14 Animal Health

Learning Objectives

After you have studied this chapter, you should be able to:

- Explain the nature of disease.
- Describe the causes of disease in general terms.
- Outline a procedure for diagnosing disease.
- Describe the body's defenses against disease.
- Describe the elements of herd health.
- Identify the effects of animal disease on human well-being.
- Describe the elements of regulatory animal medicine.

Key Terms

Active immunity
Acute disease
All-in, all-out animal management
Antibodies
Antimicrobial agent
Asymptomatic disease
Biopsy
Chronic disease
Clinical infection
Clinical sign
Contagious disease
Diagnosis
Diagnostician
Direct cause of disease
Disease
Etiology
Herd or flock health management program
Infectious diseases
Lesion
Necropsy
Passive immunity
Pathogen
Pathogenicity
Pathology
Predisposing cause of disease
Resistance
Stress
Subclinical infection
Toxin
Vector
Virulence
Zoonotic

INTRODUCTION

It is a challenge, an obligation, and a necessity to animal stewardship tha animals be maintained as near to a constant state of health as possibl and/or feasible. It is a challenge because the area of disease preventio and treatment requires, at least for some species, constant vigilance. I is an obligation because appropriate stewardship of the animals in ou care includes disease prevention and treatment. It is a necessity becau the number of diseases that can bring illness and death, and with the economic ruin, is numerous for all species.

Disease State of being other than that of complete health. Normal function of the body or its parts is disturbed.

Clinical sign Observable difference in an animal's normal function or state of health that indicates the presence of a bodily disorder.

DISEASE

In its broadest definition, **disease** is any state other than a state of compl health. In a state of disease, the normal function of the body, or some its parts, is changed or disturbed. Microorganisms and parasites can ca states of disease. Disease includes injuries such as broken bones, cuts, a burns, and metabolic disorders such as grass tetany and milk fever. A **cli cal sign** (Figure 14–1) is what the animal exhibits that is different fr the normal function. Clinical signs include fever, weight loss, edema,

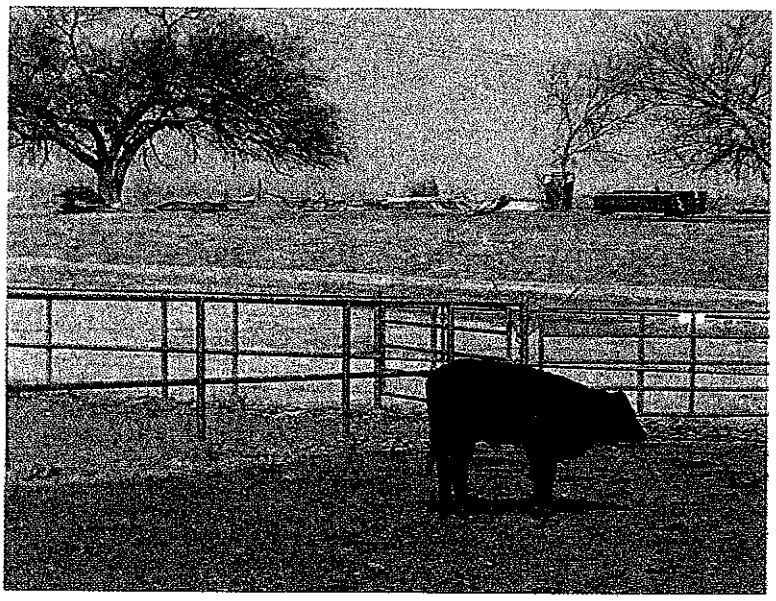

Figure 14–1
Animals display clinical signs that indicate illness. Notice the characteristic "shipping fever" posture of this calf.
(Photo courtesy of T. C. Stovall, Department of Animal Science, Oklahoma State University. Used with permission.)

reduced performance. A **lesion** refers to changes in body organs. Changes in size, color, or shape of an organ are typical lesions, as are tumors or abscesses of organs.

Understanding disease is complicated by the possibility of several interactions between the causes of disease and the victim of it. **Pathology** is the study of the essential nature of diseases. **Etiology** refers to the cause of disease or the study of causes of disease. Pathology and etiology are pursued most frequently by individuals with training in medicine and/or various science disciplines. Biochemists, microbiologists, metabolic nutritionists, molecular geneticists, statisticians, and other scientists all contribute to the fields of pathology and etiology. These individuals can be associated with various disciplines in colleges and universities, with industry groups such as drug companies, in local, state, or federal government, and in international organizations such as the Food and Agriculture Organization of the United Nations.

Lesion Abnormal changes in body organs owing to injury or disease.

Pathology The branch of medicine that deals with the essential nature of disease.

Etiology The factor that causes a disease or the study of factors that cause disease.

Causes of Disease

Animals have a natural defense system against disease involving a number of factors that can be loosely grouped under the term **resistance.** This includes the general state of health of the animal and several body mechanisms, including the immune system and behavioral adaptations, designed to repel attacks from disease-causing organisms. Obviously, these mechanisms fail from time to time. Some particularly virulent **pathogens** are so destructive because the body has virtually no defense of any kind against them. History is littered with great epidemics in both animals and humans, sometimes occurring at the same time, that have killed hundreds of thousands—even millions—of victims. Other pathogens are perhaps just as deadly or incapacitating but are less destructive because the body has better defenses against them. Disease is usually caused by a combination of **predisposing causes** and **direct causes.**

Predisposing causes are often referred to as **stress** factors (Figure 14–2). Stress factors are varied, but have in common the fact that they place unusual or additional demands on the body. They make the animal more susceptible to disease. Poor nutrition can affect an animal's immune system and predispose it to infection (Figure 14–3). Poor mineral or vitamin balance during growth can predispose animals to joint problems. The genetic makeup of an animal may leave it vulnerable to many diseases, including a variety of metabolic diseases and certain cancers. Environmental factors such as chilling, crowding, inadequate

Resistance The natural ability of an animal to remain unaffected by pathogens, toxins, irritants, or poisons.

Pathogen Any living disease-producing agent.

Predisposing cause of disease Any condition or state of health that confers a tendency and/or susceptibility to disease.

Direct cause of disease Exposure to or contact with pathogens or other substances that cause a decrease in animal health.

Stress A response by the body to a stimulus that interferes with the normal physiological equilibrium of the animal.

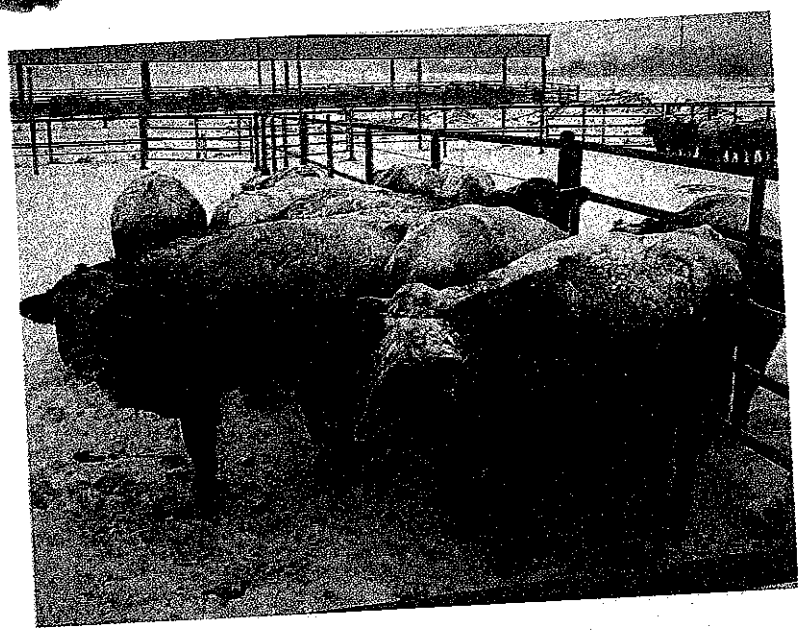

Figure 14–2
Stress factors, such as extreme or unseasonable weather conditions, predispose animals to disease.
(Photo courtesy of Blake K. Wilson. Used with permission.)

