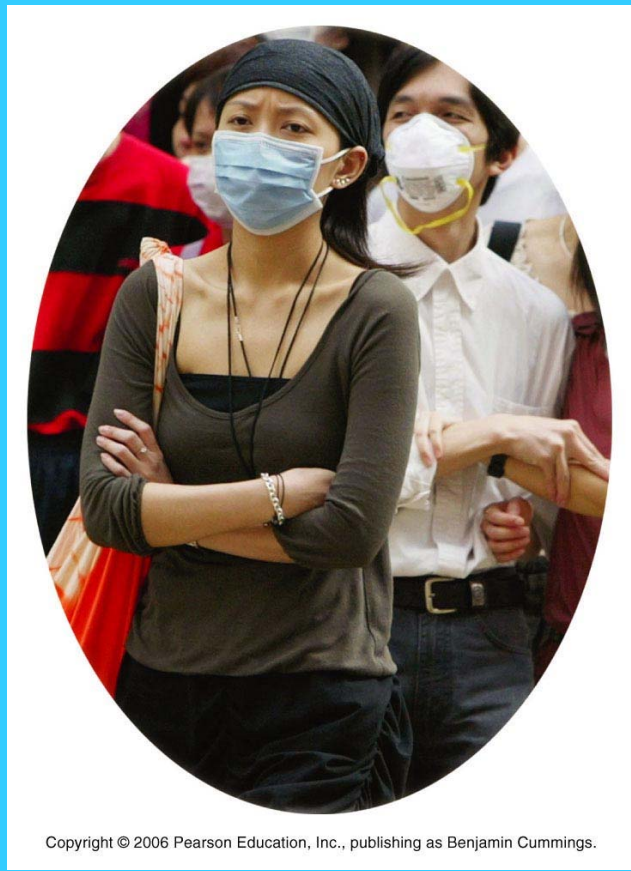
Epidemiology

Study of disease distribution and determinants

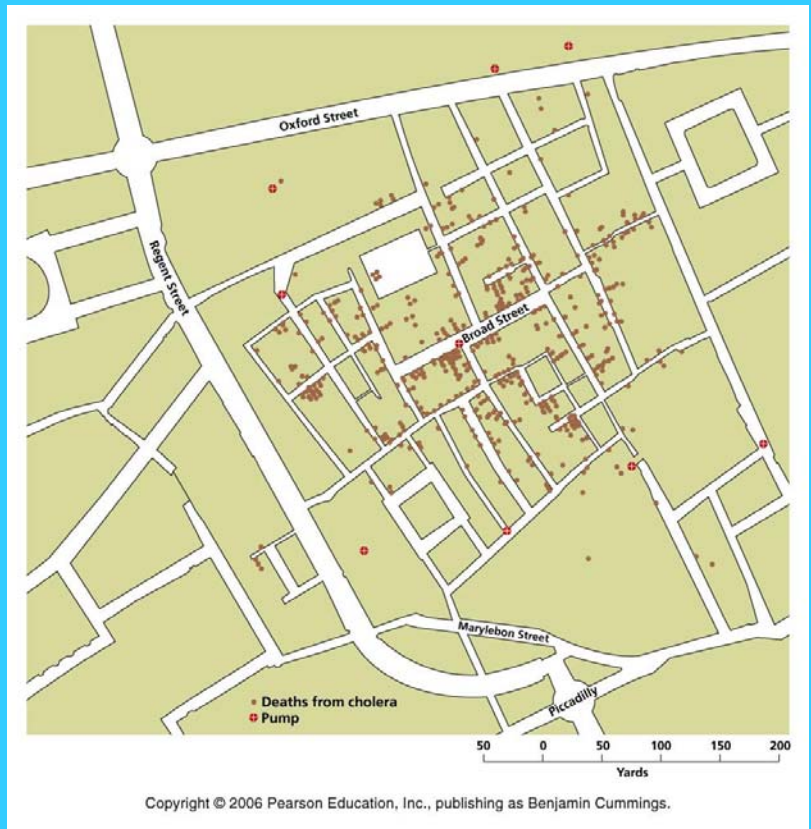
- History
- Source
- Reservoir
- Portal of exit: Transmission
- Entry into new host: Portals of entry
- Epidemiology



