DEPARTMENT OF HEALTH

DISEASE CONTROL NEWSLETTER

Volume 44, Number 1 (pages 1-32) 2017

Annual Summary of Communicable Diseases Reported to the Minnesota Department of Health, 2016

Introduction

Assessment of the population's health is a core public health function. Surveillance for communicable diseases is one type of assessment. Epidemiologic surveillance is the systematic collection, analysis, and dissemination of health data for the planning, implementation, and evaluation of health programs. The Minnesota Department of Health (MDH) collects information on infectious diseases for the purposes of determining disease impact, assessing trends in disease occurrence, characterizing affected populations, prioritizing control efforts, and evaluating prevention strategies. Prompt reporting allows outbreaks to be recognized in a timely fashion when control measures are most likely to be effective in preventing additional cases.

In Minnesota, communicable disease reporting is centralized, whereby reporting sources submit standardized reports to MDH. Cases of disease are reported pursuant to Minnesota Rules Governing Communicable Diseases (Minnesota Rules 4605.7000 - 4605.7800). The diseases listed in Table 1 must be reported to MDH. As stated in the rules, physicians, health care facilities, laboratories, veterinarians, and others are required to report these diseases. Reporting sources may designate an individual within an institution to perform routine reporting duties (e.g., an infection preventionist for a hospital). Data maintained by MDH are private and protected under the Minnesota Government Data Practices Act (Section 13.3805).

Since April 1995, MDH has participated as an Emerging Infections Program (EIP) site funded by the U.S. Centers for Disease Control and Prevention (CDC) and, through this program, has implemented active hospital- and laboratory-based surveillance for several conditions, including selected invasive bacterial diseases, foodborne diseases, tickborne diseases, and hospitalized influenza cases.

Isolates of pathogens from certain diseases are required to be submitted to MDH (Table 1). The MDH Public Health Laboratory (PHL) performs microbiologic and molecular evaluation of isolates, such as pulsed-field gel electrophoresis (PFGE) and whole genome sequencing, to determine whether isolates (e.g., enteric pathogens such as *Salmonella* and *Escherichia coli* O157:H7, and invasive pathogens such as *Neisseria meningitidis*) are related and potentially associated with a common source. Testing of submitted isolates also allows detection and monitoring of antimicrobial resistance (see pp. 28-29).

Table 2 summarizes cases of selected communicable diseases reported during 2016 by district of the patient's residence. Pertinent observations for some of these diseases are presented below. Incidence rates in this report were calculated using disease-specific numerator data collected by MDH and a standardized set of denominator data derived from U.S. Census data. Disease incidence is categorized as occurring within the seven-county Twin Cities metropolitan area (metropolitan area) or outside of it in Greater Minnesota (unless otherwise indicated).

Anaplasmosis

Human anaplasmosis, caused by *Anaplasma phagocytophilum*, is a rickettsial disease transmitted to humans by bites from *Ixodes scapularis* (the blacklegged tick or deer tick). Although human anaplasmosis was initially referred to as human granulocytic ehrlichiosis, anaplasmosis and ehrlichiosis (due to *Ehrlichia chaffeensis*) are distinct diseases caused by different rickettsial species. The same tick vector also transmits the etiologic agents of Lyme disease, babesiosis, ehrlichiosis (due to *Ehrlichia muris*), and a strain of Powassan virus. *A. phagocytophilum* can also be transmitted by blood transfusion.

In 2016, 733 confirmed or probable cases of anaplasmosis (13.4 cases per 100,000 population) were reported, up from the 613 cases reported in 2015 (Figure 1). Despite annual fluctuations in reported cases, the overall trend is an increase in yearly case totals over time. Four hundred forty-nine (61%) cases reported were male. The median age of cases was 59 years (range, 2 to 97 years), 10 years older than the median age of Lyme disease cases. As is typical, most cases had illness onsets during the summer months, with 59% of cases reporting illness onsets in June and July. In 2016, 203 (28%) cases were hospitalized at some point for their infection, with a median duration of 4 days (range, 1 to 22 days).

continued on page 4

INSIDE:

Table 1. Diseases Reportable to the Minnesota Department of Health

REPORT IMMEDIATELY BY TELEPHONE

Anthrax (*Bacillus anthracis*) M
Botulism (*Clostridium botulinum*)
Brucellosis (*Brucella* spp.) M
Cholera (*Vibrio cholerae*) M
Diphtheria (*Corynebacterium diphtheriae*) M
Free-living amebic infection M
(including at least: *Acanthamoeba* spp., *Naegleria fowleri*, *Balamuthia* spp., *Sappinia* spp.)
Hemolytic uremic syndrome M
Measles (rubeola) M
Meningococcal disease (*Neisseria meningitidis*) (invasive) M S
Middle East Respiratory Syndrome (MERS) M
Orthopox virus M
Plague (*Yersinia pestis*) M
Poliomyelitis M
Q fever (*Coxiella burnetii*) M
Rabies (animal and human cases and suspected cases)
Rubella and congenital rubella syndrome M
Severe Acute Respiratory Syndrome (SARS) M R
Smallpox (variola) M
Tularemia (*Francisella tularensis*) M
Unusual or increased case incidence of any suspect infectious illness M
Viral hemorrhagic fever M
(including but not limited to Ebola virus disease and Lassa fever)

REPORT WITHIN ONE WORKING DAY

Amebiasis (*Entamoeba histolytica/dispar*)
Anaplasmosis (*Anaplasma phagocytophilum*)
Arboviral disease
(including, but not limited to, La Crosse encephalitis, eastern equine encephalitis, western equine encephalitis, St. Louis encephalitis, West Nile virus disease, Powassan virus disease, and Jamestown Canyon virus disease)
Babesiosis (*Babesia* spp.)
Blastomycosis (*Blastomyces dermatitidis*)
Campylobacteriosis (*Campylobacter* spp.) M
Carbapenem-resistant Enterobacteriaceae (CRE) M
Cat scratch disease (infection caused by *Bartonella* species)
Chancroid (*Haemophilus ducreyi*)
Chikungunya virus disease
Chlamydia trachomatis infections
Coccidioidomycosis
Cronobacter sakazakii in infants under one year of age M
Cryptosporidiosis (*Cryptosporidium* spp.) M
Cyclosporiasis (*Cyclospora* spp.) M
Dengue virus infection
Diphyllobothrium latum infection
Ehrlichiosis (*Ehrlichia* spp.)
Encephalitis (caused by viral agents)
Enteric *Escherichia coli* infection M
(*E. coli* O157:H7, other Shiga toxin-producing *E. coli*, enterohemorrhagic
E. coli, enteropathogenic *E. coli*, enteroinvasive *E. coli*, enteroaggregative
E. coli, enterotoxigenic *E. coli*, or other pathogenic *E. coli*)
Giardiasis (*Giardia intestinalis*)
Gonorrhea (*Neisseria gonorrhoeae* infections)
Haemophilus influenzae disease (all invasive disease) M S
Hantavirus infection
Hepatitis (all primary viral types including A, B, C, D, and E) B
Histoplasmosis (*Histoplasma capsulatum*)
Human immunodeficiency virus (HIV) infection, including Acquired Immunodeficiency Syndrome (AIDS) B
Influenza M
(unusual case incidence, critical illness, or laboratory-confirmed cases)
Kawasaki disease
Kingella spp. (invasive only) M S
Legionellosis (*Legionella* spp.) M
Leprosy (Hansen's disease) (*Mycobacterium leprae*)
Leptospirosis (*Leptospira interrogans*)
Listeriosis (*Listeria monocytogenes*) M
Lyme disease (*Borrelia burgdorferi*, and other *Borrelia* spp.)
Malaria (*Plasmodium* spp.)
Meningitis (caused by viral agents)
Mumps M
Neonatal sepsis M S
(bacteria isolated from a sterile site, excluding coagulase-negative *Staphylococcus*) less than seven days after birth
Pertussis (*Bordetella pertussis*) M
Psittacosis (*Chlamydophila psittaci*)
Retrovirus infections
Salmonellosis, including typhoid (*Salmonella* spp.) M
Shigellosis (*Shigella* spp.) M
Spotted fever rickettsiosis
(*Rickettsia* spp. infections, including Rocky Mountain spotted fever)
Staphylococcus aureus M
(only vancomycin-intermediate *Staphylococcus aureus* [VISA], vancomycin-resistant *Staphylococcus aureus* [VRSA], and death or critical illness due to community-associated *Staphylococcus aureus* in a previously healthy individual)
Streptococcal disease - invasive disease caused by Groups A and B streptococci and *S. pneumoniae* M S
Streptococcal disease - non-invasive *S. pneumoniae*
(urine antigen laboratory-confirmed pneumonia)
Syphilis (*Treponema pallidum*) B
Tetanus (*Clostridium tetani*)
Toxic shock syndrome M
Toxoplasmosis (*Toxoplasma gondii*)
Transmissible spongiform encephalopathy
Trichinosis (*Trichinella spiralis*)
Tuberculosis (*Mycobacterium tuberculosis* complex) M
(pulmonary or extrapulmonary sites of disease, including clinically diagnosed disease). Latent tuberculosis infection is not reportable.
Typhus (*Rickettsia* spp.)
Unexplained deaths and unexplained critical illness (possibly due to infectious cause) M
Varicella (chickenpox) M
Vibrio spp. M
Yellow fever
Yersiniosis, enteric (*Yersinia* spp.) M
Zika virus disease B
Zoster (shingles) M
(all cases <18 years old; unusual case incidence/complications regardless of age)

SENTINEL SURVEILLANCE*

*Diseases reportable through sentinel surveillance are reportable based on the residence of the patient or the specific health care facility. Sentinel surveillance is not statewide reporting.

Staphylococcus aureus M S
Candidemia (*Candida* spp.) (blood isolates only) M S
Carbapenem-resistant *Acinetobacter* spp. (CRA), and *Pseudomonas aeruginosa* (CR-PA) M
Clostridium difficile M
Severe Acute Respiratory Illness M
Respiratory syncytial virus (RSV)

- For diseases that require immediate reporting call 24 hours a day, 7 days a week: 651-201-5414 or 1-877-676-5414.
- Report forms can be downloaded at: http://www.health.state.mn.us/diseasereport

Reportable Diseases, MN Rule 4605.7040

FOOTNOTES

M Submission of clinical materials required. Submit isolates or, if an isolate is not available, submit material containing the infectious agent in the following order of preference: a patient specimen; nucleic acid; or other laboratory material. Call the MDH Public Health Laboratory at 651-201-4953 for instructions.

S Invasive disease only: isolated from a normally sterile site, e.g.: blood, CSF, joint fluid, etc.

R In the event of SARS or another severe respiratory outbreak, also report cases of health care workers hospitalized for pneumonia or acute respiratory distress syndrome.

B Also report a pregnancy in a person with Zika; or a person chronically infected with hepatitis B, HIV, or syphilis.

Table 2. Cases of Selected Communicable Diseases Reported to the Minnesota Department of Health by District of Residence, 2016

	District (population per U.S. Census 2015 estimates)									
Disease	Metropolitan (3,012,117)	Northwestern (158,477)	Northeastern (325,803)	Central (743,891)	West Central (239,173)	South Central (290,032)	Southeastern (501,850)	Southwestern (218,251)	Unknown Residence	Total (5,489,594)
Anaplasmosis	165	119	119	196	73	10	48	3	0	733
Babesiosis	10	12	6	11	6	1	4	0	0	50
Blastomycosis	11	2	20	3	0	0	2	1	0	39
Botulism (Infant)	1	0	0	1	0	0	0	0	0	2
Campylobacteriosis	462	23	33	158	36	68	131	131	0	1,042
Cryptosporidiosis	92	9	14	76	37	61	103	73	0	465
Escherichia coli O157 infection	44	5	2	27	4	3	21	16	0	122
Hemolytic uremic syndrome	5	0	0	3	0	0	4	2	0	14
Giardiasis	352	16	49	91	31	25	60	31	0	655
Haemophilus influenzae disease	53	6	11	21	4	11	11	9	0	126
HIV (non-AIDS)	193	5	4	11	4	0	10	2	0	229
AIDS (diagnosed in 2016)	103	3	0	10	2	3	5	5	0	131
Legionnaires' disease	72	1	8	8	0	7	15	4	0	115
Listeriosis	4	0	1	0	2	1	0	0	0	8
Lyme disease	547	71	165	336	50	20	101	15	0	1,305
Measles (rubeola)	2	0	0	0	0	0	0	0	0	2
Meningococcal disease	3	0	1	0	0	0	1	0	0	5
Mumps	19	0	0	3	0	0	2	0	0	24
Pertussis	520	33	38	69	42	59	232	22	0	1,015
Q Fever (acute)	0	1	0	0	0	0	0	0	0	1
Q Fever (chronic)	0	0	0	0	1	0	0	0	0	1
Salmonellosis	478	24	50	105	28	42	75	59	0	861
Sexually transmitted diseases	19,990	486	1,302	2,378	896	978	1,912	583	1,048	29,483
Chlamydia trachomatis - genital infections	14,470	407	1,129	1,987	734	865	1,657	524	902	22,675
Gonorrhea	3,996	69	117	299	148	73	217	39	146	5,104
Syphilis, total	717	5	28	46	7	20	19	10	0	852
Primary/secondary	250	4	14	18	2	8	7	3	0	306
Early latent*	222	0	6	10	3	6	3	1	0	251
Late latent**	242	1	8	16	2	5	9	6	0	289
Congenital	3	0	0	2	0	1	0	0	0	6
Other***	0	0	0	0	0	0	0	0	0	0
Shigellosis	292	33	4	87	83	8	9	38	0	554
Streptococcal invasive disease - Group A	138	15	23	33	12	10	34	12	0	277
Streptococcal invasive disease - Group B	285	16	37	73	21	34	59	19	0	544
Streptococcus pneumoniae disease	224	13	43	92	29	17	36	31	0	485
Tuberculosis	129	3	1	10	2	4	12	7	0	168
Tularemia	1	0	1	1	0	0	0	0	0	3
Varicella	174	4	16	50	13	24	24	31	0	336
Viral hepatitis, type A	8	2	1	2	0	1	1	0	0	15
Viral hepatitis, type B (acute infections only, not perinatal)	15	1	0	3	0	0	2	0	0	21
Viral hepatitis, type C (acute infections only)	14	3	19	6	6	1	2	0	0	51
West Nile virus	14	4	2	11	22	6	5	19	0	83
Zika virus	52	0	2	4	2	5	3	5	0	73

* Duration ≤1 year
** Duration >1 year
*** Includes unstaged neurosyphilis, latent syphilis of unknown duration, and latent syphilis with clinical manifestations

County Distribution within Districts
Metropolitan - Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, Washington
Northwestern- Beltrami, Clearwater, Hubbard, Kittson, Lake of the Woods, Marshall, Pennington, Polk, Red Lake, Roseau
Northeastern - Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, St. Louis
Central - Benton, Cass, Chisago, Crow Wing, Isanti, Kanabec, Mille Lacs, Morrison, Pine, Sherburne, Stearns, Todd, Wadena, Wright
West Central - Becker, Clay, Douglas, Grant, Mahnomen, Norman, Otter Tail, Pope, Stevens, Traverse, Wilkin
South Central- Blue Earth, Brown, Faribault, LeSueur, McLeod, Martin, Meeker, Nicollet, Sibley, Waseca, Watonwan
Southeastern- Dodge, Fillmore, Freeborn, Goodhue, Houston, Mower, Olmsted, Rice, Steele, Wabasha, Winona
Southwestern- Big Stone, Chippewa, Cottonwood, Jackson, Kandiyohi, Lac Qui Parle, Lincoln, Lyon, Murray, Nobles, Pipestone, Redwood, Renville, Rock, Swift, Yellow Medicine

Arboviral Diseases

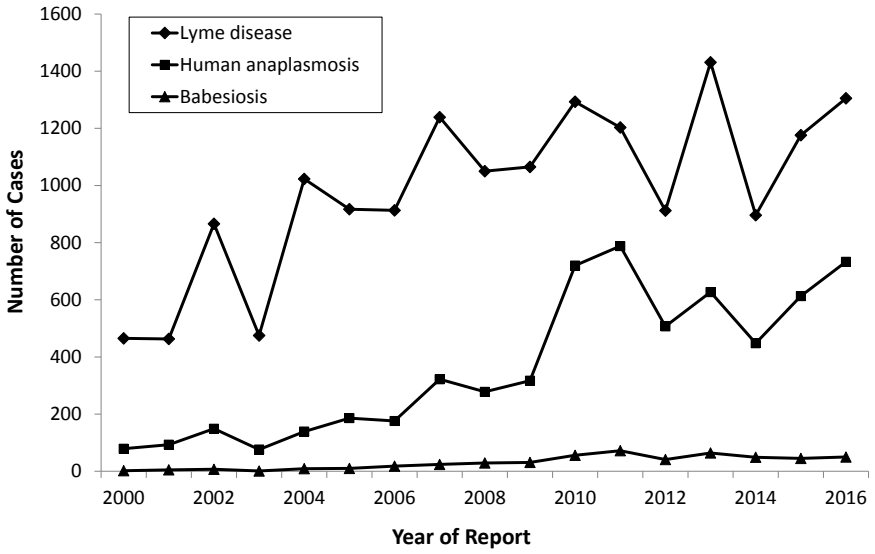
Mosquito-borne Arboviruses

Historically, the primary arboviral encephalitides found in Minnesota have been La Crosse encephalitis, Western equine encephalitis (WEE), and more recently, West Nile virus (WNV) encephalitis. Both WNV and WEE are maintained in mosquito-to-bird transmission cycles involving several different species of each, and regional variation in vectors and reservoirs is likely. WNV is established throughout Minnesota, and will probably be present in the state to some extent every year, whereas human cases of WEE occur more sporadically. Human disease risk will likely continue to be higher in central and western Minnesota where the primary mosquito vector, *Culex tarsalis*, is most abundant. Interpreting the effect of weather on arboviral transmission is complex, making it extremely difficult to predict the number of people who will become infected in any given year.

In Minnesota, 83 WNV disease cases were reported in 2016, the highest number since 2007. Fourteen (17%) had neuroinvasive presentations including encephalitis or meningitis, and there were 5 deaths. The other 69 (83%) cases had West Nile fever. Seventy-three percent (61) of the cases were male, and the median age was 55 years (range, 8 to 90 years). In 2016, 46 (55%) WNV cases were hospitalized. The majority of cases (93%) reported symptom onset in July, August, or September. Fifteen asymptomatic WNV-positive blood donors were also identified during 2016.

In 2016, 3 cases of La Crosse encephalitis were reported. All were male, and ranged in age from 4 to 11 years. One case presented with encephalitis, while the other 2 had milder febrile illnesses. The disease, which primarily affects children, is transmitted through the bite of infected *Aedes triseriatus* (Eastern Tree Hole) mosquitoes, and is maintained in a cycle that includes mosquitoes and small mammals. Exposure to infected mosquitoes typically occurs in wooded or shaded areas inhabited by this species, especially in areas where water-holding containers (e.g., waste tires, buckets, or cans) that provide breeding habitats are abundant. Since 1985, 147 cases have been reported from 22 Minnesota counties, primarily in the southeastern part of the state. Many people who are infected have no apparent symptoms, but severe disease can occur in children. The median case age for La Crosse encephalitis patients was 6 years (range, <1 to 49). Disease onsets have been reported from June through September, but most onsets have occurred from mid-July through mid-September.

Figure 1. Reported *I. scapularis*-borne Disease Cases in Minnesota, 2000-2016



In 2016, 6 cases of disease due to Jamestown Canyon virus, a California group virus related to La Crosse, were reported. The virus is transmitted by *Aedes* genus mosquitoes, and the maintenance cycle in nature is thought to include deer and other large mammals. Much remains unknown about the clinical spectrum of Jamestown Canyon virus, but the typical presentation includes fever, and in more severe cases, meningitis or encephalitis. The virus is likely widespread in Minnesota. Patients were aged 37 to 95 years and all reported experiencing febrile illnesses.

Tick-borne Arboviruses

Powassan virus (POW) is a tick-borne flavivirus that includes a strain (lineage II or "deer tick virus") that is transmitted by *Ixodes scapularis*. The virus can cause encephalitis or meningitis, and long-term sequelae occur in approximately half of those patients. Approximately 10-15% of cases are fatal. Since 2008, 27 cases (2 fatal) of POW disease have been reported in Minnesota residents. Most of these patients had neuroinvasive disease (15 encephalitis and 10 meningitis) but 2 were non-neuroinvasive fever cases. Twenty (74%) cases have been male, and the median age is 61 years (range, 3 mos. to 75 years). Similar to other tick-borne diseases, the majority of patients (20, or 74%) reported illness onsets between May and August. Seven patients (26%) had onset dates in October or November. With the exception of 2014 and 2015, cases have been reported every year since 2008, with a peak of 11 in 2011 (range, 1 to 11), and 5 cases in 2016. Cases were exposed to ticks in several north-central Minnesota counties. MDH has also identified POW virus-positive ticks at sites in the six counties that have been investigated to date (Anoka, Clearwater, Cass, Houston, Morrison, and Pine). Thus, the virus appears to be widely distributed in the same wooded parts of the state that are endemic to other pathogens transmitted by *I. scapularis.*

Babesiosis

Babesiosis is a malaria-like illness caused by a protozoan, typically *Babesia microti*, which infects red blood cells. *B. microti* is transmitted to humans by bites from *Ixodes scapularis* (the blacklegged tick or deer tick), the same vector that transmits the agents of Lyme disease, human anaplasmosis, one form of human ehrlichiosis, and

a strain of Powassan virus. *Babesia* parasites can also be transmitted by blood transfusion. *Babesia* infections can range in severity, and while most people have asymptomatic infections, people with weak immune systems, other co-morbidities, and the elderly may become seriously ill.

