8. PREVENTION AND CONTROL

The prevention guidelines offered here borrow heavily from experience in North America and the interim guidelines established by CDC following the initial outbreak of HPS in 1993 (*24*). Recommendations for personal risk reduction are given in Section 8.1. (For easy reproduction and distribution, a number of these risk reduction guidelines are presented in Annex 9.) Also below are prevention guidelines for health professionals caring for patients infected with hantavirus (Section 8.2), people working with body fluids or tissue potentially infected with hantaviruses in the laboratory (Section 8.3), and researchers involved in handling and processing rodents (Section 8.4). Ultimately, each country of the Americas should establish prevention guidelines appropriate to its own circumstances.

There is no effective vaccine for the hantaviruses in the Americas. Viruses causing HFRS are antigenically distant, and their vaccines should not be used until future research proves otherwise.

Preventing contact with rodents and their excreta is the cornerstone to primary prevention of hantaviral illness in the Americas and throughout the world. Rodents of the subfamily *Sigmodontinae* are the reservoirs of hantaviruses that cause HPS. Most of the subfamily are field rodents that occupy areas away from urban population centers. However, they may enter areas of human habitation, particularly under circumstances of high rodent density and competition for shelter and food resources. Eradication of rodent hantavirus host species is neither desirable nor feasible due to the large number of species implicated and their wide distribution and abundance. Further, in regions where plague is endemic, control of rodents without concurrent control of fleas may increase the risk of human plague as the rodent fleas seek an alternative food source. The best currently available approach for hantavirus disease control and prevention is risk reduction through the use of precautions against infection by rodent excreta, combined with environmental hygiene practices that deter rodents from colonizing the home, recreational, and work environments.

8.1 PERSONAL RISK REDUCTION

Personal risk reduction is based on principles of rodent and infection control. Below are specific recommendations for reducing rodent shelter and food sources in and around the home, recommendations for eliminating rodents inside the home and preventing them from entering the home, precautions for preventing hantavirus infection while rodent-contaminated areas are being cleaned up, prevention measures for persons who have occupational exposure to wild rodents, and precautions for campers and hikers.

These guidelines can be readily followed with minimal investment in expensive or hard-to-use equipment or materials. They also can be applied generally to help reduce encounters with rodents and their excreta, and they do not require specialized skills in rodent species identification.

8.1.1 General Household Precautions in Affected Areas

Although epidemiologic studies are being conducted to identify specific behaviors that may increase the risk for hantavirus infection in humans, rodent control in and around the home will continue to be the primary prevention strategy (see Box 1). CDC has issued recommendations for rodent-proofing urban and suburban dwellings and reducing rodent populations around homes through habitat modification and sanitation.

8.1.2 Prevent Rodents from Entering the Home

A number of steps can be taken to prevent rodents from entering the home. A set of general guidelines is given in Box 2. These practices should be adapted to local circumstances.

In addition, if rodent nests are encountered while these prevention measures are being carried out, follow the

BOX 1. General precautions for residents of affected areas.

- Reduce the availability of food sources and nesting sites used by rodents inside the home.
- Eliminate rodents inside the home (see Box 3).
- Discourage children from playing with rodents or their nests, and advise them to tell their parents if they see rodents or their nests.
- Keep food (including pet food) and water covered and stored in rodent-proof metal or thick plastic containers with tight-fitting lids.
- Store garbage inside homes in rodent-proof metal or thick plastic containers with tight-fitting lids.
- Wash dishes and cooking utensils immediately after use and remove all spilled food.
- Dispose of trash and clutter.
- Use spring-loaded rodent traps in the home continuously.
- As an adjunct to traps, use rodenticide with bait under a plywood or plastic shelter (a covered bait station) on an ongoing basis inside the house.

BOX 2. General practices for the prevention of rodent infestation of homes.

