastat™.[14] The Pharmacia CAP demonstrated a sensitivity of 97% and a specificity of 83%, compared to clinical history, while SPT demonstrated a sensitivity of 97% and a specificity of 100%.[42] Another study found the sensitivity and specificity of the CAP to be 100%

compared to clinical history and a positive SPT to define latex allergy.[43] The Alastat was found in one study to have a specificity of only 33%,[42] but, another study found it to have a sensitivity of 63.6% and specificity of 98.4% with reference to SPT.[18]

METHODS

The purpose of this study was to compare the prevalence of latex sensitization (presence of latex–specific IgE) between employees who wear latex gloves and those who do not wear latex gloves, determine occupational and non–occupational risk factors for sensitization, and whether work–related symptoms (asthma, rhinoconjunctivitis, urticaria, and hand dermatitis) were associated with being sensitized to latex or wearing latex gloves, and determine the proportion of irritant and allergic contact dermatitis among those with self-reported dermatitis.

Medical

Study Population

Two groups of employees, those who wear latex gloves on a regular basis, and those who do not wear latex gloves were selected to participate in this study. The no-latex-gloves group consisted of employees in human resources, finance, marketing, library, admitting, business office, audiovisual, facilities maintenance, medical records, volunteer office, payroll and reimbursement, quality assurance, pastoral care, the Sisters of Charity, medical education, patient and family counseling, material management, information services, and the nursing staff office. Housekeeping and food service employees were not included because these employees wear latex gloves on a regular basis.

Three clinical areas were selected to represent the latex glove using group. These were selected based on number of employees, glove use as reported by central supply, and convenience of access to employees to accomplish the evaluation. This group

included labor and delivery (L&D), the emergency department (ED), and the laboratory service. L&D used 189,384 pairs of gloves in 1997 (98,184 powdered latex, 55,800 powder–free latex, and 35,400 nonlatex). The ED used 429,600 pairs of gloves (213,600 powdered latex, 205,200 powder–free latex, and 10,800 nonlatex), and the lab used 114,870 pairs of gloves (4,320 powdered latex, 109,250 powder–free latex, and 1,300 nonlatex).

Only those employees who were present at work at the time of our visit were included in the denominator for the purpose of calculating participation rates. Those on vacation, sick leave, or not scheduled to work were not considered eligible for the study.

Questionnaire

Questionnaires were self–administered under the supervision of a NIOSH employee and consisted of questions concerning demographics (age, race, gender, job title, years worked, etc.) and information about personal history of allergic disorders, surgical procedures, latex allergy, and smoking, as well as about glove use, symptoms, and possible symptom triggers. Before the participant left, the questionnaire was reviewed for completeness by a NIOSH employee.

For analysis, latex glove exposure was determined by two questions: "Do you usually wear gloves when working in your current position?" and "What type of gloves do you wear most often?" Persons answering the first question affirmatively and specifying that they wore either powdered or non–powdered latex gloves were categorized as wearing latex gloves, while those answering the first question negatively, or in the affirmative but specifying nonlatex gloves, were classified as not using latex gloves.

Latex sensitization was defined as the presence of detectable levels of latex–specific IgE, i.e., levels $\geq$ 0.35 kiloUnits of allergen-specific antibodies per liter of serum (kU_A/L). Work–related symptoms

were defined as either those present at work but not at home, or those present both at work and at home that improved away from work. Asthma was defined as the presence of wheezing, or any two of the following three symptoms: cough, shortness of breath, and chest tightness. Rhinoconjunctivitis was defined as the presence of two of three of the following: itchy, runny nose (with or without sneezing); stuffy nose; and itchy, watery eyes. Hand dermatitis was defined as the presence of dermatitis, eczema, or other red, inflamed rash on the hands, while urticaria was defined as red, raised, itchy swellings (called hives, wheals, or urticaria), either on the hands or elsewhere. Participants were asked if they had any of these symptoms or diagnoses in the preceding 12 months. Atopy was defined as having a history of hay fever or other allergies (not including allergies to medications), eczema or atopic dermatitis, or asthma.

Antibody Testing

Blood was drawn by NIOSH phlebotomists using Becton–Dickenson serum–separating tubes. The blood was allowed to clot and then centrifuged for 10 minutes. Serum was poured into transfer tubes and frozen. Specimens were shipped on dry ice to the NIOSH Health Effects Laboratory Division in Morgantown, West Virginia, where it was analyzed for latex–specific IgE and total IgE utilizing the Pharmacia CAP test. A negative latex–specific IgE is <0.35 kU_A/L (no detectable antibodies) and positive is $\geq$ 0.35 kU_A/L (presence of detectable antibodies).

Patch Testing

Skin patch testing was offered to a sample of employees from the laboratory service who reported hand dermatitis in the preceding 12 months. The lab was selected for patch testing because of the high reported prevalence of hand dermatitis and because of convenience. Employees in L&D and ED tend to work irregular schedules, such as three on, four off, while many lab employees work Monday – Friday. The True Test™ allergen patch test set was used. It

consists of 23 substances and one negative control. They were applied on Monday, removed and read on Wednesday, and final readings were done on either Thursday or Friday. All were read by a NIOSH board-certified dermatologist. Readings of 2+ or higher were considered positive, 1+ was equivocal, and 0 was no reaction.

