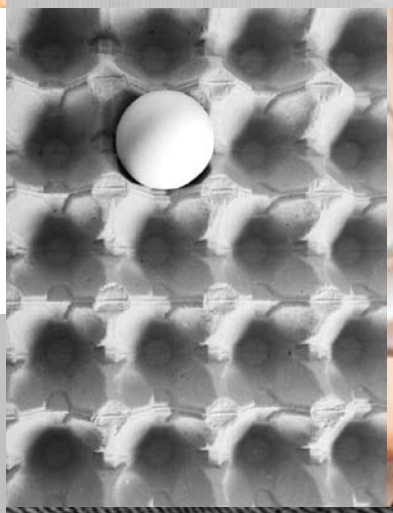
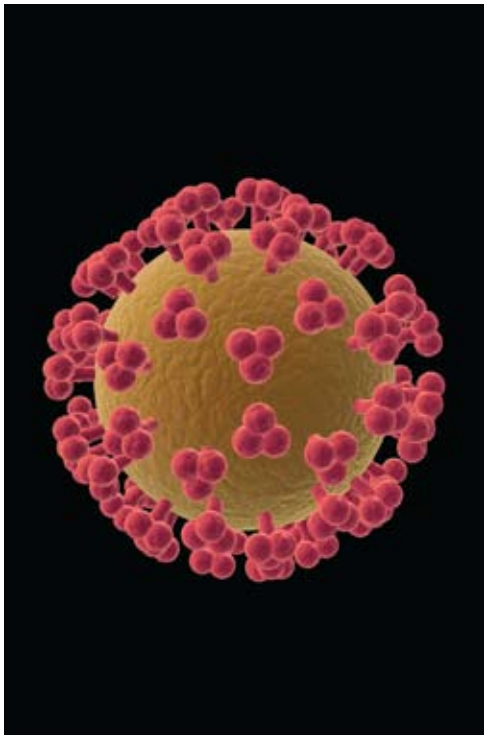


CHAPTER 6

Infectious Disease



The Bureau of Infectious Disease Prevention, Response and Services is responsible for the prevention, surveillance and control of communicable and other infectious diseases. It accomplishes its mission through the application of disease reporting, surveillance, public education, epidemiologic investigation, disease intervention and provision of appropriate public health clinical services.

In the 1960s and 1970s, it was thought that infectious diseases were all but conquered in the United States through sanitation, vaccines, antibiotics and infection control. However, this optimism was short-lived, as new diseases emerged and old ones adapted to our efforts toward control and elimination.

In the past 30 years, certain diseases, such as HIV infection, Lyme disease, West Nile virus infection and others have demonstrated that new and newly recognized diseases can emerge or readily migrate to our shores. Widespread multi-state outbreaks of foodborne illness demonstrate that our food supply is still vulnerable to contamination despite our

sophisticated understanding of how foodborne illness occurs. "Old diseases", such as tuberculosis, syphilis, whooping cough, and even mumps, pose new challenges to prevention and control.

Antimicrobial resistance in bacteria and viruses make treatment of infections more difficult and less effective. Healthcare-associated infections demonstrate the capacity of infectious diseases to flourish, even in what should be the most pristine environments. Due to wide-spread international airline travel, the rest of the world is only hours away, with infectious diseases such as malaria, tuberculosis, HIV infection and measles on our doorstep.

Prevention is key to reducing disease, death and further transmission of infectious diseases in the population. Prevention involves vaccines, clinical management, treatment, isolation, quarantine, behavior change, and improvement in the socioeconomic conditions under which people live.

Successful prevention and control of infectious diseases is built on a foundation of disease surveillance. Since the 19th century, Massachusetts has led the nation in disease surveillance. In the 21st century, surveillance has become highly automated and efficient, yet the diversity of infectious diseases with their clinical, social and economic impacts, and the diversity of the populations affected, provide ongoing challenges for prevention programs and clinical services. Vigilance is required to recognize outbreaks of disease and implement epidemiologic investigation and measures of control for effective response.

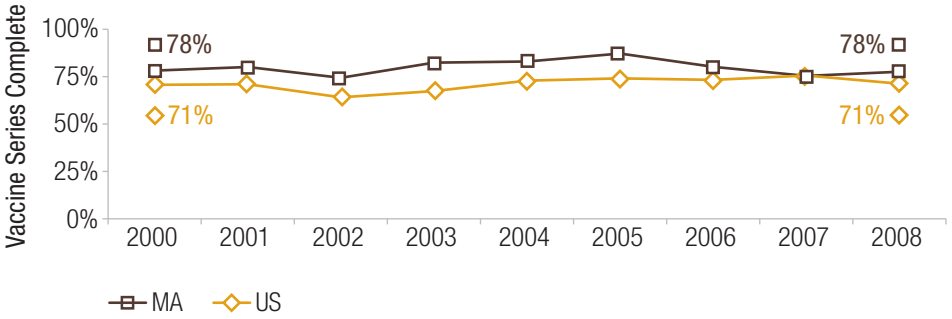
Disease surveillance is defined as the ongoing systematic collection and analysis of data and the provision of information leading to action to prevent and control disease. Surveillance data bring to light disease burden, outbreaks, trends and disparities in health outcomes. These data are also an important tool in assessing the impact of interventions to reduce disease occurrence. More than 90 infectious diseases and conditions are reportable to local boards of health and the Massachusetts Department of Public Health. Electronic methods of data collection and storage, including the Massachusetts Virtual Epidemiologic Network (MAVEN) and electronic laboratory reporting, have enhanced capacity to monitor communicable diseases in a more timely and complete fashion.

Vaccine-Preventable Infections

Massachusetts has always had, and continues to have, one of the highest levels of infant immunization in the United States.

