



# Communicable Disease in Kent County

**Part II:**

**Vaccine-Preventable Diseases**



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REPORT TO THE  
COMMUNITY 2001

## Preface

Communicable diseases are illnesses that are contagious — infections that are transmitted directly from a person or animal to another, or passed indirectly through contaminated food or water. Communicable diseases are caused by a variety of agents — bacteria, viruses, and other organisms — and can be transmitted a variety of ways: physical contact with the body or blood of an infected person or animal, through air, food, or water, and through sexual activity. Communicable diseases also cause a wide range of illnesses — from nuisance colds and respiratory infections from which people typically recover quickly, to severe sicknesses resulting in multiple organ failure and almost certain death. In spite of extraordinary scientific and technological progress in public health generally and health care specifically, communicable diseases continue to be one of the most common health problems people face.

The purpose of this report is to provide an overview and understanding of communicable disease, how communicable diseases are transmitted, and how they impact the population of Kent County. An overview of epidemiology — the study of disease in the popula-

tion and how to control it — highlights the role of the public health department in the prevention, surveillance, and control of communicable disease in the community. Finally, an examination of how the Kent County Health Department tracks and investigates all types of communicable diseases, as well as an epidemiological assessment of communicable disease in Kent County, provides a foundation for the development and implementation of community-based disease prevention and education programs.

Because any discussion of ‘communicable disease’ encompasses a wide range of illnesses, modes of transmission, and methods of prevention, this report has three parts. Part I examines gastrointestinal and diarrheal illnesses generally associated with food or water-borne disease organisms. This section, Part II, explores vaccine-preventable diseases — communicable diseases for which there are existing vaccines — and their incidence and prevalence in the community. The final section of this report, Part III, examines sexually transmissible infections including AIDS and HIV, as well as hepatitis and tuberculosis in the community.

## Introduction

Public health programs to control infectious disease in the 20<sup>th</sup> century were founded on the discovery of microorganisms (i.e., “germs” — bacteria, viruses) as the causes of many diseases. Subsequent disease control technologies — improvements in sanitation and hygiene, food safety, the development of antibiotics, and the implementation of universal childhood vaccination programs — were all aimed at reducing the spread of these disease-causing microorganisms. These advances in disease control, coupled with a growing understanding of the interconnectedness of humans, the environment, and microbes, resulted in the control of many fatal infectious diseases, as well as the global eradication of the variola (small pox) virus. The U.S. Centers for Disease Control and Prevention (CDC) recognizes communicable disease control,

### Schedule of Recommended Childhood Immunizations by Age

At birth	Hepatitis B
1-2 months	Hepatitis B
2 months	IPV (injectable poliovirus) DTaP (diphtheria, tetanus, pertussis) Hib (haemophilus influenzae type b) PCV 7 (pneumococcal conjugate)
4 months	IPV, DTaP, Hib, PCV 7
6 months	DTaP, Hib, PCV 7
6-12 months	Hepatitis B, IPV
12-15 months	MMR (measles, mumps, rubella) Varicella (chicken pox) DTaP Hib PCV 7
4-5 years	IPV, DTaP, MMR
11-12 years	Td (tetanus, diphtheria) Varicella (if necessary)
Every 10 years	Td

and specifically vaccinations (immunizations), as one of the leading public health achievements of the 20<sup>th</sup> century.

Although the small pox vaccine was available as early as 1796, it was not until after 1900 that use of the vaccine to prevent disease became widespread, and eradication of the disease was achieved in 1978. Today there are 26 vaccines that have been developed and licensed, 11 of which are recommended for use in all U.S. children, and 10 for use in selected high-risk child and adult populations. Since 1955, when federal funds were appropriated for polio vaccination, federal, state and local governments, as well as public and private healthcare providers, have collaborated to develop and maintain the vaccine-delivery system in the U.S.