Figure 14–3
Poorly nourished animals are vulnerable to infections and metabolic diseases.
(Photographer B. C. McLean. Courtesy of USDA.)

ventilation, stress related to handling, improper use of feed additives or me
ications, and many more may predispose an animal or group of anim
to disease. Poor leg structure can predispose a racehorse to fractures. Ev
the normal acts of life can predispose to disease. For example, milk fe
almost never occurs except very close to parturition.

Direct causes of disease include several categories of infectious etio
gies: bacteria, viruses, *Rickettsia,* protozoa, *Mycoplasma,* external parasi
internal parasites, fungi, and the poorly understood prions associated w
mad cow disease. These causes are distinguished by the fact that they
themselves living agents that cause disease by their presence in or on
animal's body. Diseases caused by living organisms are called **infecti**
diseases. A living organism that causes disease in another living organ
is a pathogen. Infectious diseases have four requirements for their perpe
tion: (1) The pathogen must be able to gain entrance into the body, usu
through the skin or a body orifice; (2) once there, it must be able to ada

Infectious diseases
Diseases caused by living organisms, which invade and multiply in or on the body and result in damage to the body.

(a)

(b)

Figure 14–4
Contagious diseases are those that are transmitted from animal to animal. Most infectious diseases are contagious. (a) Several pigs in this herd are affected by a contagious disease. (b) In some instances, slaughter and burial of carcasses are necessary to control the spread of threatening contagious diseases. (Photos courtesy of USDA, APHIS.)

the host environment and multiply; (3) at some point it must be able to exit the host; and (4) then infect another host so that the cycle is perpetuated. The terms **pathogenicity** and **virulence** describe the ability of an organism to cause disease. A disease is **contagious** (Figure 14–4) if it is transmitted readily from animal to animal. Most, although not all, infectious diseases are contagious. Some pathogens infect only one species or a group of closely related species. Thus there are diseases only horses or chickens can get, diseases only ruminants can get, and so on. Some infectious agents are spread from animal to animal by a **vector**, usually an arthropod such as a mosquito or tick (Figure 14–5). Table 14–1 outlines the means by which infectious agents spread from one animal or herd to another.

Other direct causes of disease are noninfectious. Nutrient deficiency diseases result directly from improperly balanced and/or improperly fed rations. Perfectly balanced rations can cause disease if the animal overeats. Some diseases, such as hemophilia, are caused directly by genetic makeup. Genetic diseases are different from genetic predispositions to disease. One does not inherit cancer, for instance. However, certain genetic makeups predispose individuals to developing cancer. By contrast, diseases such as hemophilia and muscular dystrophy are inherited diseases caused by a specific genotype that is present from the moment of conception. Other direct causes of disease include those that may cause a traumatic injury, such as a nail, a sharp instrument, a falling object, or a wet and slick floor. A metabolic disturbance is a direct cause of many diseases. **Toxins** or chemical poisons can also be direct causes of disease.

Pathogenicity The capability of an organism to produce disease.

Virulence Degree of pathogenicity.

Contagious disease Disease capable of being transmitted from animal to animal.

Vector Animal, usually an arthropod, that transfers an infectious agent from one host to another.

Toxin One of several poisonous compounds produced by some microorganisms, plants, and animals.

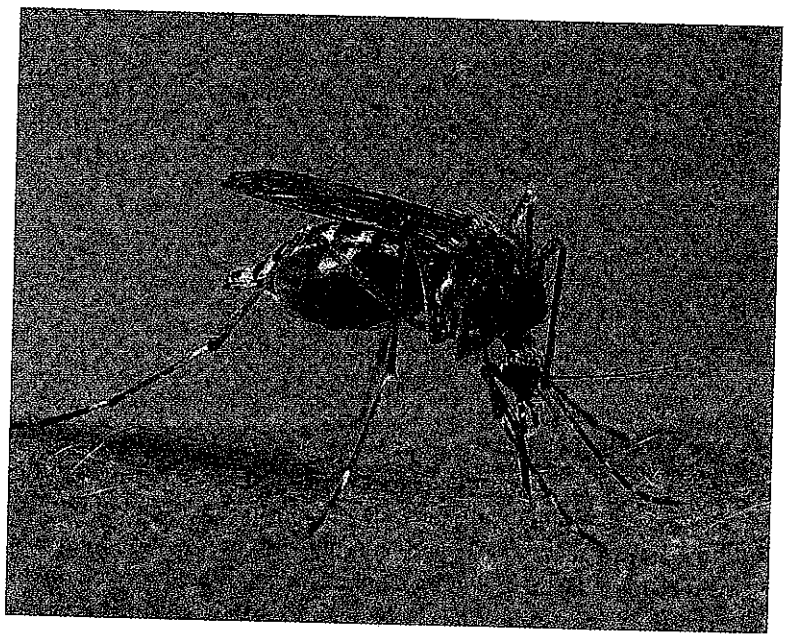

Figure 14–5
Often arthropods, mammals, reptiles, and birds transmit diseases and parasites from one species to others. Mosquitoes, such as the one pictured here, transmit several diseases. (Photo courtesy of Agricultural Research Service, USDA.)

Table 14–1
WAYS OF INTRODUCING AND SPREADING INFECTIOUS DISEASES

1. Introduction of diseased animals.
2. Introduction of animals that have recovered from a disease but are carriers of the infectious agent and can transmit it to other animals.
3. Contact with inanimate objects such as trucks, trailers, feeders, waters, and so on, that are contaminated with infectious organisms.
4. Exposure to the carcass of an infected animal.
5. Water. This may be water a sick animal in the herd contaminated or impure surface water carried from another source.
6. Pathogens carried by rodents, varmints, and birds.
7. Vectors. Some diseases are carried by arthropods, especially blood-sucking and biting insects (Figure 14–5).
8. People. The shoes and clothing of a person can carry infectious organisms from one group of animals to another.
9. Contaminated feed or feed bags.
10. Contaminated premises. This could be soil, bedding, or litter.
11. Airborne organisms.

Source: Adapted from Berry, 2007, p. 1. Used with permission.

Describing Disease

Clinical infection Infectious disease in which clinical signs are expressed. Allows identification of the disease.

Subclinical infection Infectious disease in which no readily observable clinical signs exist.

Acute disease Sudden or severe in onset and effect on the animal.

Chronic disease Continuing over a long period or having a gradual effect.

The severity of diseases is described in several ways. If the disease is infectious in nature then it may be either a **clinical** or **subclinical infection**. When clinical signs of a dis ease are present, it is clinical. Subclinical diseases don't have readily observable clinic signs. Sometimes the terms *inapparent* or *asymptomatic* are used to describe subclinic infections. Animals with subclinical infections are capable of shedding infectious agent which can spread the disease to other animals. Such animals are often called *carriers.*

Acute diseases have a sudden onset of clinical signs and a short duration illness. They are also characterized by having a clear-cut termination of the disea either the death of the animal or its recovery. The recovery should occur no long than 2 to 3 weeks after onset of the disease. **Chronic diseases** have symptoms th develop slowly over a period of weeks or even months. Early symptoms are usua minor and often nonspecific and easy to overlook. Animals may be described as " feed," "unthrifty," perhaps "lacking in bloom." Weight gains may be reduced, m production off, performance reduced, or activity levels may seem different. Often clinical signs could be attributed to dozens of diseases, which gives them little di nostic value. Chronic diseases have a lengthy duration compared to the 2- to 3-w period or less for acute diseases.

Diagnosis of Disease

Diagnosis The process of determining the nature and severity of a disease; art of distinguishing one disease from another.

Diagnostician An expert on diagnosing disease.

The combination of husbandry skills, scientific techniques, analytic ability, intuition, luck that goes into the art of detection and identification of animal disease is collecti referred to as **diagnosis**. A person with expertise in diagnosing disease is a **diagnostic** A good diagnostician can be worth his or her weight in gold. Naturally, the purpo diagnosis is to identify the cause of the clinical signs that an animal is exhibiting treatment can be devised. However, other reasons are equally or even more impor In a herd situation, the extent to which the disease poses a threat to the entire herd be assessed. Because many diseases can be transmitted from animals to humans, and versa, the health effects on the human population must also be considered.