In the early 19th century, Massachusetts was among the first places in the world to virtually eradicate the dreaded disease smallpox through the effective use of vaccine. Immunization remains the most effective disease prevention intervention. Massachusetts has always had, and continues to have, one of the highest levels of infant immunization in the United States. This is a result of a unique combination of an effective pediatric primary care system that immunizes virtually all children in their medical home,

Figure 6.1 **Vaccine Series Complete† at 24 Months**



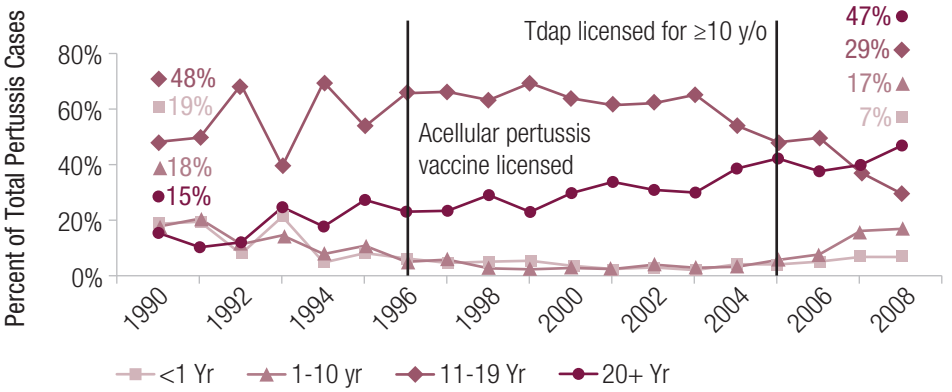
Source: CDC National Immunization Survey, 2000-2008.

and the state's provision of every recommended vaccine, for all young children, at no charge. The complex immunization schedule provides protection against a wider range of diseases, but also presents difficult issues of cost, distribution, administration, and tracking of vaccinations.

Most vaccine-preventable diseases of childhood have been essentially eliminated in Massachusetts. Beginning in the 1940s, widespread immunization against pertussis, or "whooping cough", led to marked reductions in disease and death due to this bacterial infection. However, pertussis still occurs, primarily in pre-teens, adolescents and adults, for whom old-style vaccines did not give long-lasting protection. The introduction, in 2005, of a new vaccine that can protect adolescents and adults from pertussis has decreased disease incidence and the proportion of infections in teens, who were the first target for this new vaccine.

Though whooping cough can be uncomfortable and inconvenient for older age groups, it can be very dangerous for infants too young to have completed the series of protective vaccination. These children are at risk of exposure from an infected parent or sibling, so preventing disease in the older age groups is important.

Figure 6.2 **Pertussis Cases by Age**

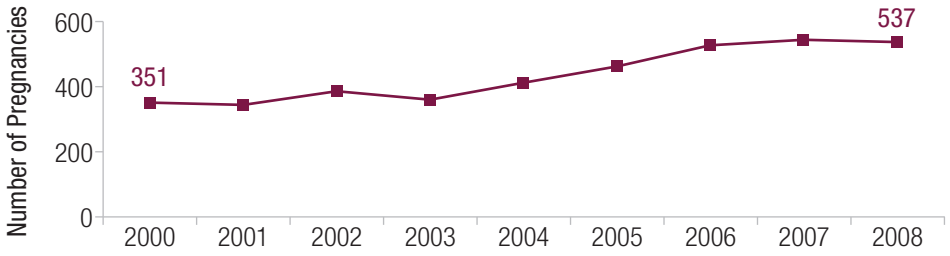


Source: MDPH Disease Surveillance System, 1990-2008.

Disease Prevention, Response and Services, MDPH

In addition to pertussis, other vaccine-preventable diseases still present significant challenges. Pregnant women who carry hepatitis B virus can pass the virus to their newborns. Ninety percent or more of those newborns will develop life-long infection with the eventual risk for cirrhosis, liver failure, liver cancer and premature death. Identification of hepatitis B infection by testing women before or during pregnancy, and the prompt administration of vaccine and antibody against hepatitis B virus to the newborn at birth will prevent infection. The implementation of electronic laboratory reporting of hepatitis B test results and the MAVEN automated disease surveillance system has resulted in a 15% increase in the number of at-risk babies identified, and life-long infections prevented.

Figure 6.3 **Hepatitis B Positive Pregnant Women Identified in Massachusetts**



Source: MDPH Disease Surveillance System, 2000-2008.

Foodborne Illness

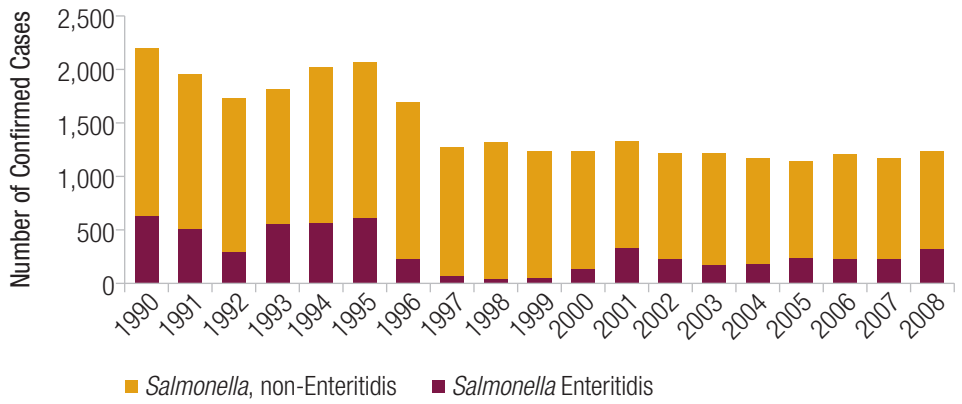
Salmonella infection continues to be a major foodborne illness, causing more than 1,000 reported cases in Massachusetts every year.

Better sanitation and increased food safety represent another public health success, but foodborne illness is still a threat. Stories about large multi-state outbreaks of salmonella infection and other foodborne diseases garner much attention, but these would not have been recognized without the work of public health laboratories. "Fingerprinting" the DNA of microorganisms allows investigators to identify relationships among cases that would not otherwise have been detected.