In 2016, 50 confirmed and probable babesiosis cases (0.9 per 100,000 population) were reported, up from the 45 cases in 2015. Despite slight annual fluctuations, case totals since 2005 (range, 10 to 72) have been consistently higher than reported totals from 1996 to 2004 (range, 0 to 9) (Figure 1). In 2016, 28 (56%) of the cases occurred in males. The median case age was 61 years (range, 3 to 88 years), down from 64 in 2015, and older than the median ages for both anaplasmosis (59 years) and Lyme disease (49 years). Onsets of illness peaked in the summer months; 38 (76%) of 50 patients with known onset reported first experiencing symptoms in June, July, or August. Fifteen (30%) cases were hospitalized for their infection in 2016 for a median duration of 5 days (range, 2 to 13 days). Although severe complications like organ failure were reported in 6 cases, there were no deaths attributable to babesiosis in 2016.

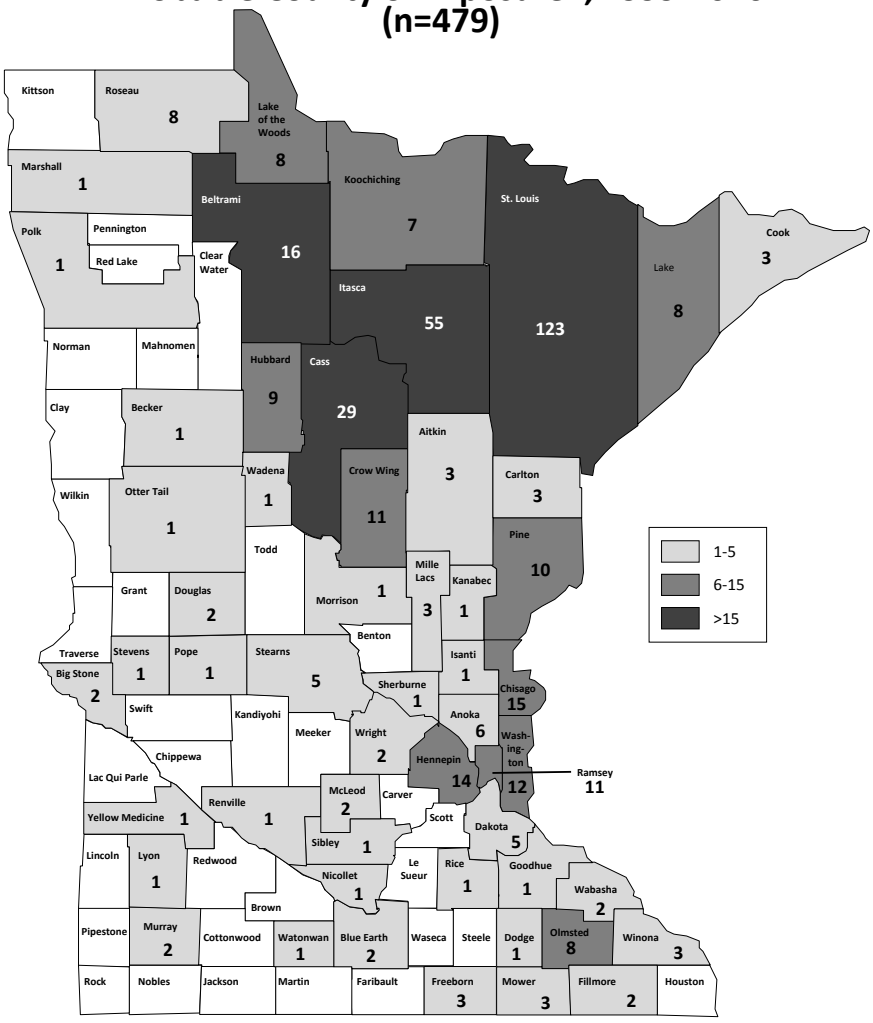
Blastomycosis

Blastomycosis is caused by the dimorphic fungus *Blastomyces dermatitidis*, which exists as a mold in the environment and a pathogenic yeast form in the body. The reservoir is moist soil enriched with decomposing organic debris. Transmission occurs primarily by inhalation of spores after disturbance of contaminated soil.

In 2016, there were 39 reported blastomycosis cases, a small increase over the 34 cases in 2015, and 32 in 2014. The median age of 2016 cases was 48 years (range, 12 to 80 years); 28 (72%) were male. Thirty-five (90%) cases were white, 2 (5%) were Asian/Pacific Islander, 1 (3%) was American Indian, and 1 was of unknown race. Twenty-three (59%) cases were hospitalized for a median of 7 days (range, 1 to 55 days). Three cases died, and in 2 of these blastomycosis was the cause of death. Thirteen cases (33%) had immunocompromising health conditions or medications, including 8 (21%) with diabetes, and 2 (5%) that were post-transplant patients. Thirty-three (85%) cases had pulmonary infection, 1 (3%) had extra-pulmonary infection, and 5 (13%) had disseminated infection.

From 1999 to 2016, 584 blastomycosis cases were reported; the median annual number was 33 (range, 22 to 48). Exposure information is available for 479 cases. The largest number, 123 (25%), were likely exposed in St. Louis County. Fifty-five (11%) cases were likely exposed in Itasca County, 29 (6%) in Cass County, 16 (3%) in Beltrami County, 15 (3%) in Chisago County, and 14 (3%) in Hennepin County. (Figure 2).

Figure 2. Human Blastomycosis Cases in Minnesota by Probable County of Exposure*, 1999-2016 (n=479)



* 52 cases were exposed in other states, 9 in Canada, and 1 in South America.

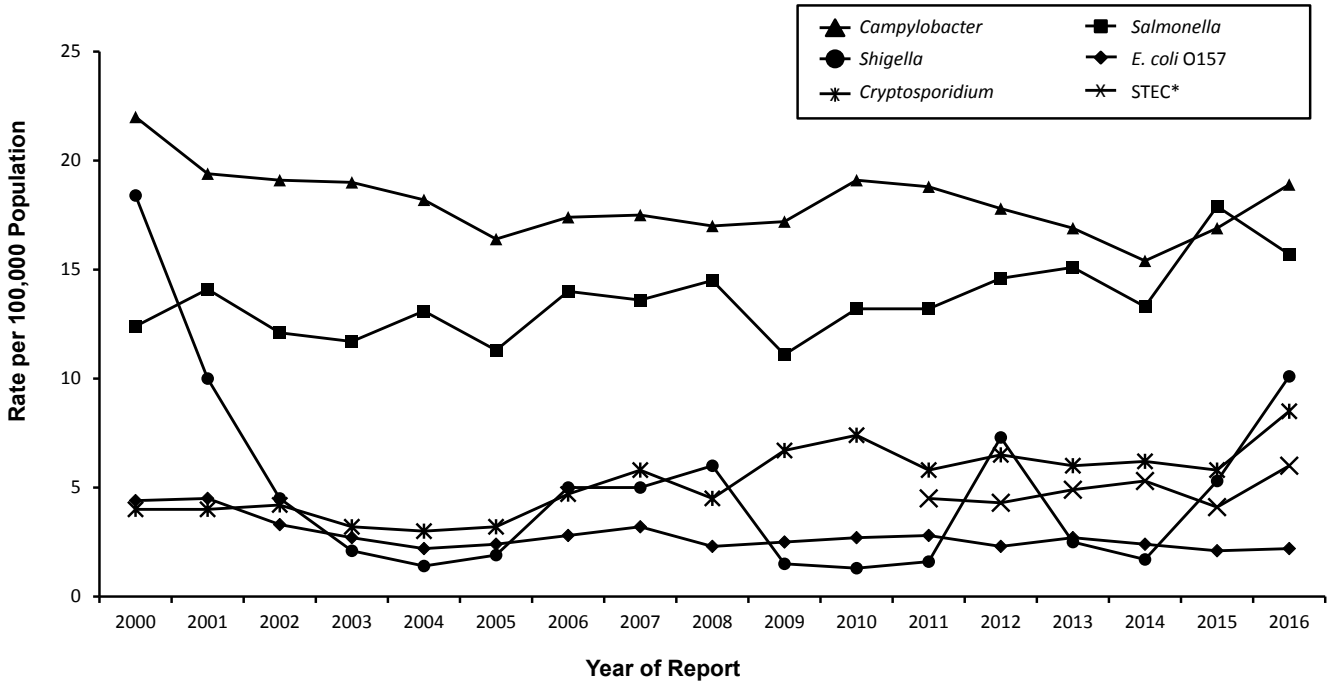
Campylobacteriosis

There were 1,042 culture-confirmed *Campylobacter* cases reported in 2016 (18.9 per 100,000 population). This is a 13% increase from the 925 cases reported in 2015, and a 15% increase from the annual median of 908 cases reported from 2006 to 2015 (range, 843 to 1,009). In 2016, 44% of cases occurred in people who resided in the metropolitan area. Of the 1,012 *Campylobacter* isolates confirmed and identified to species by MDH, 86% were *C. jejuni* and 8% were *C. coli*.

The median age of cases was 36 years (range, 1 month to 89 years). Forty-one percent were between 20 and 49 years of age, and 12% were ≤5 years of age. Fifty-five percent were male. Fifteen percent were hospitalized; the median length of hospitalization was 3 days. Forty-nine percent of infections occurred during June through September. Of the 947 cases for whom data were available, 163 (17%) reported travel outside the United States during the week prior to illness onset. The most common travel destinations were Europe (n=45),

continued...

Figure 3. Incidence of Selected Enteric Pathogens, Minnesota, 2000-2016



*STEC (Shiga toxin producing *E. coli*) includes O157 and non-O157 STEC case counts.

Mexico (n=38), Central or South America or the Caribbean (n=37), Asia (n=23), and Africa (n=13).

Five foodborne outbreaks were identified in 2016. In one outbreak, 2 culture-confirmed *C. jejuni* infections were associated with a deli. In a second outbreak, 2 culture-confirmed *C. jejuni* infections were associated with a restaurant. In another, 3 culture-confirmed *C. coli* cases were associated with a sushi restaurant. In another, 1 culture-confirmed case was associated with raw oysters sourced from Washington. Lastly, 2 cases with culture-confirmed *C. jejuni* infections were associated with duck hearts served at a restaurant. The vehicle of transmission was not confirmed for the first three outbreaks. An additional four outbreaks of *C. jejuni* infections were investigated in 2016. One outbreak was associated with environmental contamination at a poultry plant. The remaining three outbreaks were associated with a private farm, summer camp, and child care facility; however, the route of transmission was not determined.

A primary feature of public health importance among *Campylobacter* cases was the continued presence of isolates resistant to fluoroquinolone antibiotics (e.g., ciprofloxacin), which are commonly used to treat campylobacteriosis. In 2016, the overall proportion of quinolone resistance among *Campylobacter* isolates tested was 26%. However, 80% of *Campylobacter* isolates from patients with a history of foreign travel during the week prior to illness onset, regardless of destination, were resistant to fluoroquinolones. Fifteen percent of *Campylobacter* isolates from patients who acquired the infection domestically were resistant to fluoroquinolones.

In June 2009, a culture-independent test (CIDT) became commercially available for the qualitative detection of *Campylobacter* antigens in stool. In 2016, 572 patients were positive for *Campylobacter* by an antigen detection CIDT conducted in a clinical laboratory. However, only 193 (34%) of the specimens were subsequently culture-confirmed. Beginning in 2015, some clinical laboratories in Minnesota began testing stool specimens with PCR-based gastrointestinal pathogen panels, another type of CIDT. In 2016, 416 patients were positive for *Campylobacter* by a PCR gastrointestinal panel; 317 (76%) of these specimens were culture-confirmed. Only culture-confirmed cases met the surveillance case definition for inclusion in MDH case count totals.

Carbapenem-resistant *Enterobacteriaceae* (CRE)

Carbapenem-resistant *Enterobacteriaceae* (CRE) are Gram-negative bacilli that most commonly occur among patients with significant health care exposures, co-morbid conditions, invasive devices, and those who have received extended courses of antibiotics. Invasive infections caused by CRE, such as carbapenem-resistant *Klebsiella pneumoniae,* are associated with higher morbidity and mortality than those caused by carbapenem-susceptible *Enterobacteriaceae*. Another opportunistic pathogen associated with health care settings, *Acinetobacter baumannii,* can also become resistant to carbapenems. Carbapenem-resistant *A. baumannii* (CRA) is being increasingly recognized as one of the leading causes of health care-associated infections worldwide, and is associated with high mortality rates and unfavorable clinical outcomes.

Carbapenem resistance can be acquired through a variety of mechanisms. Some CRE and CRA carry

resistance genes that produce enzymes known as carbapenemases. Certain carbapenemases (e.g., *K. pneumoniae* carbapenemase [KPC]), are encoded by transmissible genetic elements that can easily spread between bacteria of similar species. KPC is the predominant carbapenemase in the United States. Other carbapenemases have been identified in the United States (e.g., New Delhi metallo-β-lactamase [NDM], Verona integron-encoded metallo-β-lactamase [VIM], active on imipenem [IMP], and oxacillinase [OXA-48]), although they are more frequently identified in other countries.

Carbapenem resistance can also be acquired through the production of a β-lactamase effective against third-generation cephalosporins (e.g., AmpC β-lactamases or extended-spectrum β-lactamases [ESBLs]) when combined with porin mutations that prevent carbapenem antibiotics from entering the cell).

Carbapenem-resistant organisms have been increasingly recognized as an important cause of health care-associated infections (HAIs). CDC identified CRE as one of three "urgent" antibiotic resistance threats requiring immediate and aggressive action. In 2017, the World Health Organization ranked 12 bacteria that posed the greatest threat to human health; CRE and CRA, as well as carbapenem-resistant *Pseudomonas aeruginosa,* are the three bacteria most urgently in need of development of new antibiotics.

MDH first identified a KPC-producing CRE in February 2009 and began voluntary CRE reporting including isolate submission. In 2012, we used standardized CRE and CRA definitions developed by the CDC EIP Multi-site Gram-negative Surveillance Initiative (MuGSI), and began active laboratory- and population-based surveillance in Hennepin and Ramsey Counties. This surveillance includes all isolates of *A. baumannii, Escherichia coli*, *Enterobacter* spp., or *Klebsiella* spp., from normally sterile sites or urine, that are resistant to imipenem, meropenem, doripenem, or ertapenem using current Clinical and Laboratory Standards Institute breakpoints (ertapenem excluded for *Acinetobacter* isolates). In Hennepin and Ramsey Counties, all carbapenem-resistant species of *Enterobacteriaceae* from any body site are reportable. An incident case is defined as the first eligible isolate of each species collected from a Hennepin or Ramsey County resident within 30 days. Statewide surveillance for CRE was initiated in 2016. For statewide surveillance, the MuGSI definition is expanded to include isolates of *E. coli*, *Enterobacter* spp., *Klebsiella* spp., or *Citrobacter* spp. from all body sites. The PHL tested all submitted 2016 isolates by PCR for KPC and NDM carbapenemase genes, and utilized other molecular and phenotypic assays (e.g., CarbaNP) to assess for additional carbapenemases when applicable.

During 2016, 380 incident CRE cases representing 367 patients were identified in Minnesota residents. Twenty-three (6%) isolates (representing 19 patients) were KPC positive (*K. pneumoniae* [12], *Enterobacter cloacae* [7], *Citrobacter freundii* [2], *E. coli* [1], and *Serratia marcescens* [1]. Of note, 2 (11%) patients were positive for the same organism in the calendar year prior to the date of initial culture. Seven (2%) incident cases (representing 7 patients) were NDM positive (*K. pneumoniae* [4], *C. freundii* [1], *E. coli* [1], and *Providencia rettgeri* [1]. All but 1 had exposure to health care overseas (Asia, Africa). Of the 380 incident cases, 2 (0.5%) isolates (representing 2 patients) were IMP positive (*P. rettgeri* [2]).

In 2016, 19 CRA isolates from 18 patients were identified in Minnesota residents. One isolate was NDM positive, with the patient having received health care exposure outside of the United States prior to initial culture. No other carbapenemases in CRA isolates were identified.

Of the 19 Minnesota residents with KPC-positive isolates, the median age was 63 years (range, 24 to 94); 11 (58%) were male, and 9 (47%) were residents of Hennepin or Ramsey County. Eleven (58%) patients were white, 3 (16%) were black, 2 (11%) were American Indian, 1 (5%) was Asian, and 2 (11%) were of unknown race. Hispanic ethnicity was reported for 2 (11%) patients. Urine (12) was the most common source followed by wounds (2), blood (2), sputum (1) and other sites (2). Thirteen (68%) were hospitalized (8 hospitalized ≥3 days prior to culture); median length of stay was 12 days (range, 1 to 58). Six patients (32%) required ICU care; in-hospital mortality was 21% with 1 patient having CRE isolated from a sterile site within 7 days of death. Other KPC-positive CRE isolates were collected in patients from outpatient settings (4), and long-term care facilities (2) without subsequent hospitalization within 30 days.

A total of 135 CRE incident cases (representing 126 patients) were reported for MuGSI during 2016. Of the 135 cases, 66 were *Enterobacter* spp., 42 were *Klebsiella* spp., and 27 were *E. coli*. KPC was identified in 5 (4%) of MuGSI CRE (*K. pneumoniae* [3] and *E. cloacae* [2]. Again, CRE was most frequently isolated from urine (127) followed by blood (7), and CSF (1). A total of 4 incident cases (representing 4 patients) of CRA were reported for MuGSI during this time period; all were isolated from urine.

During 2016, 11 NDM-producing CRE and 1 NDM-producing CRA were detected. To date, a total of 28 NDM-producing organisms (*K. pneumoniae* [13], *E. coli* [10], *K. oxytoca* [1], *C. freundii* [1], *P. rettgeri* [1], *A. baumannii* [1], and *Pseudomonas aeruginosa* [1]) from 21 patients treated in Minnesota have been detected. This includes 9 Minnesota residents and 12 non-residents, all but one of whom had received medical care outside the United States (20 patients) or in a non-Minnesota U.S. facility (3 patients) prior to their NDM-positive culture in Minnesota. In 2016, the PHL identified, and CDC confirmed, 2 IMP-producing CRE (*P. rettgeri* [2]) from Minnesota residents (no history of travel or foreign health care exposures) and 1 VIM-producing *S. marcescens* from a non-resident with significant health care exposure outside the United States prior to receiving healthcare in Minnesota.

In summary, 8% of *Enterobacteriaceae* isolates tested by the PHL during 2016 were KPC-positive; 2 patients with KPC-positive isolates had a history of KPC-positive CRE from previous years, both of them from multiple body sites. Detection of NDM and VIM serves as a reminder to clinicians that a travel history, including receipt of medical care outside the United States, is a critical component of early detection of CRE isolates with carbapenemases. CDC recommends performing rectal

continued...

screening cultures to detect CRE colonization in newly admitted patients with known hospitalization outside the United States within the last 6 months. CRE and CRA bacteria can spread in healthcare facilities (e.g., on the hands of healthcare workers or contaminated equipment) and have been associated with outbreaks in these settings in other states and countries. The spread of these pathogens can be halted with early detection and implementation of appropriate infection prevention measures, and proper communication of infection status upon patient transfer. Healthcare facilities should consider screening in-house patients with epidemiologic links to a patient colonized or infected with CRE, including any roommates. Screening might also be expanded to patients cared for by the same healthcare workers, those on the same unit, and/or patients who have had similar procedures (e.g., endoscopic procedures).

Chikungunya

Chikungunya virus is a mosquito-borne alphavirus found in Africa, Asia, and Europe. In late 2013, locally acquired cases appeared for the first time in the Americas on the Caribbean island of St. Martin, and the virus subsequently has spread thoughout Central and South America. The virus is transmitted by the same *Aedes* spp. mosquitoes (*Ae. aegypti* and *Ae. albopictus*) that also transmit dengue and Zika viruses.

Unlike many other mosquito-borne viruses, most people who are infected with chikungunya develop symptoms. The most common symptoms are fever and joint pain, but patients may also experience headache, muscle aches, or rash. Symptoms usually begin 3-7 days after a person is bitten by an infected mosquito, and most recover within a week. Joint pain may persist for weeks to years after the initial illness.

In 2016, 16 chikungunya cases were reported in Minnesota residents. The median case age was 44 years (range, 5 to 65 years). All 16 resided in the metropolitan area and symptom onsets occurred all year, from mid-January through November. All of the cases represented imported infections acquired abroad, and travel occurred to many areas of the world. Six cases reported travel to East Africa, 5 to Asia, and 5 to Mexico and Central America. Nationwide, chikungunya cases were reported from 37 states. All cases in U.S. residents were acquired while traveling abroad, and no local transmission occurred in the continental United States.

Clostridium difficile

Clostridium difficile is an anaerobic, spore-forming, Gram-positive bacillus that produces two pathogenic toxins: A and B. *C. difficile* infections (CDI) range in severity from mild diarrhea to fulminant colitis and death. Transmission of *C. difficile* occurs primarily in healthcare facilities, where environmental contamination by *C. difficile* spores and exposure to antimicrobial drugs are common. The primary risk factor for development of CDI in healthcare settings is recent use of antimicrobials, particularly clindamycin, cephalosporins, and fluoroquinolones. Other risk factors for CDI acquisition in these settings are age >65 years, severe underlying illness, intensive care unit admission, nasogastric intubation, and longer duration of hospital stay.