- Use steel wool or cement to seal, screen, or otherwise cover all openings into the home that have a diameter of 0.5 cm or more.
- Place metal roof flashing as a rodent barrier around the base of wooden, earthen, or adobe dwellings up to a height of 30 cm and buried in the soil to a depth of 15 cm.
- Place 10 cm of gravel under the base of homes or under mobile homes to discourage rodent burrowing.
- Reduce rodent shelter and food sources within 30 m of the home.
- Cut grass, brush, and dense shrubbery within 30 m of the home.
- Use raised cement foundations in new construction of sheds, barns, outbuildings, or woodpiles.
- When possible, place woodpiles 30 m or more from the house and elevate wood at least 30 cm off the ground.
- Store grains and animal feed in rodent-proof containers.
- Near buildings, remove food sources that might attract rodents, or store food and water in rodent-proof containers.
- Store hay on pallets, and use traps or rodenticide continuously to keep hay free of rodents.
- Do not leave pet food in feeding dishes.
- Dispose of garbage and trash in rodent-proof containers that are elevated at least 30 cm off the ground.
- Haul away trash, abandoned vehicles, discarded tires, and other items that may serve as rodent nesting sites.
- Place spring-loaded rodent traps at likely spots for rodent shelter within 30 m around the home, and use continuously.
- Use a nationally approved rodenticide certified for outside use in covered bait stations at places likely to shelter rodents within 30 m of the home.

recommendations in Section 8.1.4. on the cleanup of rodent-contaminated areas.

8.1.3 Eliminating Rodents Inside the Home and Reducing Rodent Access to the Home

Rodent infestation can be determined by direct observation of the animals or inferred from the presence of feces in closets or cabinets or on floors or from evidence that rodents have been gnawing at food. If rodent infestation is detected inside the home or outbuildings, rodent abatement measures should be carried out (Box 3). The directions in Section 8.1.5 on special precautions should be followed if evidence of heavy rodent infestation is present (e.g., piles of feces or numerous dead animals) or if a structure is associated with a confirmed case of hantavirus disease.

Many rodenticides can be used; instructions on product use should always be followed. Products that are used outdoors should be specifically approved for exterior use. Any interior use of a rodenticide should be preceded by use of an insecticide to reduce the risk of plague transmission; fleas that may transmit plague may leave the body of trapped or poisoned animals. Insecticide sprays or powders can be used in place of aerosols if they are appropriately labeled for flea control. When rodent densities are high, rodenticides may be used to control populations before clearing or cutting tall grass or brush. If rodenticides are used in or around homes, precautions must be used to prevent accidental poisoning of children and domestic animals.

Trapping in the home should be done with snap traps that result in immediate death of the animal. Live traps or adhesive papers should not be used because virus excretion may continue. The dead animal should be disposed of as indicated in Box 3.

There is no reason to routinely test trapped animals for hantaviruses. Routine testing can potentially increase the public biohazard since more people would catch and handle rodents if they expected them to be tested. Also, a large sample size is required in order to get an accurate picture. Usually, only a small number of rodents are infected in a given locality, so routine testing of a few trapped animals is likely to give a false negative.

Predators are important in reducing the number of rodents, but increasing the number of household cats is

BOX 3. Eliminating rodent infestation: guidance for residents of affected areas.

- Before rodent elimination work is begun, ventilate closed buildings or areas inside buildings by opening doors and windows for at least 30 minutes. Use an exhaust fan or cross ventilation if possible. Leave the area until the airing-out period is finished. This airing may help remove any aerosolized virus inside the closed-in structure.
- Seal, screen, or otherwise cover all openings into the home that have a diameter of 0.5 cm or more. Then set rodent traps inside the house, using peanut butter, fruit, sugarcane, or other substitutes as bait. Use only spring-loaded traps that kill rodents.
- Next, treat the interior of the structure with an insecticide labeled for flea control, following label instructions. Insecticide sprays or powders can be used in place of aerosols if they are appropriately labeled for flea control.
- Rodenticides may also be used while the interior is being treated, as outlined below:
  - Remove dead rodents from the traps. Wear rubber or plastic gloves while handling rodents. Place the carcasses in a plastic bag containing a sufficient amount of a general-purpose household disinfectant to thoroughly wet the carcasses. Seal and double-bag the carcasses, then dispose of them by burying them in a hole 0.5–1 m deep or by burning. If burying or burning is not feasible, contact your local or state health department about other appropriate disposal methods. Rebait and reset all sprung traps.
  - Before removing the gloves, wash gloved hands in a general household disinfectant and then in soap and water. A hypochlorite solution prepared by mixing 3 tbsp of household bleach in 4.5 L of water may be used in place of a commercial disinfectant. When using the solution, avoid spilling the mixture on clothing or other items that could be damaged.
  - Thoroughly wash hands with soap and water after removing the gloves.
  - Leave several baited spring-loaded traps inside the house at all times as a further precaution against rodent reinfestation. Examine the traps regularly.
  - Disinfect traps no longer in use by washing in a general household disinfectant or the hypochlorite solution and ***rinsing*** clean. Disinfect and wash gloves as described above, and wash hands thoroughly with soap and water before beginning other activities.

not encouraged. Although they do not become infected and excrete virus, cats may bring rodents into the home and may contaminate the home after killing or eating rodents. Asian studies have suggested that cats may actually be a risk factor for human infection, although this was not found in the United States (*25*).

