Category 8: Public Health Pest Control

Public Health Pest Control Learning Objectives

After studying this section, you should be able to:

✓ Describe the concepts and significance of host, reservoir and vector in public health pest control.
✓ Explain management methods used to control and prevent diseases.
✓ List the common public health pests.
✓ Describe how disease is transmitted from arthropods to humans.

Category 8, Public Health Pest Control

Public health pest control involves the management of insects and other animals that transmit diseases to humans. It is important to understand a few terms and concepts.

Pathogen: A microscopic organism that causes disease in living things. Examples of pathogens in humans include bacteria, viruses, fungi, protozoa and rickettsiae.

Host: A living animal that provides sustenance to a parasite. For example, California ground squirrels are hosts for rodent fleas.

Reservoirs: A host animal that can harbor a disease-causing organism over an extended period of time without showing symptoms of the disease. The disease is spread when an insect feeds on the reservoir animal and then feeds on another animal later. Insects that spread diseases but are not affected by the disease are termed vectors. For example, birds are a reservoir for West Nile virus. West Nile virus is spread from the reservoir birds to horses and humans by mosquito vectors. Horses and humans become hosts, falling ill from the virus.
Arthropods are the group of invertebrates that include insects and arachnids.

Arthropods can be vectors of disease between one animal and another, including humans.

Arboviruses are those viruses transmitted by arthropods.

Vector: Generally an insect, such as a flea, mosquito or fly, or an arachnid, such as a tick, that transmits the disease or pathogen from one animal to another. Vectors may infect hosts directly or indirectly.

Indirect transmission is also referred to as mechanical transmission: the insect transports disease organisms on its body surfaces from one host, area or reservoir to another host. An example is dysentery bacteria transmitted on the feet, body hairs or other body surfaces of a fly to a human. In mechanical transmission, the insect vector is a passive or accidental transmitter of disease. The disease does not require the vector for development, just for transportation.

Another method of transmission is biological. Disease organisms need assistance moving from one host to another. Biological transmission occurs when the vectors acquire the disease organisms, the disease organism develops in the insect or arachnid vector’s body, and then is transmitted to a host. Within the vector, the disease may remain as it was, may further develop or may reproduce.

Some diseases require time within a specific vector to develop. These insects or arachnids are termed “obligatory vectors.” Malaria is an example of a disease that requires an obligatory vector. The malaria organism develops within the mosquito before being transferred to humans via the mosquito bite or sting. Without the mosquito vector, the malaria organism would die.

Just like all other pests, it is important to understand the life cycle of these public health pests. In the malaria example above, understanding the life cycle of the malaria organism has helped control spread of the disease. We recognize that we must control the mosquito vector to reduce or eradicate malaria.

Arthropods: This is the group of invertebrate animals that includes insects and arachnids, such as spiders, ticks and lice.

Arboviruses: These are the viruses transmitted by arthropods, including ticks or mosquitoes. The word is derived from “arthropod-borne viruses.” Examples of arboviruses are the West Nile virus (mosquito vector) and Colorado tick fever (tick vector).

Zoonotic diseases: These are infections caused by pathogens that are transmitted from animals to humans. The transmission can be direct, such as rabies, which is transmitted from one mammal to another. It may also be indirect, spread by an insect or arachnid vector from one vertebrate animal to another. Examples of indirect zoonotic transmissions include malaria from mosquitoes or rodent fleas that transmit plague.
**Epizootic:** An epidemic that caused a die-off in a wild animal population. Epizootics from plague periodically occur in rodent populations, such as the California ground squirrel.

### Specific Diseases, Prevention and Control

**Plague** is caused by a bacterial infection vectored to humans by rodent fleas. The bacterium involved is called *Yersinia pestis* and is easily treated with antibiotics if diagnosed early. There are three main forms of plague infection in humans:

- **Bubonic plague** is infection of the lymphatic system. It results from a flea bite. It is the most common form, characterized by rapid onset of fever and painful swollen lymph glands. Mortality often exceeds 50 percent in untreated cases of bubonic plague.

- **Septicemic plague** is infection of the bloodstream. It is usually fatal if not treated.

- **Pneumonic plague** is infection of the lungs. It results in a pneumonia that is associated with the highest mortality and is very contagious. It requires that the victim be isolated because of easy person-to-person transmission by droplet inhalation. Domestic cats are susceptible to pneumonic plague and can transmit it to humans.

Plague is characterized by continuing cycles of infection in native rodent species with rodent fleas serving as vectors. Reservoir rodent species in Nevada may include deer mice, meadow voles and some species of wood rats. The reservoir species are thought to be the source of plague-infected fleas that transfer the infection to more susceptible host species, such as ground squirrels, chipmunks, marmots and wild rabbits. Plague epizootics among susceptible species leave infected vector fleas seeking new hosts, providing potential risk to humans and domestic animals.