The animal or herd owner or manager will most likely be the first to observe something is amiss. Experience has provided owners and managers with some unc

Table 14–2
SOME NORMAL BODY VALUES FOR SELECTED SPECIES

Animal	Rectal Temperature (°F)	Heart Rate (beats/minute)	Respiratory Rate (breaths/minute)
Cow	101.5	48–84	26–50
Sheep	102.3	70–80	16–34
Goat	102.3	70–80	15–30
Pig	102.5	70–120	32–58
Dog	102	70–120	18–34
Cat	101.5	120–140	16–40
Rabbit	103.1	180–350	35–60
Horse	100	28–40	10–14
Chicken	107.1	250–300	12–36
Turkey	105	160–175	28–49

Source: Compiled from *Merck Veterinary Manual*, 2005, and Reece, 2004.

abilities to detect illness in animals, and they often have a good idea as to the problem, its cause, and its cures. However, in many cases, a complete diagnosis requires the skills of a veterinarian. In addition to specialized training and continuing education requirements to help keep them current, licensed veterinarians have access to laboratories and other resources. A diagnostic procedure can be fairly simple or extremely complex, depending on the severity of the problem, and can include any and all of the following elements:

- History of the sick or dead animal and herd mates, if applicable.
- Clinical examination, including a record of visible signs, body temperature, observations of respiratory rate and character, and listening to the internal body sounds of lungs, rumen, intestine, and heart.
- Palpation of the body for swelling or other abnormalities.
- Rectal palpation to assess the state of various internal organs and to determine pregnancy.
- Collection of specimens such as feces, skin, blood, urine, semen, and other body fluids for various laboratory tests.
- A full diagnostic examination of a dead animal (**necropsy**).

Necropsy The examination of a body after death.

Once the information is collected, the values are compared with normative information, such as the examples shown in Table 14–2. Abnormalities in these numerical values and other nonnumerical abnormalities or problems are detected and a diagnosis is reached through the process of *differential diagnosis* (Box 14–1).

BOX 14–1
DIFFERENTIAL DIAGNOSIS

Differential diagnosis is a systematic method used to identify the disease responsible for a patient's clinical signs. Diseases with similar characteristics can often be distinguished by comparing clinical signs, physical exam findings, and the results of laboratory tests or other diagnostic procedures. For example, a differential diagnosis list for potential causes of nasal discharge in cattle would include bacterial pneumonia, viral infection, lungworm infection, nasal trauma or foreign body, esophageal obstruction (choke), or pharyngeal abscess. A diagnostician (typically a veterinarian in this scenario) would use information such as the age and vaccination status of the animal, herd history of disease, presence of other affected animals, and so on, along with physical exam findings to determine which cause of nasal discharge is most likely. At that point, the diagnostician would either pursue further testing to verify the diagnosis or begin treatment for the most likely cause and reevaluate if the problem does not resolve.

VETERINARY SERVICES AVAILABLE

Mobile

Mobile or ambulatory veterinary care has been a mainstay of agriculture for decades. It has been traditionally directed at emergency medicine in a rural setting. Such services are becoming more available in urban areas as well. Small-animal mobile clinics can meet a pet owner's need for both emergency and routine care. Many mobile veterinarians work out of a well-outfitted vehicle that makes available most of the equipment needed in everyday practice. Mobile veterinarians often provide more extensive services in affiliation with another veterinarian or at their own clinic, if the need arises (Figure 14–6).

Animal Clinics/Hospitals

Traditional animal clinics and hospitals, in which one or more veterinarians practice medicine at a fixed location, are modeled on human medical clinics. These clinics are generally well equipped and often have the capacity to hospitalize patients for extended periods of time if necessary. Veterinarians may specialize in treating large or small animals, may focus on treating just one species of animal, or they may be in mixed practice. Small-animal owners frequently receive care for their pets at animal clinics or hospitals. Many veterinary clinics have working facilities to handle large animals efficiently. For example, horses may be brought in for procedures such as castrations. Working facilities for feeder calves or feeder pigs may be provided. A producer who purchases animals can stop and have the animals inspected, vaccinated, and dewormed before taking them home. In some parts of the country, these clinics are very popular.

Programmed Health Management

Programmed health management services are much more involved than simply treating sick animals. These programs are designed to be holistic and manage the numerous aspects of a livestock operation that can affect animal health. The objective of a health management program is to reduce productivity losses owing to management errors or disease by ensuring the optimal care and well-being of the animals. Large kennels, horse and camelid stables, dairies, beef feedlots, and swine operations are among those most likely to have need for this type of program. Services include diagnosis and treatment of sick animals. In addition, the veterinarian may provide consultation on management, nutrition, housing, ventilation

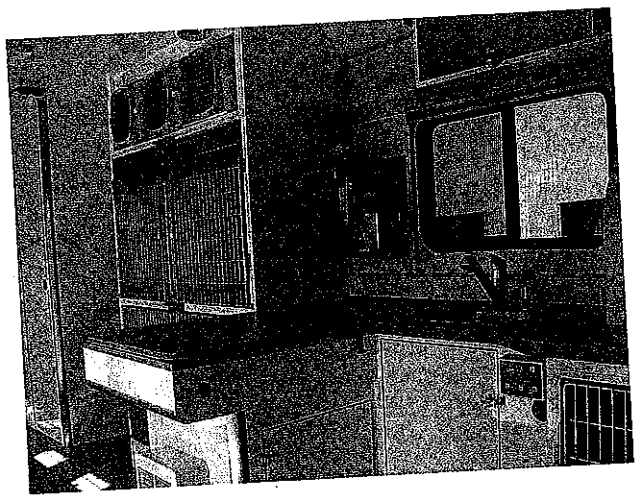

Figure 14–6
A fully equipped mobile clinic for the care of small animals may include an examination area, cage space, a surgical suite, equipment for taking X-rays and laboratory equipment for blood analysis, all within a motor home-type vehicle. (Photo courtesy La Boit inc. Used with permission.)

milking technique, vaccination programs, and any other factor that affects animal health. Training is often provided to help those who are responsible for daily animal care to detect symptoms of disease and to accomplish routine management procedures effectively such as castration or vaccination. Medications and treatment guidelines may be provided for easy-to-diagnose ailments so that animals receive the care they need in a more cost-effective and timely manner. Regularly scheduled visits by the veterinarian are used for observation, consultation, treatment, pregnancy checks, and so on. Emergency veterinary care is also generally provided as a part of these programs.

Resident Veterinarian

Some operations are of such size and scale that they need and can afford a resident veterinarian; examples of such operations may include large horse farms, beef feedlots, integrated poultry and swine operations, and a few other isolated types of operations. Resident veterinarians provide virtually all veterinary services, including programmed health management for a single or small number of operations. The term *resident* may be taken very literally, as in the case of some horse operations where the animals are so valuable that the veterinarian lives on the premises and has access to a clinic where almost any procedure can be performed. The term may also be more figurative, as in the case of resident veterinarians who provide necessary services for large confinement operations for meat animals. Such an individual may be the resident veterinarian for a cluster of operations found in proximity to each other.

Diagnostic Services

Some types of diagnostic procedures are impractical to impossible for veterinary practitioners to perform because of prohibitive equipment costs, lack of specialized training, or a variety of other reasons. Veterinary diagnostic laboratories provide services that help practicing veterinarians diagnose diseases and thereby choose appropriate therapies for their patients. Examples of services provided by diagnostic labs include necropsies, examination of **biopsy** specimens, bacterial and viral cultures, blood work and other clinical specimen analysis, serology testing, and toxicological assays. Some diseases pose such a threat to the health of animals and people that governments—local, state, and federal—require veterinarians to report suspect cases and provide diagnostic samples for verification of these diseases. States generally own and operate their own diagnostic laboratories that are staffed, in part, by veterinarians who specialize in diagnosis. These veterinarians may have advanced degrees in public health or advanced training in pathology, microbiology, toxicology, or other specialized areas of veterinary medicine. Private diagnostic facilities are also available and provide diagnostic services that focus on special niches, such as the testing of specimens from companion animals or zoo and wildlife species.