To date no hantavirus disease risk has been associated with rodents of the *Sciuridae* family (squirrels and chipmunks) or the groups of rodents used as food sources (guinea pigs, capybara, agouti, nutria, and tepisquintle).

8.1.4 Cleanup of Rodent-contaminated Areas

Areas with such evidence of rodent activity as dead rodents and rodent excreta should be thoroughly cleaned to reduce the likelihood of exposure to hantavirus-infected materials. Cleanup procedures must be performed in a manner that limits the potential for aerosolization of dirt or dust from all potentially contaminated surfaces and household goods (see Box 4).

Because hantaviruses are susceptible to standard disinfectants, these should be used extensively in cleaning. Household bleach diluted 1:10 in water is excellent for heavily contaminated areas but may damage many materials and dyes. Even common detergents will decrease viral infectivity, and the wetting action will diminish aerosol formation. The local health department should be consulted for advice on appropriate local brands and disinfectant concentrations.

Opening and cleaning buildings that have not been used for a period of time pose special problems. Rural schools, cabins, and storage sheds should be opened and allowed to ventilate for at least 30 minutes before entering to clean them (see Box 3). The delay will allow time for aerosols to decay and be diluted by outside air. Otherwise, infectious aerosols may be generated when rodents are disturbed and be retained within the room, protected from sunshine and the deleterious effect of ultraviolet light. Cleanup of the cabin should be accomplished as in Box 4*;* ***under no circumstance should a vacuum cleaner or a broom be used.***

Persons may elect to use surgical or painter's masks to protect the nose and mouth against larger particles, but they must be aware that no protection is afforded against small particle aerosols.

8.1.5 Special Precautions for Homes of Persons with Confirmed Hantavirus Infection or Buildings with Heavy Rodent Infestation

Special precautions are indicated for cleaning homes or buildings with heavy rodent infestation or that have been occupied by persons with confirmed hantavirus infection (see Box 5). Persons conducting these activities should contact the responsible local, state, or federal public health agency for guidance. These precautions may also apply to vacant dwellings that have attracted large numbers of rodents. Workers who are ei-

BOX 4. Cleanup of rodent-contaminated areas: guidance for residents of affected areas.

- Persons involved in the cleanup should wear rubber or plastic gloves.
- Spray dead rodents, rodent nests, droppings, and foods or other items that have been tainted by rodents with a general-purpose household disinfectant.
- Soak the material thoroughly and place in a plastic bag.
- When cleanup is complete (or when the bag is full), seal the bag, then place it into a second plastic bag and seal.
- Dispose of the bagged material by burying in a hole 0.5–1 m deep or by burning. If these alternatives are not feasible, contact the local or state health department concerning other appropriate disposal methods.
- After the above items have been removed, ***mop*** floors with a solution of water, detergent, and disinfectant. To avoid generating potentially infectious aerosols, do not vacuum or sweep dry surfaces before mopping.
- Spray dirt floors with a disinfectant solution. A second mopping or spraying of floors with a general-purpose household disinfectant is optional.
- Carpets can be effectively disinfected with household disinfectants or by commercial-grade steam cleaning or shampooing.
- Disinfect countertops, cabinets, drawers, and other durable surfaces by washing them with a solution of detergent, water, and disinfectant, followed by an optional wiping-down with a general-purpose household disinfectant.
- Rugs and upholstered furniture should be steam cleaned or shampooed. If rodents have nested inside furniture and the nests are not accessible for decontamination, the furniture should be removed and burned.
- Launder potentially contaminated bedding and clothing with hot water and detergent. (Use rubber or plastic gloves when handling the dirty laundry, then wash and disinfect gloves as described in Box 3.) Machine-dry laundry on a high setting or hang it to air-dry in the sun.

ther hired specifically to perform the cleanup or asked to do so as part of their work activities should receive a thorough orientation from the responsible health agency about hantavirus transmission, and should be trained to perform the required activities safely.