Plague prevention involves a comprehensive approach using habitat modification, sanitation, rodent proofing, trapping, toxic baits and public education. Precede rodent removal by flea control using an insecticide dust in the burrows to reduce populations of potentially infected host-seeking fleas. Follow label directions, including wearing the proper Personal Protective Equipment (PPE).

**Tick-borne Diseases** can be transmitted to humans by two types of ticks in Nevada and surrounding states. Hard ticks (ixodids) can vector several types of pathogens including viruses (Colorado tick fever), rickettsiae (Rocky
Diseases vectored by ticks include:
- Colorado tick fever
- Rocky Mountain spotted fever
- Lyme disease
- Relapsing fever

Mountain spotted fever), and bacteria (Lyme disease). Soft ticks (argasids) are known to vector the bacteria that cause relapsing fever in humans.

Both types of ticks become infected when taking blood meals from diseased hosts. Hard ticks quest for new hosts from vegetation. They quickly transfer to animal or human hosts that brush against the vegetation. These ticks are slow-feeding and can take days to complete taking a blood meal from a host. In Lyme disease, both the adult and the nymph form, which is about the size of a pinhead, are capable of transmitting disease. In endemic areas, removal of leaf litter and clearing tall grass and brush around houses and at the edge of gardens may reduce the numbers of ticks. Applying acaricides at the edge of woodlands near homes can be very effective in controlling ticks. Personal protection including wearing long-sleeved shirts and long pants and prompt tick removal reduces the infection rate.

Soft ticks capable of vectoring relapsing fever are found in the nests of rodents, such as squirrels and chipmunks. If the nests are in the home and the rodents become scarce, the ticks will take a meal from other nearby warm-blooded animals, including humans. Soft ticks feed for only about 20 minutes while the unsuspecting host is sleeping. The key to prevention is to rodent-proof buildings in areas where tick-borne relapsing fever is known to occur. Once an infestation has occurred, rodent nesting material should be removed. A crack-and-crevice pesticide treatment should also be performed in the nesting area to kill any remaining ticks.

**Hantavirus** is a zoonotic disease that was first identified in the Southwest in 1993. The particular strain of virus that causes disease in the West and Southwest is known as “Sin Nombre.” The primary reservoir for Sin Nombre virus is the deer mouse. The deer mouse remains unaffected by the virus, which is passed in its saliva, droppings and urine. People primarily become infected by inhaling the virus when entering or stirring up dust in a closed structure that contains infected mouse droppings and urine. Rarely, infection occurs through a mouse bite. Mortality rates for Sin Nombre virus remain high at about 40 percent. Since the discovery of Sin Nombre virus, other disease-causing strains of hantavirus have been found in New World rats and mice. For this reason, all rodent droppings should be considered potentially infectious.

Rodent removal using snap traps is recommended, as human infection has occurred when using live traps and glue boards. Seal up any openings that allow mice to enter. If at all possible, allow the infested area to remain undisturbed for four to five days after the rodents have been removed. Research indicates that the virus does not remain viable after about three to four days. Before beginning to clean an infested area, open up the windows
and doors and allow the area to air out for 30 minutes. This decreases the amount of air-borne virus in the enclosed space and decreases the risk of infection. Follow this with wet cleanup using a disinfectant or household bleach diluted 1:10 with water. Saturate the urine and droppings with the disinfectant or bleach solution and let the area soak for five to 10 minutes. For further information, consult the Hanatvirus – An Update chapter in the general section of this manual.

Mosquito-borne viruses known to cause disease in humans and domestic animals in Nevada include St. Louis encephalitis virus (SLE), Western equine encephalomyelitis virus (WEE), and West Nile virus (WNV). These viruses cycle in nature between mosquitoes and birds. Humans and domestic animals such as horses are incidental hosts that are accidentally infected but have no role in the spread of the disease. Although it is rare, humans can suffer severe permanent neurologic disability or even death from these arboviruses. Even milder forms of these arboviral illnesses can be quite debilitating and can result in extended loss of work time.

A comprehensive mosquito abatement program that integrates various control strategies is the best prevention for arboviral disease. These strategies include removal of standing water, biological controls, such as mosquito fish, and the use of larvicides (kills larva) and adulticides (kills adults).

Rabies is a zoonotic disease of public health concern in Nevada, primarily associated with bats and wild carnivores. The most recent domestic animal rabies case in Nevada is thought to have been a cow in Elko County that died of a bat strain of rabies in 1990. Daytime activity, weakness and inability to fly can be signs of rabies in bats. Rabies is almost always fatal in humans, but can easily be prevented if an exposure is followed with post-exposure prophylactic shots (PEP). The rabies virus is slow-growing, with symptoms typically developing 1 to 3 months after exposure. However, the time to develop symptoms can vary from less than 1 week to over 1 year. Since bats have very small teeth, a bite can be invisible. A victim is often unaware of being bitten and fails to seek PEP. By the time a victim displays symptoms of rabies, PEP is no longer effective.