Salmonella infection continues to be a major foodborne illness, causing more than 1,000 reported cases in Massachusetts every year. Many more cases are not diagnosed because individuals do not seek medical attention or receive laboratory testing. Food safety training and programs can prevent salmonella cases, but outbreaks related to large-scale food sources (peanut butter, spinach, pot pies, etc.) are increasingly identified. Salmonella remains a major target of national programs to make food safer.

The impact of prevention programs can be seen in the reduction of egg-related Salmonella Enteritidis in the mid-1990s. There are more than 2,500 different *Salmonella* (serotypes) found worldwide. However, *S.*

Figure 6.4 **Confirmed Salmonellosis Cases**



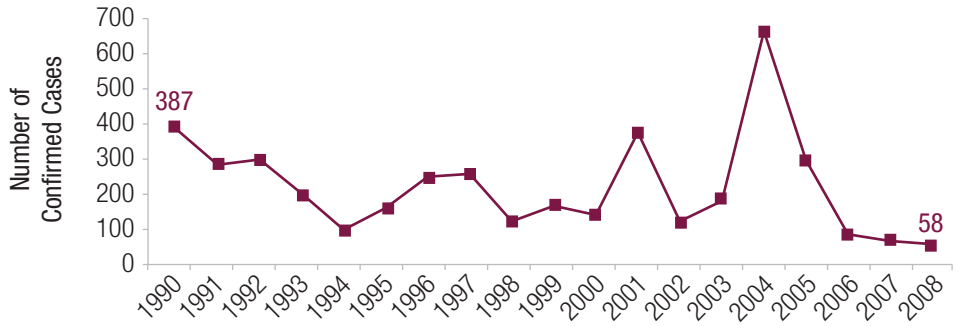
Source: MDPH Disease Surveillance System, 1990-2008.

Enteritidis accounts for a significant proportion of the reported cases in Massachusetts. Twenty years ago a major source of *Salmonella* Enteritidis infection was eggs and poultry. Action directed at reducing infection in poultry and information of safe foodhandling provided to the public reduced the proportion of infections due to this strain of *Salmonella*.

Hepatitis A is another foodborne threat that continues to present challenges to public health. Hepatitis A is an acute illness that affects the liver, but often has minimal or even no symptoms. Rarely fatal, it does not lead to long-lasting infection, but causes fever, tiredness, loss of appetite, stomach pain, nausea, diarrhea and jaundice. Hepatitis A virus is passed by the fecal-oral route and outbreaks occur through poor hygiene, food contamination, and intimate contact. Recent universal immunization of children against hepatitis A has been largely responsible for overall declines in incidence.

Three defined "outbreaks" occurred in recent years (Figure 6.5). Hepatitis A surveillance revealed an epidemic in 1995-1997 among men who have sex with men; an outbreak in 2001 was related to an infected food handler;

Figure 6.5 **Confirmed Hepatitis A Cases**



Source: MDPH Disease Surveillance System, 1990-2008.

and an outbreak in 2004-05 occurred among the homeless, substance users and the incarcerated. These outbreaks demonstrate the continued need for prevention efforts, educating food workers and others about proper hygiene and sanitary food handling.

Insect and Tickborne Illnesses

Infectious disease threats in the environment also include diseases transmitted by ticks and mosquitoes. Changes in the way we live, where we live, and population density are central to the more than 10-fold increase in reported tickborne Lyme disease across the Commonwealth over the past 15 years.

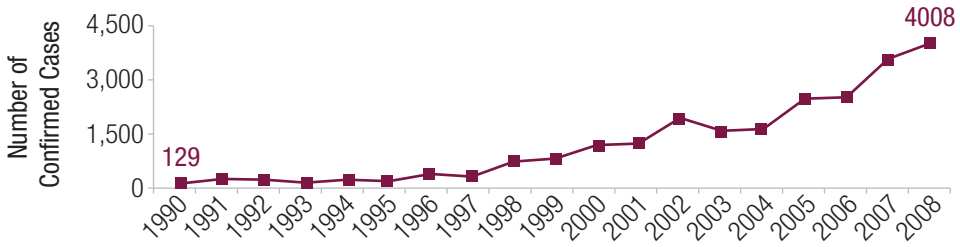
Even with these dramatic increases, we know that many cases are not diagnosed and that most cases are not reported; and thousands of people suffer with illness and potential complications, which can include joint, nerve, and heart problems. Other diseases transmitted by the deer tick are also increasing across the state. Lyme and other tickborne diseases can be prevented by tick avoidance, using tick repellents, and changes in the built environment such a keeping grasses cut short, removing low-lying branches from shrubbery, using deer fencing or choosing plants that do not attract deer.

Figure 6.7 **Confirmed Eastern Equine Encephalitis and West Nile Virus Cases**

	Number of Confirmed Cases (Deaths)	
Year	EEE	WNI
1990	3 (1)	N/A
1991	0 (0)	N/A
1992	1 (0)	N/A
1993	0 (0)	N/A
1994	0 (0)	N/A
1995	1 (1)	N/A
1996	0 (0)	N/A
1997	1 (0)	N/A
1998	0 (0)	N/A
1999	0 (0)	N/A
2000	1 (0)	N/A
2001	1 (0)	3 (1)
2002	0 (0)	22 (3)
2003	0 (0)	17 (1)
2004	4 (2)	0 (0)
2005	4 (2)	6 (1)
2006	5 (2)	3 (0)
2007	0 (0)	6 (0)
2008	1 (0)	1 (1)

Source: MDPH Disease Surveillance System, 1990-2008.

Figure 6.6 **Confirmed Lyme Disease Cases**



Source: MDPH Disease Surveillance System, 1990-2008.

Mosquitoes also transmit diseases across the Commonwealth. Eastern equine encephalitis (EEE), caused by a mosquito-transmitted virus, has a 40-50% mortality rate and a 90% rate of severe neurologic consequences in survivors. It was first described as a human infection in Massachusetts in 1938. Since that time, cases of this disease have continued to occur, primarily in cycles of seven to 19 years.