8.1.6 Precautions for Workers in Affected Areas Who Are Regularly Exposed to Rodents

Mammalogists, pest-control workers, and other persons who frequently handle or are exposed to rodents in the affected area are probably at higher risk for hantavirus infection than is the general public. The enhanced precautions warranted to protect those persons against hantavirus infection are shown in Box 6.

BOX 5. Special precautions for cleanup in homes of persons with hantavirus infection or buildings with heavy rodent infestation.

- A baseline serum sample, preferably drawn at the time these activities are initiated, should be available for all persons conducting the cleanup of homes or buildings with heavy rodent infestation. The serum sample should be stored at –20 °C.
- Persons involved in the cleanup should wear coveralls (disposable, if possible), rubber boots or disposable shoe covers, rubber or plastic gloves, protective goggles, and an appropriate respiratory protection device, such as a half-mask air-purifying (or negative-pressure) respirator with a high-efficiency particulate air (HEPA) filter or a powered air-purifying respirator (PAPR) with HEPA filters. Respirators (including positive-pressure types) are not considered protective if facial hair interferes with the face seal, since proper fit cannot be assured. Respirator practices should follow a comprehensive user program and be supervised by a knowledgeable person. Personal protective gear should be decontaminated upon removal at the end of the day. If the coveralls are not disposable, they should be laundered on site. If no laundry facilities are available, the coveralls should be immersed in liquid disinfectant until they can be washed.
- All potentially infective waste material (including respirator filters) from cleanup operations that cannot be burned or deep-buried on site should be double-bagged in appropriate plastic bags. The bagged material should then be labeled as infectious (if it is to be transported) and disposed of in accordance with local requirements for infectious waste.
- Workers who develop symptoms suggestive of HPS within 45 days of the last potential exposure should immediately seek medical attention. The physician should contact local health authorities promptly if hantavirus-associated illness is suspected. A blood sample should be obtained and forwarded with the baseline serum through the state health department to the appropriate reference laboratory for hantavirus antibody testing.

8.1.7 Precautions for Other Occupational Groups Who Have Potential Rodent Contact

Insufficient information is available at this time to allow general recommendations regarding risks or precautions for persons in the affected areas who work in occupations with unpredictable or incidental contact with rodents or their habitations. Examples of such occupations include telephone installers, maintenance workers, plumbers, electricians, and certain construction workers. Workers in these jobs may have to enter various buildings, crawl spaces, or other sites that may be rodent infested. Occasional cases have occurred among

such persons, but overall risk is very low (*76*). Recommendations for such circumstances must be made on a case-by-case basis after the specific working environment has been assessed and state or local health departments have been consulted.

8.1.8 Precautions for Campers and Hikers in the Affected Areas

There is no evidence to suggest that travel into the affected areas should be restricted. Most usual tourist activities pose little or no risk that travelers will be exposed to rodents or their excreta. However, persons engaged in such outdoor activities as camping or hiking should take precautions to reduce the likelihood of their exposure to potentially infectious materials (see Box 7).

BOX 6. Precautions for workers in affected areas who are exposed to rodents.

- A baseline serum sample, preferably drawn at the time of employment, should be available for all persons whose occupation involves frequent rodent contact. The serum sample should be stored at –20 °C.
- Workers in potentially high-risk settings should be informed about the symptoms of HPS and be given detailed guidance on prevention measures.
- Workers who develop a febrile or respiratory illness within 45 days of the last potential exposure should immediately seek medical attention and inform the attending physician of the potential occupational risk of hantavirus infection. The physician should contact local health authorities promptly if hantavirus-associated illness is suspected. A blood sample should be obtained and forwarded with the baseline serum to the appropriate reference laboratory for hantavirus antibody testing.
- Workers should wear a half-face air-purifying (or negative-pressure) respirator with eye protection or a PAPR equipped with HEPA filters when removing rodents from traps or handling rodents in the affected area. Respirators (including positive-pressure types) are not considered protective if facial hair interferes with the face seal, since proper fit cannot be assured. Respirator use practices should be in accord with a comprehensive user program and should be supervised by a knowledgeable person. Workers should wear rubber or plastic gloves when handling rodents or handling traps containing rodents. Gloves should be washed and disinfected before removal, as described earlier.
- Traps contaminated by rodent urine or feces or in which a rodent was captured should be disinfected with a commercial disinfectant or bleach solution. Dispose of dead rodents as described in Section 8.1.3.
- Persons removing organs or obtaining blood from rodents in affected areas should follow published safety guidelines (*56*).