History of Public Health

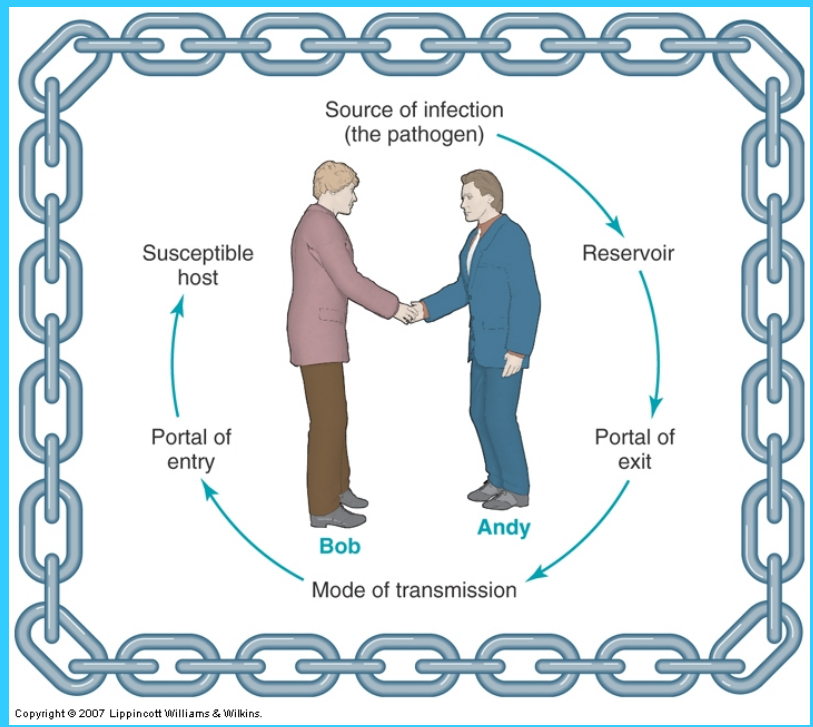
- Broad Street pump
- Cholera
- John Snow
- Contaminated water
- Remove pump handle

- Typhoid Mary
- SARS



Infectious disease process: Pathogen, Host & the environment

- Source
- Reservoir
- Portal of exit: Transmission
- Entry into new host: Portals of entry



Reservoirs

Any site a pathogen can survive

Living

Carrier: humans, diseased or asymptomatic

Zoonotic: animal-carried pathogens

Arthropods: insect-carried pathogens

Vectors = living thing or substance (e.g. blood) that transmits pathogens but is not diseased

Zoonoses

Table 14.9 Some Common Zoonoses

Disease	Causative Agent	Animal Reservoir	Mode of Transmission
Helminthic (Ch. 23)			
Tapeworm infestation	*Dipylidium caninum*	Dogs	Ingestion of larvae transmitted in dog saliva
Fasciola infestation	*Fasciola hepatica*	Sheep, cattle	Ingestion of contaminated vegetation
Protozoan (Ch. 23)			
Malaria	*Plasmodium* spp.	Monkeys	Bite of *Anopheles* mosquito
Toxoplasmosis	*Toxoplasma gondii*	Cats and other animals	Ingestion of contaminated meat, inhalation of pathogen, direct contact with infected tissues
Fungal (Ch. 22)			
Ringworm	*Trichophyton* sp. *Microsporum* sp. *Epidermophyton* sp.	Domestic animals	Direct contact
Bacterial (Chs. 19–21)			
Anthrax	*Bacillus anthracis*	Domestic livestock	Direct contact with infected animals, inhalation
Bubonic plague	*Yersinia pestis*	Rodents	Flea bites
Lyme disease	*Borrelia burgdorferi*	Deer	Tick bites
Salmonellosis	*Salmonella* spp.	Birds, rodents, reptiles	Ingestion of fecally contaminated water or food
Typhus	*Rickettsia prowazekii*	Rodents	Louse bites
Viral (Chs. 24–25)			
Rabies	*Lyssavirus sp.*	Bats, skunks, foxes, dogs	Bite of infected animal
Hantavirus pulmonary syndrome	*Hantavirus* sp.	Deer mice	Inhalation of viruses in dried feces and urine
Yellow fever	*Flavivirus* sp.	Monkeys	Bite of *Aedes* mosquito