Industrial Hygiene Methods

To evaluate the presence of airborne or occult NRL latex proteins at Exempla St. Joseph Hospital, three types of samples were collected; air samples, surface dust samples (from the back surfaces of ceiling tiles and inside air handling units), and dust accumulated on air filters in the hospital's air handling units. To evaluate concentrations of airborne NRL proteins, 23 area air samples were collected using high-volume samplers, with an average sample time of 8 hours, 17 minutes. The samplers were calibrated and it was determined that one operated at 5.7 liters per second (L/sec), the other at 6.1L/sec. To confirm sampler flow rates, the samplers were calibrated (with new filters in–line) using a recently calibrated TSI VeliCicalc® Plus Model 8360 thermoanemometer. The 8360 was first programmed to measure air flow in a 3" (7.6 cm) round duct in units of liters per second. To calibrate the samplers a 61 centimeter (cm.) length of schedule 40 PVC pipe (7.6 cm in diameter) was connected to a flange on top of the sampler using a standard circular PVC connector sleeve. A small amount of vacuum grease was used to insure a good seal between the PVC pipe and the sampler head. The pipe was attached to the sampler only temporarily for use as an extended intake plenum so that air flow calibration could be conducted. Two 1.3 cm ports had been drilled into the plenum at 90 degrees to insert the probe of the 8360 to measure airflow. To insure smooth flow in the duct, the ports were located 2.5 duct diameters from the end of the plenum and 5.5 duct diameters from the filter. The tip of the VeliCicalc® Plus was inserted in each port and five flow measurements were made across the diameter of the plenum. Ten flow measurements were taken in total and the results averaged to

determine nominal flow rates in liters per second. NRL allergen was collected using bilaminate [glass fiber and polytetrafluroethylene (PTFE)] membrane filters. Samplers were located at a height of 52" (approximate seated breathing zone height).

Surface dust was collected using micro–vacuuming techniques according to the American Society for Testing and Materials (ASTM) method D 5755–95[44] with several modifications. The area to be sampled was masked using 100 square centimeter (cm²) disposable clear plastic masking templates to demarcate an area on the back of a ceiling tile. Dust was collected using 37–millimeter sampling cassettes connected in line with Tygon® tubing to a high-volume sampling pump. The sampling train was calibrated to 28.3 liters per minute (L/min). A 1.5 inch piece of Tygon tubing was connected to the face of the cassette to act as a nozzle. The nozzle was cut to a 45° angle. As per the ASTM method, surface dust was collected by micro-vacuuming within the area of the masking template up, then down, then back and forth, for a period of two minutes, or as the method states, until no visible dust remains on the surface of the sampling area. After the surface dust sample was collected, the cassette was inverted and the pump was shut off. The nozzle was capped with a plug, and the sampler was packaged to prevent separation of the nozzle from the cassette and sealed upright in a plastic bag. For ceiling tiles, a tile adjacent to a return air grille in the room or area where air sampling was conducted was chosen. Samples were collected from sheet metal surfaces in air handling units (AHUs) using the same sample collection technique for ceiling tiles. Filter dust was collected by micro–vacuuming back and forth, then up and down, on approximately 100 cm² areas of AHUs prefilters. In some locations, where vacuum collection of a surface sample was not possible, a surface wipe sample was collected by wiping a 100 cm² area. All samples were sent to the Mayo Clinic, Rochester, Minnesota, for analysis by an inhibition assay using IgE antibodies from latex sensitive individuals.[45]

Statistical Analysis

Statistical analysis was done using SAS software (SAS Institute, Cary, North Carolina). Univariate associations between categorical outcome and exposure variables were assessed with contingency tables using Chi square or Fisher's exact test (two–tailed). Univariate associations between categorical outcome and continuous exposure variables were evaluated comparing group means using the t test, or for nonparametric data using the Mann–Whitney test. A p value of <0.05 was considered statistically significant. Univariate logistic regression was also used to evaluate associations between exposure and outcome variables. Odds ratios (OR) were used as a measure of association. An OR less than 1 means there is reduced risk; an OR greater than 1 means there is increased risk. Along with the OR, we calculated its confidence interval (CI). A CI excluding 1 means we have convincing evidence of an association with the disease. All participants were included in the analyses unless specific necessary data were missing; therefore, the denominators vary for some analyses. Values for sampling results that were below the limit of detection (LOD) were estimated by dividing the LOD by the square root of two.[46] Geometric means were calculated for area air samples, surface samples, and filter samples by department.

EVALUATION CRITERIA

Because of the wide range in dose-response for allergens in general, it is difficult to determine a safe threshold concentration for which sensitized individuals would not experience reactions, or unsensitized individuals would not experience allergic sensitization with exposure to NRL allergens. Neither NIOSH, nor the Occupational Safety and Health Administration (OSHA), nor the American Conference of Governmental Industrial Hygienists (ACGIH) has established numerical exposure limits for latex exposures. However, individual studies have suggested exposure limits. This information is provided only for comparison

purposes, and is meant to be neither an endorsement nor a confirmation. One researcher suggested that air concentrations of total latex protein less than 10 ng/m³ pose a "low" risk of latex sensitization.[47] Another researcher from Germany suggested 0.6 ng/m³ of total latex protein as an exposure limit to minimize the risk of allergic reactions in sensitized health care workers.[48]