Biopsy Surgical removal and examination of a tissue from a living body to reach a diagnosis.

THE BODY'S DEFENSE AGAINST DISEASE

In many instances, infectious agents are repelled by the body's complicated defense mechanisms. The body's general ability to ward off infection or disease is referred to as *resistance* or *immunity*. The body's defense against infection includes barriers that prevent an infectious agent's entry into the body as well as those mechanisms that attack infectious agents that have gained entrance to the body. These defenses, collectively known as the *immune system*, are the major way animals resist infection (Box 14–2).

BOX 14–2

THE IMMUNE SYSTEM

The immune system includes physical barriers as well as innate and adaptive types of immunity.

Surface barriers Protective barriers include but are not limited to skin and mucous membranes, linings of the digestive and respiratory tracts, as well as protective mechanisms such as coughing and sneezing. Cilia are found on the cells lining the respiratory tract and help move inhaled infectious agents out of the body. Mucus within nasal passages and tears produced by tear glands also play a role in an animal's resistance to infection by entrapping, diluting, or washing away infectious agents.

Innate immunity The innate immune system is the body's first defense against infectious agents that manage to enter the body despite surface barriers. The innate immune system is made up of cells and protective mechanisms that respond in a generic or nonspecific way to infectious threats. This branch of the immune system responds immediately to foreign invaders, but it does not provide specific or long-lasting protection against specific pathogens to which the animal has been previously exposed.

Adaptive immunity The adaptive immune system is a sophisticated defense that allows the body to recognize infectious agents it has previously encountered and therefore mount a quicker and stronger protective response against them. **Antibodies** are an important part of the adaptive immune system. They are proteins present in the blood and other bodily fluids and made by antibody-secreting plasma cells, which are special immune cells found primarily in the spleen and bone marrow. Antibodies are able to recognize infectious agents and attack them if they gain entrance to the body.

Maternal **passive immunity** is conferred by transfer of antibodies to an animal from its mother, either through the placenta before it is born or through colostrum shortly after it is born (Figure 14–7). These passively acquired antibodies provide protection against the infectious agents for which the mother made antibodies. They last a short time, around 3 to 4 weeks, and then deteriorate and are cleared from the blood. Another form of passive immunity that may be used to protect animals exposed to a disease to which they are not immune involves the infusion of blood serum (and the antibodies it contains) from an immune animal.

Active immunity is acquired by the animal on its own when antibodies are made by the animal's own immune system. Antibody production may be a result of exposure to an infectious agent or may be related to a vaccination designed to simulate exposure to an infectious agent. Because of the waning nature of maternal passive immunity, an animal needs to begin making its own antibodies shortly after birth to protect itself against infectious diseases.

Antibodies Proteins produced by the body that attack infectious agents and neutralize them.

Passive immunity The process of acquiring immunity by receiving preformed antibodies against an infectious agent, as from mother to offspring via colostrum.

HERD HEALTH

The demands of most types of animal production, especially horses and the food-producin animals, lend themselves to the absolute need for a coordinated **herd** or **flock health mar agement program**. Some animals, although kept individually or in small groups, are s valuable that they need comprehensive health management programs as well. Even owne of small herds should have a plan for maintaining animals in the best of health. It may n be as elaborate or as necessary from a financial perspective, but the loss of even a single an mal that could have been prevented through planning is one loss too many.

Figure 14–7
Passive immunity is conferred by transfer of antibodies to an animal. This thriving calf owes much of its early health to the antibodies received the first few hours after birth from colostrum, or first milk, from its mother.
(Photo courtesy of USDA.)

Management

The manager is responsible for making the separate parts of a herd health program work together, as a whole. Management plans for small kennels, backyard rabbitries, and cow-calf or sheep operations will be very different than those designed and implemented for a large-scale intensive dairy or swine complex. Flexibility is important for smaller operations because their overall goals differ from those of larger, more intensive operations. In addition, they have much less monetary value at stake. In contrast, large, multimillion-dollar operations with thousands of animals on the same site leave little room for flexibility.

Active immunity Immunity to an infectious agent developed in response to exposure to the infectious agent or a vaccine for the disease.

Herd or flock health management program A comprehensive and herd-specific program of health management practices.

Nutrition

As discussed previously, improperly balanced and improperly fed rations can be the direct cause of diseases. Certainly these problems must be prevented, and failing that, corrected by the proper mixing and feeding of feeds. Proper nutrition is also important from another perspective. Poorly nourished animals, either underfed or overfed, are more vulnerable to both infectious diseases and metabolic diseases. A sound nutritional program is an essential component of any herd health program.

Genetics

The elimination of genetic or hereditary diseases is largely within our ability. Many genetic faults have already been identified and documented using tools and techniques available to modern geneticists. Those tools, which include pedigree analysis, test mating, and laboratory profiling of DNA, provide the means to determine the genetics of individuals and the genetic lines of animals. As the field of molecular genetics continues to advance, more is understood each day; with that understanding, options for improving the genetic quality of livestock increase. The elimination of genetic faults in animals should be a goal of any sound and complete health program. A few specific examples of some undesirable genetic traits include ocular disorders such as retinal atrophy in certain dog breeds, bovine leukocyte adhesion deficiency in Holstein cattle, and hereditary skeletal muscle disorders in horses. Many genetic disorders have already been effectively removed from the gene pool, such as the dwarf gene in beef cattle. Advances in molecular genetics may soon give us tools to engineer enhanced disease resistance into animals or otherwise boost their productivity.

Prevention

Adages are born from the need to pass well-founded advice along to others in a short, easy-to-remember fashion. The applicable and sound adage that applies here is "an ounce of prevention is worth a pound of cure." That short phrase contains volumes of wisdom. Small investments in time and money can reap huge rewards in a reduction of suffering and loss of profit. One important preventative measure is the provision of proper housing or other protection from the environment. Many diseases, whether serious or minor, can be prevented for pennies by the proper administration of vaccines. Early treatment of parasite infections reduces production losses and prevents other parasite-related diseases. Appropriate sanitation measures decrease the potential for exposure to parasites and other infectious agents (Figure 14–8).

Strategic preventive measures are those planned well in advance of disease and are based on a variety of factors, such as seasonal changes in weather, parasite life cycles, and patterns of infection. For example, grass tetany is a nutritionally related disease that often affects grazing beef cows who are nursing calves, usually in the early spring when the weather is still quite changeable and fertilization has promoted lush grass. Strategic prevention dictates that magnesium supplementation be appropriately carried out and begun early. This can greatly reduce or eliminate grass tetany.

Figure 14–8
Appropriate udder cleaning before milking plays an important role in preventing bacterial infections that cause mastitis in dairy cattle. Attention to details of this sort costs little and does much to decrease the risk of significant production losses that would result from mastitis or other health problems. (Photo courtesy of USDA/ARS).

Tactical measures, although they may be planned for in advance, are only put into action when necessary. A tactical approach to grass tetany would include more frequent supervision of susceptible cows during stormy and/or cold weather, and emergency treatment packs readily available to treat affected cows. A grass-tetany cow often doesn't have time to wait on the vet to arrive. She needs help immediately. Anyone trained to hit the jugular vein with a needle and administer the appropriate intravenous treatment can give that help.

Herd health programs have been shown in several studies to improve returns above the cost of the program. Every herd should have a comprehensive health program in place. Such programs should be specific for each operation and each species within the operation. There are just too many variables to have a one-plan-fits-all recommendation. However, the following practices are recommended starting points for the development of comprehensive herd or flock health management plans. The same general guidelines also apply to kennel owners, cattery owners, and other group management situations for animals.