Arthropod vectors

Table 14.11 Selected Arthropod Vectors

	Disease	Causative Agent (bacteria unless otherwise indicated)
Biological Vector		
Mosquitoes		
Anopheles, Aedes	Malaria	*Plasmodium* spp. (protozoan)
	Yellow Fever	*Flavivirus* sp. (virus)
	Elephantiasis	*Wuchereria bancrofti* (helminth)
	Dengue	*Flavivirus* sp. (virus)
	Viral encephalitis	*Alphavirus* spp. (virus)
Ticks		
Ixodes, Dermacentor	Lyme disease	*Borrelia burgdorferi*
	Rocky Mountain spotted fever	*Rickettsia rickettsii*
Flea		
Xenopsylla	Bubonic plague	*Yersinia pestis*
	Endemic typhus	*Rickettsia prowazekii*
Louse		
Pediculus	Epidemic typhus	*Rickettsia typhi*
Blood-sucking flies		
Simulium, Glossina	African sleeping sickness	*Trypanosoma brucei*
	River blindness	*Onchocerca volvulus* (helminth)
Blood-sucking bug		
Triatoma	Chagas' disease	*Trypanosoma cruzi* (protozoan)
Mite (chigger)		
Leptotrombidium	Scrub typhus	*Orienta tsutsugamushi*
Mechanical Vectors		
Housefly		
Musca	Food-borne infections	*Shigella* spp., *Salmonella* spp., *Escherichia coli*
Cockroaches		
Perplaneta, Blattella, Supella	Food-borne infections	*Shigella* spp., *Salmonella* spp., *Escherichia coli*

Non-Living - SOME Important Ones

Food and milk - ingest

Feces and water - ingest (oral-fecal), contact

Air and dust - inhale

Soil - inhale or contact through cuts

Fomites - body-associated objects

Vehicles = non-living thing or substance that transmits pathogens

Modes of Transmission

- Direct skin to skin or membrane to membrane
- Indirect airborne droplets (e.g. sneezes)
- Indirectly by food/water, arthropods
- Indirectly by fomites, blood products
- Parenteral = direct needle injection
- *Direct = diseased host to host; indirect = contaminated thing/person to diseased host.*