RESULTS

Medical

Overall participation in the medical evaluation was 83.1% (532/640). Participation rates by department are listed in Tables 1 and 2. The latex glove users and non-users were very similar demographically (Table 3), except that the latex glove non-users were older by an average of 4.6 years. There was also a significant difference in the number of hours worked weekly, with the latex glove non-users working more hours than the latex glove users (Table 3). There was no difference in the length of time working in either the current department (p=0.9) or in the hospital (p=0.4)

The overall prevalence of latex sensitization (defined by the presence of latex-specific IgE) was 6.2% (33/531). There was no statistically significant difference in the prevalence of latex sensitization between employees who wear latex gloves (6.1% or 16/264) and those who do not wear latex gloves (6.3% or 16/255) (p=0.9). There was also no statistically significant difference in the prevalence of latex sensitization between employees who reported current latex glove use or having worn at least one pair of latex gloves per day at another job or in training (i.e., ever having occupational latex glove use), with a prevalence of 6.3%, and those who reported never having occupational latex glove use, with a prevalence of 5.1% (p=0.6).

Reporting of work–related hand dermatitis was more common among latex glove users (23.4%) than in the non-users (4.9%), as were rhinoconjunctivitis

(16.3% and 7.9%, respectively) and hand urticaria (9.9% and 2.1%, respectively), (p < 0.01 for each association). There was no significant difference in the reporting of work–related asthma or general urticaria (Table 4). Employees who reported rhinoconjunctivitis, hand or general urticaria, and hand dermatitis reported a significantly higher median number of gloves used per day and median number of pair–hours, a variable calculated by multiplying the number of gloves worn daily by the average duration of wear of each pair (Tables 5 and 6). There was no difference between those who were sensitized and those who were not sensitized in median number of gloves used per day(1.5 vs 1.0, respectively, p=0.8) or median number of pair–hours (0.4 and 0.3, respectively, p=0.7). There was evidence of a dose–response relationship between increasing levels of glove use and all health effects except asthma (Table 7). There was no significant association between work–related asthma, rhinoconjunctivitis, general or hand urticaria, or hand dermatitis and latex sensitization, although prevalence of hand urticaria and hand dermatitis was higher in those who were sensitized (Table 8). Twenty–four percent of those with latex sensitization reported no Type I (immediate hypersensitivity) allergic health effects either at work or home, while 62.1% reported no work–related Type I symptoms.

The prevalence of atopy was similar in both groups, 60.2% in the latex glove non-users and 61.1% in the latex glove users. The mean total IgE level in atopics was 96.6 kU/L, compared to 58.1 kU/L in nonatopics (p=0.06). Atopy was significantly associated with latex sensitization, with 81.3% of those with latex sensitization being atopic, compared to 59.5% of those who were not sensitized (p <0.05).

Reported respiratory and dermatologic allergic reactions related to avocados, kiwis, peaches, chestnuts, or bananas were not significantly associated with latex sensitization (p=1.0). The number of surgeries ranged from 0-30 and was not significantly associated with latex sensitization (p=0.3). There was no association between

sensitization and the number of gloves worn daily (e.g., those who wore more than 18 pairs of latex gloves daily were as likely as those who wore no latex gloves to be sensitized [OR=0.9, 95% CI=0.3-2.3]). Similarly, those who reported more than 7 pair-hours of latex glove use daily were not more likely to be sensitized than those who reported 0 pair-hours (OR=0.8, 95% CI=0.3-2.2). There was no significant difference in the prevalence of sensitization between those who wore powdered latex gloves and those who wore powder-free latex gloves (4.7% vs. 7.0%, p=0.4).

Males were significantly more likely to have latex sensitization (12.1% vs. 4.1% [p < 0.01]). Gender, however, was not related to atopy. Females predominated in all job categories except facilities maintenance worker, physician, and physician's assistant, but sensitization was not associated with job category. Office workers (administrative and clerical, managers, and telephone operators) had a sensitization rate of 6.3%; facilities workers, housekeepers, and other 11.4%; medical technologists and phlebotomists 5.3%; nurses and nurses assistants 3.0%; and physicians assistants and physicians 5.9% (p=0.3). Categories had to be combined into these 5 groups due to small expected numbers in certain cells.

Age and race were not significantly associated with latex sensitization (p=0.07 for both). Hours worked per week were not associated with latex sensitization (p=0.3). There was no difference in the length of time working in either the current department (p=0.6) or in the hospital (p=0.7) between the sensitized and the nonsensitized.

Six persons reported being diagnosed with latex allergy by a physician, five by history and physical exam alone, and one by a glove use test. None had skin prick testing or serum antibody testing performed by their physician. Only one of the six had latex–specific IgE in this study. This individual reported work–related hand urticaria and eczema. Of the other five, one reported work–related asthma,

two rhinoconjunctivitis, one hand urticaria, two generalized urticaria, and three hand dermatitis.

There were 36 persons in the lab who reported hand dermatitis in the last 12 months. Five no longer worked at the hospital when patch testing was done. Of the 31 remaining, 20 had work schedules that would accommodate patch testing, and 17 agreed to participate. One of these was unable to tolerate the testing and removed the patches after several hours. Of the 16 who completed testing, only 1 had a positive reaction to any of the rubber additives. This individual had a 2+ reaction to thiuram mix, and a 1+ reaction to carba mix.