- Consult a veterinarian. Make him or her aware of the objectives and goals for the herd. Hobby herds may have a different set of decision-making criteria applied to them than will commercial herds. Provide the veterinarian with all pertinent information.
- Have an operational procedure for the herd health plan. Make it detailed. Develop a calendar from the plan. Consult it often and do those things that the calendar says it is time to do.
- Identify animals in some permanent way and keep records of vaccination history, previous health problems, medications, reproductive information, and other health-related information. A variety of preformatted record books and computer-assisted programs are available for most species. However, good useful records can be kept in longhand in a spiral notebook. The value of records generally depends more on the talent and conscientious nature of the record keeper than on the tools used to keep the records.
- Choose animals to be added to the herd from healthy, vigorous stock. Developing a closed herd of females as quickly as possible will reduce the exposure to outside animals because only males will need to be brought into the herd. Have a veterinarian examine any animals prior to bringing them into a herd. Reduce the need for introducing any outside animals by using artificial insemination if possible.
- Separate animals by such characteristics as age, source, intended function, and so on.
- Use **all-in, all-out animal management** whenever possible. This is more practical for such operations as broiler production than it may be for other situations. E

All-in, all-out animal management Adding all animals to a facility, such as a farrowing house, at the same time and then removing them at the same time.

practicing this type of management on a limited scale, such as in a farrowing house, can prevent many infectious disease problems.

- Be sure rations are balanced, mixed properly, and fed as they should be. For small producers, hobbyists, and those working with specialty breeds, purchase high-quality, commercially prepared feeds from reputable companies and feed according to the recommendations of the company nutritionists.
- Provide clean water in a way that it will stay clean.
- Vaccinate for the diseases known to be a problem for your species in your area.
- Minimize the number of people to whom your animals/herd are exposed.
- Develop an eye for disease. Observe animals frequently and regularly.
- Make all reasonable attempts to discover what caused the death of any animal from the herd. Have necropsy examinations done. In addition, have a plan for properly disposing of dead animals. Check with your local health authorities, your veterinarian, or the state veterinarian's office to determine any laws that apply, as well as the safest and most effective procedures.

ANIMAL DISEASE AND HUMAN WELL-BEING

Emotional Loss

Although disease and/or death of almost any animal are accompanied by some economic loss, the emotional aspect of animal loss is also important. The very old and the very young are especially vulnerable, but few of us are immune to the emotional upheaval that death and disease of the animals in our care can bring to us. The loss of a valuable companion, a trusted mount, or even a prized breeding animal can inflict deep emotional wounds.

Animal Disease and Human Health

Certain diseases are **zoonotic**, which means they may be passed to humans from birds, fowl, livestock, pets, or wild animals. Over 100 such diseases have been identified. Whereas some zoonotic infections, such as ringworm, are merely irritating in the discomfort they produce, others, such as leptospirosis or rabies, can be debilitating and/or life threatening. Some zoonotic infections are so problematic that their detection must be reported to one or more government agencies. Obviously, people in close contact with animals—farmers, veterinarians, slaughter plant workers, and so on—stand the greatest risk from the widest variety of infections. However, the public is also at risk. The greatest public risk is from food poisonings by organisms like *Escherichia coli* 0157:H7, *Salmonella, Listeria,* and *Campylobacter.* Although these risks are small for any individual at any time, the very thought of the food supply contributing to disease is an emotional hot-button issue with the public. The 2006 outbreak of *E. coli* in fresh spinach is an example of a food-associated zoonotic disease. In this instance, because the bacterial contamination was suspected to be from an animal source, the outbreak was considered zoonotic. Zoonoses can be transmitted to humans in the following major ways:

Zoonotic The ability to be passed from animals to humans under natural conditions.

- Contamination of animal products with infectious agents or contamination of other food products with infectious agents from an animal source. Many safeguards are in place to avoid this means of disease transmission.
- Direct exposure to infected animals or to hay, water, or food contaminated by a diseased animal, or exposure to fetuses or tissues expelled in cases of infectious abortion.
- Animal or arthropod bites that can spread rabies, Venezuelan or Eastern equine encephalomyelitis virus, West Nile virus, Rocky Mountain spotted fever, Lyme disease, and others.

People are protected from exposure to zoonotic diseases in several ways. One way is to eradicate the disease from the animal population. The U.S. government, in cooperation with the states, has major eradication efforts under way to eradicate brucellosis, tuberculosis, and other zoonotic diseases. Interupting the cycle of transmission from animals to humans is another way to prevent zoonoses. Milk is pasteurized to prevent the possible spread of salmonellosis, brucellosis (undulant fever in humans), tuberculosis, and others. Meat is inspected to prevent the transmission of such diseases as trichinosis, brucellosis, and tapeworm infections. Sanitation procedures are taught to farm workers so they know how to protect themselves. Animals can be vaccinated against diseases like rabies so that, even if bitten by a rabid animal, they will neither get nor transmit the disease. Another method of controlling zoonoses is to destroy the infected population. This has been one of the strategies employed in Europe to try to bring mad cow disease under control.

Another current and controversial topic concerning the interrelationship of human and animal health is the use of **antimicrobial agents** in food-producing animals. Antimicrobial agents have become an important part of intense animal husbandry and are used in feed at very low doses for growth promotion, especially in swine and poultry production. Despite numerous studies over the past two decades, the impact of this practice on human health remains controversial. To address the growing concern over the threat of antimicrobial resistance on public health, in June of 2010 the Food and Drug Administration (FDA) issued a draft of guidelines for the judicious use of medically important antimicrobial drugs in animal agriculture. The FDA recommends phasing in changes to limit the animal use of medically important antimicrobial drugs to situations in which they are necessary for assuring the health of the animal and are used under the guidance of a veterinarian. Further recommendations and legislation regarding the use of antimicrobial agents in food animals continue to evolve. For up-to-date information on this complex and controversial topic, visit www.fda.gov/AnimalVeterinary/SafetyHealth/default.htm.

Antimicrobial agent Natural or synthetic drugs that inhibit or kill bacteria. This capability makes them unique for controlling infectious diseases caused by pathogenic bacteria.

In addition to the problem of zoonoses and antimicrobial resistance, the loss of an animal industry or industries because of disease decreases the supply of quality protein for the human diet. This increases prices. Although it affects everyone, the poor tend to suffer first and longest in these situations.

Animal Disease and National Economies

History is full of examples in which disease in the animal population has had profound effects on economies, nations, and peoples. Great Britain's war effort was seriously hurt in 1940 by an outbreak of foot-and-mouth disease, a disease that struck Europe again in 2001. In 1929, the Chicago livestock yards had to be closed because of the same disease. At that time, closing Chicago to livestock was equivalent to shutting down the meatpacking industry. More recently, the farm economy, thus the national economy, of Europe has been under tremendous pressure because of the losses caused by another serious malady, mad cow disease. Confirmation of three cases of mad cow disease in the United States had a significant effect on prices and trade of U.S. cattle and beef. The economic impact in the United States was much less severe than that in Great Britain, and as a result of vigilant surveillance and effective regulatory controls, U.S. beef exportation is on its way to recovery.

In many developing nations, trade suffers because diseases among the country's animals force other governments to prohibit shipment of products from entering their countries. Avian influenza, or bird flu, has recently had a tremendous economic impact on the poultry industry. Countries in Asia and Africa, many of which are poor, are among those hit hardest by mass poultry culling and infections. Their economies falter and their people suffer as the livelihoods of millions

threatened and a critical source of dietary protein is lost. Additionally, a pandemic bird flu infection among humans, which is a realistic threat, could cost the global economy up to $2 trillion, according to a recent World Bank estimate. The H1N1 flu pandemic that began in 2009 involved a virus that originated from pre-existing swine influenza viruses. Therefore, in the early stages of the pandemic, the virus was referred to as *swine flu*, although it is not known whether it first emerged in people or pigs. Further characterization of the virus revealed that it contained genetic material from bird and human flu strains as well as swine flu strains. Because of its genetic makeup and because it was not transmitted by swine, the CDC and other U.S. officials have named the virus "2009 H1N1 flu." Whether or not the initial cases were truly zoonotic, the swine flu pandemic has exacted tremendous costs to human health as well as to the world economy. By August 2010, the World Health Organization (WHO) had attributed at least 18,449 human deaths to the H1N1 pandemic. Around that time, it was determined that the 2009 H1N1 flu had largely run its course and was entering the post-pandemic phase, during which individual infections and possible flu outbreaks are expected to continue as 2009 H1N1 circulates as a seasonal flu strain.