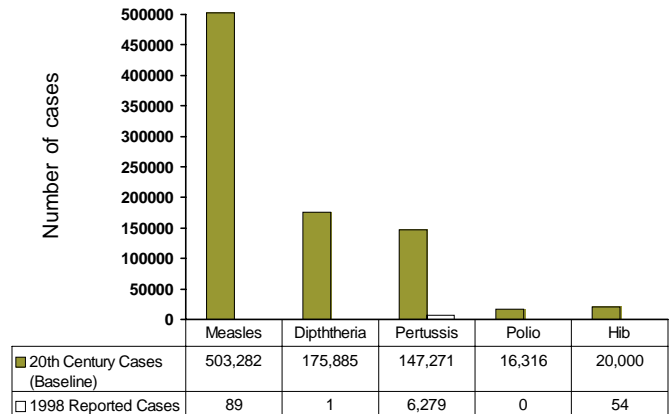
# Vaccination Coverage and Disease

Vaccination coverage — the percentage of children and adults immunized — in the U.S. is currently at record high levels (although it is not and will likely never be 100%). In 1999, immunization coverage among children aged 19-35 months was 90% or greater for three or more doses of diphtheria, tetanus and pertussis vaccine (DTaP); three or more doses of polio vaccine; three or more doses of Hib vaccine; and one or more doses of measles vaccine. Coverage with the recommended *four* doses of DTaP was 81%, and coverage for all three doses of hepatitis B vaccine was 88%. Varicella (chicken pox) coverage for children 19 to 35 months had reached 59%. Among adults, immunization coverage tends to be somewhat lower: only 65% of people over 65 years of age received the flu vaccine in 1997, and 45% of seniors had ever received pneumococcal (pneumonia) vaccine.

When comparing historical 20<sup>th</sup> century ‘pre-vaccination era’ disease levels to those at the end of the 1990’s, the effectiveness of vaccination on reducing disease is obvious (see graph, right). Vaccine-preventable disease outbreaks have occurred in children and adults when vaccination levels have dropped. While transmission of vaccine-

preventable diseases in the U.S. is today extremely limited, each of these diseases still circulates in populations around the globe. When an international traveler who has a vaccine-preventable disease comes into the U.S. from abroad, unvaccinated persons are at risk of becoming infected with it.

## Cases of Vaccine-Preventable Disease in the U.S., 20th Century and 1998



# Vaccination Programs

The Kent County Health Department is committed to controlling and reducing vaccine-preventable disease by promoting and administering immunizations, and by investigating all cases of vaccine-preventable illness in Kent County. The Health Department operates eight

community public health clinics where children can receive recommended immunizations at no cost, as well as other health promotion and screening services. Over 60,000 vaccinations and TB tests are given in Kent County Public Health Clinics each year.

### Disease Surveillance and Investigation

The goals of surveillance and epidemiological investigation of the occurrence of vaccine-preventable diseases are to:

- Rapidly identify cases of vaccine-preventable disease that may threaten the public’s health;
- Implement post-exposure prophylaxis or other prevention measures to prevent spread of the disease;
- Identify the populations at most risk of contracting vaccine-preventable disease;
- Develop vaccination prevention strategies that target high-risk persons;
- Evaluate the adequacy of vaccine programs for protecting the public’s health; and
- Develop effective vaccine-preventable disease prevention and education messages.

In 1993, a retrospective study of children entering kindergarten in Kent County during the 1990-1991 school year revealed that only 43% had been appropriately immunized at age two. The study, done to coincide with the federal government’s Childhood Immunization Initiative (CII), also found that Michigan reported the lowest vaccination rates nationwide. Since that time, initiatives on the local, state, and federal levels have all worked to improve immunization rates. The federal Vaccines For Children (VFC) program has increased access to immunization for uninsured and underinsured children, while physician education programs seek to eliminate missed vaccination opportunities. A state law that took effect in the late 1990’s requiring children in childcare or preschool be immunized for Hepatitis B has had a great impact on immunization rates. The Kent County Health Department has integrated immunization into the Women Infant Children (WIC) Program to further reduce missed opportunities to immunize children. By 1997, the Kent County immunization rate had climbed to 86%, somewhat higher than the overall Michigan immunization rate of 79%.

## Six Common Misconceptions about Vaccination

### 1. Diseases had already begun to disappear before vaccines were introduced, because of better hygiene and sanitation.

Undoubtedly, better hygiene and sanitation has contributed to declines in disease. However, significant declines in disease occurrence have been documented to coincide with the introduction of vaccine for many diseases.

### 2. The majority of people who get disease have been vaccinated.

Most routine childhood vaccines are effective for 85% to 95% of recipients. In outbreak situations, most unvaccinated exposed persons will get the disease. Because vaccinations are not 100% effective, a small percentage of vaccinated persons will get the disease. One community-based study showed that the rate of measles was 22 times higher, and the rate of pertussis six times higher, in unvaccinated children than in vaccinated children.

### 3. There are “hot lots” of vaccine that have been associated with more adverse events and deaths than others.

Reviewing published lists of “hot lots” will not help parents identify the best or worst vaccines for their children. This is because 1) the reports of health problems are only those that occur around the time the vaccination was received; they are not necessarily the cause of the problem, and 2) because comparison of adverse events need to be made based on the lot size, as they can vary from several hundred thousand to several million doses.