Environmental

Area Air Samples

Seven samples were collected in non–clinical areas of the hospital (Table 9). Five of seven samples had no detectable amounts of NRL allergen, the minimum detectable concentration (MDC) was 0.12 nanograms per cubic meter of air (ng/m^3). One sample, collected in inpatient admitting, had a concentration between the LOD and the limit of quantitation (LOQ), that is, a "trace" concentration. The only sample with quantifiable amounts of NRL allergen was a sample collected in the medical records area which had a concentration of 0.26 ng/m^3.

Sixteen samples (from a variety of clinical areas) had concentrations of NRL that ranged from less than the MDC of 0.24 ng/m^3 to 3.33 ng/m^3. Four samples contained trace concentrations and three samples had no detectable NRL (Table 10). The laboratory reported differences in LODs for the sets of air samples from the non–clinical areas (approximately 20 ng/sample) and the clinical areas (approximately 40 ng/sample). The laboratory reported the reason for these differences was a different amount of phosphate buffer used to extract NRL from the filters in the two sets of samples (total sample extraction volumes of either 250 microliters or 500 microliters, respectively, were used in the analyses). Dilutional

differences, related to phosphate buffer extraction volumes, accounted for the doubling differences in analytical LODs which were reported.

Surface Dust Samples

Ten samples were collected in clinical areas and nine samples in non–clinical areas (Tables 9 and 10). In the non–clinical areas, seven of the samples had no detectable NRL antigens, one surface dust sample from the AHU serving the medical records area had a trace concentration, and one sample from AHU serving the inpatient admitting had 368 nanograms per 100 square centimeters ($ng/100\ cm^2$).

In the clinical areas, 7 of the 10 samples had no detectable NRL antigens. One sample, collected from the back of a ceiling tile in L&D suite 242, had 118 $ng/100\ cm^2$ and two surface samples, collected inside AHUs AC–16 and AC–10, contained 1,022 and 3952 $ng/100\ cm^2$.

Filter Dust Samples

Two filter dust samples were collected from AHUs serving non–clinical areas of the hospital; neither had detectable NRL antigens (Table 9). Five samples of filter dust were collected from AHUs serving clinical areas of the hospital (Table 10). Filter dust concentrations of antigens ranged from 4,433 ng/gram of dust (ng/gm) in AC–3, which serves the emergency department, to 83,682 ng/gm in AC–18, which serves the labor and delivery areas.

Geometric mean concentrations of NRL in the air and on surfaces and filters were calculated by department. Individual participants were assigned the geometric mean concentration for their department. Mean concentrations were compared between the sensitized and the nonsensitized. We found levels of airborne, surface, and filter latex proteins were higher in the work areas of the nonsensitized (Table 11).

DISCUSSION

We found that neither current nor past occupational use of latex gloves was associated with latex sensitization in this study population. The prevalence rate of latex sensitization at Exempla St. Joseph Hospital is at the low end of the range reported in the medical literature for other hospitals. While prevalence studies of health care workers found rates of sensitization ranging from 2.9 to 22% (most in the 5–15% range),[15-30] few have compared these rates to those in a similar group without occupational exposure to latex. Thus, it has been difficult to determine the magnitude of the occupational risks faced by health care workers. Two studies of blood donors found the prevalence of latex sensitization to be 6.4%[31] and 7.7%.[32] Other studies of non-occupationally exposed groups, such as adults attending health screening or allergy clinics, children admitted for allergy testing, or the general population, have found rates of 0.12% to 20%.[30,33-40]

There was a significant association between latex glove use and rhinoconjunctivitis, hand urticaria, and hand dermatitis. However, there was no significant difference in the prevalence of these symptoms by sensitization status. There are several potential reasons for this apparent discrepancy. First, the serum test may not be as sensitive as reported, and thus we may have missed cases of sensitization. However, the test sensitivity should not differ between exposure groups, and therefore this is an unlikely explanation. Second, glove use may be a proxy for other exposures in the workplace that cause allergic symptoms. Since there were only 32 sensitized individuals in this study, there may have been insufficient statistical power to detect and association between sensitization and the health effects. Finally, because latex allergy is a high-profile issue among HCWs, symptoms reporting may have been subject to an awareness bias.

Atopy is an established risk factor for latex allergy, and this was supported by our study. While the prevalence of atopy was high in our study, it did not differ between the latex glove users and non-users. Our case definition of atopy was based on self–reported history of hay fever, eczema or atopic dermatitis, or asthma. A study of apprentices entering the fields of animal health, pastry making, and dental hygiene found atopy rates of 54.4%, 58.1%, and 52.5%, respectively.[34] This was determined by the presence of at least one SPT positive to common aeroallergens, a common objective method for determining atopic status. The significant association of latex sensitization with male gender has been reported elsewhere,[31,49] as has the lack of an association with age.[16,18,19,20,22,29,31,36]

Other risk factors for latex sensitization identified in previous studies include allergies to kiwi, avocado, banana, chestnut, and other foods. We did not find an association between them and reported respiratory and dermatologic Type I allergic symptoms, but we did not ask about oral symptoms, which may be more common when the route of exposure is ingestion. Having multiple surgical procedures has been hypothesized to be a risk factor, especially in children with spina bifida, because of the extensive mucosal exposure to latex gloves. Some studies have found an association with increasing numbers of surgical procedures;[40,50] others have not.[18,36,49,51] In this study, however, the number of surgical procedures was not associated with the presence of latex–specific IgE. The lack of association between sensitization and number of gloves worn daily, duration of time each pair was worn, or pair–hours of glove use per day and sensitization was not unprecedented. Others have documented a lack of association between measures of glove use and sensitization.[15,16,20] However, retrospective self-reports of glove use as a measure of exposure are subject to error. The lack of association with job title/category has also been documented in other studies.[16,18,28]