In the early 2000s, a marked increase in the number of CDI cases and mortality due to CDI was noted across the United States, Canada, and England. Most notable was a series of large-scale outbreaks in Quebec first reported in March 2003. During this period, Quebec hospitals reported a 5-fold increase in healthcare-acquired CDI. These and other healthcare facility (e.g., long-term care facilities) outbreaks have been associated with the emergence of a more virulent strain of *C. difficile*, designated North American PFGE type 1 (NAP1), toxinotype III.

In 2009, in an effort to better understand the burden of CDI in Minnesota, as part of EIP, MDH initiated population-based, sentinel surveillance for CDI at clinical laboratories serving Stearns, Benton, Morrison, and Todd Counties; in 2012 Olmsted County was added.

CDIs that occur outside the traditional healthcare settings (i.e., community-associated) have also been receiving increased attention. Community-associated (CA) CDI data from 2009-2011 across 10 EIP sites showed that 64% of CA CDI patients received prior antibiotics, and 82% had some outpatient healthcare exposure.

A CDI case is defined as a positive *C. difficile* toxin assay on an incident stool specimen from a resident (≥ 1 year of age) of one of the five counties. A CDI case is classified as healthcare facility-onset (HCFO) if the initial specimen was collected >3 days after admission to a healthcare facility. Community-onset (CO) cases who had an overnight stay at a healthcare facility in the 12 weeks prior to the initial specimen are classified as CO-HCFA, whereas CO cases without documented overnight stay in a healthcare facility in the 12 weeks prior to the initial specimen result are classified as CA. A more detailed set of case definitions is available upon request.

In 2016, 903 incident cases of CDI were reported in the five sentinel counties (227 per 100,000 population), an increase from 202 per 100,000 population in 2015. Fifty-eight percent of these cases were classified as CA, 25% as CO-HCFA, and 17% as HCFO. The median ages for CA, CO-HCFA, and HCFO cases were 52 years, 63 years, and 75 years, respectively. Fifty-two percent of CA cases were prescribed antibiotics in the 12 weeks prior to stool specimen collection compared to 75% of HCFO cases and 78% of CO-HCFA cases. Of the 524 putative CA cases eligible for interview, 342 were interviewed and confirmed as CA cases. Fifty-four percent of CA cases reported antibiotic use in the 12 weeks prior to illness onset date. Most common uses of antibiotics included treatment of ear, sinus, or upper respiratory infections (27%); dental procedures (13%); urinary tract infections (14%); and skin infections (9%).

Cryptosporidiosis

During 2016, 465 cases of cryptosporidiosis (8.5 per 100,000 population) were reported. This is markedly higher than the median number of cases reported annually from 2006 to 2015 (median, 321.5 cases; range, 235 to 389). The median age was 21 years (range, 6 months to 94 years). Children 10 years of age or younger accounted for 33% of cases. Fifty-six percent of cases occurred during July through October. The incidence of cryptosporidiosis in the Southwestern, Southeastern, South Central, and West Central districts (33.4, 20.5, 21.0, and 15.5 cases per 100,000, respectively) was significantly higher than the statewide incidence.

Only 92 (20%) reported cases occurred among residents of the metropolitan area (3.0 per 100,000). Thirty-seven (8%) cases required hospitalization, for a median of 3 days (range, 2 to 41 days).

Eight confirmed outbreaks of cryptosporidiosis were identified in Minnesota in 2016, accounting for 53 laboratory-confirmed cases. Six recreational water outbreaks of cryptosporidiosis occurred, accounting for 77 cases (32 laboratory-confirmed). The waterborne outbreaks were associated with a private kiddie pool (Yellow Medicine County) and five municipal pools/aquatic centers (Brown, Fillmore, Hennepin, Steele, and Waseca Counties). One outbreak of cryptosporidiosis was associated with school field trips to a farm in Meeker County, resulting in 72 cases (20 laboratory-confirmed). One outbreak of cryptosporidiosis due to person-to-person transmission at a child care center in Hennepin County accounted for 3 cases (1 laboratory-confirmed).

Dengue

Dengue fever is one of the most frequently occurring mosquito-borne diseases worldwide, with an estimated 50-100 million cases (including approximately 500,000 cases of severe dengue) each year. About 2.5% of those with severe dengue (also known as dengue hemorrhagic fever) die. Four serotypes of dengue virus are transmitted to humans through the bite of *Aedes aegypti* and *Ae. albopictus* mosquitoes. The risk is widespread in tropical or subtropical regions around the world, especially where water-holding containers (e.g., waste tires, buckets, or cans) provide abundant mosquito breeding habitat.

In 2016, 29 dengue cases were reported in Minnesota residents. The median case age was 38 years (range, 14 to 68 years) and onset of symptoms occurred throughout the year from January through November. Twenty-six cases (90%) resided in the metropolitan area, and all infections were acquired abroad. Cases reported travel to many areas of the world, including to Southeast Asia (11), Mexico and Central America (9), Africa (7), and the Caribbean (2).

Escherichia coli O157:H7 and Other Shiga Toxin-producing *E. coli*, and Hemolytic Uremic Syndrome

During 2016, 122 culture-confirmed cases of *Escherichia coli* O157 infection (2.21 per 100,000 population) were reported. The number of cases represents a 10% decrease from the median number reported annually from 2006 to 2015 (median, 136 cases; range, 114 to 163). During 2016, 44 (36%) cases occurred in the metropolitan area. Eighty-six (70%) occurred during May through October. The median age of the cases was 18 years (range, 5 months to 87 years). Twenty-seven percent were 4 years of age or younger. Forty-one (33%) were hospitalized; the median hospital stay was 3 days (range, 1 to 42 days). No cases died.

In addition to the 122 culture-confirmed *E. coli* O157 cases, 204 cases of Shiga toxin-producing *E. coli* (STEC) infection were identified in 2016. Of those, culture-confirmation was not possible in 8, and therefore it is unknown if those were O157 or another serogroup. Among the remaining 196 cases with STEC other than O157, *E. coli* O103 accounted for 47 (24%) cases, *E. coli* O111 for 28 (14%), *E. coli* O26 for 27 (14%), *E. coli* O145 for 19 (10%), *E. coli* O121 for 18 (9%), and *E. coli* O45 for 5 (3%). The median age of the non-O157 STEC cases was 25 years (range, 4 months to 94 years). Forty (20%) cases were hospitalized; the median hospital stay was 2 days (range, 1 to 10 days). One case, an 87 year-old, died.

Culture-independent tests (CIDTs) have become increasingly adopted by clinical laboratories for the detection of Shiga toxin in stool. Eighty-four patient specimens that were positive by a CIDT conducted at a clinical laboratory were not subsequently culture-confirmed, and therefore did not meet the surveillance case definition for inclusion in MDH case count totals.

Six *E. coli* O157 outbreaks were identified during 2016. Four outbreaks were due to person-to-person transmission in childcare facilities, one outbreak involved foodborne transmission, and a transmission route could not be identified in one outbreak. The six outbreaks resulted in 38 illnesses. In January, an outbreak was associated with commercially distributed alfalfa sprouts. Seven cases, all laboratory-confirmed, were identified. The implicated product was recalled. A second outbreak with person-to-person transmission occurred at a childcare facility in Kanabec County. Four cases, one laboratory-confirmed, were identified. A third outbreak was associated with a festival at a middle school. The transmission route was not determined. Three cases, all laboratory-confirmed, were identified. A fourth outbreak with person-to-person transmission occurred at a childcare facility in Stearns County. Eight cases, all laboratory-confirmed, were identified. A fifth outbreak with person-to-person transmission occurred at a childcare facility in Lyon County. Ten cases, all laboratory-confirmed, were identified. Two cases developed hemolytic uremic syndrome. Lastly, an outbreak with person-to-person transmission occurred at a childcare facility in Rice County. Two cases, both laboratory-confirmed, were identified.

Two non-O157 STEC outbreaks were identified during 2016. One involved foodborne transmission and one was due to animal contact. An outbreak of *E. coli* O145 infections was associated with animal contact at an outreach center. Two cases, both laboratory-confirmed, were identified in Minnesota. A multistate outbreak of *E. coli* O121 and *E. coli* O26 infections was associated with flour. Seven cases, all laboratory-confirmed, were identified in Minnesota. The implicated product was recalled.

Hemolytic Uremic Syndrome (HUS)

In 2016, 14 HUS cases were reported. The number of reported cases is similar to the median number of cases reported annually from 2006 to 2015 (median, 14.5 cases; range, 10 to 22). In 2016, the median age of HUS cases was 4.2 years (range, 10 months to 13 years); 10 cases occurred in children <7 years of age. All 14 cases were hospitalized, with a median hospital stay of 17 days (range, 5 to 41 days). No cases died. From 1997 through 2016, the overall case fatality rate among HUS cases was 4.9%. Thirteen HUS cases reported in 2016 were post-diarrheal. *E. coli* O157:H7 was cultured from the stool of 11 (82%) cases, and *E. coli* O145 was cultured from the stool of one case. In 2016, there were 3 outbreak-associated HUS cases.

continued...

Giardiasis

During 2016, 655 cases of *Giardia* infection (11.9 per 100,000) were reported. This represents a 4% decrease from the median number of cases reported annually from 2006 through 2015 (median, 685 cases; range, 620 to 1,105). Recent immigrants and refugees continue to represent a substantial proportion of cases, accounting for 37% of all cases. An additional 12% of cases reported international travel in the 3 weeks prior to illness onset. Excluding recent immigrants and refugees, the median age of cases was 38 years (range, 6 months to 84 years). Fifteen percent were <10 years of age, and 33% were >50 years of age. Fifty-seven percent of non-immigrant and refugee cases were male. *Giardia* infections showed a summer/fall seasonality; 52% of non-immigrant and refugee cases occurred during July through October. Twenty-eight (4%) cases required hospitalization, for a median of 4 days (range, 1 to 14 days). One outbreak was identified that accounted for 2 laboratory-confirmed cases. The outbreak occurred among a group of campers who drank improperly treated surface water along a Lake Superior hiking trail.

Haemophilus influenzae

One hundred twenty-six invasive *Haemophilus influenzae* disease cases (2.3 per 100,000 population) were reported in 2016. Cases ranged in age from newborn to 97 years (median 70 years*).* Allowing for more than one syndrome per case, 52 (41%) cases had pneumonia; 30 (24%) had bacteremia without another focus; 15 (12%) had septic shock; 12 (10%) had meningitis; 4 (3%) had epiglottitis; 2 (2%) had peritonitis; 3 (2%) had abscess; 1 (1%) had a combination of meningitis, pneumonia, and otitis media; and 1 (1%) each had cholangitis, empyema, endometritis, endophthalmitis, pyelonephritis, septic abortion, and septic arthritis. Sixteen (13%) cases died.

Of 118 *H. influenzae* isolates for which typing was performed at PHL, 15 were type a, 17 type f, 5 type b, 4 type e, and 77 were untypeable. The 5 type b (Hib) disease cases compared to 2 cases in 2015, 1 in 2014, and 4 in 2013. Three were in children <4 years old, 2 were in adults; all survived. Two had meningitis, one had bacteremia without another focus of infection, one had bacteremia with septic shock, and one had a combination of meningitis and pneumonia. One of the three children, who was <3 months old had received 1 dose of vaccine, and the other two (ages 1 and 3 years) had not been vaccinated.

Thirty-five (30%) of the case-isolates were resistant to ampicillin and produced ß-lactamase, but all were susceptible to amoxicillin-clavulanate, which contains a ß-lactamase inhibitor. Two isolates showed intermediate resistance to ampicillin and did not produce ß-lactamase. Ten isolates showed non-susceptibility to 2 or more antibiotics. Of those, 3 showed non-susceptibility to 3 antibiotics.

The 16 deaths occurred in patients ranging in age from newborn to 92 years. Seven cases had pneumonia, 8 had bacteremia without another focus of infection (of these 2 also had septic shock), and 1 had meningitis. Fourteen cases had *H. influenzae* isolated from blood, 1 from CSF, and 1 from the heart. Co-morbidities were reported in 15 cases. Of the 16 cases that died, 13 case-isolates were untypeable, 1 was serotype a, and 2 isolates were not available for serotyping.

HIV Infection and AIDS

The incidence of HIV/AIDS in Minnesota remains moderately low. In 2015, state-specific HIV infection diagnosis rates ranged from 1.9 per 100,000 population in New Hampshire to 29.2 per 100,000 in Louisiana. Minnesota had the 17th lowest HIV infection rate (6.3 cases per 100,000 population). In 2015, state-specific AIDS diagnosis rates ranged from 1.2 per 100,000 persons in Wyoming to 13.5 per 100,000 population in Louisiana. Minnesota had the 14th lowest AIDS rate at 3.0 AIDS cases reported per 100,000 population).

As of December 31, 2016, a cumulative total of 11,309 cases of HIV infection (6,639 AIDS cases and 9,161 HIV [non-AIDS] cases) were reported among Minnesota residents. Of the 11,309 cases, 3,824 (34%) are known to have died. By the end of 2016, an estimated 8,554 persons with HIV/AIDS were assumed to be living in Minnesota.

The annual number of AIDS cases reported in Minnesota increased steadily from 1982 through the early 1990s, reaching a peak of 361 cases in 1992. Beginning in 1996, the annual number of new AIDS diagnoses and deaths declined sharply, primarily due to better antiretroviral therapies. In 2016, 131 new AIDS cases (Figure 4) and 67 deaths among persons living with HIV infection were reported.

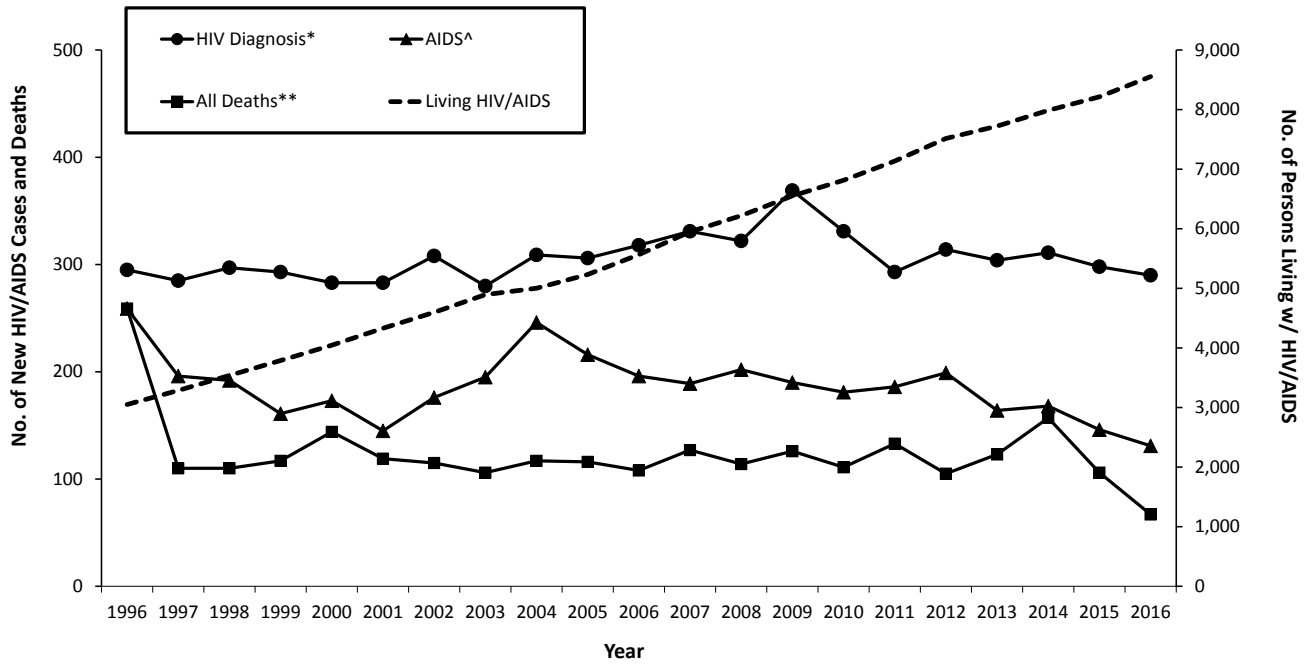
The number of HIV (non-AIDS) diagnoses has remained fairly constant over the past decade from 2006 through 2016, at approximately 269 cases per year. There was a peak of 280 newly diagnosed HIV (non-AIDS) cases in 2009, and 229 new HIV (non-AIDS) cases were reported in 2016.

In 2016, 82% (238/290) of new HIV diagnoses (both HIV [non-AIDS] and AIDS at first diagnosis) occurred in the metropolitan area. Regionally, there was a 41% increase in new HIV cases in Greater Minnesota, with 52 cases in 2016 compared to 37 cases in 2015. However, HIV or AIDS cases have been diagnosed in residents of more than 98% of counties statewide. HIV infection is most common in areas with higher population densities and greater poverty.

The majority of new HIV infections in Minnesota occur among males. Trends in the annual number of new HIV infections diagnosed among males differ by race/ethnicity. New infections occurred primarily among white males in the 1980s and early 1990s. Whites still comprise the largest number of HIV infections among males, but the proportion of cases that white males account for is decreasing. In 2016 there were 102 new infections among white males. During the past decade, the number of cases among black African American males has fluctuated from year to year, with 47 HIV diagnoses in 2016. This represents a 17% decrease among African American males from 2015 to 2016. Of note, cases among black, African-born men increased 65% from the previous year with 38 cases in 2016 compared to 23 cases in 2015. The number of HIV infections diagnosed among Hispanic males remained similar to the previous year with 23 in 2016 (21 in 2015).

Females account for an increasing percentage of new HIV infections, from 11% of new infections in 1990 to

Figure 4. HIV/AIDS in Minnesota:Number of New Cases, Prevalent Cases, and Deaths by Year, 1996-2016



* Includes all new cases of HIV infection (both HIV [non-AIDS] and AIDS at first diagnosis) diagnosed within a given calendar year.

** Deaths among HIV cases, regardless of cause.

^ Includes all new cases of AIDS diagnosed within a given calendar year, including AIDS at first diagnosis. This includes refugees in the HIV+ Resettlement Program, as well as other refugee/immigrants diagnosed with AIDS subsequent to their arrival in the United States.

22% in 2016. Trends in HIV infections diagnosed annually among females also differ by race/ethnicity. Early in the epidemic, whites accounted for the majority of newly diagnosed infections. Since 1991, the number of new infections among women of color has exceeded that of white women. Since 2005, the annual number of new infections diagnosed among black African American females has decreased slightly overall, although without a clear pattern from year to year. In 2016 there were 13 cases diagnosed among African American women, compared to 15 in 2015. In 2016 the number of new cases among black African-born women was 32, accounting for 49% of all new diagnoses among women. The annual number of new infections diagnosed among Hispanic, American Indian, and Asian females is small, with 10 or fewer cases annually in each group.

Despite relatively small numbers of cases, persons of color are disproportionately affected by HIV/AIDS in Minnesota. In 2016, men of color comprised approximately 17% of the male population in Minnesota and 55% of new HIV diagnoses among men. Similarly, persons of color comprised approximately 13% of the female population and 74% of new HIV infections among women. It bears noting that race is not considered a biological cause of disparities in the occurrence of HIV, but instead race can be used as a proxy for other risk factors, including lower socioeconomic status and education.

A population of concern for HIV infection is adolescents and young adults (13-24 years). The number of new HIV infections among males in this age group has remained higher than new diagnoses among females since 1999, with 53 cases reported in 2016. Since 2005, the number of cases among young males has increased by about 77%. The number of new HIV infections among adolescent females has remained relatively consistent over time; in 2016 there were 14 cases. From 2014 to 2016, the majority (63%) of new infections among male adolescents and young adults were among youth of color (99/154), with young black African American males accounting for 57% of cases among young males of color. During the same time period, young women of color accounted for 79% (27/34) of the cases diagnosed, with young black African-born women accounting for 52% of cases among young women of color. Between 2014 and 2016 after re-distributing those with unspecified risk, 87% (137/157) of new cases among young males were attributed to male-to-male sex. Among young females, 88% (31/34) of new cases were attributed to heterosexual sex.

Since the beginning of the epidemic, male-to-male sex has been the predominant mode of exposure to HIV reported in Minnesota, although the number and proportion of new HIV infections attributed to men who have sex with men (MSM) has declined since 1991. In 1991, 70% (318/455) of new HIV diagnoses were attributed to MSM (or MSM who also inject drugs); in 2016, this group accounted for 63% of new diagnoses (141/225).

The number and percentage of HIV infections in Minnesota attributed to injection drug use (IDU) has declined over the past decade, falling from 12% (54/455) of cases in 1991 to 10% (27/290) in 2016. Heterosexual contact with a partner who has or is

continued...

at increased risk of HIV infection is the predominant mode of exposure to HIV for women. In 2016, 80% of 65 new HIV diagnoses among women is attributed to heterosexual exposure.

Historically, race/ethnicity data for HIV/ AIDS in Minnesota have grouped non-African born blacks and black African-born persons together as "black." In 2001, we began analyzing these groups separately, and a marked trend of increasing numbers of new HIV infections among black African-born persons was observed. In 2016, there were 70 new HIV infections reported among black Africans. While black African-born persons comprise less than 1% of the state's population, they accounted for 24% of all HIV infections diagnosed in Minnesota in 2016.

HIV perinatal transmission in the United States decreased 90% since the early 1990s. The trend in Minnesota has been similar. While the number of births to HIV-infected women increased nearly 7-fold between 1990 and 2016, the rate of perinatal transmission decreased 11-fold, from 15% in 1994-1996 to 1.7% over the last 3 years (2014-2016) with no HIV-positive births from HIV-infected mothers in Minnesota in 2016.