### 4. Vaccines can cause harmful side effects, illnesses, and even death.

Vaccines are actually very safe, and continue to be made safer. Most vaccine adverse events are minor and temporary, such as a sore arm or mild fever. More serious adverse reactions, or vaccine-related deaths are so rare (on the order of one per hundreds of thousands of vaccinations) that the risk cannot be accurately assessed. However, investigations and detailed records of adverse reactions are made in order to identify any potential association of side effects with a vaccine or vaccination.

### 5. Vaccine-preventable diseases have been virtually eliminated from the United States, so vaccination is not necessary.

Vaccine-preventable diseases are very rare in the U.S., but they have not been eliminated; nor have they been eliminated in other parts of the world. For these reasons, vaccination continues to be necessary, and important. Being vaccinated also protects others, by reducing the ability of a disease to spread in the population.

### 6. Giving a child multiple vaccinations for different diseases at the same time increases the risk of harmful side effects and can overload the immune system.

Several studies have shown that simultaneous administration of vaccines in combination is as safe and effective as any vaccine alone. Providing vaccines simultaneously allows for early protection of children and, on a more practical level, reduces the number of office visits -- and shots -- required to achieve protection.

However, although these rates were improving, missed opportunities continued to be the leading reason children were not vaccinated completely, or on time, and the need to track individual immunization records became increasingly obvious. In 1997, the Michigan Legislature authorized funding for the Michigan Childhood Immunization Registry (MCIR), a statewide electronic childhood immunization registry that is accessible by public and private healthcare providers. The MCIR tracks a child’s immunization history so any provider can know immediately if a child’s immunizations are up-to-date, and if not, which vaccines the child needs. Two main advantages of the MCIR, and of electronic immunization registries generally, are that they help prevent missed immunization opportunities, and help prevent duplicate vaccinations. Children under two years of age are the most vulnerable to vaccine-preventable diseases, and 80% of recommended vaccinations should be given before the second birthday; the MCIR helps providers keep track of the many immunizations given early in life.

Although immunization rates are measured somewhat differently than they were in 1993, the current completion rate for Kent County Health Department clients (children 19-35 months of age) for five of the recommended childhood vaccinations has reached 89% (April, 2001). In addition, 98.5% of children entering school in Kent County have up-to-date immunizations.

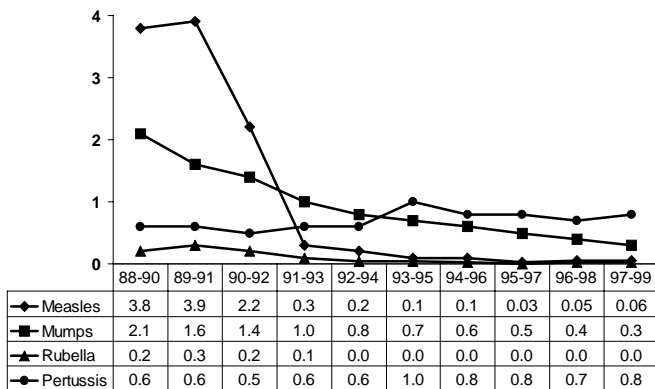
In addition to childhood immunization, immunization for international travelers continues to be an important disease prevention measure. Travel immunizations help protect travelers from diseases they may encounter in other parts of the world -- where sanitation and disease control may not be as developed as in the U.S. -- and prevent them from bringing these diseases back into the U.S. where they can be spread to others. Recommended travel immunizations vary depending upon a traveler’s destination. Contact the local health department at least two months prior to traveling abroad to determine what immunizations are needed.

# Vaccine-Preventable Disease Surveillance and Prevention

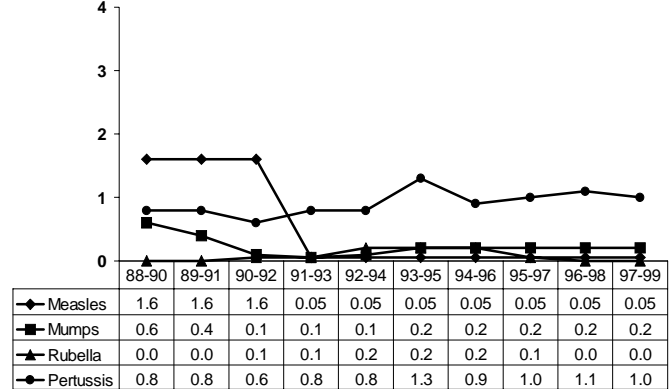
Vaccination is responsible for a significant decline in the occurrence of many diseases in the U.S. However, continued surveillance of vaccine-preventable disease, and monitoring vaccination coverage generally, help the public health system identify under-vaccinated populations, and evaluate efforts to increase coverage. An estimated 11,000 children are born each day in the U.S., each requiring 15-19 doses of vaccine by 18 months of age in order to be protected from 11 potentially fatal childhood diseases. Assuring access to immuni-

zation for people in all age groups, and at all socioeconomic levels, is critical to maintaining and increasing vaccination coverage rates even further. The CDC suggests, however, that low-income and minority children (and adults) are at greater risk for under-immunization. Ensuring that rates of immunization coverage remain high, and addressing disparities in rates where they are identified, will continue to require the collaboration and cooperation of national, state, local, private, and public partners.