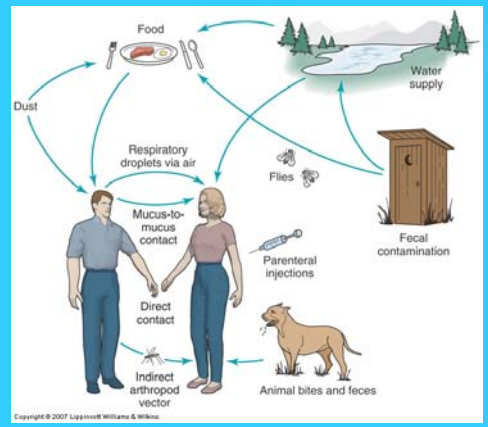


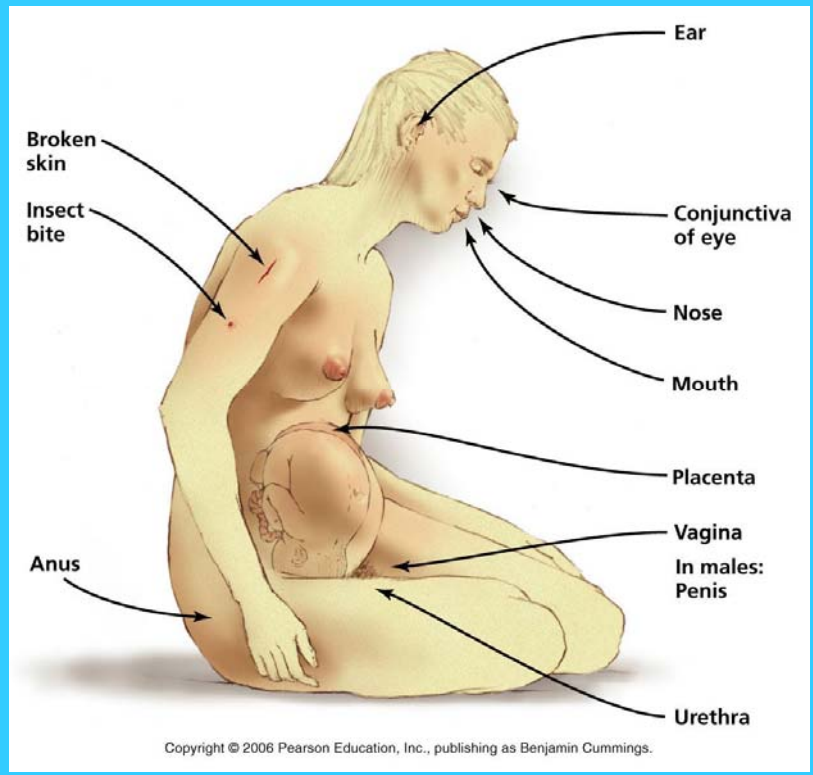
TABLE 11-5

Common Routes of Transmission of Infectious Diseases

ROUTE OF EXIT	ROUTE OF TRANSMISSION OR ENTRY	DISEASES
Skin	Skin discharge → air → respiratory tract	Chickenpox, colds, influenza, measles, staph and strep infections
	Skin to skin	Impetigo, eczema, boils, warts, syphilis
Respiratory	Aerosol droplet inhalation	Colds, influenza, pneumonia, mumps, measles, chickenpox, tuberculosis
	Nose or mouth → hand or object → nose	
Gastrointestinal	Feces → hand → mouth	Gastroenteritis, hepatitis, salmonellosis, shigellosis, typhoid fever, cholera, giardiasis, amebiasis
	Stool → soil, food, or water → mouth	
Salivary	Direct salivary transfer	Herpes cold sore, infectious mononucleosis, strep throat
Genital secretions	Urethral or cervical secretions	Gonorrhea, herpes, *Chlamydia* infection
	Semen	Cytomegalovirus infection, AIDS, syphilis, warts
Blood	Transfusion or needlestick injury	Hepatitis B, cytomegalovirus infection, malaria, AIDS
	Insect bite	Malaria relapsing fever
Zoonotic	Animal bite	Rabies
	Contact with animal carcasses	Tularemia, anthrax
	Arthropod	Rocky Mountain spotted fever, Lyme disease, typhus, viral encephalitis, yellow fever, malaria, plague

Entry

- Skin
- Mucous membranes: line body cavities
- Placenta
- Parenteral route: puncture, surgery, deep abrasions