Influenza

Several influenza surveillance methods are employed. Data are summarized by influenza season (generally October-April) rather than calendar year.

Hospitalized Cases

Surveillance for pediatric (<18 years of age) laboratory-confirmed hospitalized influenza cases in the metropolitan area was established during the 2003-2004 influenza season and expanded statewide for the 2008-2009 season. Since the 2013-2014 season, clinicians are encouraged to collect a throat or nasopharyngeal swab, or other specimen from patients of all ages admitted to a hospital with suspect influenza, and submit the specimen to the PHL for influenza testing. For the 2014-2015 season, influenza B subtyping was added by the PHL.

During the 2016-2017 influenza season (October 1, 2016 – April 30, 2017), 3,892 laboratory-confirmed hospitalized cases (70.9 cases per 100,000 persons compared to 27.5 cases per 100,000 in 2015-2016) were reported. Of those 2,253 (58%) were from the metropolitan area. Cases included 2,631 influenza A (23 A[H1N1] pdm09, 1,152 H3, and 1,456 unknown A type), 1,232 influenza B (600 of Yamagata lineage and 36 of Victoria lineage), 5 positive for both influenza A and B, and 24 of unknown influenza types. Among the cases, 8% were ≤18, 10% were 19-49, 17% were 50-64, and 65% were ≥65 years of age. Median age was 73 years. Residents of the metropolitan area made up 58% of cases.

Deaths

There were 2 pediatric influenza-associated deaths (both were H3).

Laboratory Data

The Minnesota Laboratory System (MLS) Laboratory Influenza Surveillance Program is made up of more than 110 clinic- and hospital-based laboratories, voluntarily submitting testing data on a weekly basis. These laboratories perform rapid testing for influenza and respiratory syncytial virus (RSV). Significantly fewer laboratories perform viral culture testing (for influenza, RSV, and other respiratory viruses. Nine laboratories perform PCR testing for influenza, and three also perform PCR testing for other respiratory viruses. The PHL also provides further characterization of submitted influenza isolates to determine the hemagglutinin serotype to indicate vaccine coverage. Tracking laboratory results assists healthcare providers with patient diagnosis of influenza-like illness (ILI) and provides an indicator of the progression of the influenza season as well as prevalence of disease in the community. Between October 2, 2016 - May 20, 2017, laboratories reported data on 31,546 influenza PCR tests, 4,176 (13%) of which were positive for influenza. Of these, 312 (7%) were positive for influenza A/(H3), 33 (<1%) were positive for influenza A(H1N1) pdm09, 2,043 (49%) were positive for influenza A-not subtyped, and 1,788 (43%) were positive for influenza B.

Sentinel Surveillance

We conduct sentinel surveillance for ILI (fever >100° F, and cough, and/or sore throat in the absence of known cause other than influenza) through outpatient medical providers including those in private practice, public health clinics, urgent care centers, emergency rooms, and university student health centers. There are 26 sites in 22 counties. Participating providers report the total number of patient visits each week and number of patient visits for ILI by age group (0-4 years, 5-24 years, 25-64 years, ≥65 years). Percentage of ILI peaked during the week of February 19-25 at 5.7%.

Influenza Incidence Surveillance

MDH was one of eight nationwide sites to participate in an Influenza Incidence Surveillance Project for the 2016-2017 influenza season. Five clinic sites reported the number of ILI patients and acute respiratory illness (ARI; recent onset of at least two of the following: rhinorrhea, sore throat, cough, or fever) patients divided by the total patients seen by the following age groups: <1 year, 1-4 years, 5-17 years, 18-24 years, 25-64 years, and ≥65 years, each week. Clinical specimens were collected on the first 10 patients with ILI and the first 10 patients with ARI for PCR testing at the PHL for influenza and 13 other respiratory pathogens. Minimal demographic information and clinical data were provided with each specimen.

From July 24 2016 – June 20, 2017, these clinics saw 1,700 ILI and 6,891 ARI patients. They submitted 785 specimens for influenza and respiratory pathogen testing; 216 (28%) were positive for influenza. Of those, 150 (69%) were positive for influenza A/(H3), 1 (<1%) was positive for influenza A(H1N1)pdm09, 3 (1%)were positive for influenza A-type unspecified, 44 (20%) were positive for influenza B/Yamagata lineage, and 17 (8%) were positive for influenza B/Victoria lineage. In addition to influenza A and B, the following pathogens were detected by PCR: 1 (<1%) was positive for influenza C, 15 (2%) adenovirus, 16 (2%) human metapneumovirus, 27 (3%) respiratory syncytial virus, 105 (13%) rhinovirus, 3 (<1%) enterovirus, 6 (1%) parainfluenza virus 2, 10 (1%) parainfluenza virus 3, 28 (4%) coronavirus 229E, 10 (1%) coronavirus OC43, 3 (<1%) coronavirus NL63, and 17 (2%) coronavirus HKU1 (note: these coronaviruses are not SARS-virus or MERS-CoV).

ILI Outbreaks (Schools and Long-Term Care Facilities)

Since 2009, schools reported outbreaks when the number of students absent with ILI reached 5% of total enrollment, or when three or more students with ILI are absent from

the same elementary classroom. Three hundred ninety-one schools in 66 counties reported ILI outbreaks during the 2016-2017 school year. The number of schools reporting ILI outbreaks since the 2009-2010 school year ranged from a low of 92 in 2013-2014 to a high of 1,302 in 2009-2010.

An influenza outbreak is suspected in a long-term care facility (LTCF) when two or more residents in a facility develop symptoms consistent with influenza during a 48- to 72-hour period. An influenza outbreak is confirmed when at least one resident has a positive culture, PCR, or rapid antigen test for influenza and there are other cases of respiratory illness in the same unit. One hundred eighty-two facilities in 61 counties reported confirmed outbreaks during the 2016-2017 influenza season. The number of LTCFs reporting outbreaks ranged from a low of three in 2008-2009 to a high of 209 in 2012-2013.

Legionnaires' Disease

During 2016, 115 confirmed cases of Legionnaires' disease (2.1 per 100,000 population) were reported. This was the highest number of cases ever reported in Minnesota and represented a 125% increase over the median number of cases (51) reported over the previous 5 years (range, 31 to 58 cases). The criteria for confirmation of a case are a clinically compatible illness and at least one of the following: 1) isolation of any *Legionella* organism from respiratory secretions, lung tissue, pleural fluid, or other normally sterile fluid by culture, or 2) detection of *L. pneumophila* serogroup 1 antigen in urine using validated reagents, or 3) seroconversion of fourfold or greater rise in specific serum antibody titer to *L. pneumophila* serogroup 1 using validated reagents. A single antibody titer of any level is not considered diagnostic. Patients positive by PCR only are classified as suspect cases; in 2016, there were 8 suspect cases.

All 115 had pneumonia, and 105 (91%) were hospitalized, with a median duration of hospitalization of 6 days (range, 1 to 39 days). Of those hospitalized, 40 (38%) were admitted to an intensive care unit and 23 (22%) required mechanical ventilation. Six (5%) cases died. Seventy-two (63%) cases were male. Older adults were more often affected, with 94 (82%) cases occurring among individuals ≥50 years (overall median age, 60 years; range, 23 to 97 years). Eighty-one (70%) cases had onset dates in June through September. Seventy-two (63%) cases were residents of the metropolitan area and 43 (37%) were residents of Greater Minnesota.

Twenty-three (20%) of the 115 cases, plus one resident of another state, were associated with a community outbreak traced to *Legionella*-contaminated aerosols from a business cooling tower. One case was linked to an outbreak associated with an improperly maintained hotel spa; the other illnesses in that outbreak fit the profile for Pontiac fever, a milder form of legionellosis than Legionnaires' disease. One case was linked to a cluster of 4 cases diagnosed over 5 years among workers at a manufacturing facility where water mist exposures occurred. Two cases were linked to hotel-associated outbreaks in other states. The remaining 88 cases (77%) were epidemiologically classified as sporadic. Of the 75 sporadic cases for whom information was available, 13 (17%) had traveled out of state, and 4 (5%) had traveled out of the country during the 10 days prior to illness onset.

The Infectious Diseases Society of America and the American Thoracic Society, in consensus guidelines on the management of community-acquired pneumonia in adults, recommend urinary antigen assay and culture of respiratory secretions on selective media for detection of legionellosis. Culture is particularly useful for public health because environmental and clinical isolates can be compared by molecular typing in outbreak investigations.

Listeriosis

Eight listeriosis cases were reported during 2016. All were hospitalized, and 1 died. The median age of cases was 67 years (range, 51 to 90 years). Seven had *Listeria monocytogenes* isolates from blood and 1 from a knee aspirate. No pregnancy-associated cases were identified. The 8 cases are similar to the median number of cases reported from 1996 through 2015 (median, 7 cases; range, 3 to 19). The overall case fatality rate for listeriosis in Minnesota from 1998 through 2016 was 18%. In 2016, 1 case was part of a multi-state outbreak of 8 cases in seven states likely associated with commercially distributed hummus produced at a Virginia facility.

Lyme Disease

Lyme disease is caused by *B. burgdorferi*, a spirochete transmitted to humans by bites from *Ixodes scapularis* (the blacklegged tick or deer tick). Recently, a new species of bacteria, *B. mayonii*, has also been identified as a cause of human disease. In Minnesota, the same tick vector also transmits the agents of babesiosis, human anaplasmosis, one form of human ehrlichiosis, and a strain of Powassan virus.

In 2016, 1,305 confirmed Lyme disease cases (23.78 cases per 100,000 population) were reported. In addition, 821 probable cases (physician-diagnosed cases that did not meet clinical evidence criteria for a confirmed case but that had laboratory evidence of infection) were reported. Despite some yearly fluctuations, the number of reported cases of Lyme disease has been increasing, as evidenced by the median number of cases from 2006 through 2016 (median, 1,176; range, 896 to 1,431) compared to the median from 1996 to 2005 (median, 464; range, 252 to 1,023) (Figure 1).

Eight hundred one (62%) confirmed cases in 2016 were male. The median age of cases was 49 years (range, 1 to 100 years). Physician-diagnosed erythema migrans (EM) was present in 973 (75%) cases. Four hundred one (31%) cases had one or more late manifestations of Lyme disease (including 262 with a history of objective joint swelling, 115 with cranial neuritis including Bell's Palsy, 21 with acute onset of 2nd or 3rd degree atrioventricular conduction defects, 9 with lymphocytic meningitis, and 4 with radiculoneuropathy) and confirmation by Western immunoblot (positive IgM ≤30 days post-onset or positive IgG). Of the 1,200 cases with known onset dates, onset of symptoms peaked from June through August, with 61% of EM cases experiencing symptom onset in June or July. This timing corresponds with peak activity of nymphal *I. scapularis* ticks in mid-May through mid-July. The majority of cases either resided in or traveled to endemic counties in north-central, east-central, or southeast Minnesota, or Wisconsin.

continued...

Malaria

Malaria is a febrile illness caused by several protozoan species in the genus *Plasmodium*. The parasite is transmitted to humans by bites from infected *Anopheles* genus mosquitoes. The risk of malaria is highest in the tropical and sub-tropical regions of the world. Although local transmission of malaria frequently occurred in Minnesota over 100 years ago, all of the cases reported in Minnesota residents in recent years have been imported infections acquired abroad.

In 2016, 66 malaria cases (1.2 per 100,000 population) were reported. Fifty-two (79%) cases were identified with *P. falciparum*, 5 (8%) with *P. vivax*, 4 (6%) with *P. ovale*, 4 (6%) with *P. malariae,* and 1 (2%) with mixed *Plasmodium* species infection. The median age of cases was 33 years (range, 1 to 80 years). Of the 58 cases with known race, 51 (77%) were black, 4 (6%) were white, 1 (2%) was Asian, and 1 (2%) was American Indian or Alaskan Native. Sixty-three cases were Minnesota residents at the time of their illness, 55 (87%) of which
resided in the metropolitan area. Three patients were residents of a country other than the United States. Of the 58 cases with known country of birth, 5 (9%) were born in the United States. Sixty-one (92%) cases in 2016 likely acquired malaria in Africa, and 3 (5%) cases were likely acquired in Asia. Exposure information was not available for 2 cases.
Eighteen countries were considered possible exposure locations for malaria infections, including Liberia (19), Nigeria (9), Cameroon (6), Ethiopia (5), and Sierra Leone (5), as well as several other countries in sub-Saharan Africa.

Measles

In 2016, 2 measles cases were reported. Both were Hennepin County residents. One was a black, non-Hispanic 6 year-old. The case and her family had recently returned from Somalia. The other was a 7 year-old sibling of the first case. The first case was unvaccinated and the second case had received 1 dose of measles-containing vaccine. The two siblings had rash onsets within 2 days of each other and were both hospitalized and recovered without complications.
Both siblings were exposed to their 2 year-old unvaccinated sibling who had been diagnosed with measles in Somalia. Both cases were confirmed by PCR at the PHL.

Meningococcal Disease

Five *Neisseria meningitidis* (NM) invasive disease cases (0.09 per 100,000 population) were reported in 2016; 7 cases were reported in 2015. Two were serogroup C, 2 were serogroup Y, and 1 case was serogroup B. All cases were sporadic.

Cases ranged in age from 12 years to 89 years. Three of the 5 occurred in the metropolitan area, while in 2015, 5 of the 7 cases occurred in Greater Minnesota area. Two cases had meningitis, 2 had bacteremia without another focus of infection, and 1 had pneumonia. There were no deaths.

One case-isolate demonstrated intermediate resistance to both ampicillin and penicillin. No isolate had ciprofloxacin resistance.

Incidence of invasive NM was fairly stable at about 0.30 cases per 100,000 persons since 2005 (with the exception of 2008 when incidence increased to 0.57 cases per 100,000 persons); however, invasive NM has decreased since 2011. Quadrivalent MenACWY is recommended at 11-12 years with a necessary booster at age 16. Vaccination rates for at least 1 dose among 13-17 year old Minnesota adolescents have increased from 39% percent in 2008 to 84% percent in 2015 (National Immunization Survey Teen, CDC at https://www.cdc.gov/vaccines/vaxview/index.html).

In Minnesota, from 2011-2016 the proportion of invasive NM cases that were serogroup B was 53% compared to the prior 6 years (2005-2010) when 36% of cases were serogroup B. Two menB vaccines are available; clinicians should vaccinate patients 10 years of age and older with specific risk factors, and discuss MenB vaccine with patients who are 16-23 years old.

Mumps

In 2016, 24 mumps cases were reported. Seventeen (71%) were classified as confirmed (tested positive by PCR), and 8 as probable (tested positive by IgM serology or were linked to another case or outbreak). Of the confirmed cases, 15 (88%) were genotyped as G which is the dominant genotype circulating in the United States for the past 10 years.

Sixteen (66%) cases were acquired in Minnesota and were not linked to outbreaks occurring elsewhere. Four cases were household contacts of a confirmed case, and 4 acquired mumps from international or domestic travel. Cases ranged in age from 16 to 53 years. Fourteen (58%) cases reported a history of receiving at least 1 dose of mumps-containing vaccine but had no documentation of those doses. Four had a documented history of 2 doses of mumps-containing vaccine; 3 cases had a documented history of 1 dose. Three reported unknown vaccination status. No case reported a previous history of mumps disease.

There was an increase in reported cases nationally in 2016, with many cases occurring in neighboring Midwestern states. The majority of Minnesota cases were indigenously acquired indicating that mumps cases are being underreported. Up to 30% of mumps infections are asymptomatic, and an additional 40-50% may have only nonspecific or primarily respiratory symptoms, making surveillance challenging. Apart from the 4 cases who acquired mumps from a close contact, no documented transmission or sustained outbreaks occurred within Minnesota.

Neonatal Sepsis

Statewide surveillance for neonatal sepsis includes reporting of any bacteria (other than coagulase-negative *Staphylococcus*) isolated from a sterile site in an infant <7 days of age, and mandatory submission of isolates. In 2016, 59 cases (0.85 cases per 1,000 live births) were reported compared to 58 cases in 2015. All were identified via blood or cerebrospinal fluid (CSF). Most cases (90%) were culture-positive within the first 2 days of life. Group B *Streptococcus* was most common (21) followed by *Escherichia coli* (17), *Streptococcus viridians* (7), *Enterococcus* spp. (6), *Staphylococcus aureus (3),* other *Streptococcus* spp. (2), and 1 each of *Haemophilus influenzae*, *Pseudomonas aeruginosa*, and *Klebsiella* spp.

Pertussis

In 2016, 1,015 pertussis cases (18 per 100,000 population) were reported. Laboratory confirmation was available for 770 (76%) cases, 13 (2%) of which were confirmed by culture and 757 (98%) of which were confirmed by PCR. In addition, 97 (10%) cases met the clinical case definition and were epidemiologically linked to laboratory confirmed cases, and 148 (15%) met the clinical case definition only. Five hundred twenty (51%) of the reported cases occurred in residents of the metropolitan area.

Paroxysmal coughing was the most commonly reported symptom, which 896 (88%) cases experienced. Approximately one fourth (270) reported whooping. Although commonly referred to as "whooping cough," very young children, older individuals, and persons previously immunized may not have the typical "whoop". Post-tussive vomiting was reported in 419 (41%) cases. Infants and young children are at the highest risk for severe disease and complications. Pneumonia was diagnosed in 26 (3%) cases, only 2 of which were in an infant; 9 (35%) were 2 to 16 years old, 11 (42%) were 20 to 88 years old. Twenty-three (2%) cases were hospitalized; 4 (17%) hospitalized patients were <6 months of age. No deaths occurred.

Pertussis is increasingly recognized in older children and adults. During 2016, cases ranged in age from <1 month to 88 years. Three hundred thirty-three (33%) cases occurred in adolescents 13-17 years, 290 (29%) in children 5-12 years, 240 (24%) in adults ≥18 years, 136 (13%) in children 6 months through 4 years, and 16 (2%) in infants <6 months of age. The median age of cases was 14 years. Infection in older children and adults may result in exposure of unprotected infants. During 2016, 45 cases were in infants <1 year of age. A likely source of exposure was identified for 19 of those cases; 5 were infected by adults ≥18 years, 5 by an adolescent 13-17 years, 8 by a child <13 years, and 1 case-exposure's age was unknown. Twenty-six infant cases had no identified source of infection. ACIP recommends vaccination of women at ≥20 weeks gestation during each pregnancy in an effort to protect young infants. Ensuring up-to-date vaccination of children, adolescents, and adults, especially those in contact with young children is also important. Vaccinating adolescents and adults with Tdap will decrease the incidence of pertussis in the community and thereby minimize infant exposures.

Although unvaccinated children are at highest risk for pertussis, fully immunized children may also develop disease, particularly as the number of years since vaccination increase. Disease in those previously immunized is usually mild. Efficacy for currently licensed DTaP vaccines is estimated to be 71-84% in preventing typical disease within the first 3 years of completing the series. Waning immunity sharply increases at 7 years of age, and most are susceptible by 11-12 years of age when Tdap booster is recommended. Recent studies suggest that immunity wanes sharply 2 years from receipt of Tdap. Of the 179 (18%) cases who were 7 months to 6 years of age, 120 (67%) were known to have received at least a primary series of 3 doses of DTP/ DTaP vaccine prior to onset of illness; 59 (33%) received fewer than 3 doses and were considered preventable cases.

Reporting rules require clinical isolates of *Bordetella pertussis* be submitted to the PHL in order to track changes in circulating strains. Isolates for all 26 culture-confirmed cases were received and sub-typed, with 5 distinct PFGE patterns identified. Nationally, isolates have had low minimum inhibitory concentrations (falling within the reference range for susceptibility) to erythromycin and azithromycin. Only 11 erythromycin-resistant *B. pertussis* cases have been identified in the United States.

Laboratory tests should be performed on all suspected cases. Culture of *B. pertussis* requires inoculation of a specimen of nasopharyngeal mucus on special media and incubation for 7 to 10 days. However, *B. pertussis* is rarely identified late in the illness; therefore, a negative culture does not rule out disease. A positive PCR result is considered confirmatory in patients with a 2-week history of cough illness. PCR can detect non-viable organisms. Consequently, a positive PCR result does not necessarily indicate current infectiousness. Patients with a 3-week or longer history of cough illness, regardless of PCR result, may not benefit from antibiotic therapy. Whenever possible, culture should be done in conjunction with PCR testing. Serological tests may be useful for those with coughs >2 weeks.

Pertussis remains endemic despite an effective vaccine and high coverage rates with the primary series. Reported incidence of pertussis has consistently increased over the past 10 years, particularly in middle school-aged children, adolescents, and adults.

Q Fever

Q fever is an acute or chronic illness caused by the bacterium *Coxiella burnettii*. Cattle, sheep, and goats are the primary sources of human infection. Transmission can occur through contact with infected animal tissue, inhalation of aerosolized bacteria, ingestion of unpasteurized dairy products, and tick bites.

In 2016, 2 confirmed cases were reported, 1 acute and 1 chronic. The acute Q fever case was a 58 year-old who was most likely exposed through a tick bite; the chronic case was a 67 year-old who was most likely exposed 2 years prior by drinking unpasteurized goat milk. Both cases were hospitalized, for 3 and 8 days, respectively, and both cases survived.

