Work-Related Hantavirus Exposures at Yosemite National Park: Key Findings and Recommendations

Occupational Health Branch, California Department of Public Health
www.cdph.ca.gov/programs/OHB
August 2013 (for public release)

This document summarizes the key findings and recommendations from an investigation of hantavirus exposure among employees at Yosemite National Park (Yosemite) conducted in the fall of 2012. A more comprehensive report, including detailed tables, will be issued subsequently.

Background

In the summer of 2012, ten overnight visitors to Yosemite became infected with a form of hantavirus called Sin Nombre virus. Eight of these ten visitors developed a serious illness, hantavirus pulmonary syndrome (HPS); three died. Nine of these ten stayed in Signature Tent Cabins in Curry Village, which were later found to be infested with deer mice inside the cabin walls, were closed on August 28, 2012, and subsequently demolished. Sin Nombre virus is found in the urine, feces, and saliva of the deer mouse (*Peromyscus maniculatus*), and is mainly transmitted to people when they breathe in dust or airborne particles contaminated with the virus. Most cases of HPS occur sporadically, and HPS clusters are rare.

Outside of Yosemite, some prior cases of HPS have been identified among employees who work with and around deer mice, or live in areas that have deer mice. No Yosemite employees were among the known HPS cases in 2012, but there was general interest and concern among Yosemite employees about the visitor illnesses and potential risk for employees. In September 2012, the Superintendent of Yosemite invited representatives from the Occupational Health Branch (OHB) of the California Department of Public Health (CDPH) to visit Yosemite as part of the ongoing investigation into cases of HPS among park visitors.

What we did

In response to a request from the National Park Service (NPS), OHB conducted an assessment of Yosemite employee hantavirus safety, which addressed employees of the two major employers in Yosemite (to be referred to as "Employer A" and "Employer B"). The assessment included:

1. A voluntary survey of all interested Yosemite employees (primarily of Employer A and Employer B), held on two occasions (September 26, 2012, at the El Portal Administrative Complex, and October 16-17, 2012, at the Yosemite Village Auditorium), consisting of:

- A blood test to detect evidence of previous hantavirus infection
- A questionnaire addressing work activities, living environment, past exposures to mice, and training and knowledge about measures to prevent hantavirus infection

2. A walkthrough of several work areas conducted on September 16-17, 2012
3. A review of hantavirus prevention policies and practices (Employer A and Employer B) as described in interviews or documents

Blood samples collected from interested employees were analyzed for hantavirus antibodies by staff in the CDPH Viral and Rickettsial Diseases Laboratory. Letters notifying participants of their individual blood test result and aggregate test results, and an accompanying CDPH hantavirus prevention fact sheet, were mailed to all participants on December 12, 2012. Aggregate blood test results were provided to the two employers during a conference call the same day.

What we found

Five hundred twenty-six employees (526) provided a blood sample, and 522 completed the questionnaire. Of those completing the questionnaire, 61% were employees of Employer A, and 39% were employees of Employer B. Eighty-four (16%) worked in or around signature tent cabins in the previous year. As shown in Table 1, a cross-section of Yosemite employees with many different job duties participated in the survey, and more than half had been employed at Yosemite for at least five years.

Blood Test

Only one employee (less than 1%) tested positive for previous hantavirus infection. This percentage is similar to past studies among workers with frequent contact with rodents such as biologists and environmental health technicians. This employee did not have an illness compatible with HPS during the summer or fall of 2012, when some visitors to Yosemite became ill with HPS. It is not possible to determine when this employee became infected.

Cleaning Heavy Mice Infestations

Yosemite National Park Directive #9 (April 25, 2012), Hantavirus Risk Reduction Program (hereafter referred to as the “Hantavirus Directive”), defines heavy infestations as "piles of feces or numerous nests or dead rodents." This definition was included in the survey questionnaire. Twenty-five percent (25%) of employees reported cleaning a heavy infestation as part of their work duty in the previous year; 17% reported cleaning a heavy infestation in their home in Yosemite. In total, 32% of employees reported cleaning a heavy infestation at work or home in the previous year. Cleaning a heavy infestation at either work or home was most commonly

reported among laborers (50%); electrician and maintenance workers (47%); medical, fire, police, search and rescue personnel (44%); and rooms keepers and hospitality workers (44%).