8.2 RECOMMENDATIONS ON HOSPITAL ISOLATION PROCEDURES FOR PATIENTS WITH HANTAVIRUS PULMONARY SYNDROME

In North America, there is no evidence for person-to-person hantavirus transmission, and no health care workers involved in the care of HPS patients are known to have become infected with the virus (*27, 28*). In South America, however, there has been an outbreak of person-to-person transmission of Andes virus involving several health care workers (*43, 44, 48*).

Universal precautions with such barrier methods as gowns and gloves should be followed when caring for all hospitalized patients with HPS. In North America, there is insufficient evidence of interhuman transmission to warrant respiratory isolation procedures. Such procedures are practiced, however, in some hospitals until infection with SNV is confirmed, particularly in those regions where pneumonic plague and other respiratory transmitted infections are known to occur. Patients with respiratory disease should be managed with precautions appropriate to prevalent regional diseases.

In South America, if HPS is a consideration, universal precautions should be applied, surgical masks should be used, and the patient should be placed in a private room. These added safety measures are recommended, but each country should administer them based on its own epidemiological situation and local acute care facilities. Surgical masks are recommended because of the question of interhuman transmission with Andes virus

BOX 7. Reducing risk of hantavirus infection: guidance for hikers and campers.

- Avoid coming into contact with rodents and rodent burrows or disturbing dens, such as pack rat nests.
- Do not use cabins or other enclosed shelters that are rodent infested until they have been appropriately cleaned and disinfected.
- Do not pitch tents or place sleeping bags in areas in proximity to rodent feces or burrows or near possible rodent shelters (e.g., garbage dumps or woodpiles).
- If possible, do not sleep on the bare ground. Use a cot with the sleeping surface at least 30 cm above the ground. Use tents with floors.
- Keep food in rodent-proof containers.
- Promptly bury (or—preferably—burn, followed by burying, when in accordance with local requirements) all garbage and trash, or discard in covered trash containers.
- Use only bottled water or water that has been disinfected by filtration, boiling, chlorination, or iodination for drinking, cooking, washing dishes, and brushing teeth.

and other American viruses with which we have little practical experience. A surgical mask covering the mouth and nose will protect mucous membranes against droplets but will not protect against the inhalation of small-particle aerosols. In the previously mentioned Andes virus outbreak, the exact route of transmission was not defined, but small-particle aerosols were not implicated (*43, 44, 77*). If procedures which may be associated with generating high concentrations of droplets and small-particle aerosols, such as tracheostomy or intubation, are undertaken, additional protection is desirable, including goggles and a HEPA mask.

Intensive care unit staff should carefully adhere to the use of universal precautions, including surgical mask, gown, and gloves. If available, a private room should be used. If not, the risk for others in the ICU is very low. Even in the outbreak with person-to-person transmission, there were no cases among ICU staff and the effective contacts between cases were thought to occur before or shortly after hospital admission.

Studies to evaluate the potential for interhuman transmission of HPS-causing viruses are ongoing in South America, and recommendations for isolation procedures will evolve accordingly.

8.3 RECOMMENDED LABORATORY PRECAUTIONS WHEN WORKING WITH HANTAVIRUSES

Extensive experience with the hantaviruses that cause HFRS and a lesser experience with HPS indicate that infection has not been transmitted from clinical laboratory specimens. Viral antigens have been detected in necropsy specimens, and RT-PCR readily detects viral genetic material. Viral RNA has been found in tracheal aspirates and bronchial washings and has been detected by RT-PCR in blood and plasma obtained early in the course of disease. The implications of these findings for the infectivity of blood or tissues are unknown, but the potential for transmission may be present.

On the basis of available evidence regarding risk for laboratory-acquired hantavirus infection, at least Biosafety Level 2 (BSL-2) facilities and practices are recommended for laboratory handling of sera from persons potentially infected with the agents of HPS (see Annex 4). It is recommended that universal precautions be followed whenever human blood is handled. The use of a certified biological safety cabinet is recommended for all handling of human body fluids when potential exists for splatter or aerosolization.

Manipulation of disease-causing hantaviruses in cell culture and rodent tissues should be performed at Biosafety Level 3 (BSL-3) (Annex 4). Four laboratory workers were infected while working with cell culture-adapted Hantaan virus. Although the procedures associated with infection are unclear, all four persons worked repeatedly with hantavirus cultures and performed centrifugation of concentrated virus (*54*). This has led to recommendations for special precautions when working with virus concentrates (*78*).