Results of area air sampling during this investigation reveal that very low levels of airborne NRL proteins were found at the locations sampled. Concentrations ranged from less than 0.12 to 3.33 ng/m³. Airborne NRL was more commonly present

in clinical areas, where both powdered and powder–free NRL gloves were used, than in non–clinical areas of the hospital, where no gloves were used. NRL was reported at trace to quantifiable levels in 13 of 16 (81%) of samples from clinical areas, compared to 2 of 7 (29%) samples from non–clinical areas. It is difficult to assign any meaning to the finding that the nonsensitized had significantly higher airborne concentrations of NRL proteins in their work areas because the levels were extremely low overall.

One hospital in the U.S. (which had switched to powder free gloves) adopted an in–house guideline of 10 ng/m³ for total NRL allergen.[52] The 10 ng/m³ guideline was based on extensive industrial hygiene sampling at the hospital which suggested that 10 ng/m³ is a concentration seldom exceeded when powder–free gloves were used at the facility. When sampling results exceed 10 ng/m³ at this hospital, uncontrolled sources of latex allergen, such as NRL in environmental dust, are investigated. Another study, in a hospital laboratory,[53] found that when powdered latex gloves were used, NRL concentrations ranged from 39–311 ng/m³. In the same laboratory, concentrations of NRL were less than 0.02 ng/m³ when powder–free gloves were used. A study in a large medical center found concentrations ranging from 0.3 to 1.8 ng/m³ in areas where powdered gloves were never or seldom used, and from 13 to 208 ng/m³ in areas where powdered gloves were used frequently.[45]

The hospital's ventilation system does not use ceiling plenums as return pathways for building supply air, and this is reflected in the low to absent amounts of NRL allergen found on the backs of ceiling tiles. Environmental dusts which contain NRL can pose a hazard for health care workers or other employees who might be exposed to NRL–containing environmental dusts if such dusts are disturbed during maintenance activities. NRL allergen was present in all of the filter dust cake collected from AHUs which serve clinical areas. NRL (adsorbed to USP cornstarch) is reported to be present in a variety of particle sizes, and in one study

with a mass aerodynamic diameter of greater than 7 micrometers.[45] This information suggests that AHUs properly configured with a minimum of 30–35% efficient pleated panel or pad prefilters and 65% or greater efficient bag or pocket final filters should be effective in removing NRL–containing particles from building return air.

One limitation of this study is the cross–sectional nature of the investigation. It is possible that sensitized workers who were symptomatic left the workplace. This, however, did not appear to be a major factor since there was no difference in years worked in the department or in the hospital by either exposure classification or latex sensitization status. In addition, we asked if employees had ever had another job or training position where they wore at least one pair of latex gloves daily, but we were not able to quantify levels of previous exposure. We found no difference in prevalence of sensitization between those who ever had occupational exposure to latex gloves and those who never had. We did not inquire about non–occupational exposures to latex other than surgery, but there is no reason to suspect they would differ between the two occupational/exposure groups. Symptoms and exposure were self–reported. Other potential limitations are that serologic testing may be less sensitive than SPT, but as noted previously, the Pharmacia CAP has been shown to be highly sensitive and specific.

Strengths of this study include the large sample size, the high participation rates, the use of air sampling to quantify area airborne concentrations of latex, and the inclusion of a virtually unexposed comparison group.

CONCLUSIONS

We found that neither current nor past occupational latex glove use was a significant risk factor for the development of latex sensitization. Job category was not associated with sensitization, either. Atopy is an established risk factor for the development of

sensitization to latex, and this was supported by our study. A large percentage of sensitized individuals were asymptomatic. Sensitized individuals were not more likely to experience work–related respiratory allergic symptoms, but they did have higher rates of hand urticaria and hand dermatitis, although the differences were not statistically significant. Airborne, surface, and filter concentrations of latex proteins were higher in the work areas of the nonsensitized employees than in the work areas of the sensitized employees, but levels were very low, even in areas where powdered gloves were used. Use of latex gloves was associated with self-reported work-related hand dermatitis, rhinoconjunctivitis, and hand urticaria, but not with asthma or generalized urticaria. However, use of any type of gloves will increase irritant contact dermatitis.

Recommendations

Because over 6% of the employees in this study are sensitized and thus at risk of adverse reaction to NRL, it is important to reduce exposures in the hospital to a minimum. The following recommendations for preventing latex allergy in the workplace are based on current knowledge and a common-sense approach to minimizing latex-related health problems.[2]

1. Provide workers with nonlatex gloves to use when there is little potential for contact with infectious materials (for example, in the Food Service Industry).

2. Appropriate barrier protection is necessary when handling infectious materials. If latex gloves are chosen, provide reduced protein (<50 micrograms of total water extractable protein per gram as per FDA labeling regulations), powder-free gloves to protect workers from infectious materials while minimizing their exposure to NRL.