The Hantavirus Directive requires that all employees who clean heavy infestations as part of their job duties be enrolled in a respiratory protection program, including medical clearance and annual respirator fit testing, and use a negative-pressure air purifying respirator equipped with P-100 filters (or more protective respirator). In addition, employees are required to wear gloves (rubber, disposable latex, or nitrile), protective goggles, Tyvek® or other protective coveralls, and shoe covers.

However, among employees who reported cleaning a heavy infestation at work, only 11% reported using the respiratory protective equipment specified in the Hantavirus Directive. In addition, only 22% of employees cleaning heavy infestations reported having been fit tested for a respirator in the previous year (users of powered air purifying respirators, or PAPRs, were excluded from this analysis because these respirators do not require fit testing). Initial and annual fit testing is necessary to ensure that the respirator seals adequately to the wearer's face, affording the intended level of protection. While 84% of employees reported that they always had ready access to gloves, only 40% said they always had access to goggles. Most employees (76%) reported wearing rubber, latex, or nitrile gloves while cleaning a heavy infestation, 17% reported wearing goggles, and very few wore coveralls (4%) or shoe covers (2%).

Nearly three-quarters (73%) of employees who cleaned a heavy infestation at work reported always having access to bleach or chemical disinfectant. The Hantavirus Directive also states that contaminated surfaces must be in contact with a disinfectant for at least ten minutes before cleaning. However, overall, only 42% of employees cleaning heavy infestations at work reported following the complete disinfection and cleaning process – always having access to bleach or disinfectant, using bleach or disinfectant, and waiting at least ten minutes after saturating surfaces, droppings, nests, and dead rodents before cleaning.

Cleaning Light Mice Infestations

The Hantavirus Directive defines light infestations as "few droppings in one area, a few nests, and one or two dead rodents." This definition was included in the survey questionnaire. Sixty-seven percent (67%) of employees reported cleaning a light infestation at work during the previous year. Among the 365 employees who were living in Yosemite, 73% reported seeing a light infestation at home and 63% reported cleaning a light infestation at home in the previous year. The vast majority (77%) of employees reported cleaning light infestations either at home or at work.

The Hantavirus Directive requires that employees cleaning light infestations saturate dead rodents, rodent droppings, and the urine-stained area with a commercial disinfection product or chlorine bleach solution (1:10 solution, prepared fresh daily). After spraying disinfectant, at

least ten minutes should elapse before using paper towels to pick up the infestation and dispose of it in garbage. Employees should avoid cleaning activities that create airborne dust, including sweeping.

Most employees (77%) who cleaned a light infestation at work in the previous year reported always having access to a disinfectant; however, only 69% reported using a disinfectant when cleaning.

According to the Hantavirus Directive, any employee cleaning light rodent infestations should wear rubber, latex, nitrile, or vinyl gloves. Of the employees cleaning light infestations as part of their job duties, 80% reported that they always had access to gloves; the majority (65%) stated they wore rubber, latex, or nitrile gloves. Under the Hantavirus Directive, the use of an N-95 filtering facepiece respirator is voluntary when cleaning a light infestation, and wearing protective goggles is also voluntary. Approximately half of the employees reported cleaning a light infestation without wearing any respiratory protection, while 19% reported using some type of respirator (N-95 filtering facepiece, half-mask respirator with P-100 filters, or PAPR). Nine percent reported using goggles.

Opening Closed Buildings

The Hantavirus Directive identifies opening closed buildings as an activity that poses a risk for hantavirus exposure. Closed buildings provide shelter for mice, and buildings that have been closed for extended periods of time require special procedures for opening, airing out, and cleaning to reduce the risk of exposure to airborne hantavirus-containing particles. Forty-two percent (42%) of employees reported opening a closed building in the previous year. Opening closed buildings was most commonly reported among electrician and maintenance workers (70%), rangers and trail workers (54%), and laborers (46%).

The Hantavirus Directive requires employees who open closed buildings to be enrolled in a respiratory protection program, including medical clearance and respirator fit testing, and to use a negative-pressure air purifying respirator equipped with P-100 filters (or more protective respirator). However, only 20% of employees opening closed buildings reported being fit tested for a respirator in the previous year (PAPR users excluded). The survey did not include any questions regarding the actual use of any personal protective equipment while opening closed buildings.