A few examples of animal disease affecting our domestic economy include restrictions on the state-to-state transport of horses in 1971 because of Venezuelan equine encephalomyelitis and restrictions on horse transport in 1998 and 1999 owing to an outbreak of equine infectious anemia. Livestock diseases cost ranchers, farmers, and consumers approximately billions of dollars yearly.

Despite the serious impact animal disease can have on society, do not draw the conclusion that all of agriculture and, by extension, the civilized world is one disease away from collapse. This just isn't so. The state of our knowledge, the arsenal of weapons, and the resources available to marshal against animal disease are impressive and getting better. The general population is very well protected. We should all be comforted when we hear of a meat recall or detection of a reportable disease by a surveillance program. It means the system in place is working.

Animal Disease and Farm Income

Disease can decrease income for operations that depend on either the production of individual animals, such as a horse farm, or profit from average or overall herd production, such as a beef feedlot or dairy farm. Operations that focus on the productivity of individual animals are vulnerable to the ravages of disease, which may cause losses in several forms. Death among livestock is an easily measured loss that can be accounted for on an individual basis. The profit from the remaining animals must pay for the lost individual before a profit can be declared. In most cases, the loss of a single animal robs the producer of the profit from several others. A less dramatic but sometimes greater economic drain to operations that depend on average rather than individual production within the herd is the loss of product. This can occur when meat or milk is condemned at the processing plant. The product may be deemed unwholesome owing to either the direct effects of the disease process or the antibiotic or other drugs used to treat the disease. Food safety inspection systems are in place to prevent such unwholesome product from entering the human food chain. Potentially, the greatest loss of all is the loss of gain or satisfactory production that results from unthriftiness caused by disease. An animal that has been ill and then recovers frequently performs at lower rates than if it had never been ill. A cow with subclinical mastitis has reduced milk production because of the infection. Reproductive failures and decreased numbers of offspring can be complications of some diseases. In addition to these losses, the costs of veterinary services, drugs, and labor drain the profit from the operation.

BIOTERRORISM

Most thinking and planning regarding bioterrorism has focused largely on humans as the primary target. Certainly much human illness, death, and panic could be accomplished in this way. However, when economic and political vulnerabilities are considered, agricultural bioterrorism (the intentional targeting of a nation's livestock and crop resources) is at least as likely. It has also been suggested that an attack on the food supply or food economy might be more attractive to terrorists because of the secondary effects on humans and the potential for deniability that might make the response or retribution less likely. The General Accounting Office has concluded that intentional disease attacks against agricultural commodities, especially livestock, would be economically devastating.

U.S. agriculture is becoming more vulnerable to agricultural bioterrorism owing to the continuing trends of intensive production techniques, vertical integration, the increasing industrial dependence on the export market, and the lack of U.S. livestock resistance against many pathogens and pests. Added to this agricultural vulnerability is the relative ease of acquiring, producing, and disseminating animal pathogens. To better manage the increasing risks of agricultural bioterrorism, the Department of Homeland Security has led the development of a National Response Plan that spells out how the nation would work together in the event of a terrorist attack. Efforts to create stockpiles of important vaccines as well as create laboratory networks to enhance disease diagnosis and monitoring are under way.

It is beyond the scope of this text to do other than raise awareness on this topic. An excellent resource for current information on bioterrorism is www.bt.cdc.gov bioterrorism, which offers an overview of bioterrorism and several links to more resources. For current information regarding the safety of the food supply, www foodsafety.gov is a resource that brings together information from relevant websites

REGULATORY ANIMAL MEDICINE

Regulatory animal medicine is the sum of the activities directed by the governme agencies charged with these tasks:

- Keep foreign animal diseases out of the United States.
- Stop or slow the spread of animal diseases across state lines.
- Eradicate selected animal diseases from the United States.
- Assist in the protection of the welfare of particular groups of animals.

Currently, some 40 diseases not present in the United States are considered a th to U.S. poultry and livestock. A single outbreak of foot-and-mouth disease carrie estimated first-year price tag of $10 billion for containment alone. Clearly, prev ing the introduction of foreign animal diseases needs to be, and is, a priority government and private organizations.

Federal Regulation

USDA's Animal and Plant Health Inspection Service (APHIS) is a multifaceted ag with a broad mission that includes protecting and promoting U.S. agricultural he regulating genetically engineered organisms, administering the Animal Welfare and carrying out wildlife damage management activities. APHIS is organized in program units, and an Office for Emergency Management and Homeland Sec along with three management support units and the Office of Civil Rights. Five six program units as well as the Office for Emergency Management and Homelar curity are briefly described with relevance to regulatory animal medicine in Box

BOX 14–3

ANIMAL AND PLANT HEALTH INSPECTION SERVICE

Animal Care (AC) is charged with the responsibility of inspecting animals in research, exhibition, and other regulated industries to ensure compliance with animal welfare legislation and to ensure the proper stewardship of these animals.

International Services and Trade Support Team (IS) works with foreign governments to protect U.S. agriculture and enhance agricultural trade. IS negotiates entry requirements for U.S. agricultural products to other countries and for agricultural products shipped to the United States. Preclearance in the country of origin is often easier, more practical, and a better means of excluding disease. IS also cooperates with foreign governments in agricultural pest and disease control or eradication programs. Cooperative eradication programs include efforts directed at screwworms and classical swine fever.

The *Plant Protection and Quarantine (PPQ) Service* was responsible for safeguarding U.S. agriculture and natural resources from damage related to the entry and spread of animal and plant pests and noxious weeds until March 1, 2003. At that time, The *Bureau of Customs and Border Protection (CBP)* was created within the Department of Homeland Security and made responsible for the inspection and prevention efforts necessary to keep prohibited agricultural items from entering the United States. PPQ works with the CBP to ensure the continued success of agricultural inspection by providing training and expertise in pest detection and identification. Box 14–4 provides a brief overview of agricultural inspection by the CBP. PPQ also oversees plant import and export and responds to the introduction of plant pests or plant health emergencies.

Veterinary Services (VS) works to prevent the introduction of animal diseases to the United States by regulating the importation of animals and animal products. If a disease is introduced, VS takes emergency action to contain it. Exotic Newcastle disease was accidentally introduced in the 1980s by pet birds, and then in 2002–2003 it was detected in backyard poultry flocks. VS led the effort to contain and eradicate the disease in both instances. VS also conducts disease eradication programs for existing animal diseases in cooperation with the states, provides health certification for exported animals and animal products, conducts diagnostic tests, and is the licensing authority for veterinary biological products and manufacturers. If private producers or practicing veterinarians detect or suspect an exotic disease, they contact one of over 300 specially trained state and federal veterinarians located throughout the United States to investigate the situation. If an exotic disease is diagnosed, VS can send a specially trained task force into the site of the outbreak to direct the eradication plan. The APHIS *Office of Emergency Management and Homeland Security* coordinates the response effort to ensure that available resources at federal, state, and local levels are used effectively and efficiently to contain and eradicate exotic disease threats.

Wildlife Services (WS) is responsible for reducing wildlife damage to agriculture and natural resources, minimizing potential wildlife threats to human health and safety, and protecting threatened and endangered species.

The Bureau of Customs and Border Protection, which is responsible for agricultural inspection is briefly described in Box 14–4.

APHIS has responsibility for regulating the importation and exportation of plants, animals, and agricultural products. Regulations depend on the product and the country's product of origin. Animals must have a health certificate issued by veterinary health officials in the exporting country. Meat, some dairy products, and other animal products are restricted from countries that have a different disease status than that in the United States. Live animal imports are restricted, and many animals must be quarantined at one of three animal import centers located in Newburgh, New York; Miami; and Los Angeles. Cattle from countries affected with bovine spongiform encephalopathy (BSE), foot-and-mouth disease, or rinderpest cannot be imported into the United States. Cattle from within a quarantined region along the Texas-Mexico border must be inspected and treated for cattle fever ticks before being moved from the tick-infested zone to prevent the further spread of babesiosis, a protozoal disease carried by the cattle fever tick, into the United States. (Figure 14–9). Personally owned pet birds and commercial shipments of pet birds enter through one of three USDA-operated bird quarantine facilities in New York City; Miami, Florida; and Los Angeles, California. Canada has sufficiently stringent import rules that birds may enter from Canada without quarantine.