3. Ensure that workers use good housekeeping practices to remove latex-containing dust from the workplace:

Identify occupied areas that might become contaminated with latex dust for frequent cleaning (upholstery, carpets, ventilation ducts, and plenums). Use high-efficiency, low-emission vacuum cleaners and bags.

Make sure that workers carefully change ventilation filters and vacuum bags in latex-contaminated areas, and take precautions to avoid dislodging filter dust into the environment.

Insure that HVAC maintenance personnel understand that dust laden prefilters and final filters should be handled with care to insure that NRL–containing dust is not accidently released into building supply air during maintenance activities such as filter change–outs. Maintenance employees should avoid excessive exposures to dusts which might be generated during filter change–out. If necessary, use a NIOSH approved N–95 filtering facepiece respirator to reduce exposures to dusts from AHU filters.

4. Provide workers with education programs and training materials about latex allergy.

5. Periodically screen high-risk workers for latex allergy symptoms. Detecting symptoms early and removing symptomatic workers from latex exposure are essential for preventing long-term health effects. Medical removal should not be a substitute for other more effective means of protecting workers (reducing or eliminating exposure). In cases where medical removal is necessary, the wages and benefits of the worker should be protected.

6. Evaluate current prevention strategies whenever a worker is diagnosed with latex allergy.

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Table 1. Participation Rates in Non—clinical Areas

Department	Participation Rate (%)
Outpatient/Emergency Department Admitting	9/10 (90%)
Inpatient Admitting	6/9 (67%)
Material Management	23/32 (72%)
Information Services	18/21 (86%)
Medical Records	24/31 (77%)
Environment of Care	40/47 (85%)
Medical Education	4/5 (80%)
Pastoral Care	7/7 (100%)
Library	2/3 (67%)
Human Resources	9/14 (64%)
Business Office	14/19 (74%)
Nursing Staff Office	14/15 (93%)
Volunteer Office	1/1 (100%)
Marketing	6/8 (75%)
Patient and Family Counseling	9/12 (75%)
Payroll and Reimbursement	4/7 (57%)
Quality Assurance	9/9 (100%)
Finance	19/24 (79%)
Audiovisual	2/2 (100%)
Sisters of Charity	6/7 (86%)
Total	**228/285 (80%)**

Table 2. Participation Rates in Clinical Areas

Department	Participation Rate (%)
Emergency Department	138/166 (83%)
Laboratory	98/106 (93%)
Labor and Delivery	68/83 (82%)
Total	**304/355 (86%)**

Table 3. Demographics and Selected Characteristics by Exposure Group

	No Latex Gloves n=239	Latex Gloves n=248
Mean Age (Years)	44	39*
Gender		
Male	25%	26%
Female	75%	74%
Race		
White	79%	83%
Black	7%	6%
Hispanic	11%	7%
American Indian or Alaskan native	0%	1%
Asian or Pacific islander	3%	3%
Other	1%	1%
History of Atopy	60%	61%
Smoking Status		
Current	17%	15%
Former	27%	24%
Never	56%	61%
Years Worked in Current Department		
<1	22%	23%
1–5	34%	31%
6–10	18%	22%
11–20	19%	17%
>20	7%	8%
Average Number of Hours Worked Per Week		
1–40	55%	78%*
40+	45%	22%*

*$p < 0.05$

Table 4. Prevalence (%) of Work–related Health Effects[#] by Latex Glove Use

	No Latex Gloves	Latex Gloves
Asthma	4/246 (2%)	2/260 (1%)
Rhinoconjunctivitis	19/240 (8%)	42/257 (16%)*
Hand Urticaria	5/243 (2%)	26/262 (10%)*
General Urticaria	5/241 (2%)	13/262 (5%)
Hand Dermatitis	12/243 (5%)	61/260 (24%)*

\#   defined as either present at work, but not at home, or present both at work
     and at home, but improved while away from work

* $p < 0.01$

Table 5. Median Number of Gloves Used Per Day by Work-related Health Effect

Health Effect	Present			Absent		
	n	Median	Range	n	Median	Range
Asthma	6	0	0-160	498	2	0-160
Rhinoconjunctivitis	61	10	0-50	434	0*	0-160
Hand Urticaria	31	20	0-75	472	0*	0-160
General Urticaria	18	19	0-75	483	1*	0-160
Hand Dermatitis	73	15	0-160	428	0*	0-100

* $p < 0.05$

Table 6. Median Daily Pair–Hours of Glove Use by Work-related Health Effect

Health Effect	Present			Absent		
	n	Median	Range	n	Median	Range
Asthma	6	0	0-8	497	0.5	0-193
Rhinoconjunctivitis	61	3.8	0-50	433	0*	0-193
Hand Urticaria	31	6.3	0-50	471	0*	0-193
General Urticaria	18	4.6	0-50	482	0.5*	0-193
Hand Dermatitis	72	5.6	0-53	428	· 0*	0-193

* $p < 0.05$

Table 7. Prevalence (%) of Work–related Health Effects by Level of Daily Glove Use

	Rhinoconjunctivitis* n (%)	Hand Urticaria* n (%)	General Urticaria* n (%)	Hand Dermatitis* n (%)	Asthma n (%)
0 pairs of gloves	19 (8)	5 (2)	5 (2)	12 (5)	4 (2)
1–9 pairs	9 (12)	5 (6)	0 (0)	17 (21)	1 (1)
10–18 pairs	12 (16)	3 (4)	4 (5)	11 (15)	1 (1)
19+ pairs	21 (22)	18 (18)	9 (9)	31 (31)	0 (0)