From 1997 to 2016, 20 confirmed acute cases and 5 confirmed chronic cases of Q fever were reported. The median age of acute cases was 58 years (range, 11 to 76 years); the median age of chronic cases was 40 years (range, 23 to 75 years). Seven (78%) cases for which both race and ethnicity were known were white, non-Hispanic, 1 (11%) was black, non-Hispanic, and 1 (11%) was mixed race, non-Hispanic. During this time, 13 (68%) of the 19 cases for whom exposure information was available, were likely exposed through direct or indirect contact with infected animals, 3 (16%) were likely exposed through ingestion of unpasteurized dairy products, and 3 (16%) through a tick bite. Five (42%) of the 13 cases with known occupations were employed in an agriculture-related occupation.

continued...

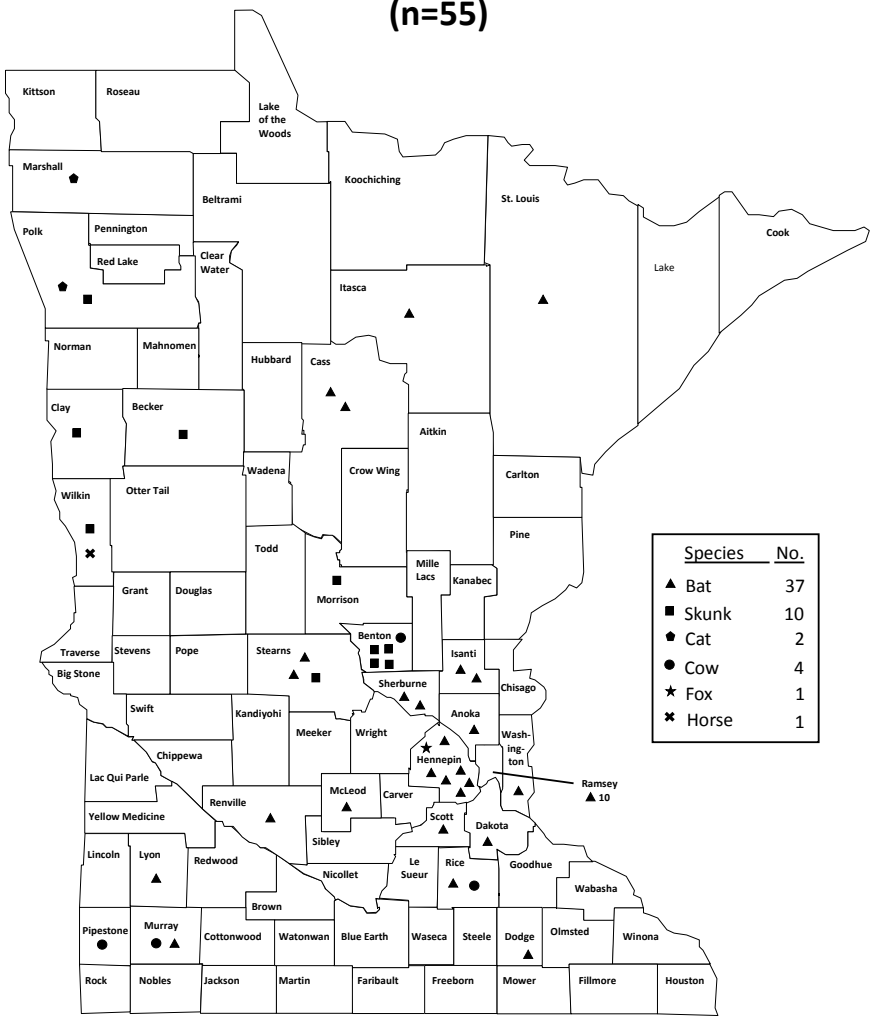
Rabies

In Minnesota, the animal reservoirs for rabies are skunks and multiple bat species. Dogs, cats, and livestock are generally exposed to rabies through encounters with skunks. Vaccinating these domestic animals for rabies provides a buffer between wildlife and people.

In 2016, 55 (2.6%) of 2,085 animals tested were positive for rabies. This is a nearly two-fold increase from 2014 (33 [1.4%]) and 2015 (28 [1.4%]) and more consistent with the number of positives seen from 2008 to 2013. The majority of positive animals in 2016 were bats (37/55 [67%]), followed by skunks (10/55 [18%]), cattle (4/55 [7%]), cats (2/55 [4%]), horses (1/55 [2%]), and foxes (1/55 [2%]) (Figure 5). There were no human cases of rabies.

From 2003 to 2016, 798 (2.4%) of 33,278 animals tested were positive for rabies. The median number of rabies positive animals identified annually was 57 (range, 28 to 94). From 2003 to 2016, 310/672 (46%) skunks, 55/795 (7%) cattle, 344/9,476 (3.6%) bats, 8/308 (2.6%) horses, 45/10,133 (0.4%) cats, 28/9,215 (0.3%) dogs, 0/1,054 (0%) raccoons, and 9/1,623 (0.6%) other animals (fox [4], goat [2], woodchuck, bison, deer) tested positive for rabies. Rabies in raccoons is rare in Minnesota. The last raccoon that tested positive for rabies was 24 years ago, and 1,054 raccoons have been tested from 2003 to 2016 with none positive for rabies. This is in contrast to the eastern United States, where raccoons are the most common source of terrestrial rabies.

Figure 5. Rabid Animals by County Minnesota, 2016 (n=55)



* Placement of symbol in county does not represent exact geographical location of the case.

Salmonellosis

In 2016, 861 *Salmonella* cases (15.7 per 100,000 population) were reported. This is a 19% increase from the median annual number of cases reported from 2006 to 2015 (median, 724 cases; range, 578 to 975), but a 12% decrease from the 975 cases reported in 2015.

Of the 98 serotypes identified in 2016, 5 serotypes, *S.* Enteritidis (206), *S.* I 4,[5],12:i:- (100), *S.* Typhimurium (84), *S.* Newport (64), and *S.* Infantis (50) accounted for 59% of cases. *Salmonella* was isolated from stool in 743 (86%), urine in 60 (7%), and blood in 51 (6%) cases. Other specimen sources included wound (3), bone, sputum, nasal swab, and sinus.

Two hundred eleven (25%) cases were hospitalized; the median length of hospital stay was 4 days (range, 1 to 36 days). Two culture-confirmed *Salmonella* cases died; a 52 year-old who died of complications from cardiopulmonary arrest with cardiomegaly (*Salmonella* sp. was isolated from a sputum specimen); and a 65 year-old who died of respiratory failure, urosepsis, and metastatic prostate cancer (*S. Mbandaka* was isolated from a urine specimen).

Of the 769 cases with known travel history, 155 (18%) had travelled internationally during the week prior to their illness onset. There were 11 *S.* Typhi cases; 3 had traveled to or emigrated from India, 1 to India and several European countries, 1 to Kenya, 1 to Bangladesh, 1 to the United Kingdom, 1 to multiple countries in Asia, and 3 did not report any travel. There was 1 *S.* Paratyphi B case who traveled to Ecuador.

In 2015, culture-independent tests (CIDTs) became commercially available for the detection of *Salmonella* nucleic acid in stool. In 2016, 34 patient specimens that were positive by a culture-independent test conducted at a clinical laboratory were not subsequently culture-confirmed, and therefore did not meet the surveillance case definition for inclusion in MDH case count totals.

Seventy-five cases were part of 14 *Salmonella* outbreaks in 2016, including 3 cases that were part of two national outbreaks with no

exposures in Minnesota. During January through September, 1 culture-confirmed *S.* Newport case, 1 culture-confirmed *S.* Enteritidis case, and 12 probable cases were part of an outbreak of *Campylobacter* and *Salmonella* infections among contractors working in a chicken processing plant. Multiple high-risk environmental exposures were identified among cases. One *S.* Montevideo case was part of a multi-state outbreak of *S.* Montevideo and *S.* Senftenberg infections in nine states that was associated with pistachios. The outbreak strain of both serotypes was found in samples of raw pistachios at the farm. In March, 2 *S.* Oslo cases were part of a multi-state outbreak of 14 cases in eight states that was associated with Persian cucumbers. Six culture-confirmed cases and 1 probable case of *S.* Enteritidis infection were part of a multi-state outbreak that included 1 additional case in Virginia. The outbreak was associated with a pre-packaged leafy greens mixture of kale, spinach, chard, and carrots. Two culture-confirmed and 2 probable cases of *S.* Typhimurium infection were associated with exposure to *Salmonella* in a commercial microbiology laboratory. One culture-confirmed and 1 probable case were secondary household contacts of the 2 primary cases. During April through July, 32 salmonellosis cases were part of multi-state outbreaks of 895 cases in 48 states associated with live poultry. The Minnesota cases had serotypes *S.* Infantis (17), *S.* Enteritidis (8), *S.* Hadar (3), *S.* Indiana (3), and *S.* Ohio (1). This was the largest number of illnesses linked to contact with backyard poultry ever recorded nationally. Ten *S.* Anatum cases were part of an outbreak of 32 cases in nine states associated with consumption of jalapeno peppers from a common consolidator/grower. During May through July, 7 culture-confirmed and 2 probable cases of *S.* I 4,[5],12:i:- infection were associated with sushi restaurants. Traceback of suspected ingredients did not identify a common source. In June, 1 *S.* Reading case was associated with a multi-state outbreak of 36 cases of *S.* Reading and *S.* Abony infection in nine states. Alfalfa sprouts from a Colorado sprouter was the implicated vehicle; the Minnesota case was exposed in Colorado. Two *S.* Heidelberg cases from different households were associated with direct or indirect contact with one black roughneck monitor lizard, which was fed frozen chicks. During August through December, 2 culture-confirmed and 4 probable cases of *S.* Uganda infection were identified among workers at a turkey hatchery. Four culture-confirmed cases and 1 probable case of *S.* Infantis infection were linked to a Mexican-style restaurant. The vehicle was not identified. In August, 2 *S.* Enteritidis cases in Minnesota residents were part of a restaurant outbreak in Missouri. The vehicle was eggs from a local farmer. In November and December, 2 *S.* Typhimurium cases were associated with contact with hedgehogs purchased froman online private seller.

Severe Acute Respiratory Illness

In 2013, Minnesota established surveillance for severe acute respiratory illness (SARI) in hospitalized patients at three metropolitan area hospitals. Residual respiratory specimens from patients are submitted to the PHL for testing for 20 respiratory pathogens (16 viral, 4 bacterial) and medical records are reviewed.

In 2016, 3,500 patient specimens were received. Children <2 years accounted for 51% of submitted specimens (1,789), and 62% of all specimens came from children <18 years old (2,901). Adults aged 18-44, 45-64, and ≥65 years accounted for 9% (310), 15% (513), and 15% (508) of submitted specimens, respectively. Median patient age was 5 years (range 0-103 years). Of tested specimens, 1,863 (53%) were positive for at least one pathogen; 429 (12%) had ≥2 pathogens detected. Rhinovirus/enterovirus (832, 24%), respiratory syncytial virus (503, 14%), adenovirus (211, 6%), parainfluenzaviruses 1-4 (187, 5%), human metapneumovirus (201, 6%), and influenzas A, B, and C (180, 5%) were the most commonly detected pathogens.

Sexually Transmitted Diseases (STDs)

Surveillance for gonorrhea and chlamydia in Minnesota are monitored through a mostly passive surveillance system involving review of submitted case reports and laboratory reports. Syphilis is monitored through active surveillance, which involves immediate follow-up with the clinician upon receipt of a positive laboratory report. Although overall incidence rates for STDs in Minnesota are lower than those in many other areas of the United States, certain population subgroups in Minnesota have very high STD rates. Specifically, STDs disproportionately affect adolescents, young adults, and persons of color.

Chlamydia

Chlamydia trachomatis infection is the most commonly reported infectious disease in Minnesota. In 2016, 22,675 chlamydia cases (428 per 100,000 population) were reported, representing a 7% increase from 2015 (Table 3).

Adolescents and young adults are at highest risk for acquiring a chlamydia infection (Table 4). The chlamydia rate is highest among 20 to 24-year-olds (2,391 per 100,000), followed by the 15 to 19-year-old age group (1,617 per 100,000). The incidence of chlamydia among adults 25 to 29 years of age (1,102 per 100,000) is considerably lower but has increased in recent years. The chlamydia rate among females (560 per 100,000) is more than twice the rate among males (293 per 100,000), a difference most likely due to more frequent screening among females.

The incidence of chlamydia infection is highest in communities of color (Table 4). The rate among blacks (1,825 per 100,000) is 9 times higher than the rate among whites (193 per 100,000*).* Although blacks comprise approximately 5% of Minnesota's population, they account for 22% of reported chlamydia cases. Rates among Asian/Pacific Islanders (342 per 100,000), Hispanics (522 per 100,000), and American Indians (943 per 100,000) are over 2 to 4 times higher than the rate among whites.

Chlamydia infections occur throughout the state, with the highest reported rates in Minneapolis (1,196 per 100,000) and St. Paul (912 per 100,000). While there was an overall increase of 7% across the state in 2016, the greatest increase for chlamydia was seen in Greater Minnesota. This area displayed an increase of 11%, as shown in Table 4. Every county in Minnesota had at least 2 cases in 2016.

continued...

Table 3. Number of Cases and Rates (per 100,000 Persons) of Chlamydia, Gonorrhea, and Syphilis, 2012-2016

	2012		2013		2014		2015		2016	
Disease	**No.**	**Rate**	**No.**	**Rate**	**No.**	**Rate**	**No.**	**Rate**	**No.**	**Rate**
Chlamydia	18,048	340	18,724	353	19,897	375	21,238	400	22,675	428
Gonorrhea	3,082	58	3,872	73	4,073	77	4,097	77	5,104	96
Syphilis, Total	335	6.3	537	10.1	629	11.9	654	12.3	852	16.1
Primary/Secondary	118	2.2	193	3.6	257	4.8	246	4.6	306	5.8
Early latent	96	1.8	139	2.6	159	3.0	185	3.5	251	4.7
Late latent	120	2.3	205	3.9	213	4.0	220	4.1	289	5.4
Other*	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Congenital**	1	1.5	0	0.0	0	0.0	3	4.3	6	8.7

* Includes unstaged neurosyphilis, latent syphilis of unknown duration, and late syphilis with clinical manifestations.
** Congenital syphilis rate per 100,000 live births.
Note: Data exclude cases diagnosed in federal or private correctional facilities.

Gonorrhea
Gonorrhea is the second most commonly reported STD in Minnesota. In 2016, 5,104 cases (96 per 100,000 population) were reported. This is the highest reported rate of gonorrhea in the last decade (Table 3).

Adolescents and young adults are at greatest risk for gonorrhea (Table 4), with rates of 244 per 100,000 among 15 to 19-year-olds, 416 per 100,000 among 20 to 24-year olds, and 302 per 100,000 among 25 to 29-year-olds. Gonorrhea rates for males (109 per 100,000) were higher than females (83 per 100,000). Communities of color are disproportionately affected by gonorrhea. The incidence of gonorrhea among blacks (657 per 100,000) is 17 times higher than the rate among whites (37 per 100,000). Rates among Asian/Pacific Islanders (63 per 100,000), Hispanics (103 per 100,000), and American Indians (321 per 100,000) are up to 7 times higher than among whites.

Gonorrhea rates are highest in the cities of Minneapolis and St. Paul (Table 4). The incidence in Minneapolis (448 per 100,000) is over 1.5 times higher than the rate in St. Paul (271 per 100,000), 6.5 times higher than the rate in the suburban metropolitan area (69 per 100,000), and 11.5 times higher than the rate in Greater Minnesota (39 per 100,000). In 2016, the suburban area saw the largest increase in cases at 41%.

The emergence of quinolone-resistant *N. gonorrhoeae* (QRNG) in recent years has become a particular

Table 4. Number of Cases and Incidence Rates (per 100,000 Persons) of Chlamydia, Gonorrhea, and Primary/Secondary Syphilis by Residence, Age, Race/Ethnicity, and Gender, 2016

	Chlamydia		Gonorrhea		Primary/ Secondary Syphilis	
Disease	**No.**	**Rate**	**No.**	**Rate**	**No.**	**Rate**
Total	22,675	428	5,104	96	306	5.8
Residence						
Minneapolis	4,577	1,196	1,714	448	127	33.2
St. Paul	2,600	912	772	271	29	10.2
Suburban	7,306	335	1,510	69	94	4.3
Greater Minnesota	7,302	298	961	39	56	2.3
Age						
<15 years	167	16	32	3	1	0.1
15-19 years	5,946	1,617	897	244	14	3.8
20-24 years	8,505	2,391	1,481	416	49	13.8
25-29 years	4,107	1,102	1,126	302	49	13.1
30-34 years	1,959	571	621	181	60	17.5
35-44 years	1,431	210	596	88	71	10.4
≥45 years	560	26	350	17	62	2.9
Gender						
Male	7,701	293	2,881	109	267	10.1
Female	14,959	560	2,214	83	87	1.4
Transgender^^	15	-	7	-	2	-
Race^/Ethnicity						
White	8,912	193	1,718	37	162	3.5
Black	5,127	1,825	1,846	657	71	25.3
American Indian	635	943	216	321	17	25.3
Asian/PI	755	342	140	63	19	8.6
Other^^	340	-	40	-	0	-
Unknown^^	5,599	-	886	-	10	-
Hispanic^^	1,307	522	258	103	27	10.8

* Residence information missing for 890 cases of chlamydia and 146 cases of gonorrhea.
** Suburban is defined as the metropolitan area (Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington Counties), excluding the cities of Minneapolis and St. Paul.
^ Case counts include persons by race alone. Population counts used to calculate results include race alone or in combination.
^^ No comparable population data available to calculate rates.
^^^ Persons of Hispanic ethnicity may be of any race.
Note: Data exclude cases diagnosed in federal or private correctional facilities.

concern. Due to the high prevalence of QRNG in Minnesota as well as nationwide, quinolones are no longer recommended for the treatment of gonococcal infections. Additionally, CDC changed the treatment guidelines for gonococcal infections in August 2012. CDC no longer recommends cefixime at any dose as a first-line regimen for treatment of gonococcal infections. If cefixime is used as an alternative agent, then the patient should return in 1 week for a test-of-cure at the site of infection. New CDC STD Treatment Guidelines were released in 2015.

Syphilis
Surveillance data for primary and secondary syphilis are used to monitor morbidity trends because these represent recently acquired infections. Data for early syphilis (which includes primary, secondary, and early latent stages of disease) are used in outbreak investigations because these represent infections acquired within the past 12 months and signify opportunities for disease prevention.

Primary and Secondary Syphilis
The incidence of primary/secondary syphilis in Minnesota is lower than that of chlamydia or gonorrhea (Table 3), but has remained elevated since an outbreak began in 2002 among men who have sex with men (MSM). In 2016, there were 306 cases of primary/secondary syphilis in Minnesota (5.8 cases per 100,000 persons). This represents a 26% increase compared to the 246 cases (4.6 per 100,000) reported in 2015.

Early Syphilis
In 2016, the number of early syphilis cases increased by 29%, with 557 cases, compared to 431 cases in 2015. The incidence remains highly concentrated among MSM. Of the early syphilis cases in 2016, 468 (84%) occurred among men; 358 (64%) of these were MSM; 44% of the MSM diagnosed with early syphilis were co-infected with HIV. However, the number of women reported has continued to increase from 2012.

Congenital Syphilis
Six congenital syphilis cases were reported in 2016. This is the largest number of cases in more than 25 years.

Chancroid
Chancroid continues to be very rare in Minnesota. The last case was reported in 1999.

Shigellosis

In 2016, 554 culture-confirmed cases of shigellosis (10.1 per 100,000 population) were reported. This represents a 190% increase from the 292 cases reported in 2015, and is 300% greater than the median annual number of cases reported during 2006-2015 (median, 185.5 per year; range, 66 to 391). *S. sonnei* accounted for 512 (92%) cases, and *S. flexneri* for 38 (7%) cases. The species was not identified in 3 (1%) cases. There was 1 *S. dysenteriae* infection reported in 2016. Cases ranged in age from 11 months to 87 years (median, 11.5 years). Twenty-eight percent of cases were ≤5 years of age; 46% of cases were 18 years of age or older. Fifty-eight percent of cases were female. Ninety-eight (18%) cases were hospitalized. No cases died.

Forty-three percent of cases reported either non-white race (201 of 538 cases) or Hispanic ethnicity (69 of 526 cases). Of the 513 cases for which travel information was available, 20 (4%) travelled internationally (14 of 477 [3%] *S. sonnei*, and 6 of 33 [18%] *S. flexneri*). Fifty-three percent of cases resided in the metropolitan area, including 26% in Hennepin County and 12% in Ramsey County.

One hundred eight (19%) cases were part of 30 *Shigella* outbreaks identified in 2016 (median, 2 laboratory-confirmed cases per outbreak; range 1 to 29). All 30 outbreaks were due to person-to-person transmission of *S. sonnei*: 24 outbreaks were in child care facilities, five outbreaks were in schools or preschools, and one outbreak was in a shelter.

In 2016, 133 patients were positive for *Shigella* by a culture-independent diagnostic test conducted in a clinical laboratory. Ninety-three (72%) of the 129 specimens that were received at MDH were subsequently culture-confirmed and therefore met the surveillance case definition for inclusion in MDH case count totals.

In 2016, 50 of the 544 *Shigella* isolates received at MDH were tested for antimicrobial resistance. Of the 50 isolates, 46% (23 isolates) were susceptible to trimethoprim-sulfamethoxazole, 98% (49 isolates) were susceptible to ampicillin, and 100% were susceptible to azithromycin.