Laboratory transmission of Old World hantaviruses from rodents to humans via the aerosol route is well documented (*78*). Exposures to rodent excreta, fresh rodent necropsy material, and animal bedding are associated with risk. In animal holding areas, the period of exposure to infectious animal excreta required for transmission may be short. For this reason, experimental rodent inoculations should be performed at BSL-3 with respiratory protection, or at BSL-4 (*78*). For more information, see Annex 4.

8.4 GUIDELINES FOR HANDLING AND PROCESSING RODENTS

Although inhalation of aerosolized virus is thought to be the most common route of infection, it is also possible that human infection occurs when virus or virus-contaminated materials are introduced into broken skin, conjunctivae, or mucous membranes, or when accidentally ingested with food or water (*56*). Infection has been transmitted by bite. Personnel collecting blood or tissue samples from live or freshly killed rodents are at risk for exposure to virus in the blood and organs of hantavirus-infected animals. The most important prophylactic measure for personnel who are trapping, handling, bleeding, or dissecting rodents is to be aware of potential routes of infection and carefully avoid conditions that may lead to infection. Fundamental precautions include minimizing exposure to rodent excreta, avoiding the creation of aerosols, always wearing proper personal protective equipment, properly anesthetizing animals before handling them, and carefully disinfecting contaminated working spaces, equipment, and clothing. Precautions should also be used when handling frozen tissues or blood taken from potentially infected animals (*56*).

More detailed information on precise rodent trapping and processing procedures and recommended precautions can be found in a report entitled "Methods for Trapping and Sampling Small Mammals for Virologic Testing," published by CDC (*56*). A Spanish version of this document is also available through the Pan American Health Organization (PAHO).

The control and prevention recommendations in this report represent general measures to minimize the like-

lihood of human exposure to hantavirus-infected rodents in areas affected by the outbreak of hantavirus-associated respiratory illness. Many of the recommendations may not be applicable or necessary in unaffected locales. The impact and utility of the recommendations will be assessed as they are implemented and will be continually reviewed by PAHO/WHO, CDC, and national, state, and local health agencies as additional epidemiologic and laboratory data related to HPS become available.

8.5 HEALTH EDUCATION

Health education efforts for HPS are intended to enhance recognition and management of disease and to prevent cases by reducing human contact with rodents. Amelioration of the impact of clinical disease depends on health care providers having adequate knowledge and skills. Prevention relies on the knowledge and ability of the general public to reduce their contact with rodents. Multiple communication channels and messages should be used to reach these two target populations.

This section outlines the numerous communication channels, messages, and issues surrounding HPS health education for health professionals (Section 8.5.1) and for the general public (Section 8.5.2). Suggested materials and services for HPS prevention are also provided (Section 8.5.3). Specific HPS educational materials available for use in educating health professionals and the general public are listed in Annex 5. Examples are also provided of health education methods in Argentina (Annex 6), Chile (Annex 7), and the United States of America (Annex 8).

8.5.1 Education for Health Professionals

Since early recognition of a case may improve the patient's chance of survival (through the application of appropriate supportive measures), physicians and other medical personnel play an important role in early case identification. Therefore, educational programs should be targeted to all medical personnel and should focus on the clinical features of the disease, diagnosis, patient management and treatment, and prevention recommendations. It is also necessary for other health professionals, such as public health officials, epidemiologists, laboratorians, and public health educators, to be knowledgeable of the latest research, including those results particularly pertinent to their region, in order to maintain an active surveillance system and to develop effective community-based programs. Additionally, materials targeting the general public should be made available to physicians to distribute to their patients.

8.5.2 Education for the General Public

Health education programs for the general public can be divided into two types of interventions: preventive measures during nonoutbreak situations and rapid response when there is a suspected case. Prevention is the best strategy and can be approached by following simple precautions to reduce human contact with rodents. The information provided in Sections 8.1 through 8.4 lists numerous step-by-step recommendations to reduce contact between humans and rodents. Promoting these recommendations in areas with large rodent populations should reduce the risk of infection. However, cases may still occur, and an effective health education response must be implemented quickly to ensure that patients seek medical attention at an early and appropriate time, to prevent additional cases, and to relieve the public's concerns.