West Nile Virus infection, another mosquito-transmitted infection, did not occur in North America until 1999. Cases have occurred across the state since 2001. Surveillance, education, and prevention through reduction of mosquitoes and mosquito exposure are key elements of a multi-agency effort to reduce human risk and disease.

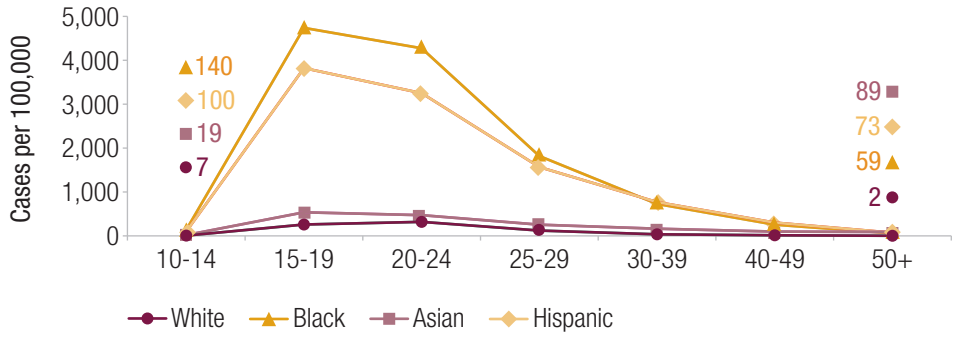
Sexually Transmitted Infections

Sexually transmitted infections are reportable directly to the Massachusetts Department of Public Health. Sexually transmitted bacterial infections, such as chlamydia infection, gonorrhea and syphilis require treating those infected and their sexual partners to prevent complications and further transmission. Left untreated, these diseases can lead to pelvic inflammatory disease, infertility, and in the case of syphilis, neurologic complications.

Syphilis tends to occur in older individuals, while chlamydia infection and gonorrhea are predominantly reported in teenagers and young adults. In 2008, 68% of chlamydia infections and 54% of gonorrhea cases were reported in persons under 25 years of age, an indisputable indicator of levels of unprotected sexual intercourse in these populations.

Comprehensive health education, including sexuality and sexually transmitted diseases, has been shown to be associated with reduced risk of sexually transmitted infection. Reported chlamydia infection has been increasing for 10 years which is attributable partly to successful screening of asymptomatic individuals. Racial and ethnic disparities in rates of chlamydia infection are present in all ages and are increasing. It is critical that appropriate educational and prevention efforts be put in place to address this threat to the health and fertility of the young.

Figure 6.9 **Chlamydia Incidence by Age**



Source: MDPH Disease Surveillance System 2008.

Although down from historic high levels in the 1960s, numbers of cases of reported gonorrhea have been essentially stable for the past five years, with little to no progress in control. Gonorrhea affects men and women nearly equally, and there are marked racial and ethnic disparities in the burden of infection, as seen with chlamydia infection. Appropriate educational and prevention programs are needed to control this serious sexually transmitted infection.

With the adoption of safer sex practices in the 1980s, and the control of a subsequent epidemic of syphilis among crack cocaine and other drug users

Figure 6.8a **Chlamydia Infection by Age (N=17,434)**

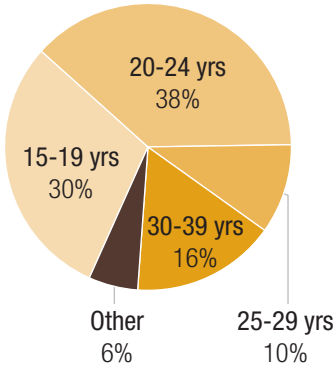
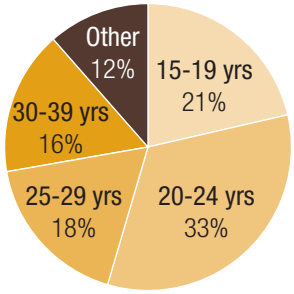
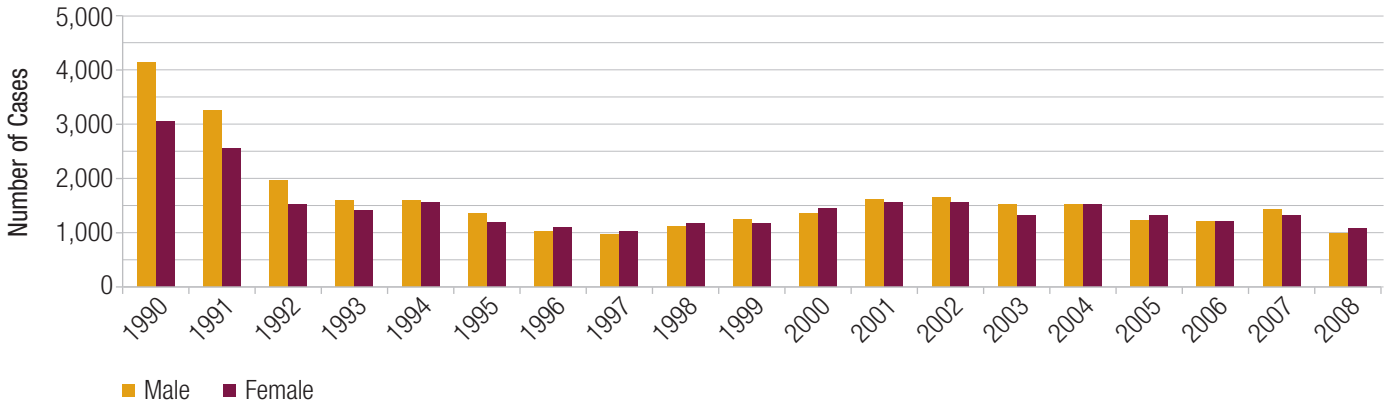


Figure 6.8b **Gonorrhea Infection by Age (N=2,075)**



Source: MDPH STD Surveillance System 2008.