Pathogenesis

Steps involved in the development of disease

Infection: colonization by a microorganism

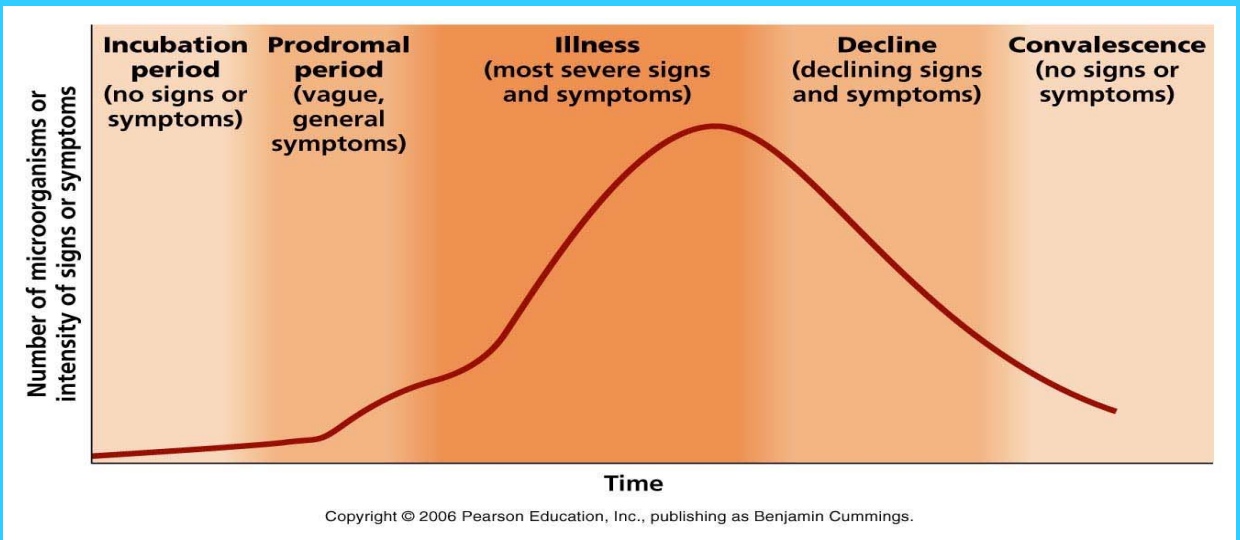
Primary, Secondary

Incubation: pathogen arrival to symptoms

Prodromal: early symptoms, usually general

Illness: typical disease-specific symptoms

Convalescence: recovery or disease regress



Incubation period

Table 14.8 **Incubation Periods of Selected Infectious Diseases**

Disease	Incubation Period
Staphylococcus food-borne infection	<1 day
Influenza	about 1 day
Cholera	2 to 3 days
Genital herpes	about 5 days
Tetanus	5 to 15 days
Syphilis	10 to 21 days
Hepatitis B	70 to 100 days
AIDS	1 to > 8 years
Leprosy	10 to >30 years