Staphylococcus aureus

Invasive *Staphylococcus aureus* (SA) infections are classified into one of three categories: hospital-onset (HO-SA), healthcare-associated, community-onset (HACO-SA), and community-associated (CA-SA). SA must be isolated from a normally sterile body site >3 days after the date of hospital admission for a case to be considered HO-SA. HACO-SA cases have at least one HA risk factor identified in the year prior to infection; examples of risk factors include residence in a long term care facility, recent hospitalization(s), dialysis, presence of an indwelling central venous catheter, and surgery. CA-SA cases do not have any identifiable HA risk factors present in the year prior to infection.

In 2005, as part of EIP, population-based surveillance of invasive methicillin-resistant SA (MRSA) was initiated in Ramsey County; surveillance was expanded to include Hennepin County in 2008. The incidence rate was 11.6 per 100,000 in 2016 (Ramsey: 12.0/100,000 and Hennepin: 11.4/100,000) compared to 11.2 per 100,000 population in 2015. In 2016, MRSA was most frequently isolated from blood (75%, 155/206), and 10% (21/206) of the cases died in the hospital. HACO-MRSA cases comprised the majority (65%, 133/206) of invasive MRSA infections in 2016; CA-MRSA cases accounted for 25% (52/206) and 10% (21/206) cases were HO-MRSA. The median age for all cases was 61 years (range, <1 to 93); the median age was 59 (range, 20 to 82), 64 (range, 20 to 93), and 54 years (range, <1 to 86) for HO-, HACO-, and CA-MRSA cases, respectively.

In August 2014, as part of EIP, population-based surveillance of invasive methicillin-sensitive SA (MSSA) was initiated in Hennepin and Ramsey Counties. The incidence rate was 26.5 per 100,000 in 2016 (Ramsey: 27.4/100,000 and Hennepin: 26.1/100,000) compared to 28.7 per 100,000 population in 2015. In 2016, MSSA was most frequently isolated

continued...

from blood (74%, 346/470), and 10% (45/470) of the cases died in the hospital. HACO-MSSA cases comprised the majority (55%, 261/470) of invasive MSSA infections in 2016; CA-MSSA cases accounted for 36% (168/470) and 9% (41/470) cases were HO-MSSA. The median age for all cases was 58 years (range, <1 to 103); the median age was 52 (range, <1 to 94), 61 (range, 2 to 103), and 53 years (range, <1 to 95) for HO-, HACO-, and CA- MSSA cases, respectively.

Vancomycin-intermediate (VISA) and vancomycin-resistant *S. aureus* (VRSA) are reportable, as detected and defined by Clinical and Laboratory Standards Institute approved standards and recommendations: a minimum inhibitory concentration (MIC)=4-8 µg/ml for VISA and MIC ≥16 µg/ml for VRSA. Patients at risk for VISA and VRSA generally have co-morbidities such as diabetes and end stage renal disease requiring dialysis, previous MRSA infections, recent hospitalizations, and recent exposure to vancomycin. There have been no VRSA cases in Minnesota. Prior to 2008, the PHL had confirmed 1 VISA case. Between 2008 and 2015, the PHL confirmed 16 VISA cases; 2008 (3), 2009 (3), 2010 (2), 2011 (5), and 2013 (3). MDH confirmed 2 VISA cases in 2016: 1 isolated from a tissue biopsy from a psoas abscess, and the other from a blood specimen. Both patients were hospitalized at time of specimen collection, had been prescribed vancomycin during the year before collection, and had a history of MRSA. Among all 18 cases of VISA, 10 (53%) were male and the median age was 64 years (range, 27 to 86). Of those cases with known history (17), 89% reported recent exposure to vancomycin.

Streptococcal Invasive Disease – Group A

Invasive Group A streptococcal disease (GAS) is defined as GAS isolated from a normally sterile site such as blood, cerebrospinal fluid, or wound when accompanied with necrotizing fasciitis or streptococcal toxic shock syndrome (STSS). Two hundred seventy-seven cases (4.8 cases per 100,000 population), including 24 deaths, were reported in 2016, compared to 236 cases and 14 deaths in 2015. Ages of cases ranged from <1 to 99 years (median, 59 years). Fifty percent of cases were residents of the metropolitan area. Allowing for multiple presentations per patient, 94 (34%) had cellulitis, 67 (24%) bacteremia without another focus of infection, 61 (22%) septic shock 26 (9%) septic arthritis and/or osteomyelitis, 27 (10%) pneumonia, 23 (8%) abscess, 19 (7%) necrotizing fasciitis, and 8 (3%) had STSS. Twenty-seven (10%) cases were residents of long-term care facilities. Eighteen facilities had a single case, three had 2 cases, and one had 3 cases. The 3 cases at the same facility all matched by PFGE. The 24 deaths included 5 that presented with just septic shock; 4 had bacteremia without another focus of infection; 1 pneumonia; 1 meningitis; 1 empyema; 1 otitis media; 4 both septic shock and cellulitis; 3 both septic shock and pneumonia; and 2 with septic shock, necrotizing fasciitis and STSS (missing information for 2). Of the 24 deaths, the most frequently reported underlying conditions were: atherosclerotic cardiovascular disease (7), heart failure (7), chronic kidney disease (5), chronic obstructive pulmonary disease (4), obesity (4) and diabetes (4). Eight case fatalities had two or more co-morbidities, and 3 had none reported.

Streptococcal Invasive Disease – Group B

Five hundred forty-four cases of invasive group B streptococcal (GBS) disease (9.9 per 100,000 population), including 27 deaths, were reported in 2016. By age group, annual incidence was highest among infants <1 year of age (49.8 per 100,000 population) and cases aged ≥70 years (34.2 per 100,000). Fifteen (55%) of the 27 deaths were among cases ≥65 years. Fifty-two percent of cases were residents of the metropolitan area. Bacteremia without a focus of infection occurred most frequently (35%), followed by cellulitis (22%), septic arthritis (8%), abscess (7%), osteomyelitis (4%), and meningitis (1%). The majority (73%) of cases had GBS isolated from blood; other isolate sites included joint fluid (10%) and bone (2%).

Thirty-eight cases were infants or pregnant women (maternal cases), compared to 42 cases in 2015. Twenty-one infants developed early-onset disease (occurred within 6 days of birth [0.3 cases per 1,000 live births]), and 13 infants developed late-onset disease (occurred at 7 to 89 days [0.2 cases per 1,000 live births]). Two stillbirth/spontaneous abortions were associated with the 4 maternal GBS infections.

Since 2002, there has been a recommendation for universal prenatal screening of all pregnant women at 35 to 37 weeks gestation. In light of this, we reviewed the maternal charts for all early-onset cases reported in 2016. Overall, 13 of 21 women who delivered GBS-positive infants underwent prenatal screening for GBS. Of these, 4 were positive and 9 negative. Four of the 8 women who did not receive prenatal screening were screened upon admission to the hospital and prior to delivery. Of these, 1 was positive and 3 were negative. Among the 21 women who delivered GBS-positive infants, 14 received intrapartum antimicrobial prophylaxis (IAP). The woman with a positive GBS screen after hospital admission also received IAP.

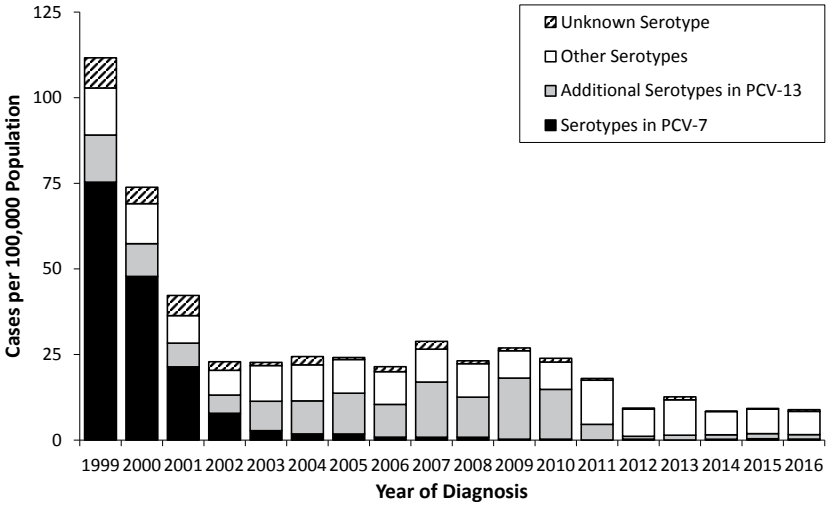
Streptococcus pneumoniae Invasive Disease

In 2016, 485 (8.8 per 100,000) cases of invasive pneumococcal disease (IPD) were reported. By age group, annual incidence rates per 100,000 were 8.8 cases among children aged ≤4 years, 2.2 cases among children and adults aged 5-39 years, 10.2 cases among adults 40-64 years, and 26.4 cases among adults aged ≥65 years.

Pneumonia occurred most frequently (48% of infections), followed by bacteremia without another focus of infection (30%), septic shock (9%), and meningitis (6%). Forty-seven (10%) cases died. Health histories were available for 45 cases; of these, 44 had an underlying health condition reported. The conditions most frequently reported were emphysema/chronic obstructive pulmonary disease (11), diabetes (10), cardiac failure (8), current smoker (8), solid organ malignancy (6), alcohol abuse (6), atherosclerotic cardiovascular disease (6), and dementia (2).

In 1999, the year before the pediatric pneumococcal conjugate vaccine (Prevnar [PCV-7]) was licensed; the rate of IPD among children <5 years of age in the metropolitan area was 111.7 cases/100,000. Over the years 2000-2002 there was a major downward trend in incidence in this age group (Figure 6). Rates in each of the subsequent 8 years were level or somewhat higher. Based on the

Figure 6. Invasive Pneumococcal Disease Incidence Among Children <5 Years of Age, by Year and Serotype Group, Metropolitan Area, 1999-2001; Minnesota, 2002-2016



PCV-13 contains the 7 serotypes in PCV-7 (4,6B,9V,14,18C,19F, and 23F) plus 6 additional serotypes (1,3,5,6A,7F, and 19A).

distribution of serotypes among isolates from these cases, this increase was limited to disease caused by non-vaccine serotypes (i.e. serotypes other than the 7 included in PCV-7) (Figure 6).

In March 2010, the U.S. Food and Drug Administration approved a 13-valent pediatric pneumococcal conjugate vaccine (PCV-13 [Prevnar 13]) which replaced PCV-7. This vaccine provides protection against the same serotypes in PCV-7, plus 6 additional serotypes (serotypes 1, 3, 5, 6A, 7F, and 19A). From 2007 to 2010, the majority of IPD cases among children <5 years of age has been caused by the 6 new serotypes included in PCV-13 (Figure 6). Since 2011, the majority of IPD cases among children <5 years of age has been caused by serotypes not included in PCV-13.

In 2016, 15% of cases with isolates available for testing were caused by 3 of the PCV-13-included serotypes: 3 (13%), and 19A (2%), 7F (1%). In August 2014, the Advisory Committee on Immunization Practices (ACIP) recommended that all adults ≥65 years receive 1 dose of PCV-13 followed by 1 dose of 23-valent pneumococcal polysaccharide vaccine (PPSV-23) 6 to 12 months later. Among adults ≥65 years, 16% of cases in 2016 had PCV-13 serotypes.

Of the 458 isolates submitted for 2016 cases, 84 (18%) isolates were resistant to penicillin using meningitis breakpoints. Using non-meningitis breakpoints, 2 (<1%) of 458 isolates were resistant to penicillin and 9 (2%) exhibited intermediate level resistance (Note: CLSI penicillin breakpoints changed in 2008; refer to the MDH Antibiogram on pages 26-27). Multi-drug resistance (i.e., high-level resistance to two or more antibiotic classes) was exhibited in 76 (17%) isolates.

Toxoplasmosis

Toxoplasmosis is an illness caused by the coccidian protozoan *Toxoplasma gondii*. Cats are the primary reservoir for *T. gondii*. *T. gondii* transmission in the United States is primarily foodborne, through handling or consumption of undercooked pork, lamb, or venison containing bradyzoites, the microscopic tissue cyst form of the parasite. People also can be infected through direct contact with cat feces that contains *Toxoplasma* oocysts or though consumption of food or water that has been contaminated with oocysts.

In 2016, 7 cases were reported, similar to the 9 reported in 2015 and 7 reported in 2014. Three cases had immunocompromising conditions. Six cases were diagnosed with ocular toxoplasmosis, and 1 case was diagnosed with generalized toxoplasmosis. There was 1 congenital case and no pregnant cases. The median age of cases was 39 years (range, 18 to 78 years). Three cases were male. Three cases were white, 2 were black, and 2 were Asian; all 7 were non-Hispanic.

Tuberculosis

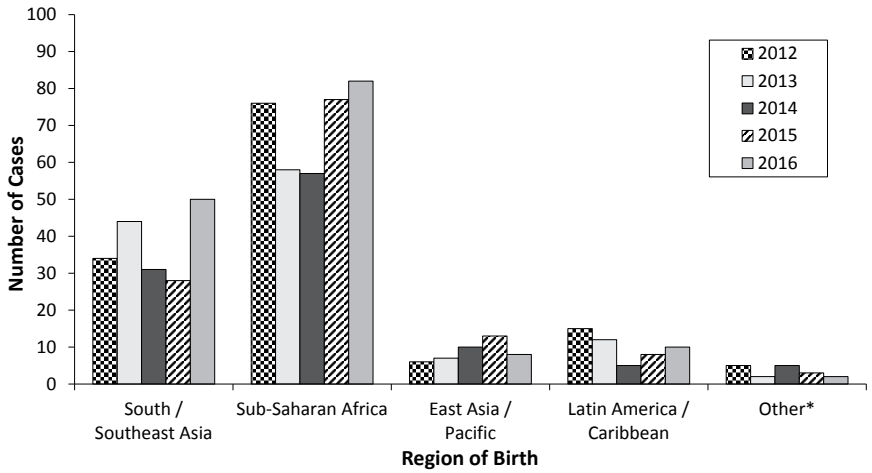
In 2016, 168 tuberculosis (TB) cases (3.1 per 100,000 population) were reported. Although this represents a 12% increase in the number of cases compared to 2015 (150), it is a 29% decrease in the number of cases since 2007, when the highest number (238) in the past decade was reported. Unlike most years, Minnesota's TB incidence rate in 2016 was higher than the national rate of 2.9 cases per 100,000 population. Seven (4%) cases died.

Twenty (23%) counties had at least 1 case in 2016. The majority (77%) of cases occurred in the metropolitan area, primarily in Hennepin (44%) and Ramsey (24%) Counties. Sixteen (10%) were from the other five metropolitan counties. The remaining 23% of cases were reported from Greater Minnesota. Among metropolitan area counties, the highest TB incidence rate in 2016 was reported in Ramsey County (7.4 per 100,000 population), followed by Hennepin County (6.0 per 100,000). The TB incidence rate for all Greater Minnesota counties combined was 1.6 per 100,000 population.

Most (81%) TB cases were identified as a result of individuals seeking medical care for symptoms of disease. Various targeted public health interventions identified a portion of the remaining 19% of cases. Such case identification methods are high priority core prevention and control activities and include follow-up evaluations resulting from abnormal findings on pre-immigration exams performed overseas (7%), contact investigations (5%), and domestic refugee health assessments (2%). An additional 5% were identified through other screening (e.g., other immigration medical exams, employment screening, and other targeted testing for TB). Two (1%) cases were diagnosed with active TB disease incidentally while being

continued...

Figure 7. Non U.S.-Born Tuberculosis Cases by Region of Birth and Year of Report, Minnesota, 2012 – 2016



* "Other" includes Eastern Europe, North Africa/Middle East, and Western Europe.

evaluated for another medical condition.

TB incidence is disproportionately high among racial minorities in Minnesota as well as in the United States. In 2016, 8 cases occurred among non-Hispanic whites. In contrast, among non-Hispanic persons of other races, 88 cases occurred among blacks (25.0 cases per 100,000), 59 among Asians/Pacific Islanders (21.1 cases per 100,000), and 1 case among American Indians (1.5 cases per 100,000). Twelve cases were Hispanic persons of any race (4.2 cases per 100,000). The vast majority of black (94%) and Asian cases (98%) were non U.S.-born.

In 2016, the percentage of TB cases in Minnesota occurring in persons born outside the United States was 90%, compared to 68% of TB cases reported nationally. The 152 non U.S.-born TB cases reported in Minnesota represented 36 different countries of birth; the most common region of birth among these cases was Sub-Saharan Africa (54% of non U.S.-born cases), followed by South/Southeast Asia (33%), Latin America (including the Caribbean) (7%), East Asia/Pacific (5%), and North Africa/Middle East (1%) (Figure 7).

Individuals in other high risk groups comprise smaller proportions of the cases. Note that patients may fall under more than one risk category. Eighteen percent occurred among persons with certain medical conditions that increase the risk for progression from latent TB infection (LTBI) to active TB disease (e.g., diabetes, prolonged corticosteroid or other immunosuppressive therapy, end stage renal disease). The next most common risk factor was HIV infection (7%). Substance abuse (including alcohol abuse and/or injection and non-injection drug use) during the 12 months prior to their TB diagnosis was reported for 4% of patients. Four percent reported being homeless during the 12 months prior to diagnosis. Long-term care facility residence at time of diagnosis accounted for 1% of cases.

By site of disease, 57% of cases had pulmonary disease exclusively. Another 10% had both pulmonary and extrapulmonary sites of disease, and 33% had extrapulmonary sites exclusively. Among patients with an extrapulmonary site of disease, the most common sites were lymphatic (62%), followed by musculoskeletal (15%). Extrapulmonary disease is generally more common among persons born outside the United States. In 2016, 46% of non U.S.-born patients had at least one extrapulmonary site of disease, compared to only 19% of U.S.-born cases.

Of 136 culture-confirmed TB cases with drug susceptibility results available, 28 (21%) were resistant to at least one first-line anti-TB drug [i.e., isoniazid (INH), rifampin, pyrazinamide, or ethambutol], including 19 (14%) cases resistant to at least INH. There were 8 new cases of multidrug-resistant TB (MDR-TB; resistance to at least INH and rifampin) reported in 2016, compared to a total of 5 MDR-TB cases in the previous 5-year period (2011-2015).

Tularemia

Tularemia is an acute illness caused by the bacterium *Francisella tularensis* subspecies *tularensis* (type A) or *holarctica* (type B). Routes of transmission include arthropod bites (particularly ticks and deer flies), contact with infected animals, and exposure to contaminated water, food, or soil. There are six main clinical forms of disease and all include fever: ulceroglandular, glandular, pneumonic, oropharyngeal, oculoglandular, and typhoidal.

In 2016, 3 confirmed ulceroglandular tularemia cases were reported; 2 cases had type B tularemia, and 1 diagnosed by serology only had an unidentified subtype. Ages were 5, 8, and 67 years; 2 were male. Two were hospitalized and all survived. Two cases likely acquired tularemia from a tick or deer fly bite, and 1 acquired tularemia from a fish hook injury.

From 2007 to 2016, 9 tularemia cases were reported, with a range of 0 to 3 cases annually. Six cases had ulceroglandular tularemia, 2 had typhoidal tularemia, and 1 had glandular tularemia. Six of 7 cases with a known tularemia subtype had type B, and 1 had type A. The median age of cases was 61 years (range, 2 to 87 years). Five cases most likely had vector-borne exposures (tick or biting fly bite), 2 cases had waterborne exposures, 1 case had a zoonotic exposure (cat scratch), and 1 case's exposure could not be determined. All 8 cases for which race was known were white.

Unexplained Critical Illnesses and Deaths of Possible Infectious Etiology and Medical Examiner Deaths Surveillance

Surveillance for unexplained critical illnesses and deaths of possible infectious etiology (UNEX) began September 1995. Focus is given to cases <50 years of age with no significant underlying conditions; however, any case should be reported regardless of the patient's age or underlying medical conditions to determine if further testing conducted or facilitated by MDH may be indicated. In addition to provider reporting, death certificates are reviewed for any deaths in persons <50 years of age with no apparent significant underlying conditions for possible unexplained infectious syndromes.

In 2006, MDH began Medical Examiner (ME) Infectious Deaths Surveillance (known as MED-X) to evaluate all ME cases for infectious-related deaths. MEs report explained and unexplained cases. Unexplained deaths in previously healthy individuals <50 years of age are included regardless of infectious hallmarks; this is predominantly represented by Sudden Unexplained Infant Deaths. In addition, MDH reviews death certificates, in which an autopsy was performed by an ME, with a potential infectious cause of death listed. Cases found through death certificate review are also considered for UNEX surveillance if they are <50 years of age and have no immunocompromising conditions. Testing of pre-mortem and post-mortem specimens is conducted at the PHL and the CDC Infectious Diseases Pathology Branch (IDPB). Cases are excluded from UNEX if they are determined to be explained by providers, are not critically ill, or have no infectious disease hallmarks.