Hantavirus Knowledge and Training

To gauge employees' understanding of proper hantavirus safety practices and the rationale behind those practices, the employee survey included multiple choice questions based on information contained in the Hantavirus Directive. Only 58% of employees correctly answered that ordinary disinfectants can be used to kill hantavirus. This knowledge is important for all employees, since cleaning up a light rodent infestation safely requires disinfectant use. Only

40% of respondents knew that it is the responsibility of all employees to determine if a mouse infestation is light or heavy when doing a general exposure assessment. The purpose of this policy is presumably to have all employees be able to distinguish between a light infestation which they have been trained and equipped to clean up safely, as compared to a heavy infestation which should be cleaned up by a co-worker provided with more in-depth training and a higher level of protective gear including respiratory protection.

Most employees provided correct responses to questions on how people are exposed to hantavirus (inhalation of contaminated particles), the time period for developing symptoms following exposure (1 to 6 weeks), and the fact that hantavirus infection is not spread from person to person.

Thirty percent (30%) of employees reported that their only hantavirus safety training was in the form of a written brochure or a copy of the Hantavirus Directive, and 3% reported having had no training.

Limitations of the survey

The survey was conducted in September and October 2012, and by this time, many seasonal employees had left for the year. The participation rate for Employer B was calculated from an employee payroll list provided to OHB dated October 9, 2012; for Employer A, the Yosemite employee phone list and Yosemite payroll list were combined to calculate a participation rate. Among employees at Yosemite when the survey was administered, approximately 32% of Employer A's employees (319/1008) and 12% of Employer B's employees (203/1667) participated. Because of the limited participation rate and because individuals who chose to participate in the survey may be different than those who did not participate, the results of our survey may not be representative of all Yosemite employees. Furthermore, sharing of information among employees and the timing of the employee survey after the outbreak and substantial media coverage may have influenced responses. Finally, while the definitions of heavy and light mice infestations were stated in the questionnaire, employees may have subjectively perceived light infestations as heavy infestations.

Conclusions

While only one employee had blood test evidence of a Sin Nombre virus infection, and it is not possible to determine when this infection occurred, many Yosemite employees reported commonly encountering and cleaning up mice infestations at work, regardless of their job description, employer, or length of time employed in the park. Hantavirus infection remains an ongoing risk to employees, with serious health consequences, and implementing well-known

protective measures can help prevent transmission of the virus. However, these precautions, as outlined in the Hantavirus Directive, were not universally known or followed by employees. A lack of access to and use of cleaning supplies and personal protective equipment leaves employees with potential for hantavirus exposure. Enhanced and continuing vigilance of Yosemite's health and safety personnel, managers and supervisors, and employees will be necessary to adequately protect employees from future hantavirus exposures.

Recommendations

1. **Ensure that employees who are cleaning heavy mice infestations have in-depth training on how to perform this work safely, and have the necessary supplies and equipment.**

    - Employees whose job includes cleaning heavy mice infestations should be identified in advance; should be provided in-depth training on clean-up procedures and on how to properly select and wear personal protective equipment, including respiratory protection (see recommendation #2); and should demonstrate their ability to safely clean up heavy infestations.
    - Employees should always wear a respirator when cleaning heavy infestations.
    - Supervisors/managers should be responsible for ensuring that gloves, goggles, Tyvek® or other protective coveralls, shoe covers, and disinfectants are available to employees cleaning heavy infestations, and that safety procedures are consistently followed. Although not mentioned in the Hantavirus Directive, face shields could also be used in place of goggles, if preferred.

2. **Ensure implementation of an OSHA-compliant respiratory protection program that includes all employees who may clean heavy infestations, open closed buildings, or perform any other job duties considered high risk for hantavirus exposure.**

    - The respiratory protection programs (of Employer A and Employer B) should include written procedures for all components of a comprehensive respirator program including respirator selection, medical clearance, annual fit testing (for wearers of tight-fitting respirators), annual training, program evaluation, and recordkeeping that documents provision of these services for all employees included in the program.