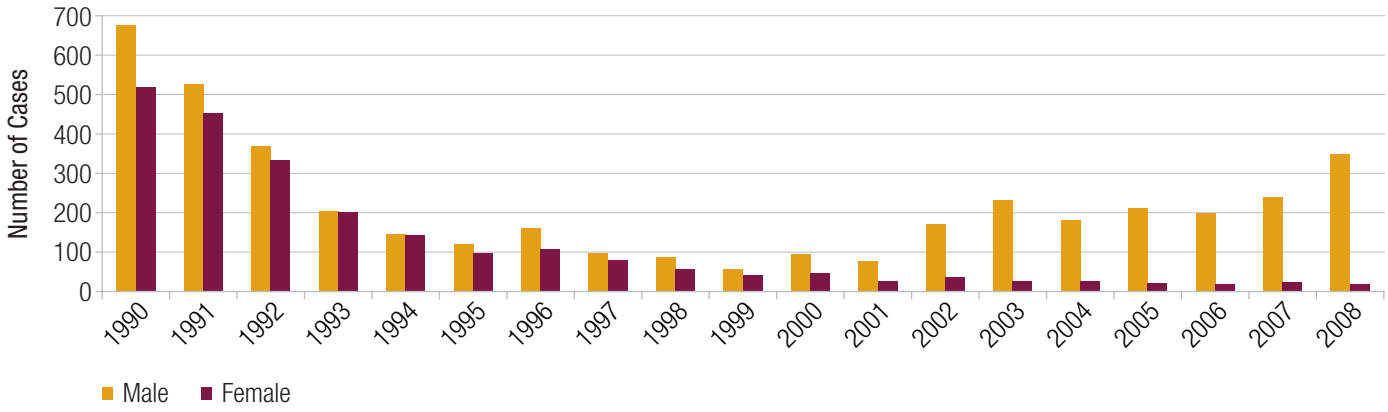
Figure 6.10 **Gonorrhea Cases by Gender**



Source: MDPH Disease Surveillance System, 1990-2008.

in the early 1990s, reported cases of early (infectious) syphilis reached record low levels in the late 1990s. However, since 2000, reported syphilis cases have increased in men, and in particular in men who have sex with men. The use of the Internet to find sexual partners, "prevention fatigue" among older men and the lack of an experience of the early impact of AIDS among younger men contributed to increased unprotected sex and syphilis. These conditions provide new challenges to the prevention and control of this sexually transmitted infection.

Figure **6.11 Infectious Syphilis Cases by Gender**



Source: MDPH Disease Surveillance System, 1990-2008.

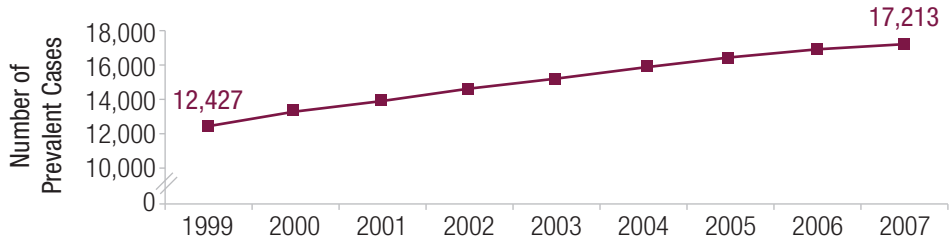
HIV/AIDS

Infection with the human immunodeficiency virus (HIV) is transmitted through unprotected sex and the type of blood contact that comes with sharing contaminated injection equipment. Since the beginning of the epidemic, 29,797 persons have been reported with HIV/AIDS in

Massachusetts. As of December 31, 2008, a total of 17,540 (59%) of these individuals were living with HIV/AIDS, and as many as 8,000 others may be infected and not know they are infected.

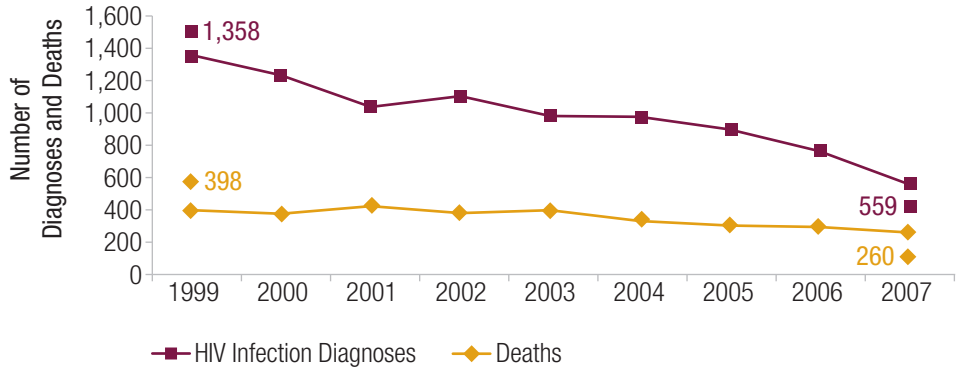
The number of people living with HIV/AIDS increased 38% between 1999 and 2007, and new HIV infection diagnoses exceeded the number of deaths each year. Between 2001 and 2006, newly reported HIV infections decreased by more than 25%, indicating the effectiveness of both prevention programs focused on HIV-risk behaviors and widespread treatment of HIV-infected individuals with antiviral medications, which can reduce their infectiousness. This trend appears to be extending into 2007.

Figure 6.12 **People Living with HIV/AIDS**



Source: MDPH Disease Surveillance System, 1999-2007.

Figure 6.13 **HIV Infection and Death among People Reported with HIV/AIDS**

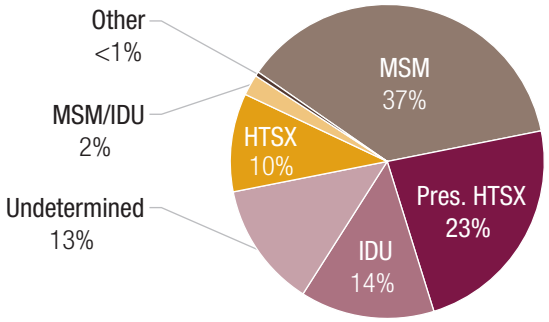


Source: MDPH Disease Surveillance System, 1999-2007.