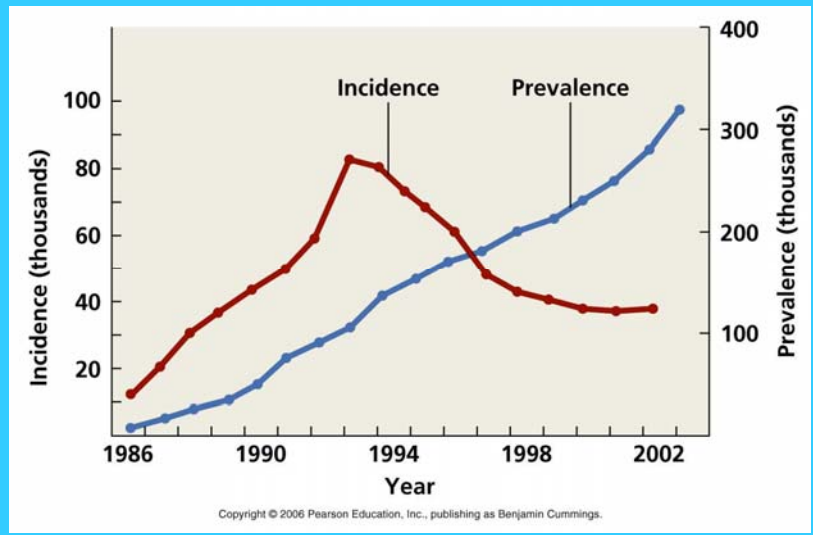
Classification

Table 14.12 Terms Used to Classify Infectious Diseases

Term	Definition
Acute disease	Disease in which symptoms develop rapidly and that runs its course quickly
Chronic disease	Disease with usually mild symptoms that develop slowly and last a long time
Subacute disease	Disease with time course and symptoms between acute and chronic
Asymptomatic disease	Disease without symptoms
Latent disease	Disease that appears a long time after infection
Communicable disease	Disease transmitted from one host to another
Contagious disease	Communicable disease that is easily spread
Noncommunicable disease	Disease arising from outside of hosts or from opportunistic pathogen
Local infection	Infection confined to a small region of the body
Systemic infection	Widespread infection in many systems of the body; often travels in the blood or lymph
Focal infection	Infection that serves as a source of pathogens for infections at other sites in the body
Primary infection	Initial infection within a given patient
Secondary infection	Infections that follow a primary infection; often by opportunistic pathogens

Epidemology

- Incidence : # of new cases
- Prevalence : total of number of cases



Epidemiology: Terminology

Morbidity: # disease cases/time and population
Mortality: # disease deaths/time and population
Endemic: diseases always present/population
Epidemic: high #/time and population (pp 178)
Legionnaire's, E. coli, hantavirus, cryptosporidiosis, West Nile virus
Pandemic: worldwide epidemic (pp179)
HIV, TB, Malaria

Communicable/Contagious: human to human transmission

Frequency of Disease

Endemic: diseases always present/population

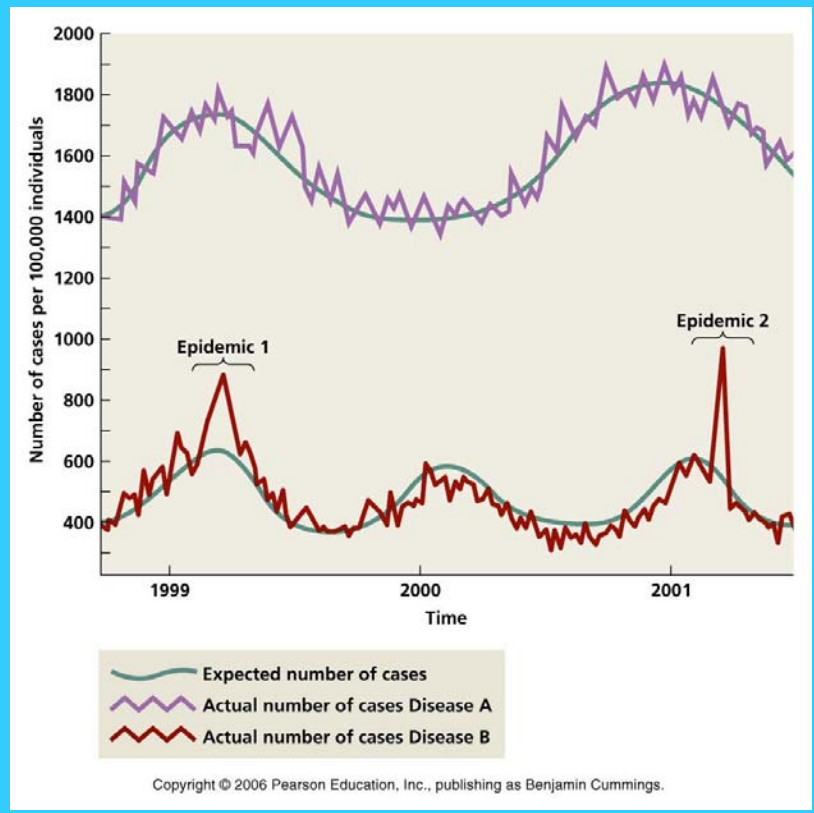
Sporadic: few scattered cases

Epidemic: high #/time and population (pp 178)