Preventive Measures During Nonoutbreak Situations

Health education programs targeting the general public during nonoutbreak situations should accomplish three goals: inform about the disease, help to identify personal risk, and provide prevention recommendations. The messages should be tailored to the cultural and socioeconomic status of the at-risk populations, their level of disease risk, and the rodent habits, population density, and infection prevalence. It is particularly important to emphasize the following common areas of confusion:

- Not all species of rodents are reservoirs for HPS-associated hantaviruses. In order to develop appropriate messages for the public, health professionals need to be informed about the differences among rodent species, such as geographic distribution and behavior of rodent reservoirs, and which of the local species are particularly dangerous. For example, *Rattus norvegicus* is a common rodent found in urban areas. The number of *R. norvegicus* found near and in the home or the workplace should be reduced for sanitary reasons, but not for controlling HPS since this species is not a carrier of HPS-associated hantaviruses.
- Among those rodent species that are reservoirs for HPS-associated hantaviruses, infection is common and every rodent is potentially dangerous, but the risk of human disease is very low.
- While direct contact with rodents or their excreta is potentially dangerous and should be avoided, the main route of human infection is aerosols that may be generated by the rodents or from the rodent excreta.

In most communities, it will be impossible to completely eliminate rodents around the home or worksite. Therefore, messages should be based on managing human contact with the rodent population using the recommendations presented in this section.

Because supportive care is important to survival and patients may deteriorate rapidly, those who have symptoms suggesting HPS must be educated to seek medical attention. The wording of the message will vary depending on the cultural context, proximity of hospitals, diagnostic capability available, and other diseases endemic to the area.

Messages and materials should be directed at the many diverse groups within the general public. Multiple cultural perspectives, such as needs, values, and beliefs for each group, should be considered and addressed. Human contact with the rodent reservoirs tends to be higher in rural areas. Therefore, obstacles commonly encountered in these areas, such as lower economic status, lower reading levels, use of a local language, and accessibility difficulties, should be considered when developing the educational program.

Schools, parks, tourist areas, grocery stores, doctors' offices, health centers, campgrounds, and other areas frequently visited by the target population are possible sites to promote prevention messages. Parks, tourist areas, and campgrounds are particularly important to target because of the increased number of rodents in these settings.

Rapid Response When There Is a Suspected Case

Health education works in conjunction with clinical, laboratory, and epidemiology disciplines when responding to a suspected case. Once the risk factors associated with disease transmission have been identified and prevention measures have been developed, the population at risk can be targeted with education materials and campaigns. Additionally, intensive efforts should be made in the local communities and with the family members of any cases to provide information on the warning signs and symptoms of hantavirus infection, as well as prevention and control measures.

8.5.3 Materials and Services

Many materials and services can be used to educate health professionals and the general public. These include videotapes, slide sets, print materials, the Internet, mass media news coverage, public service announcements, national campaigns, audio conferences, seminars, and telephone hot lines. Annex 5 lists brochures, posters, pamphlets, and other educational materials provided by CDC. The information provided in the materials can be easily adapted to meet local needs.

Videotapes

A videotape can provide numerous messages within a short amount of time. Primarily used as a teaching tool, videotapes can reach a large audience and provide for repetitious viewing to clarify points and recommendations. For example, videotapes may be used to improve viewer comprehension of prevention recommendations by demonstrating specific cleanup procedures of rodent-contaminated areas. Videotapes do not provide any interaction between health educators and the general public, so they should be used as part of a comprehensive prevention program that employs other information dissemination methods and materials.

CDC has developed two videotapes on HPS. *Preventing Hantavirus Disease* targets the general public, and *A New Hantavirus* targets health professionals. Both videos are available in English and Spanish, in both VHS and PAL formats, and are free of charge. The two videos are described in Annex 5, and CDC's overall health education program is profiled in Annex 8.

Slide Sets

Slide sets are relatively inexpensive tools for teaching health professionals about HPS. As new information is discovered, slide sets can be updated and adapted easily. For example, slide sets may be used to show chest X-rays from patients with HPS to give a better picture of findings upon clinical presentation. CDC has developed a slide set with accompanying text which is available for public health workers, epidemiologists, medical professors, or infectious disease physicians for their use in giving presentations to their own audiences. The slides can be downloaded from the CDC Internet site in PowerPoint™ format in either English or Spanish. The slides provided may be combined with other slides addressing the local situation.