The leading mode of exposure among persons recently diagnosed with HIV infection in Massachusetts was sexual behavior between men (37% of cases), sharing of injection drug equipment represents an additional 14% of cases. Ten percent of cases were identified as linked to heterosexual exposure with someone infected with HIV or at high risk of infection, while an additional 23% were due to presumed heterosexual sex with a person of unknown HIV status or risk profile.

With increased application of routine HIV testing in pregnancy and effective antiviral therapy, perinatal transmission of HIV infection to newborn babies has been virtually eliminated in Massachusetts.

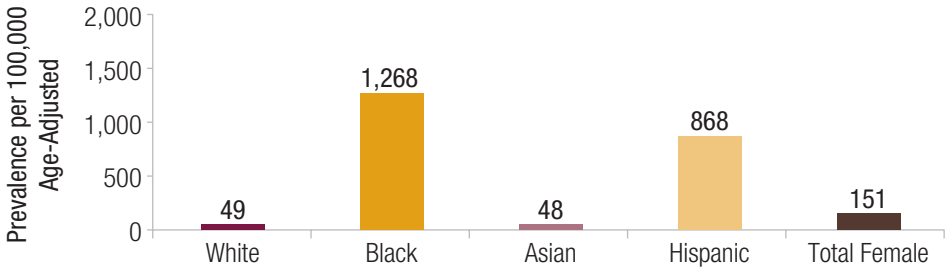
Figure 6.14 **Recent HIV Infection by Exposure Mode**



Source: MDPH Disease Surveillance System, 2005-2007.

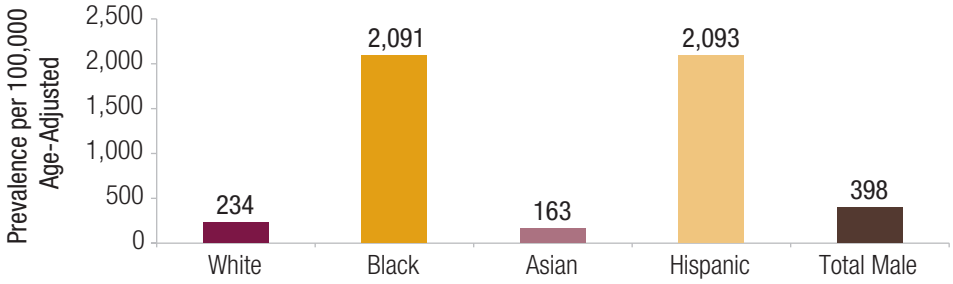
Significant racial and ethnic disparities exist in the distribution of HIV/AIDS. Among Whites, the rate of infection for men and women combined is 139 per 100,000 individuals. Age-adjusted rates among Blacks are 1,644 per 100,000 for men and women combined, a rate 12 times that of Whites. Among Hispanics, age-adjusted rates are 1,438 per 100,000 for men and women combined, a rate 10 times greater than that of Whites. However, these disparities manifest differently in men and women. HIV/AIDS rates for men are substantially higher than for women, yet racial and ethnic disparities exist for both genders.

Figure 6.15 **HIV/AIDS Prevalence Among Females**



Source: MDPH Disease Surveillance System.

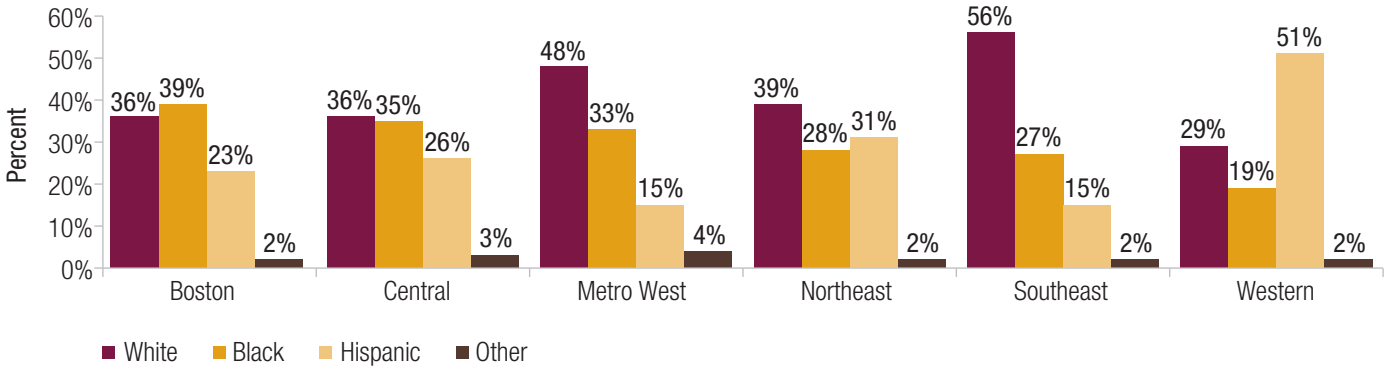
Figure 6.16 **HIV/AIDS Prevalence Among Males**



Source: MDPH Disease Surveillance System.

The distribution of HIV/AIDS by race, ethnicity and exposure varies widely across the Commonwealth. Those born outside the United States account for over 40% of people recently diagnosed with HIV infection in the Northeast and Metrowest areas of the state. In the Western part of the state, the largest proportion of newly diagnosed infections is among Hispanics. Men who have sex with men make up the largest proportion in the Boston, Metrowest and Southeast regions. The largest proportions of women are in the Western, Central, and Northeast regions. Injection drug use is the leading mode of exposure to HIV in the Western and Central regions.

Figure 6.17 **Recent HIV Infection By Health Service Region**



Source: MDPH Disease Surveillance System, 2005-2007.

Persons born outside the United States make up 12% of the population, but account for 20% of people living with HIV/AIDS and 30% of people recently diagnosed with HIV infection.