* $p < 0.05$

Table 8. Prevalence (%) of Work–related Health Effects by Latex–specific Antibody Status

	Negative Latex-specific IgE (<0.35 kU$_A$/L)	Positive Latex-specific IgE ($\geq$0.35 kU$_A$/L)
Asthma	6/479 (1%)	0/32 (0%)
Rhinoconjunctivitis	59/471 (13%)	3/31 (10%)
Hand Urticaria	27/479 (6%)	4/31 (13%)
General Urticaria	18/477 (4%)	0/31 (0%)
Hand Dermatitis	67/477 (14%)	8/31 (26%)

Table 9. Environmental Sampling in Non-clinical Areas

Sample Type	Location - air handling unit for area	Latex (ng/m³)	Surface ng/100cm²	Filter dust	Glove usage
Area	Medical Education - AHU 4	< LOD			no gloves
Ceiling tile	100 cm², centered on back surface		< LOD		
Filter dust	30% pleated pre, 75% mini pleat final filters			< LOD	
AHU	RA duct near access panel		< LOD		
Area	Outpatient registration - AHU 2 Russell	< LOD			no gloves
Ceiling tile	100 cm², centered on back surface		< LOD		
Filter dust	from AHU 2 Russell			< LOD	
AHU	from AHU 2 Russell, before final filters		< LOD		
Area	Medical records - AC 8	0.26			no gloves
Ceiling tile	100 cm², centered on back surface		< LOD		
Filter dust	no sample, 30% pre 90% final filters				
AHU	AC-8 between pre and final filters		Trace		
Area	Inpatient admitting - AHU DD1 A&B	Trace			no gloves
Ceiling tile	100 cm², centered on back surface		< LOD		
Filter dust	no sample, 10% pre, 65% final bag filters				
AHU	100 cm² downstream of RA fan on AHU DD1 A&B		368		
Area	Facilities Management - AHU DD1 A&B	< LOD			no gloves
Ceiling tile	100 cm², centered on back surface		< LOD		
Filter dust	no sample, 10% pre, 65% final bag filters				
AHU	see sample above for inpatient admitting				

Table 9 (continued)

Sample Type	Location - air handling unit for area	Latex (ng/m³)	Surface ng/100cm²	Filter dust	Glove usage
Area	Mullen Bldg, 3rd Fl. FCU above Cts	< LOD			no gloves
Ceiling tile	no sample, hard ceiling				
Filter dust	no sample,				
AHU	100 cm², center, back surface of access panel				
Area	I-70 Executive Center	< LOD			no gloves
Ceiling tile	no sample				
Filter dust	no sample				
AHU	no sample				

Notes:

LOD	=	limit of detection
MDC	=	minimum detectable concentration (0.12 ng/m³), based on a sample volume of 165,402 Liters
AHU	=	air handling unit
FCU	=	fan coil unit
AHU interior	=	inside AHU or duct plenum
Ceiling tile	=	back side of tile, 100cm² surface area
Area sample	=	on cart 52" above floor in occupied/patient care areas
Trace	=	concentration at the LOD for analytical method
< LOD	=	latex reported not detected (ND) on analytical report
ng/m³	=	nanograms per cubic meter of air
ng/100cm²	=	nanograms per 100 square centimeters

air samples: LOD = approximately 20 nanograms (ng)/sample
surface samples: LOD = approximately 100 ng/sample

Table 10. Environmental Sampling in Clinical Areas

Sample Type	Hospital Location - Air Handler	Latex ng/m²	Surface ng/100cm²	Filter dust ng/gm	Gloves used
Area	ED zone 1, Rm 6, AC 3 and AHU 1 Russell	0.62			P, PF
Ceiling tile	no sample				
Filter dust	filter type 30% pre filters, 90% final filters			13,196	
AHU	100 cm² floor of AHU plenum		< LOD		
Area	ED zone 2, bed 16 - AC-3	2.00			P, PF
Ceiling tile	100 cm² ceiling tile, near bed 16		< LOD		
Filter dust	filter type 35% pre filters, 90% final filters			4,433	
AHU	100 cm² duct of AC-3 AHU		< LOD		
Area	ED zone 2, Rm. 12 - AC 3 and AHU 1 Russell	< LOD			PF
Ceiling tile	see above sample				
Filter dust	see sample for ED zone 1				
AHU	see sample above				
Area	ED zone 3, bed 35 - AHU 1 Russell	0.41			P, PF
Ceiling tile	CT near bed 35		< LOD		
Filter dust	filter type 30% pre filter and 65% final filters			13,196	
AHU	100 cm2 floor of AHU plenum		< LOD		
Area	ED zone 4 , room 57, AC 3, AHU 1 Russell	Tr			P, PF
Ceiling tile	no sample				
Filter dust	see sample above				
AHU	see sample above				
Area	Immediate Resp. Lab - dedicated single AHU	Tr			P, PF
Ceiling tile	CT near hematology area		< LOD		
Filter dust	filter type 30% pocket pad filter			16,214	