3. **Ensure provision of basic hantavirus awareness and safety training to all employees at least annually.**

    - Train all employees to be able to distinguish between light and heavy mice infestations. The use of photos as guidance may be helpful during training.
    - Include a hands-on component, with demonstrations of prescribed light infestation cleaning practices, and provide periodic reinforcement of training as needed.

- Ensure that seasonal employees and contractors are trained in hantavirus prevention and light infestation cleaning before they start work for the season.

4. **Expand rodent exclusion efforts to employee workspaces.**

   - Apply rodent exclusion methods, as described in the CDC/CDPH Hantavirus Site Visit Report (based on September 14-18, 2012 site visit), as extensively as possible, to workspaces; also follow guidance in the NPS Rodent Exclusion Manual (http://www.nps.gov/public_health/info/eh/vector/nps_rp_manual_v2.pdf).

5. **Improve rodent control in employee housing in Yosemite.**

   - Expand rodent exclusion efforts to employee housing within Yosemite.
   - Clarify the process and responsibility for cleaning heavy mice infestations in employee housing.
   - Offer opportunities for any family members of employees who live in park housing to receive information and/or participate in hantavirus awareness training to learn about symptoms, how to exclude mice and clean up light infestations, etc.

6. **Clarify how Yosemite employees should seek care for hantavirus symptoms.**

   - Encourage employees with early symptoms of hantavirus infection (fever, fatigue, and shortness of breath) to report symptoms to their manager or supervisor.
   - Provide a mechanism for prompt medical evaluation of any employee who reports symptoms of hantavirus infection; access should be available regardless of job title, employment seasonality, or personal health insurance status.

7. **NPS should implement procedures to ensure that any contractor's hantavirus safety program provides effective protection to all employees, including implementation of the CDPH recommendations and compliance with the NPS Hantavirus Directive.**

   - NPS should conduct more comprehensive audits of contractor safety programs, including reviewing records related to training and the respiratory protection program, and obtaining evaluation input by interviewing employees.
   - If the results of these audits prove unsatisfactory, NPS should consider working with contractors to improve their safety programs.

Table 1: Demographic and Occupational Characteristics of Participants*

	Total (n=522)	Employer A (n=319)	Employer B (n=203)
Sex			
Male	293 (56%)	185 (58%)	108 (53%)
Female	228 (44%)	133 (42%)	95 (47%)
Race			
White	418 (84%)	266 (87%)	152 (80%)
Other	50 (10%)	21 (7%)	29 (15%)
Multiracial	28 (6%)	18 (6%)	10 (5%)
Hispanic	36 (7%)	19 (6%)	17 (9%)
Education			
High school, GED, or less	56 (11%)	18 (6%)	38 (19%)
Some college	193 (38%)	99 (31%)	94 (47%)
Bachelor's degree or higher	264 (51%)	198 (63%)	66 (33%)
Occupation			
Electrical, maintenance, sanitation, restoration	97 (19%)	61 (19%)	36 (18%)
Ranger, trail worker, forest management	75 (14%)	71 (22%)	4 (2%)
Food service, customer service, driver	72 (14%)	13 (4%)	59 (29%)
Administration, clerical, office	69 (13%)	42 (13%)	27 (13%)
Management	67 (13%)	20 (6%)	47 (23%)
Science	57 (11%)	57 (18%)	0 (0%)
Medical, search and rescue, security, law, fire	41 (8%)	38 (12%)	3 (1%)
Laborer	26 (5%)	17 (5%)	9 (4%)
Rooms keeper, hospitality	18 (3%)	0 (0%)	18 (9%)
Employment seasonality			
Year-round	402 (77%)	225 (71%)	177 (88%)
Seasonal	117 (23%)	93 (29%)	24 (12%)
Total time employed at Yosemite			
Less than 1 year	59 (11%)	35 (11%)	24 (12%)
1-4 years	162 (31%)	102 (32%)	60 (30%)
5-9 years	104 (20%)	61 (19%)	43 (21%)
10-19 years	91 (17%)	63 (20%)	28 (14%)
20-29 years	59 (11%)	29 (9%)	30 (15%)
Over 30 years	46 (9%)	28 (9%)	18 (9%)

*Numbers may not always total to 522 as not all participants responded to every question.