The differential impact of HIV/AIDS on communities of color demonstrates the critical need for culturally and linguistically appropriate prevention efforts.

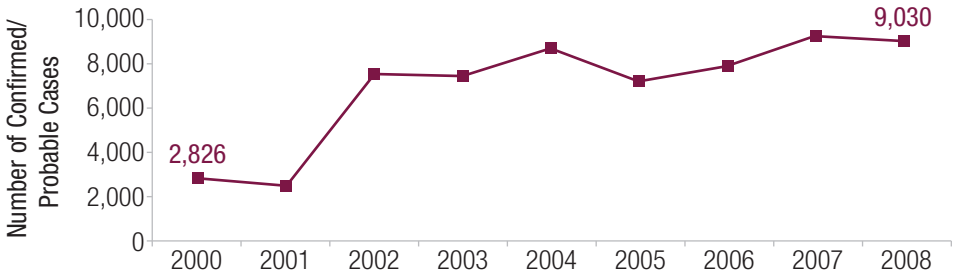
Hepatitis C

Hepatitis C, similar to HIV infection, is transmitted through blood exposure, such as injection drug equipment sharing, needlestick injuries in health care settings, and, before 1992, via blood transfusions. It is estimated that more than 100,000 people in Massachusetts have chronic hepatitis C, and some of them are at risk of cirrhosis, liver failure and liver cancer. A test to diagnose hepatitis C has been available for twenty years, but many people are unaware of their infection because they are not symptomatic and have not sought medical care.

Each year, from 7,000 to 9,000 people recently testing positive for hepatitis C are reported to the Massachusetts Department of Public Health. Most newly-diagnosed cases are in older adults; most of whom were

infected many years ago, but an increasing proportion of newly diagnosed cases is being reported in adolescents and young adults who were almost certainly infected recently. Treatment decisions are complex. Curative treatment is now available, although it can be prolonged, uncomfortable and expensive, and with an uncertain outcome. Untreated people with hepatitis C and those not responding to treatment face the prospect of lifelong chronic infection and the need for ongoing health care services

Figure 6.18 **Confirmed and Probable Chronic Hepatitis C Cases**



Source: MDPH Disease Surveillance System, 2000-2008.

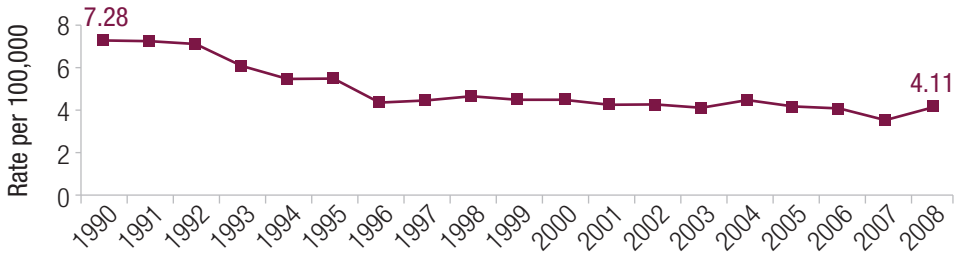
For chronic hepatitis C infection, the difference between a confirmed and probable case are the types of laboratory tests done. Both definitions indicate a strong likelihood of infection; as such, probable and confirmed cases of disease are included together.

Tuberculosis

Tuberculosis (TB) disease can be found in any part of your body but it usually affects the lungs. The most common symptoms of TB disease are coughing, fever, loss of appetite, weight loss, weakness, night sweats and fatigue. While most persons with TB infection control the organism with their immune system and remain in a latent, asymptomatic state, some individuals develop an active form of the illness, causing the symptoms listed above and the risk for transmitting TB to others. In the 19th century, TB was the number one cause of death in Massachusetts. Fortunately, it can be treated successfully and cured, and now causes few deaths. However, TB is still with us and presents new and difficult challenges.

When latent infection is identified by skin test screening, treatment can prevent active TB, and thereby prevent the infected person from someday becoming infectious. More than 80% of the TB cases reported in 2008 were among people born in countries where infection in early life is common. These individuals come from more than 50 different countries, and have different cultures and languages. For this reason, and because skin testing is complicated to administer and read correctly, the challenge of TB prevention is substantial.

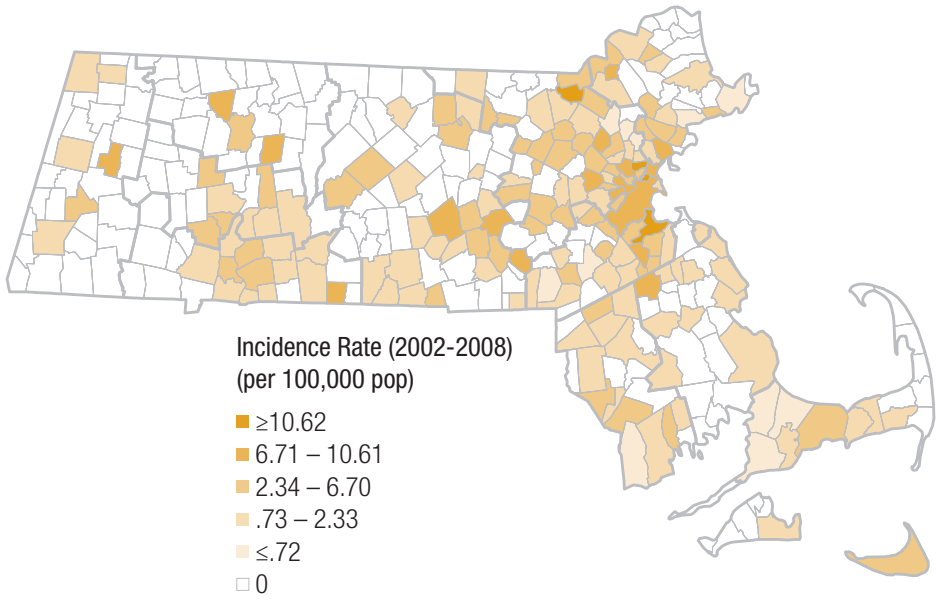
Figure 6.19 **Confirmed Active Tuberculosis Rates**



Source: MDPH Disease Surveillance System, 1990-2008.