BOX 14–4

U.S. CUSTOMS AND BORDER PROTECTION

The *Customs and Border Protection (CBP)* employs approximately 2,400 agricultural specialists that were formerly inspectors with the PPQ unit of USDA-APHIS. These agricultural specialists work at key U.S. ports of entry, international airports, border stations, and international mail facilities, where they inspect commercial cargo, luggage, and passengers/pedestrians. These inspectors enforce USDA regulations and seize prohibited meat, plant materials, and animal products (Figure 14–10). On a typical day in 2009, CBP inspectors were responsible for seizing 4,291 prohibited agricultural items. They use a variety of methods such as X-ray screening and trained detector dogs to find agricultural contraband. Each year, these dogs, known as the Beagle Brigade, are responsible for the seizure of over 1100 prohibited meat, plant, or animal products, including approximately 150 agricultural pests at ports of entry (Figure 14–11).

Source: Compiled from U.S. Customs and Border Protection, 2009.

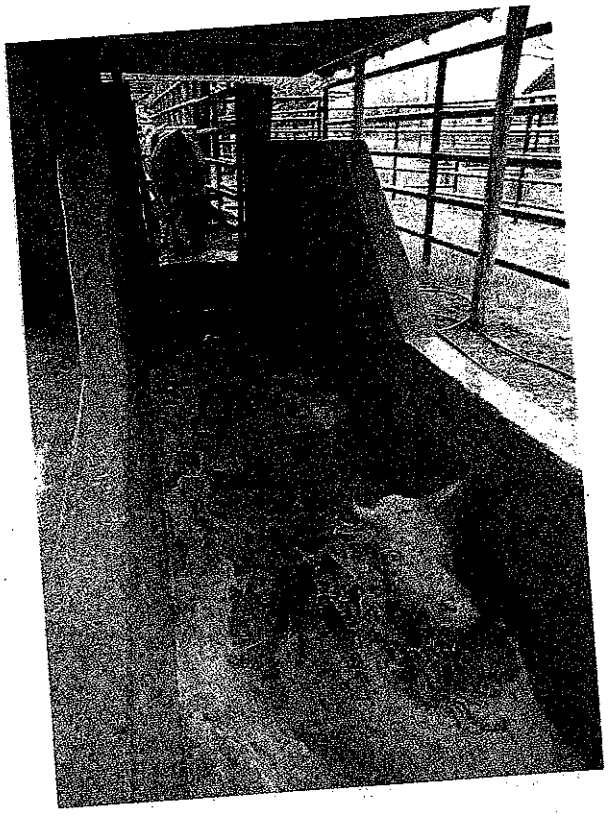

Figure 14–9
These cattle are from a region of southern Texas quarantined because of infestation by the species of tick that transmits bovine babesiosis. A tick treatment bath is one of the measures taken to prevent further spread into the United States of the tick and the disease it transmits. (Photo courtesy of USDA/ARS.)

Figure 14–10
Customs and Border Protection agricultural specialists detect, confiscate, and destroy items held by international travelers that could bring pests and diseases into the United States. Pictured here are confiscated meat and vegetables at Dulles International Airport, Sterling, Virginia. (Photographer Ken Hammond. Courtesy of USDA.)

Figure 14–11
The Beagle Brigade is instrumental in helping Customs and Border Protection detect contraband at U.S. ports and airports. Undetected contraband could threaten U.S. agriculture, the food supply, and the economy. (Photo courtesy of USDA/APHIS.)

The prevention of the entrance of mad cow disease, or bovine spongiform encephalopathy (BSE), to the United States is a good current example of APHIS's service. This disease has severely affected Europe's livestock industry. In 1989, APHIS began restricting the importation of live ruminants and ruminant products from Great Britain and other countries where BSE has been diagnosed. During the same year, it began a BSE surveillance program to monitor for the disease. This program included the direct examination of the brains of thousands of cattle. These and other measures were designed to prevent the entrance of this disease to the United States, and thereby protect the health of our livestock, our people, and our economy. However, in December 2003, it was announced by the USDA that a dairy cow in Washington state had tested positive for BSE. After an extensive investigation including the location and testing of animals that had entered the United States from Canada with the affected cow, as well as other animals in contact with the affected cow, it was determined that there were no collateral cases. As of June 1, 2004, an enhanced BSE testing program was implemented by the USDA. In June 2005, a second BSE-positive cow was detected in Texas, and then, in March 2006, a third case of BSE in the United States was detected in a cow in Alabama. Based on data collected in the United States over recent years, including over a half million samples from the enhanced surveillance program, the USDA estimates that less than one in a million cattle in the United States is infected with BSE, with the total number of BSE infected cattle in the country estimated to be between 4 and 7. The number of BSE-infected cattle in the United States is expected to decline as long as current regulations maintain low risk for introduction and spread of the disease. APHIS's ongoing BSE surveillance program continues to sample approximately 40,000 animals each year. For the latest on BSE, visit the USDA BSE information page at http://www.fas.usda.gov/dlp/BSE/bse.html.

Another example of the work done to protect the agricultural sector of the United States began in early 2001. At that time, the USDA began a coordinated effort among several government and private agencies, including APHIS, to guard against a North American outbreak of foot-and-mouth disease (FMD). FMD is a highly contagious viral disease of cattle, swine, sheep, goats, deer, and other cloven-hoofed ruminants. Although rarely transmissible to humans, FMD is devastating to livestock. An outbreak would potentially have severe economic consequences associated with losses in the production and marketing of meat and milk (Figure 14–12). The disease is difficult to control and has occurred in over 60% of the world. In today's highly mobile environment, FMD could be accidentally introduced and

Figure 14–12
Foot-and-mouth disease symptoms. Foot-and-mouth disease is characterized by fever and blister-like lesions followed by erosions on the tongue and lips, in the mouth, on the teats, and between the hooves. Many affected animals recover, but the disease leaves them debilitated. It causes severe losses in the production of meat and milk. (Photo courtesy of USDA.)

disseminated in the United States. A single infected animal or one contaminated sau
sage could carry the virus to American livestock. To protect against the occurrenc
of this disease, the U.S. government monitors FMD occurrence worldwide, evalu
ates the potential risk of foreign outbreaks to the United States, and reduces diseas
spread by assisting other nations with a rapid response when FMD or other devastat
ing diseases are detected.

Avian influenza, or bird flu, is another disease the USDA and other goverr
ment agencies are working hard to safeguard the nation against. Avian influenza
a virus that infects wild birds and domestic poultry (Figure 14–13). High-pathog
nicity strains of avian influenza (HPAI) have been rapidly spreading in some par
of the world and have been responsible for three outbreaks in poultry in the Unit
States, the most recent of which was in 2004. A rapid and coordinated respon
by the USDA and state, local, and industry leaders limited that outbreak to o
flock and led to its rapid eradication from the country. To prevent the introdu
tion of HPAI into the United States, the USDA quarantines and tests live birds tl
are imported into the country, maintains restrictions on poultry importation fr
regions with confirmed outbreaks of HPAI, and conducts surveillance of U.S. b
populations. Low pathogenic avian influenza (LPAI), which is also referred to as
North American type of H5N1 avian influenza, is another type of avian influe
infection that commonly occurs in wild birds in the United States and Cana

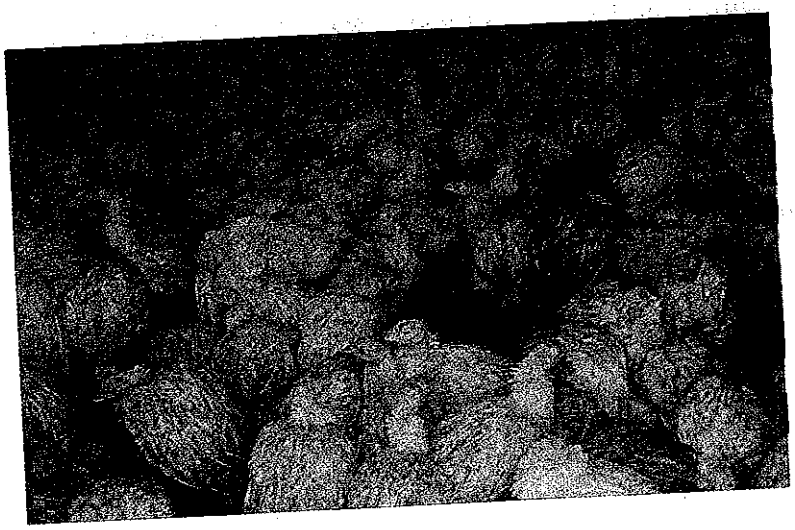

Figure 14–13
These turkeys are showing signs of diarrhea and depression related to infection with avian influenza. (Photo courtesy of USDA.)