In 2016, 97 cases met UNEX criteria (73 deaths, 24 critical illnesses), compared to 87 cases in 2015. Of the 97, 73 (75%) were reported by providers, 23 (24%) were found by death certificate review, and 1 (1%) was discovered by public health investigation of a related UNEX case. Thirty-nine (40%) cases presented with respiratory symptoms, 25 (26%) with sudden unexpected death, 19 (20%) with neurologic symptoms, 6 (6%) with shock/sepsis, 4 (4%)

Table 5. UNEX/MED-X Pathogens Identified as Confirmed, Probable, or Possible Cause of Illness, 2016*

Pathogen Identified	UNEX (n=41)	MED-X (n=39)**
Adenovirus type 1	1	0
Aeromonas spp.	1	0
Carbapenem-resistant *Enterobacteriaceae*	0	1
Clostridium difficile	0	1
Epstein-Barr Virus	1	1
Enterococcus spp.	0	1
Escherichia coli	0	2
Flavobacteriales Family	1	0
Group A Streptococcus/*Streptococcus pyogenes*	3	1
Haemophilus influenzae	0	1
Haemophilus influenzae type A	1	0
Herpes simplex virus 1	1	0
Influenza A virus (no hemagglutinin typing information available)	0	2
Influenza A – H1	8	0
Influenza B virus	1	0
Klebsiella pneumoniae	0	3
La Crosse Encephalitis virus	1	0
Leptospira interrogans	1	0
Norovirus	1	0
Parainfluenza virus type 2	1	0
Parainfluenza virus type 3	1	0
Parainfluenza virus type 4	0	1
Parvovirus B-19	1	0
Powassan virus	1	0
Proteus mirabilis	0	1
Pseudomonas spp.	1	1
Respiratory syncytial virus	4	0
Rhinovirus	1	0
Staphylococcus aureus	4	6
Staphylococcus aureus - MRSA	0	4
Streptococcus spp.	4	2
Streptococcus agalactiae	0	1
Streptococcus intermedius	0	1
Streptococcus mitis	0	1
Streptococcus parasanguinis	0	1
Streptococcus pneumoniae	11	10
Streptococcus viridans	0	1
Treponema pallidum	1	0

* Some cases had multiple pathogens identified as possible coinfections contributing to illness/death.
** MED-X includes pathogens identified by the Medical Examiner. If the cause was found through testing at MDH/CDC it is included in the UNEX column.

continued...

with cardiac symptoms, 2 (2%) with gastrointestinal illness, and 2 (2%) with multiple symptoms. The age of cases ranged from newborn to 73 years. The median age was 12 years among 73 reported cases, and 50 years among 23 non-reported cases found through active surveillance. Sixty-one percent resided in the metropolitan area, and 52% were female.

There were 218 MED-X cases in 2016; 73 of these also met UNEX criteria. The median age of the cases was 47.5 years, and 56% were male. There were 137 (63%) cases found through death certificate review; MEs reported 81 (37%) cases. The most common syndrome was pneumonia/upper respiratory infection (n=87 [40%]). Of the 218 cases, 68 (31%) were confirmed to have had an infectious cause, 143 (66%) had possible infectious causes, and 7 (3%) were non-infectious or unknown cause.

There were 163 cases that had specimens tested at PHL and/or IDPB. Forty-three cases had pathogens identified as confirmed, probable, or possible cause of illness, including 41 UNEX cases (Table 5). Among 47 unexplained deaths occurring in those <50 years of age without any immunocompromising conditions, UNEX helped to identify the pathogen(s) involved in 20 (43%) cases. ME surveillance detected an additional 39 cases with pathogens identified by MEs as the cause of death (Table 5). Cases with pathogens of public health importance detected included a 32-week gestation female who died hours after birth. The neonate was noted to have hydrops fetalis at birth, and placental pathology revealed acute chorioamnionitis and funisitis. CDC laboratory testing detected *Treponema pallidum* subsp. Pallidum from multiple tissues collected at autopsy. This case represents the first congenital syphilis death in Minnesota in over 25 years. UNEX laboratory testing detected *Leptospira* spp. infection in a 12 year-old male who presented with Bell's palsy. A public health investigation was initiated, and the family dog was found to be recently infected with *Leptospira* spp. Finally, UNEX surveillance was able to diagnose a case of influenza A H1N1 in an 18 year-old female whose family refused autopsy based on religious grounds. Based on this diagnosis, the UNEX team was able to assist diagnosing a hospitalized family member with an influenza A H1N1/MSSA coinfection.

Varicella and Zoster

During 2016, 336 varicella cases (6.0 per 100,000 population) were reported. One hundred seventy-four (52%) were from the metropolitan area. Cases ranged from 5 weeks to 69 years of age. Thirty-two cases (10%) were <1 year, 154 (46%) were 1-6 years, 74 (22%) were 7-12 years, 21 (6%) were 13-17 years, and 55 (16%) were ≥18 years of age. Five cases were hospitalized; one was 3 years, and 4 were >12 years of age. Three had severe disease and/or complications including bacterial superinfection, Guillain-Barré syndrome, and prolonged rash. Three were immunocompromised and 1 had a co-morbidity. Four had never received varicella-containing vaccine; 2 had medical contraindications, 1 had a history of childhood disease, and 1 was unvaccinated for unknown reason(s). One case with a predisposing condition had been vaccinated with 1 dose of varicella vaccine. There were no varicella-related deaths.

Varicella is sometimes identified by parents/guardians reporting to schools and child care facilities, rather than diagnosed by a clinician. Of the 335 cases for which information regarding diagnosis was available, 249 (74%) had visited a health care provider, 25 (8%) had consulted a provider or clinic by telephone, 11 (3%) had been identified by school health personnel, and 50 (15%) had not consulted a clinician. Of the 320 cases for which information regarding laboratory testing was available, 97 (30%) had testing performed.

A varicella outbreak is defined as ≥5 cases in the same setting. Outbreaks in Minnesota K-12 schools have been declining markedly in number and size since vaccination requirements were phased in beginning in 2004. In 2016, no schools reported outbreaks. One child care center reported an outbreak with 9 cases. Six cases had received 1 dose of varicella vaccine as recommended for their age group, and all had a mild rash (<50 lesions). Three cases were unvaccinated; 1 was underage for vaccination, and 2 were unvaccinated due to parental refusal. Two unvaccinated cases had more than 50 lesions and 1 had over 250 lesions. Only the case with the most severe rash had fever, and no complications or hospitalizations were reported.

Zoster cases in children <18 years of age are reportable; 85 cases were reported. Cases may be reported by school health personnel, child care staff, or healthcare providers. Ages ranged from 7 months to 17 years (median 10 years). Varicella vaccine became a requirement for entry into kindergarten and 7th grade in 2004, and the incidence of zoster in children has declined from 15.7 per 100,000 population in 2006 to 6.6 per 100,000 population in 2016. Zoster with dissemination or complications (other than post-herpetic neuralgia) in persons of any age is also reportable; 64 such cases were reported, and 56 were hospitalized. Thirty-one (48%) cases were ≥60 years, 21 (33%) were 30 to 59 years, and 12 (19%) were <30 years of age. Thirty-seven (58%) had co-morbidities or were being treated with immunosuppressive drugs. Nineteen cases had disseminated rash or disease, 16 had meningitis, 11 had cellulitis or other bacterial superinfection, 9 had encephalitis or meningoencephalitis, 7 had Ramsay-Hunt Syndrome, and 2 had Bell-like palsy. Immunocompromising conditions and immunosuppressive drug treatment were more common among cases with disseminated rash or disease (68%) than among those with meningitis without dissemination (6%). Two deaths occurred, 1 in a case with encephalitis and 1 with disseminated disease.

Viral Hepatitis A

In 2016, 15 cases of hepatitis A (0.3 per 100,000 population) were reported. Eight cases were residents of the metropolitan area. Nine of the cases were female. Cases ranged in age from 15 to 78 years (median, 42 years). Race was known for all cases; 13 (87%) were white, 1 (7%) was Asian, and 1 (7%) was black. No cases were known to be of Hispanic ethnicity.

Five cases were associated with travel. No risk factor was identified for the other 10 cases. No outbreaks occurred.

Viral Hepatitis B

In 2016, 21 cases of acute hepatitis B virus (HBV) infection (0.4 per 100,000 population) were reported. In 2012, the case definition for acute hepatitis B was revised to include laboratory confirmed asymptomatic acute cases. Two of the 21 cases were asymptomatic, laboratory-confirmed infections.

Acute cases ranged in age from 21 to 72 years (median, 42 years). Fifteen (71%) cases were residents of the metropolitan area, including 10 (48%) in Hennepin County and 2 (10%) in Ramsey County. Seventeen (81%) cases were male, and 9 (43%) were between 13-39 years of age. Race was known for 20 cases; of those, 13 were white, 5 were black, and 2 were Asian. No cases were of Hispanic ethnicity. Incidence rates were higher among Asians (0.7 per 100,000) and blacks (1.4 per 100,000), than among non-Hispanic whites (0.3 per 100,000).

Two hundred thirty reports of newly identified cases of confirmed chronic HBV infection were received in 2016. A total of 23,525 persons are estimated to be alive and living in Minnesota with chronic HBV infection. The median age of chronic HBV cases in Minnesota is 45 years. In addition, the hepatitis registry was matched with Minnesota death records for the first time in 2016, and deceased persons were removed from the registry.

In addition to the 21 hepatitis B cases, 1 perinatal infection was identified in an infant who tested positive for HBsAg during post-vaccination screening performed between 9 and 15 months of age. The perinatal case was born in 2016. The infected infant was born in the United States and had received hepatitis B immune globulin and 3 doses of hepatitis B vaccine in accordance with the recommended schedule and was therefore considered a treatment failure. Three hundred thirty-seven infants born to HBV-infected women during 2015 had post-serologic testing demonstrating no infection.

Viral Hepatitis C

In 2016, 51 cases of acute hepatitis C virus (HCV) infection (0.9 per 100,000) were reported. In 2012, the case definition for acute hepatitis C changed to include documented asymptomatic seroconversion. Of the 51 cases, 6 (12%) were asymptomatic, laboratory-confirmed acute infection.

Thirty-eight (75%) cases resided in Greater Minnesota. The median age of all cases was 39 years (range, 16 to 67 years). Thirty (59%) cases were female. Race was known for 48 cases; of those, 33 (69%) were white, 13 (27%) were American Indian, and 2 (4%) were black. No cases were known to be of Hispanic ethnicity.

MDH received 1,817 reports of newly identified chronic hepatitis C infections in 2016. In 2016 the case definition for chronic hepatitis C changed to exclude those previously reported. The hepatitis registry was matched with Minnesota death records for the first time in 2016, and deceased persons were removed. A total of 35,623 persons are estimated to be alive and living in Minnesota with chronic HCV infection. The median age of these cases is 57 years.

Zika Virus

Zika virus is a mosquito-borne flavivirus that was first discovered in 1947 in Uganda, and the first human cases were identified in 1952. Historically this virus occurred only sporadically in Africa and Asia, but it gained attention after it resulted in outbreaks in Micronesia in 2007 and French Polynesia in 2013-2014. In Spring 2015, cases were reported from Brazil, representing the first time the virus had been found in the Americas. Since then, the virus has spread to nearly 50 countries and territories in the Western Hemisphere, and infections during pregnancy have been associated with adverse fetal outcomes, including microcephaly. Zika has been shown to be transmitted perinatally as well as through sexual contact, a route of transmission that has never before been associated with a mosquito-borne virus. The mosquito vectors for humans are the same *Aedes* spp. mosquitoes (*Ae. aegypti* and *Ae. albopictus*) that transmit dengue virus and Chikungunya virus.

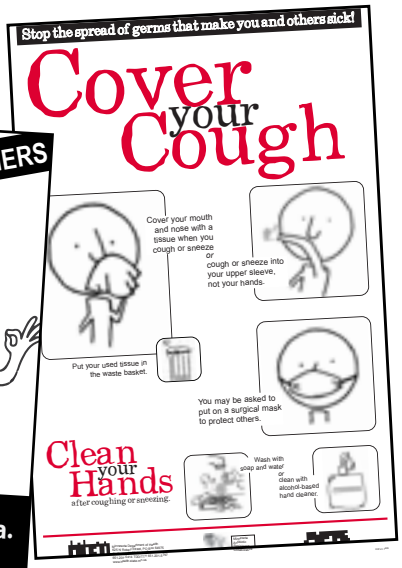
Most people (up to 80%) infected with Zika virus do not develop symptoms, and of those that do, most will develop mild symptoms like fever, rash, joint pain, and conjunctivitis. Symptoms usually begin 3-7 days after a person is bitten by an infected mosquito, and most recover within a week. In some cases, severe complications such as Guillain-Barré syndrome can occur in patients following infection. With such a high proportion of asymptomatic infections, it is possible that many infections go undetected.

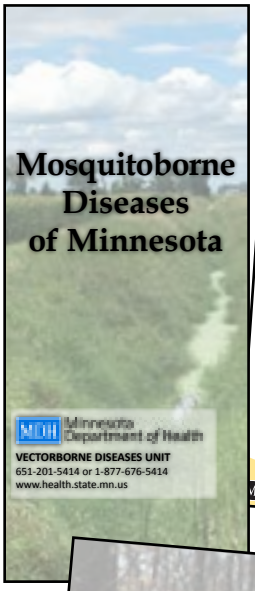
In 2016, 73 cases of Zika virus disease were reported in Minnesota residents. The median case age was 37 years (range, <1 to 82 years). Cases resided throughout Minnesota, although the majority (53 [73%]) were from the metropolitan area, and were reported throughout the year. Ninety-seven percent (71) of cases presented with relatively mild illness, although one individual had Guillain-Barré syndrome, and one was a probable congenital infection. Six women were found to have laboratory evidence of Zika virus infection during pregnancy, and to date, none of these infections have been associated with adverse pregnancy outcomes. All but 1 of the cases represented imported infections acquired abroad. This domestic case was due to sexual transmission from a symptomatic male to his female partner. For those cases associated with travel, patients reported travel to 24 different countries and territories in the Americas, with Haiti (13), Mexico (11), Nicaragua (7), Guatemala (4), and Jamaica (4) being the most common.

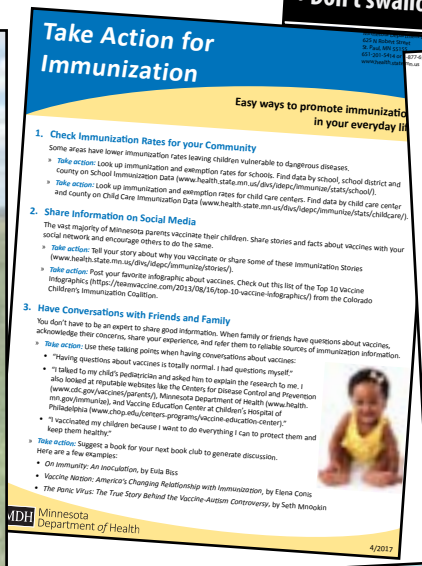
Nationwide, human cases of Zika virus disease were reported from 49 states and the U.S. territories of Puerto Rico, American Samoa, and the U.S. Virgin Islands. Most U.S. cases were acquired while traveling abroad, although local transmission was identified in Miami, Florida and Brownsville, Texas, resulting in 224 locally acquired cases (218 from Florida and 6 from Texas).

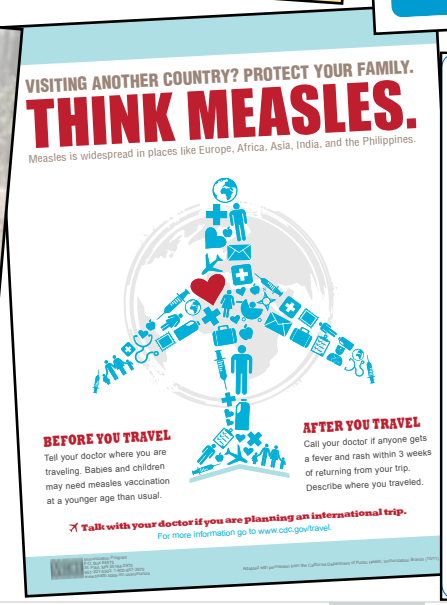
Posters and Other Materials

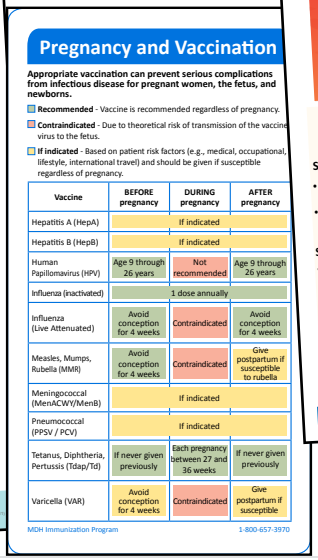
The Minnesota Department of Health has a variety of posters and other print materials visit www.health.state.mn.us/divs/idepc to find all of these and many more.

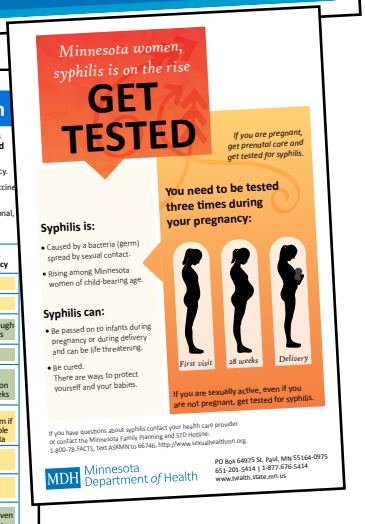


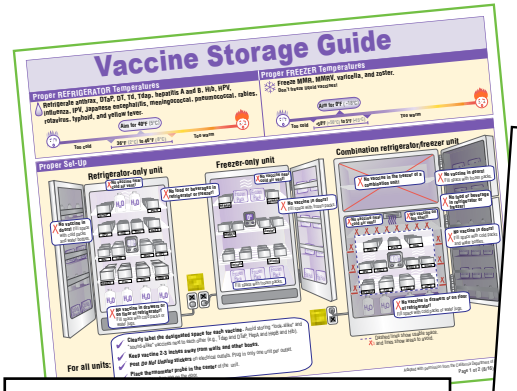


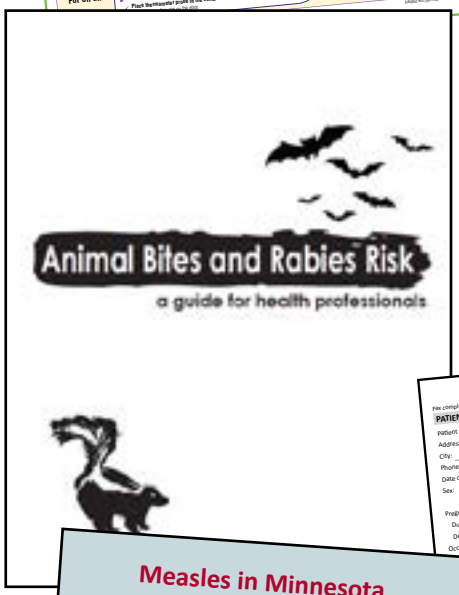


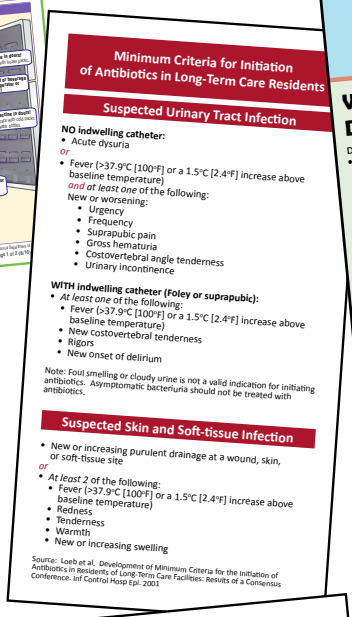


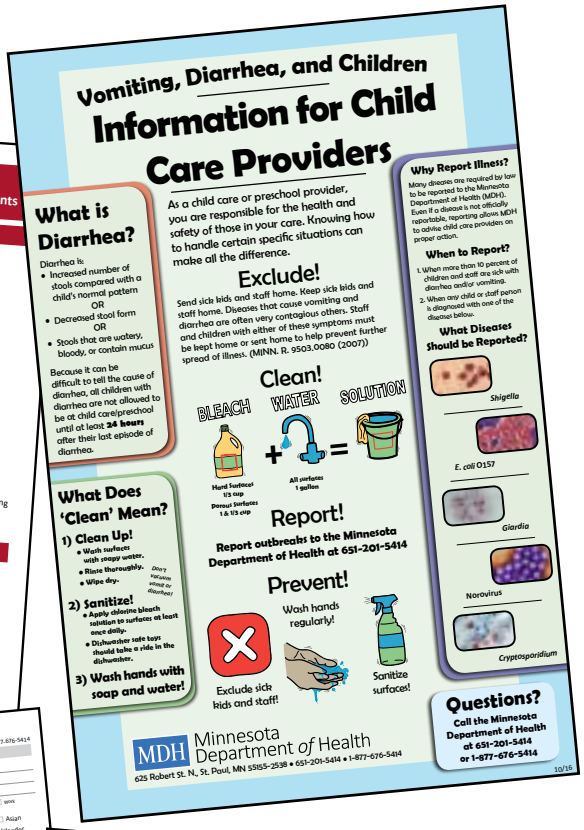


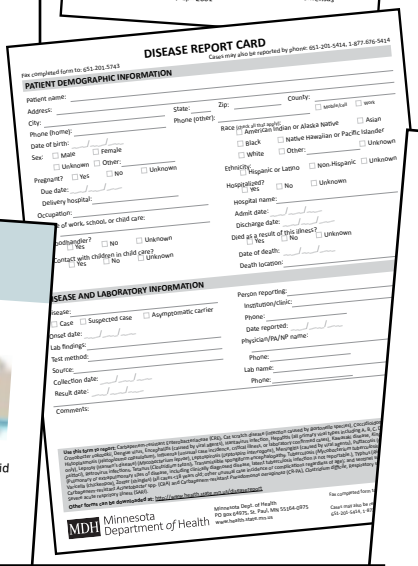



Vaccine Storage Guide
Proper REFRIGERATOR Temperatures
Proper FREEZER Temperatures
Proper Set-Up
Refrigerator-only unit
Freezer-only unit
Combination refrigerator/freezer unit
For all units:

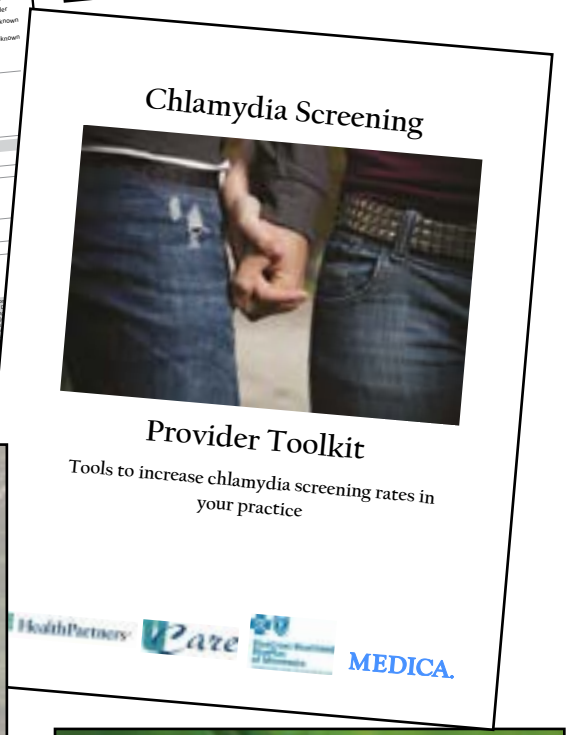

Animal Bites and Rabies Risk
a guide for health professionals


Minimum Criteria for Initiation of Antibiotics in Long-Term Care Residents
Suspected Urinary Tract Infection
NO indwelling catheter:
WITH indwelling catheter (Foley or suprapubic):
Suspected Skin and Soft-tissue Infection

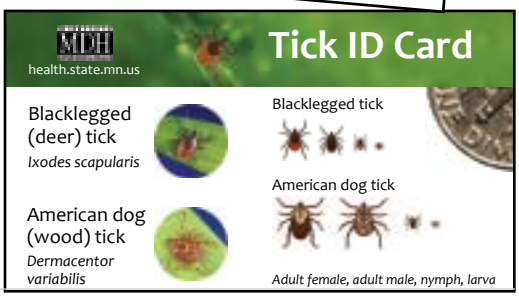

Vomiting, Diarrhea, and Children
Information for Child Care Providers
What is Diarrhea?
Exclude!
Clean!
BLEACH
WATER
SOLUTION
What Does 'Clean' Mean?
Report!
Prevent!
Why Report Illness?
What Diseases Should be Reported?
Shigella
E. coli O157
Giardia
Norovirus
Cryptosporidium
Questions?
Minnesota Department of Health


DISEASE REPORT CARD
PATIENT DEMOGRAPHIC INFORMATION
DISEASE AND LABORATORY INFORMATION
MDH Minnesota Department of Health


Measles in Minnesota
Watch for symptoms
Fever
Runny Nose
Rash
Cough
Red Eyes
Check immunization records


Chlamydia Screening
Provider Toolkit
Tools to increase chlamydia screening rates in your practice
HealthPartners
Park Nicollet
MEDICA.