TB is one of the most unequally distributed diseases, primarily affecting communities of color, non-US born individuals, and the poor. In 2008, 80% of TB cases occurred in members of the minority community. Eighty-two percent of people with TB were born outside the US. The oldest and poorest cities in the Commonwealth have the most TB.

Figure 6.20 **Average Annual Tuberculosis Incidence Rate**



Source: MDPH Disease Surveillance System, 2002-2008.

Despite vaccines, antimicrobials and all of the advances of modern medicine, infectious diseases still present a challenge to public health. The characteristics of modern life; travel, population growth and medical treatment that results in suppression of immunity creates new opportunities for infectious agents and new vulnerabilities to infection. Thus, the broad spectrum of historical and emerging infectious diseases requires continued vigilance, and attention to prevention and control. These prevention and control efforts must be multi-factorial and involve multidisciplinary approaches that include basic science, disease surveillance, education, health promotion,

clinical services, behavioral interventions and the use of vaccines and antimicrobials; approaches that have already proved effective. These are the essential components of public health infectious disease control.

Policy Perspective: Infectious Disease

Donna Bright
Director of Evaluation, Research and Planning
JRI Health, a division of Justice Resource Institute

We now know that as long as humans are social beings and interact with a constantly changing environment, infectious diseases are here to stay. Vigilant prevention, early detection and effective treatment/interventions have been our best hope of minimizing disease and death. Yet new and persistent trends pose complex challenges to these public health response strategies. Emerging infections remain among the principal challenges to human survival. An increasingly mobile population provides opportunity for more widespread transmission. Increasing antibiotic resistance and growing numbers of immunocompromised patients threaten intervention efforts. Lastly, poverty and other social inequalities are stubborn determinants of health that challenge surveillance efforts and make prevention and treatment of infectious disease disparate and complicated. How do we use tried and true public health tools (epidemiology, prevention and multi-level intervention strategies) in new and better ways that keep pace with current and emerging trends?

Recent public health priorities speak to addressing health disparities found across relevant demographics: race, age, gender, sexual orientation and socioeconomic status. We recognize that key aspects of one's living and working circumstances and their lifestyles are influenced by these demographics and determine one's health. A fundamental premise of the social determinants approach is that there are many non-biological reasons for health inequities that can be targeted and addressed via social and economic policies. Many health policy experts believe that shifting our public health efforts toward addressing these structural factors (such as housing, discrimination, poverty) would go a long way in minimizing disease and disparities.

A 2008 report by the World Health Organization's Commission on the Social Determinants of Health – "Closing the gap in a generation: health equity through action on the social determinants of health" – calls for three principal areas of action:

- tackle the daily living conditions in which people are born, grow, live, work and age;
- tackle the structural drivers of those conditions at global, national

and local levels;
- carry out more research to measure the problem, evaluate action and increase awareness.

This is our next greatest challenge to preventing infectious disease: better integrating public health tools with community strategies that advocate social justice. Public health departments can make the case to policy makers for enacting social and economic policies that address the root of health inequities (such as poverty and discrimination) and for funding effective responses to social determinants of health. Departments can do this by generating clear evidence of the causal pathways (both proximal and distal) of social determinants of health *and* by strategic communication of that evidence. Similarly, a case can be made to the general public for organizing around a collective response: taking action that influences political priorities, health care and other organization policies or action that changes community norms.

For example, comprehensive sex education has been shown to be associated with reduced risk of sexually transmitted infections, yet Massachusetts does not require sex education in schools; and many parents are ill equipped to teach their children about not only abstinence as the best method for avoiding STIs and unintended pregnancy, but also about condoms and contraception to reduce the risk, and about the interpersonal and communication skills that help young people explore their own values, goals, and options.

The Massachusetts Department of Public Health could work across government and private agencies to aggregate the evidence and generate new evidence as needed to stimulate debate and make a more compelling case for changing school policies, particularly in districts with high prevalence of STIs among youth. In the meanwhile, more public health funding could be allocated for community based organizations to implement and test culturally specific sex education curricula among high risk youth, and educate parents – in an effort to change community norms, learn from practice and provide additional resources for informing school boards and state policy. Similar combinations of public health and community strategies can be employed to make the case for stably housing all residents or for on-demand access to drug treatment as critical health promotion and disease prevention tools. Perhaps most important, public health departments could help generate the political will for action.

FIGURE NOTES

Figure 6.1: For 2000-2001: ≥ 4 DTP, ≥ 3 Polio, ≥ 1 Measles-containing vaccine, ≥ 3 Hib, and ≥ 3 HepB. 2002-2008: ≥ 4 DTaP/DTP, ≥ 3 Polio, ≥ 1 Measles-containing vaccine/MMR, ≥ 3 Hib, ≥ 3 HepB, and ≥ 1 Varicella.

Figure 6.2-6.11: Data as of August 2009 and are subject to change.

Figure 6.7: WNI was not reportable in Massachusetts until 2003.

Figure 6.12-6.17: Data as of January 2009 and are subject to change.

Figure 6.14: Data as of January 2009 for HIV infection diagnosed between 2005 and 2007. MSM = Male-to-Male Sex, Pres. HTSX = Presumed Heterosexual Sex, IDU = Injection Drug Use, HTSX = Heterosexual Sex.

Figure 6.15-6.16: Age-adjusted prevalence based on 2000 population estimates from the MDPH Center for Health Information, Statistics, Research and Evaluation. API = Asian/Pacific Islander.

Figure 6.17: For HIV infection diagnosed between 2005 and 2007.

Figure 6.18: Data as of August 2009 and are subject to change.

Figure 6.19: Rates per 100,000 population. Data as of August 2009 and are subject to change.

Figure 6.20: Rates per 100,000 population. Incidence cases as of August 2009 aggregated from years 2002-2008.