This influenza type is rarely fatal in birds and typically causes no signs of disease or only a minor illness; neither is this virus a human-health concern. However, because of the potential for LPAI to mutate into the HPAI, the World Organization for Animal Health (OIE) began requiring in 2006 that confirmed LPAI infections with H5 and H7 subtypes be reported. Therefore, the USDA now tracks LPAI in wild birds, backyard flocks, commercial flocks, and live-bird markets. Should an outbreak of HPAI occur within the United States, the USDA would lead an emergency response plan that would include quarantine, eradication, disinfection, continued monitoring, and testing of the affected region. In addition, USDA works with international organizations to assist countries affected by HPAI in disease prevention, management, and eradication efforts. At press time for this text, HPAI continues to be a problem in many countries throughout the world. For current information on avian influenza, visit the Department of Health and Human Services website at www.avianflu.gov.

Animal Disease Traceability Framework

The traceability of livestock and the ability to determine where diseased or at-risk animals are and where they have been is of central importance in preserving U.S. animal health in the face of a disease outbreak. An accurate and efficient animal tracing system serves to reduce the number of animal deaths during an outbreak and also limits the number of animal owners affected in such a situation. However, establishing a nationwide program for animal identification and disease traceability is not a simple task. Between 2004 and 2010, the USDA tried to implement the National Animal Identification System (NAIS) as a voluntary program that would register livestock premises as well as identify and trace individual animals. Although the importance of disease traceability is without question, the perceived intrusion of the NAIS, as well as the equipment cost and labor involved in tagging animals, proved to be problematic. The program was highly criticized, especially among small producers. With only 36% participation, the voluntary and unpopular NAIS program was discontinued and will be replaced by a new animal disease traceability framework. Regulations for identifying and tracking livestock are currently under development and are expected to be implemented by 2013. The new program for tracing animal disease is designed to be a flexible one in which each state or tribal nation will define the details of animal identification so as to minimize the burden for producers but still meet a national standard. According to each state's established guidelines, and in cooperation with the USDA, official identification will be required for interstate transportation of livestock, but it will not be mandated for animals remaining within a state or tribal nation. For additional up-to-date information about the animal disease traceability framework, visit www.usda.gov/traceability.

State Regulation

Each state has a *state veterinarian.* These individuals usually serve under the direction of the head of the department of agriculture, although this may vary from state to state. State veterinarians and their offices are responsible for administering the legislation specific to their state—for example, interstate transport regulations and quarantine regulations for stock moving into or through the state. They are responsible for cooperating with APHIS on federally directed programs such as the brucellosis and hog cholera programs.

Accredited Veterinarians

The Veterinary Accreditation program administered by the Veterinary Services division of APHIS qualifies private veterinarians to work cooperatively with federal and state veterinarians and animal health officials in preventing, controlling, and

eradicating livestock and poultry diseases. More than 80% of all U.S. veterinarians are accredited. Accredited veterinarians assist producers in buying, selling, and transporting animals by examining animals for health and soundness, testing for specific diseases, and issuing certificates of inspection.

United States Animal Health Association (USAHA)

The United States Animal Health Association (USAHA) is a national nonprofit organization of approximately 1,400 members. It works with state and federal animal health officials, veterinarians, livestock producers, national livestock and poultry organizations, research scientists, the extension service, and seven foreign countries to control livestock diseases in the United States. The USAHA is not a government agency, but it does serve as an advisory body to the USDA. The USAHA informs state and federal authorities of current disease situations, methods of control, and other information of importance about animal disease. This group unofficially coordinates disease control work among states and the federal government and suggests new laws, regulations, and programs for disease control. The USAHA has 32 working committees set up to deal with the various aspects of disease control in domestic livestock. The USAHA holds an annual meeting each fall preceded by spring meetings of the four regional groups that make up the association.

Organizations

The following resources are provided for those of you who wish to seek additiona information.

American Veterinary Medical Association

1931 North Meacham Road, Suite 100
Schaumburg, IL 60173-4360
Phone: (800) 248-2862
Fax: (847) 925-1329
E-mail: avmainfo@avma.org
http://www.avma.org/

USDA, APHIS, Animal Care

4700 River Road, Unit 84
Riverdale, MD 20737-1234
Phone: (301) 734-7833
Fax: (301) 734-4978
E-mail: ace@aphis.usda.gov
http://www.aphis.usda.gov

United States Animal Health Association

P.O. Box 8805
St. Joseph, MO 64508
Phone: (816) 671-1144
Fax: (816) 671-1201
E-mail: usaha@usaha.org
http://www.usaha.org/

SUMMARY AND CONCLUSION

Disease is any state other than a state of complete health. In a state of disease, the normal function of the body, or some of its parts, is changed or disturbed. Maintaining animals as near to a constant state of health as possible or feasible is a challenge, an obligation, and a necessity to animal stewardship. Animals have a natural defense system against disease involving a number of factors that can be loosely grouped under the term *resistance.* When the defense mechanisms fail, disease occurs.

Disease is usually caused by a combination of predisposing causes and direct causes. Predisposing causes are often referred to as stress factors. They come in great variety, but have in common the fact that they place unusual or additional demands on the body. Direct causes of disease include several categories of infectious etiologies: bacteria, viruses, protozoa, external parasites, internal parasites, fungi, and the poorly understood prions associated with mad cow disease. These causes are distinguished by the fact that they are themselves living agents that cause disease by their presence in or on the body. Diseases caused by living organisms are called infectious diseases. Other direct causes of disease are noninfectious. Nutrient deficiency diseases result directly from improperly balanced and/or fed rations. Some diseases such as hemophilia are directly caused by genetic makeup. The direct cause of an injury may be a nail, a sharp instrument, a falling object, or a wet and slick floor. A metabolic disturbance is a direct cause of many diseases. Toxins or chemical poisons can also be direct causes of disease.

Detection and identification of animal disease is collectively referred to as diagnosis. One of several types of veterinary services can be called on to diagnose, treat, and prevent animal diseases. A comprehensive herd health plan is a good idea for any production unit. It should include the specifications for management, nutrition, genetics, and disease prevention. Several types of human losses are associated with animal loss related to diseases. As a means of minimizing those losses, the USDA, state governments, and private organizations work together to fight disease in animals.

STUDY QUESTIONS

1. What are the motivating factors for keeping animals healthy? Are some of these factors different for companion animals than for livestock species?
2. What is a clinical sign? A lesion?
3. Define *pathology* and *etiology.*
4. Describe in detail the causes of disease. Include a discussion of the difference between direct and predisposing causes of disease.
5. What is the difference between a clinical and a subclinical infection? Acute and chronic disease?
6. In your own words, outline a diagnostic procedure for determining why an animal is off his feed and appears to be ill.
7. Describe the general types of veterinary services available to producers and other animal owners. Which would be the best choice, in your opinion, for a 100-dog kennel owner? A 10,000-sow farrowing house? A 50,000-sow farrowing unit? A horse owner who has three horses? A llama owner with 20 breeding females? Support your decision in each case.
8. What are the different parts of the immune system and types of immunity? How does an animal receive or develop immunity?
9. Why is a herd health plan so important? What are all the elements that must be considered?
10. Describe the effects of animal health on human health and well-being.
11. What is the purpose of regulatory animal medicine? Who are the major groups involved in regulatory medicine? What is the function of each?

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