Table 10. *(continued)*

Sample Type	Hospital Location - Air Handler	Latex ng/m³	Surface ng/100cm²	Filter dust ng/gm	Gloves used
AHU					
Area	Immediate Resp. Lab - dedicated single AHU	< LOD			P, PF
Ceiling tile	see above sample				
Filter dust	see IRL sample above				
AHU					
Area	Immediate Resp. Lab - dedicated single AHU	Tr			P, PF
Ceiling tile	CT in lab area		< LOD		
Filter dust	see IRL sample above				
AHU					
Area	L&D Del. Rm 244 - AHU AC 18	2.90			P, PF
Ceiling tile	no sample				
Filter dust	filter type 10% pad pre 65% final bag filter			83682	
AHU					
Area	L&D Del. Rm 247 - AHU AC 16	Tr			P, PF
Ceiling tile	no sample				
Filter dust	see L&D Rm. 244 sample above				
AHU					
Area	L&D Suite 242 - AHU AC 16	3.33			P, PF
Ceiling tile	100 cm² ceiling tile, room 242		118		
Filter dust	see sample above				
AHU interior	100 cm² MA plenum before pre filters see above, prefilter AC-18		1,022		
Area	L&D Del. Rm 3 - AHU AC 16	1.10			P, PF
Ceiling tile	solid ceiling, no sample				
Filter dust	see L&D suite 244 sample above				

Table 10. *(continued)*

Sample Type	Hospital Location - Air Handler	Latex ng/m³	Surface ng/100cm²	Filter dust ng/gm	Gloves used
Area 1	Microbiology Laboratory - AC- 10	< LOD			P, PF
Area 2	Microbiology Laboratory	0.57			
Ceiling tile	solid ceiling, no sample				
Filter dust	filter type 10% pad pre filter, 65% pocket filter			4473	
Area 1	Typing–cross match lab - AHU AC 10	0.49			P, PF
Area 2	Typing–cross match lab	0.89			
Ceiling tile	100 cm² floor of AHU			3,952	
Filter dust	see micro. lab filter dust sample above				

Notes:

LOD	=	limit of detection
LOQ	=	limit of quantitation
MDC	=	Minimum detectable concentration (0.24 ng/m³), based on a sample volume of 165,402 Liters
MA	=	make–up air (supply air to building)
AHU	=	air handling unit
FCU	=	fan coil unit
AHU interior	=	inside AHU or duct plenum
ED	=	Emergency Department
L&D	=	Labor and Delivery
Ceiling tile	=	sample collected on back side of tile, 100cm² surface area
Area sample	=	sampler placed on cart 52" above floor in occupied or work areas
Trace	=	concentration at LOD for analytical method
< LOD	=	latex reported not detected (ND) on analytical report
ng/m³	=	nanograms per cubic meter of air
ng/100cm²	=	nanograms per 100 square centimeters
ng/gm	=	nanograms per gram

air samples: LOD = approximately 40 nanograms (ng)/sample
filter dust: LOD = 500 ng/gram of dust
surface samples: LOD = 100 ng/sample

Table 11. Geometric Mean Levels of Environmental NRL Proteins by Sensitization Status

Geometric Mean	Sensitized	Not Sensitized
Airborne Latex	0.34 ng/m^3 (n=23)	0.47 ng/m^3* (n=393)
Surface Latex	124.9 ng/100 cm^2 (n=22)	172.2 ng/100 cm^2 (n=375)
Filter Latex	14,307.6 ng/gm dust (n=14)	25,279.2 ng/gm dust (n=299)

* $p<0.05$

National Institute for Occupational Safety and Health (NIOSH) Study of Latex Allergy in Hospital Employees Summary of Findings

What NIOSH Did

- Sampled air, surfaces, and air handling unit filters for latex proteins, in clinical and nonclinical areas

- Administered questionnaires to employees and tested their blood for antibodies to latex (latex sensitization)

What NIOSH Found

- Latex proteins were more commonly found in clinical areas, but airborne latex levels were very low in all areas

- Neither current nor past use of latex gloves was associated with latex sensitization (the presence of antibodies to latex in worker's blood)

- A personal history of allergies was related to latex sensitization

- Itchy, runny and stuffy noses; itchy, watery eyes; and hives were more common among workers who used latex gloves, but these effects were not correlated with latex sensitization

What Exempla St. Joseph Hospital Managers Can Do

- Provide nonlatex gloves to workers with low potential for contact with infectious material, for example, food service employees

- If latex gloves are provided for employees who handle infectious material, they should be low-protein and powder-free

- Ensure workers use good housekeeping practices to remove latex-containing dust from the workplace

- Provide educational programs and materials about latex allergy to workers

- Periodically screen workers for latex allergy symptoms

What Exempla St. Joseph Hospital Employees Can Do

- Use nonlatex gloves when there is little potential for contact with infectious material, such as in food service or routine housekeeping duties

- If you use latex gloves, use low-protein, powder-free gloves

- Use good housekeeping practices to remove latex-containing dust from the workplace

- Use latex allergy educational programs and materials provided by your employer

- If you develop symptoms of latex allergy avoid direct contact with latex-containing objects until you see a doctor who knows about the problem

CDC
CENTERS FOR DISEASE CONTROL
AND PREVENTION

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 # 98-0096-2737

National Institute for
Occupational Safety and Health
NIOSH

**For Information on Other
Occupational Safety and Health Concerns**

**Call NIOSH at:
1-800-35-NIOSH (356-4674)
or visit the NIOSH Homepage at:
http://www.cdc.gov/niosh/homepage.html**