Legionnaire's, E. coli, hantavirus, cryptosporidiosis, West Nile virus

Pandemic: worldwide epidemic (pp179)

HIV, TB, Malaria



Epidemiological data

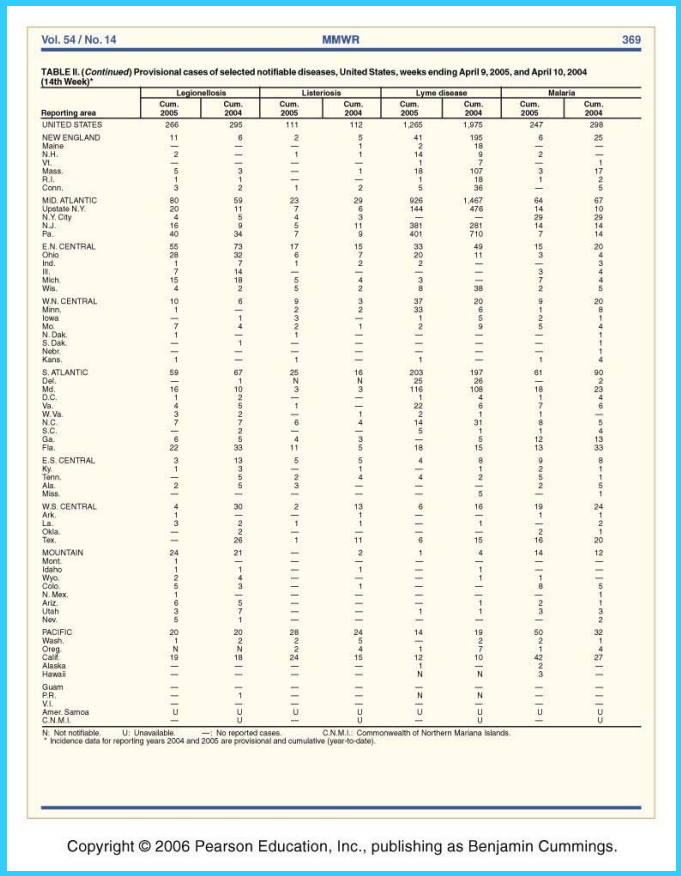


TABLE II. (*Continued*) Provisional cases of selected notifiable diseases, United States, weeks ending April 9, 2005, and April 10, 2004 (14th Week)*