Exclusion from buildings is the best method of bat control. Excluding bats must be done in accordance with federal law, as some species of bats are protected. Young bats must be able to fly before an exclusion strategy will work. If you seal entry/exit points while young are present, they will die inside the building, resulting in additional problems. Make sure the bats have departed for the evening and then seal up all openings greater than one-quarter inch. This includes vents, chimneys and other openings in the roof,
Eves or soffits, gaps around windows or doors, gaps around conduit or pipes, and holes or gaps in window screens. For migratory species, the best time to implement exclusion measures is the fall or winter. No pesticides are registered for bat control.

Most bat bites occur when people handle or provoke them. Anyone doing work, such as bat removal and exclusion, should consider pre-exposure rabies vaccinations as a measure of personal protection. As with all animals, use caution and common sense when handling dead bats.

Vaccination of domestic animals and control of stray and feral animals by animal control agencies since 1950 have resulted in reduced rabies in domestic animals in the U.S. However, wild animal rabies remains a threat and is spreading in some areas.

Bed bugs are not associated with disease transmission in the United States. Bed bugs are small insects that range from a poppy seed to an apple seed in size. They are commonly brown in color and have a flat, oval shape when unfed. When not feeding, they can hide in a number of places, including the piping, seams and other areas of the mattress and box spring, in cracks of the bed frame and headboard, in clutter near the bed, under baseboards, in curtains and under loose wallpaper. These insects are considered a public health concern because they can be a terrible nuisance and are difficult to eradicate.

Bed bugs spread readily, moving from infested furniture, bedding, baggage, boxes and clothing to new sites. While they typically feed on blood every 5 to 10 days, they can go for more than a year without feeding. The ease with which they spread and their ability to live without food for over a year makes them difficult to eradicate once an infestation has occurred. Control of bedbugs requires that all bedding and clothing be removed and washed in hot water. Clutter that may provide additional hiding places for bed bugs should be removed. Thorough cleaning of infested areas is required to control an infestation. Insecticide sprays and/or dusts are used for control, but READ THE LABEL. Make sure the pesticide product you choose is labeled for indoor use and labeled for use on bed bugs. Applications should be made to cracks, crevices and other places where bed bugs hide. Do not overlook mattress seams and tufts, cracks along baseboards and moldings, loose carpet edges, loose wallpaper, and hollows in bed frames or other furniture.

Cockroaches are nuisance insects that may cause rare, isolated cases of food-borne illness and asthma. Cockroach control depends on maintaining strict cleanliness. Remove any crumbs, dirty dishes or food and drink spills, and fix leaking pipes or faucets to eliminate food and water sources for cockroaches. Use insecticide applications with products that are labeled for
use inside a dwelling or kitchen to get rid of a cockroach infestation. Follow-up treatments may be needed as cockroaches continue to hatch after the initial treatment. If more than one application of a pesticide is required, use pesticides with different mechanisms of action to prevent development of resistance in cockroaches.

There are four species of importance:

- The German cockroach is the most common. Usually found outdoors, these cockroaches enter the premises in search of moisture. Limit food and water sources and eliminate access to aid in control. The German cockroach has developed resistance to chlorinated hydrocarbons, so use one of the newer insecticides developed for cockroach control. Contact your local dealer for specific insecticides to control German cockroaches.

- The American cockroach is large and red. Like the German cockroach, the American cockroach is usually found outdoors and enters the premises in search of moisture. Limit food and water sources and eliminate access to aid in control. A quick knockdown residual insecticide is generally used to control these pests. Contact your local dealer for specific recommendations.

- The Oriental cockroach is black and shiny. Usually outside, these cockroaches also enter premises in search of moisture, like the German and American cockroaches. Limit food and water sources and eliminate access to aid in control. A quick knockdown residual insecticide is generally used to control these pests. Contact your local dealer for specific insecticides.

- The brown banded cockroach is very common in certain areas. Unlike the other three species mentioned, brown banded cockroaches prefer warm and dry locations. They are found in structures generally away from water sources. Good sanitation is important. Eliminate food sources. Block entry points by filling in cracks, crevices and other entry sites at ducts, moldings or other openings. Baits and traps are used to control these pests, along with quick knockdown residual insecticides. Contact your local dealer for specific recommendations.

**Conclusion**

Category 8, Public Health Pest Control, involves the management of insects and other animals that transmit diseases to humans. Cleanliness and good sanitation are very important in preventing or at least limiting infestations. Prevention and exclusion are the best methods of control for many of these pests.
For current information regarding public health and infectious diseases, see the Centers for Disease Control and Prevention, [http://www.cdc.gov](http://www.cdc.gov), and the Directors of Health Promotion and Education, [http://www.dhpe.org](http://www.dhpe.org).