MAKE YOUR WATER SAFE
No matter how remote or clean-looking a backcountry water source seems, it may still contain viruses, bacteria, and parasites that make people sick with diarrhea and vomiting.
Boil
Boiling water for 1 minute is most effective at removing harmful pathogens from untreated water sources.
Filter & Disinfect
If boiling is not possible, a combination of filtration followed by chemical disinfection is also effective. Water conditions, filter pore size, disinfection concentration, treatment time, and other factors impact the product's effectiveness. Manufacturer's instructions must always be followed.
BOIL
FILTER
DISINFECT
MDH Minnesota Department of Health
Waterborne Diseases Unit • 625 Robert St. N., St. Paul, MN 55155-2538 • 651-201-5414 • 1-877-676-5414


MDH
health.state.mn.us
Tick ID Card
Blacklegged (deer) tick
Ixodes scapularis
Blacklegged tick
American dog (wood) tick
Dermacentor variabilis
American dog tick
Adult female, adult male, nymph, larva

Antimicrobial Susceptibilities of Selected Pathogens, 2016

On the following pages is the *Antimicrobial Susceptibilities of Selected Pathogens, 2016*, a compilation of antimicrobial susceptibilities of selected pathogens submitted to MDH during 2016 in accordance with Minnesota Rule 4605.7040. Because a select group of isolates is submitted to MDH, it is important to read the notes entitled "Sampling Methodology" and "Trends, Comments, and Other Pathogens."

DEPARTMENT OF HEALTH

Antimicrobial Susceptibilities of Selected Pathogens, 2016

Sampling Methodology
* all isolates tested
§ ~15% sample of statewide isolates received at MDH
† ~10% sample of statewide isolates received at MDH
‡ isolates from a normally sterile site

		Campylobacter spp. [1§]	*Salmonella enterica* (non-typhoidal) [2†]	*Shigella* spp. [3§]	*Neisseria gonorrhoeae* [4]	*Neisseria meningitidis* [5*‡]	Group A *Streptococcus* [6*‡]	Group B *Streptococcus* [7*‡]	*Streptococcus pneumoniae* [8*†‡]	*Mycobacterium tuberculosis* complex [9*]	Healthcare-associated MRSA [10*†]	Community-associated MRSA [10*†]	*Haemophilus influenzae* [11*‡]
Number of Isolates Tested		132	84	50	90	5	265	513	456	136	134	46	118
		% susceptible											
ß-lactam antibiotics	amoxicillin								95				100
	ampicillin		80	98		80	100	100					69
	penicillin				0	80	100	100	82#/99¶				
	cefixime				100[4]								
	cefuroxime sodium								91				99
	cefotaxime						100	100	94#/99¶				100
	ceftriaxone		95	100	100[4]	100			93#/99¶				
	ceftaroline										100	100	
	meropenem					100			93				100
Other antibiotics	ciprofloxacin	75[1]	94	100	67	100							100
	levofloxacin					100	99	99	99		35	54	
	azithromycin	97		100[3]	93[4]	100							99
	erythromycin	97					88	47	61		19	28	
	clindamycin						96/89[6]	66/57[7]	92		63/54[10]	87/69[10]	
	chloramphenicol		95	100					98				99
	gentamicin	99											
	doxycycline										98	98	
	tetracycline	30			17		88		90		96	96	98
	trimethoprim/sulfamethoxazole		98	46					80		100	100	80
	linezolid										100	100	
	daptomycin										98	100	
	telavancin										100	100	
	vancomycin						100	100	100		99	100	
TB antibiotics	ethambutol									94			
	isoniazid									86			
	pyrazinamide									90			
	rifampin					100				94	95	100	100

Trends, Comments, and Other Pathogens

[1] *Campylobacter* spp. — Quinolone susceptibility was determined for all isolates (n=985); isolates that were screened as nalidixic acid-susceptible were assumed to be ciprofloxacin-susceptible. Only 20% of isolates from patients returning from foreign travel (n=157) were susceptible to quinolones. *Campylobacter* susceptiblities were determined using CDC NARMS 2014 report standards (www.cdc.gov/narms).

[2] *Salmonella enterica* (non-typhoidal) — Antimicrobial treatment for uncomplicated gastroenteritis due to *Salmonella* is not generally recommended.

[3] *Shigella* spp. — For cases in which treatment is required and susceptibility is unknown or an ampicillin and trimethoprim/sulfamethoxazole-resistant strain is isolated, azithromycin for 3 days, ceftriaxone for 2 to 5 days, or a fluoroquinolone (such as ciprofloxacin) for 3 days is recommended. For susceptible strains, ampicillin or trimethoprim/sulfamethoxazole is effective; amoxicillin is less effective because of its rapid absorption from the gastrointestinal tract (Red

TB antibiotics	ethambutol			94			
	isoniazid			86			
	pyrazinamide			90			
	rifampin	100		94	95	100	100

Trends, Comments, and Other Pathogens

[1] *Campylobacter* spp.	Quinolone susceptibility was determined for all isolates (n=985); isolates that were screened as nalidixic acid-susceptible were assumed to be ciprofloxacin-susceptible. Only 20% of isolates from patients returning from foreign travel (n=157) were susceptible to quinolones. *Campylobacter* susceptiblities were determined using CDC NARMS 2014 report standards (www.cdc.gov/narms).
[2] *Salmonella enterica* (non-typhoidal)	Antimicrobial treatment for uncomplicated gastroenteritis due to *Salmonella* is not generally recommended.
[3] *Shigella* spp.	For cases in which treatment is required and susceptibility is unknown or an ampicillin and trimethoprim/sulfamethoxazole-resistant strain is isolated, azithromycin for 3 days, ceftriaxone for 2 to 5 days, or a fluoroquinolone (such as ciprofloxacin) for 3 days is recommended. For susceptible strains, ampicillin or trimethoprim/sulfamethoxazole is effective; amoxicillin is less effective because of its rapid absorption from the gastrointestinal tract (*Red Book*, 2015). Isolates with no zone of inhibition of bacterial growth using 15 µg of azithromycin were considered to have decreased susceptibility. An increase in infections with decreased azithromycin susceptibility has been reported in adult males nationally; recent outbreaks were published in the June 5, 2015 *MMWR* (http://bit.ly/29zq9nl).
[4] *Neisseria gonorrhoeae*	Routine resistance testing for *Neisseria gonorrhoeae* by the MDH PHL was discontinued in 2008. Susceptibility results were obtained from the CDC's Contracted Laboratories, and are for isolates obtained through the Gonococcal Isolate Surveillance Program. Isolates (n = 90) were received from the Red Door Clinic in Minneapolis. Resistance criteria for the following antibiotics have not been established therefore the data reflect reduced susceptibility using provisional MIC breakpoints for cefixime ≥0.5 µg/ml, ceftriaxone ≥0.5 µg/ml, and azithromycin ≥2.0 µg/ml. Also, the number of *N. gonorrhoeae* isolates submitted for testing decreased from 105 in 2015 to 90 in 2016.
[5] *Neisseria meningitidis*	In 2016, 1 case-isolate was intermediate to both ampicillin (MIC =.25 µg/ml) and penicillin (MIC =.12 µg/ml). There were no case isolates with ciprofloxacin resistance. The MIC interpretive criteria for azithromycin, ciprofloxacin, levofloxacin, and rifampin apply to prophylactic therapy and do not apply to therapy of patients with invasive meningococcal disease.
[6] Group A *Streptococcus*	The 265 isolates tested represent 96% of the 277 total cases. Among the 20 erythromycin resistant-clindamycin susceptible or intermediate isolates, 19 had inducible clindamycin resistance for a total of 89% of isolates that were susceptible to clindamycin and did not exhibit inducible clindamycin resistance.
[7] Group B *Streptococcus*	100% (21/21) of early-onset infant, 100% (13/13) late-onset infants, 100% (4/4) of maternal, and 95% (475/506) of other invasive GBS cases were tested. Among 104 erythromycin resistant - clindamycin susceptible or intermediate isolates, 48 (46%) had inducible resistance to clindamycin for a total of 57% (291/513) that were susceptible to clindamycin and did not exhibit inducible clindamycin resistance. 80% (30/38) of infant and maternal cases were susceptible to clindamycin and did not exhibit inducible clindamycin resistance.
[8] *Streptococcus pneumoniae*	The 456 isolates tested represent 94% of 485 total cases. #Case-isolates susceptible by meningitis breakpoints for cefotaxime, ceftriaxone (intermediate = 1.0 µg/ml, resistant ≥ 2.0 µg/ml) and penicillin (resistant ≥ 0.12 µg/ml). ¶Case-isolates susceptible by nonmeningitis breakpoints for cefotaxime, ceftriaxone (intermediate = 2.0 µg/ml, resistant ≥ 4.0 µg/ml), and penicillin (intermediate = 4.0 µg/ml, resistant ≥ 8.0 µg/ml). Isolates were screened for high-level resistance to rifampin at a single MIC; 100% (456/456) were ≤ 2 µg/ml. Using meningitis breakpoints, 17% (76/456) of isolates were resistant to two or more antibiotic classes and 9% (41/456) were resistant to three or more antibiotic classes. (CLSI also has breakpoints for oral penicillin V; refer to the most recent CLSI recommendations for information).
[9] *Mycobacterium tuberculosis* (TB) complex	National guidelines recommend initial four-drug therapy for TB disease, at least until first-line drug susceptibility results are known. Of the 28 TB cases reported in 2016 resistant to at least one first-line drug, all (100%) were born outside the U.S. There were 8 new cases of multidrug-resistant TB (MDR-TB)(i.e. resistant to at least isoniazid and rifampin). All were also resistant to ethambutol, and two cases were resistant to all four first-line TB medications (isoniazid, rifampin, ethambutol and pyrazinamide).
[10]Methicillin-resistant *Staphylococcus aureus* (MRSA)	206 cases of invasive MRSA infection were reported in 2016 in Ramsey and Hennepin Counties, 87% (180/206) had an isolate submitted and antimicrobial susceptibility testing conducted. Of cases with an isolate tested, 74% (134/180) were epidemiologically classified as healthcare-associated (hospital and community onset). Healthcare-associated isolates were screened for mupirocin resistance with 1% (1/134) exhibiting high-level resistance (MIC >256 µg/ml), 63% (84/134) of isolates were susceptible to clindamycin by broth microdilution; however, among 58 erythromycin resistant-clindamycin susceptible or intermediate isolates, 12 had inducible clindamycin resistance for a total of 54% (72/134) that were susceptible to clindamycin and did not exhibit inducible clindamycin resistance. For community-associated cases (46/180 isolates), 2% (1/46) exhibited high-level mupirocin resistance. 87% (40/46) were susceptible to clindamycin by broth microdilution; however, among 27 erythromycin resistant-clindamycin susceptible or intermediate isolates 30% (8/27) had inducible clindamycin resistance for a total of 69% (32/46) that were susceptible to clindamycin and did not exhibit inducible clindamycin resistance. In 2016, 2 isolates were confirmed as vancomycin intermediate.
[11]*Haemophilus influenzae*	In 2016, 35 (30%) of the case-isolates were resistant to ampicillin and produced ß-lactamase, but all were susceptible to amoxicillin-clavulanate, which contains a ß-lactamase inhibitor. 2 case isolates showed intermediate resistance to ampicillin and did not produce ß-lactamase. 10 case-isolates showed resistance (I or R) to 2 or more antibiotics. Of those 10, 3 case-isolates showed resistance to 3 antibiotics.
Bordetella pertussis	In 2015, 26 case-isolates of pertussis were screened for erythromycin susceptibility in Minnesota and none were resistant.
Carbapenem-resistant Enterobacteriaceae (CRE)	The 2016 CRE definition is based on 2016 CLSI breakpoints and includes Enterobacteriaceae that are resistant to at least one carbapenem (doripenem, ertapenem, imipenem, or meropenem) or are positive for carbapenemase production. Of the 511 isolates submitted in 2016 from 439 patients, 40 (8%) isolates (representing 26 patients) were bla_{KPC}-positive, including 21 (53%) *Klebsiella pneumoniae*, 10 (25%) *Enterobacter cloacae*, 5 (13%) *E. coli*, 3 (8%) *Citrobacter freundii*, and 1 (3%) *Serratia marcescens*: 18/26 (69%) patients with bla_{KPC}-positive isolates were residents of Minnesota. Additionally, 10 isolates (representing 8 patients) were positive for bla_{NDM}, including 5 (50%) *Klebsiella pneumoniae*, 3 (30%) *E. coli*, 1 (10%) *Citrobacter freundii*, and 1 (10%) *Providencia rettgeri*. 6/10 (60%) patients with bla_{NDM} -positive isolates were Minnesota residents; all but one had exposure to health care overseas (Asia, Africa). 3 isolates were positive for carbapenemases not routinely tested for: 2 *Providencia rettgeri* isolates from 2 Minnesota residents were bla_{IMP}-27 positive and 1 *Serratia marcescens* isolate from a non-Minnesota resident was positive for bla_{VIM} (Asia).
Escherichia coli O157:H7	Antimicrobial treatment for Shiga toxin-producing *E. coli* infection is not recommended.

The MDH Antibiogram is available at:
http://www.health.state.mn.us/divs/idepc/dtopics/antibioticresistance/antibiogram.html

Laminated copies can be ordered from:
Antibiogram, Minnesota Department of Health, IDEPC, PO Box 64975, St. Paul, MN 55164 or by calling 651-201-5414.

Emerging Infections in Clinical Practice & Public Health

Emerging and Re-Emerging Infectious Diseases

November 17, 2017

Radisson Blu-Mall of America
Bloomington, MN

7:00 *am*	*Registration and Continental Breakfast*
7:30	**Welcome and Introductions**
7:40	**Keynote: Pertussis, Mumps, and Meningococcus Outbreaks: What is Happening and How can we Respond?**
8:25	**Questions and Discussion**
	Amanda Cohn, Centers for Disease Control and Prevention
8:40	**Ocular Manifestations of Infectious Diseases**
9:10	**Questions and Discussion**
	John Chen, MD, PhD, Mayo Clinic
9:25	**High consequence Infectious Disease (HCID): When is a biocontainment unit needed?**
9:55	**Questions and Discussion**
	Susan Kline, MD, MPH, University of Minnesota
10:10	*Refreshment Break*
10:25	**Emerging Antibiotic Resistance in Sexually Transmitted Infections: Novel Approaches**
10:55	**Questions and Discussion**
	Meghan Rothenberger, MD, University of Minnesota
11:10	**Resistant fungal infections and antifungal agent stewardship**
11:40	**Questions and Discussion**
	Raj Mody, MD, Minnesota Department of Health
11:55	Lunch
12:55 pm	**Vector Borne Encephalitis**
1:25	**Questions and Discussion**
	Allen Aksamit, MD, Mayo Clinic
1:35	**Hot Topics**
2:05	**Questions and Discussion**
	Richard Danila, PhD, MPH, Minnesota Department of Health
2:15	**Multi-Drug Resistant Tuberculosis: What Clinicians Need to Know**
2:45	**Questions and Discussion**
	Dean Tsukayama, MD, Hennepin County Medical Center
2:55	*Refreshment Break*
3:10	**2017 Measles Outbreak in Minnesota**
3:40	**Questions and Discussion**
	Kristin Ehresmann, RN, MPH, Minnesota Department of Health
	Ruth Lynfield, MD, Minnesota Department of Health
3:50	**Panel: Interesting and Unusual Case Presentations of Public Health Importance**
	Moderator: *Phillip K. Peterson, MD - University of Minnesota*
	Presenter: *Stacy Holzbauer, DVM, MPH - Minnesota Department of Health*
	Panelists: *Peter Bornstein • Mark Sannes • Aaron Tande • Robin Patel • Laura Norton*
5:00	*Evaluations & Adjourn*

www.z.umn.edu/emerginginfections

Faculty and Curriculum Subject to Change

University of Minnesota

Emerging Infections in Clinical Practice & Public Health

Registration Form

November 17, 2017

Radisson Blu – Mall of America
Bloomington, MN

Please type or print clearly. A name badge and Statement of Participation are generated from this document. SM -3781

Name _____

Affiliation _____ **Department** _____

Address _____ ☐ HOME ☐ OFFICE

City _____ **State** _____ **Zip** _____

Telephone _____ **E-mail** _____

Receipts, confirmations and driving directions are e-mailed from our office. Please provide your e-mail address and print clearly.

DEGREE

☐ **MD** ☐ **DO** ☐ **PhD** ☐ **PharmD** ☐ **RPh** ☐ **MPH**
☐ **APRN (NP, CNS, CRNA, CNM)** ☐ **RN** ☐ **PA** ☐ **Other** _____

SPECIALTY

☐ **Family Medicine/Subspecialty** _____ ☐ **Internal Medicine/Subspecialty** _____
☐ **Pediatrics/Subspecialty** _____ ☐ **Infection Prevention** _____
☐ **Public Health** _____ ☐ **Other** _____
☐ **Laboratorian** _____

REGISTRATION FEES	**Early Rate On or Before October 20**	**Regular Rate After October 20**
☐ Physician	$225	$275
☐ Other Healthcare Professionals	$195	$245
☐ Retired Physicians	$180	$225
UMN/ M Health, Mayo, MDH (must have UMN ID to qualify for these rates)		
☐ Full-time Faculty	$195	$245
☐ Other Healthcare Professionals	$145	$195
☐ Adjunct Faculty	$145	$195
☐ Resident / Fellow / Student	$80	$100

SPECIAL REQUESTS *Special needs, such as dietary restrictions, lactation room, etc., should be **requested in advance**. These requests cannot always be honored on site.*

Dietary: _____ Other: _____

TO REGISTER

Mail this registration form and your check, payable to **Regents of the University of Minnesota**, to:

Office of Continuing Professional Development, University of Minnesota Medical School
MMC 293, Mayo Memorial Bldg.
Room G-254, 420 Delaware Street SE
Minneapolis, MN 55455
For credit card payment, register online at http://www.cme.umn.edu/emerginginfections

CANCELLATION POLICY

In the event you need to cancel your registration, the registration fee, less a $50 administrative fee, will be refunded if you notify us by 4:30 p.m. CST on **November 3, 2017**. No refunds will be made after this date. If you have any questions, please contact our office at (612) 626-7600 or (800) 776-8636, or e-mail us at cme@umn.edu.

UNIVERSITY OF MINNESOTA
Continuing Professional Development

DEPARTMENT OF HEALTH
625 Robert Street North
P.O. Box 64975
Saint Paul, Minnesota 55164-0975

The Disease Control Newsletter is available on the MDH IDCN web site:
(http://www.health.state.mn.us/divs/idepc/newsletters/dcn/index.html)