Reporting area	Legionellosis		Listeriosis		Lyme disease		Malaria	
	Cum. 2005	Cum. 2004	Cum. 2005	Cum. 2004	Cum. 2005	Cum. 2004	Cum. 2005	Cum. 2004
UNITED STATES	266	295	111	112	1,265	1,975	247	298
NEW ENGLAND	11	6	2	5	41	195	6	25
Maine	—	—	—	1	2	18	—	—
N.H.	2	—	1	1	14	9	2	—
Vt.	—	—	—	—	1	7	—	1
Mass.	5	3	—	1	18	107	3	17
R.I.	1	1	—	—	1	18	1	2
Conn.	3	2	1	2	5	36	—	5
MID. ATLANTIC	80	59	23	29	926	1,467	64	67
Upstate N.Y.	20	11	7	6	144	476	14	10
N.Y. City	4	5	4	3	—	—	29	29
N.J.	16	9	5	11	381	281	14	14
Pa.	40	34	7	9	401	710	7	14
E.N. CENTRAL	55	73	17	15	33	49	15	20
Ohio	28	32	6	7	20	11	3	4
Ind.	1	7	1	2	2	—	—	3
Ill.	7	14	—	—	—	—	3	4
Mich.	15	18	5	4	3	—	7	4
Wis.	4	2	5	2	8	38	2	5
W.N. CENTRAL	10	6	9	3	37	20	9	20
Minn.	1	—	2	2	33	6	1	8
Iowa	—	1	3	—	1	5	2	1
Mo.	7	4	2	1	2	9	5	4
N. Dak.	1	—	1	—	—	—	—	1
S. Dak.	—	1	—	—	—	—	—	1
Nebr.	—	—	—	—	—	—	—	1
Kans.	1	—	1	—	1	—	1	4
S. ATLANTIC	59	67	25	16	203	197	61	90
Del.	—	1	N	N	25	26	—	2
Md.	16	10	3	3	116	108	18	23
D.C.	1	2	—	—	1	4	1	4
Va.	4	5	1	—	22	6	7	6
W. Va.	3	2	—	1	2	1	1	—
N.C.	7	7	6	4	14	31	8	5
S.C.	—	2	—	—	5	1	1	4
Ga.	6	5	4	3	—	5	12	13
Fla.	22	33	11	5	18	15	13	33
E.S. CENTRAL	3	13	5	5	4	8	9	8
Ky.	1	3	—	1	—	1	2	1
Tenn.	—	5	2	4	4	2	5	1
Ala.	2	5	3	—	—	—	2	5
Miss.	—	—	—	—	—	5	—	1
W.S. CENTRAL	4	30	2	13	6	16	19	24
Ark.	1	—	—	1	—	—	1	1
La.	3	2	1	1	—	1	—	2
Okla.	—	2	—	—	—	—	2	1
Tex.	—	26	1	11	6	15	16	20
MOUNTAIN	24	21	—	2	1	4	14	12
Mont.	1	—	—	—	—	—	—	—
Idaho	1	1	—	1	—	1	—	—
Wyo.	2	4	—	—	—	1	1	—
Colo.	5	3	—	1	—	—	8	5
N. Mex.	1	—	—	—	—	—	—	1
Ariz.	6	5	—	—	—	1	2	1
Utah	3	7	—	—	1	1	3	3
Nev.	5	1	—	—	—	—	—	2
PACIFIC	20	20	28	24	14	19	50	32
Wash.	1	2	2	5	—	2	2	1
Oreg.	N	N	2	4	1	7	1	4
Calif.	19	18	24	15	12	10	42	27
Alaska	—	—	—	—	1	—	2	—
Hawaii	—	—	—	—	N	N	3	—
Guam	—	—	—	—	—	—	—	—
P.R.	—	1	—	—	N	N	—	—
V.I.	—	—	—	—	—	—	—	—
Amer. Samoa	U	U	U	U	U	U	U	U
C.N.M.I.	—	U	—	U	—	U	—	U

N: Not notifiable. U: Unavailable. —: No reported cases. C.N.M.I.: Commonwealth of Northern Mariana Islands.
* Incidence data for reporting years 2004 and 2005 are provisional and cumulative (year-to-date).

Table 14.13 Nationally Notifiable Infectious Diseases[a]

- Acquired immunodeficiency syndrome (AIDS)
- Anthrax
- Botulism
- Brucellosis
- Chancroid
- *Chlamydia trachomatis,* genital infections
- Cholera
- Coccidioidomycosis
- Cryptosporidiosis
- Cyclosporiasis
- Diphtheria
- Ehrlichiosis
- Encephalitis/meningitis, arboviral
- Enterohemorrhagic *E. coli*
- Giardiasis
- Gonorrhea
- *Haemophilus influenzae,* invasive disease
- Hansen disease (leprosy)
- Hantavirus pulmonary syndrome
- Hemolytic uremic syndrome, postdiarrheal
- Hepatitis A
- Hepatitis B
- Hepatitis C
- HIV infection
- Legionellosis
- Listeriosis
- Lyme disease
- Malaria
- Measles
- Meningococcal disease
- Mumps
- Pertussis

[a]Diseases for which hospitals, physicians, and other health care workers are required to report cases to state health departments, who then forward the data to the CDC.