Print Materials

Brochures, posters, and pamphlets can be used to educate both health professionals and the general public. Different types of print materials are more effective de-

pending upon the amount of information presented. If numerous facts must be presented, brochures and pamphlets are beneficial. These materials are effective when introducing new information, presenting guidelines, or serving as a reference for suggested recommendations, such as the recommendations for keeping homes rodent-proof. In comparison, posters should be used to present small amounts of information. They can be placed on the walls of health centers, grocery stores, doctors' offices, and other common places, serving as a quick reference or constant reminder. For example, posters can be placed in rural grocery stores serving as a reminder to place food in sealed containers. As with any print material, consideration must be made for those who are unable to read or who read at a lower level or use another language. Pictures or drawings can help communicate messages to these audiences.

Educational efforts in Argentina included door-to-door distribution of brochures by health workers. This method ensured that families received information about HPS and also provided a mechanism to answer individual questions. Argentina's health education program is described in Annex 6.

The Internet

The Internet is an easy and quick delivery channel to educate health professionals and the general public about HPS. The information presented on an Internet Web site can be easily categorized and users can select what is useful to them, thereby satisfying the needs of various audiences. Additionally, the Internet is inexpensive, can be easily updated, and can be accessed worldwide. Although probably directly accessible to only a small fraction of the target audience, the Internet still has the capability to reach large audiences through downloaded information. CDC has an extensive Internet site on HPS. Information can be downloaded freely, reproduced, and used in educational publications or as a teaching supplement. The CDC HPS Web page (http://www.cdc.gov/ncidod/diseases/hanta/hantvrus.htm) can also be linked to a local Internet page.

Mass Media and Public Service Announcements

The use of the mass media can be quite successful in reaching target audiences quickly. This is especially important during an outbreak. Television, radio, and newspapers can be helpful in disseminating information to large audiences, but it is important that the disseminated messages be correct. A public health liaison can be identified to work specifically with the media to help ensure accuracy in news coverage.

Public service announcements (PSAs) are another way to reach large audiences. While the content of PSAs can be controlled, the times they are broadcast on either radio or television are chosen by the stations, which may not be the most popular listening or viewing times. The Ministry of Health in Chile has developed numerous PSAs for television, with topics ranging from rodent-proofing homes to cleaning cabins before summer vacation. Chile's PSA campaign is described in Annex 7.

National Campaigns

National campaigns can serve as an effective medium to bring information about HPS to large audiences at one time. Since many differing audiences within the general public need to be reached simultaneously, numerous messages and communication channels must be used. Successful campaigns utilize many of the other materials and education tools described in this section. Even if the epidemic is at the local level, national campaigns provide the opportunity to educate the general public about HPS and allay fears, abolish rumors and exaggerations, minimize stigmatization of individuals from affected areas, and prevent economic losses from a consumer boycott of products manufactured in affected areas. Since the media are usually involved in national campaigns, they must be educated about HPS to ensure information is reported accurately and responsibly. The recent appearance of HPS, with its dramatic clinical picture, has generated an inordinate amount of media interest in the United States and other countries. Education of the media will also improve the quality of their reporting. The description in Annex 7 of the national campaign in Chile includes much information on that country's use of the mass media.

Audio Conferences

Numerous health care professionals, public health workers, and medical and nursing students from several regions in a country can all participate simultaneously in listening to presentations via a speaker telephone. Prior to the audio conference, participants are provided with a copy of slides and a syllabus for each topic discussed. This is a simple and fairly inexpensive way (depending on long distance telephone services and rates) to provide health care professionals with up-to-date informa-

tion in a timely manner. It also provides a mechanism for the listener to interact with hantavirus experts, better addressing specific needs and questions. Additionally, the materials provided can be used to teach others. HPS topics that might be addressed in audio conferences include epidemiology, ecology, clinical features, patient management, diagnostics, pathology, and health education and prevention.

Seminars

Regional or national hantavirus experts can conduct seminars on all aspects of the disease for physicians and health care providers in their communities or through professional associations. They also allow for interaction among participants and immediate feedback on content and future needs.

Telephone Hot Lines

A telephone hot line is an inexpensive mechanism for health educators to answer questions from both the general public and health professionals. Additionally, callers can be asked to help identify topics that are important to them, as well as to identify topics not addressed in the educational programs. A telephone hot line may also serve as a mechanism for the public to request print materials to be sent by mail or fax.