**Rates of Vaccine-Preventable Diseases in Michigan, 1988-1999 (per 100,000 population)**



**Rates of Vaccine-Preventable Diseases in Kent County, 1988-1999 (per 100,000 population)**



## Overview of Vaccine-Preventable Diseases

The diseases listed on the following pages are all vaccine-preventable. They are also all on the list of nationally notifiable diseases, meaning that if a case of any of these diseases is diagnosed by a health care provider or laboratory anywhere in the U.S., it must be reported to the local or state health department.

The Kent County Health Department Communicable Disease Unit investigates all reports of vaccine-preventable disease in Kent County, and identifies individuals at risk of contracting it. When a case of vaccine-preventable disease is confirmed, the Health Department provides confidential education to the infected individual, and often to close contacts of the individual, about how to prevent the disease from infecting others. The Health Department also provides necessary post-exposure treatment to at-risk contacts of the infected person. As part of these disease control activities, the Kent County Health Department also notifies the Michigan Department of Community Health, Bureau of Epidemiology, and issues alerts to local health care providers, in order to prevent an outbreak of disease.

Without vaccination, these tasks would be much more difficult, would occur more frequently, and losses -- both economic and human -- associated with disease would be greater.

### Types of Vaccines and How They Work

There are only two types of vaccines: live attenuated and inactivated. The characteristics of live and inactivated vaccines are different, and determine how the vaccine is used.

Live attenuated vaccines are produced by modifying a disease-producing ("wild") virus or bacteria in a laboratory. The resulting vaccine organism retains the ability to replicate (grow) and produce immunity, but usually does not cause illness. Current vaccines for diseases using this approach are; measles, mumps, rubella, polio (OPV), yellow fever, vaccinia, varicella.

Inactivated vaccines can be composed of either whole or partial bacteria or viruses. Toxoids and polysaccharide vaccines are types of inactivated vaccines and are composed of fractions of bacterial cell wall (polysaccharide vaccines) or bacterial toxins (toxoids). Generally, three to five doses are required before immunity to the disease. Current vaccines using this approach are; influenza, polio (IPV), rabies, hepatitis A, pertussis, diphtheria, tetanus, pneumococcal, meningococcal, and Hib.

## Overview of Vaccine-Preventable Diseases

### Polio (Poliomyelitis; Infantile paralysis; Polioviral fever)

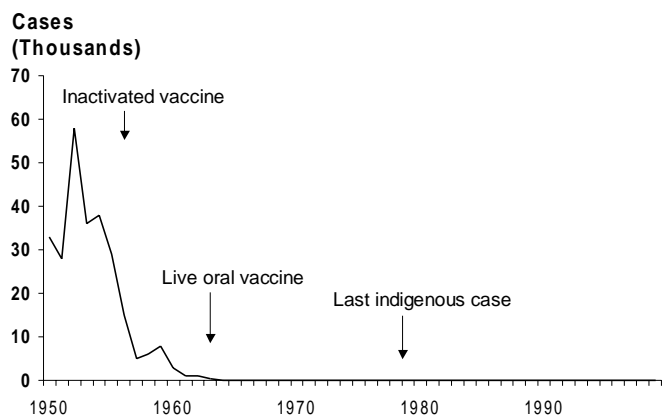
#### Epidemiology:

Polio vaccine was introduced in the U.S. in 1955. Since then, cases of polio have declined significantly and wild poliovirus has been eradicated from the Western Hemisphere. The last documented indigenous transmission of wild poliovirus in the U.S. occurred in 1979. The only cases reported recently have been associated with international travelers, or with oral poliovirus vaccine. The last documented case of polio in Michigan was in 1987.

Along with a decrease in the number of people affected, vaccination provides economic and social benefits. In 1994, it was estimated that every dollar spent to administer oral polio vaccine saved \$3.40 in direct medical costs and \$2.74 in indirect societal costs. The savings will be even higher as polio vaccination campaigns continue and polio, like small pox, is eradicated worldwide.

<b>Organism:</b>	Virus
<b>Transmission:</b>	By accidentally ingesting fecally-contaminated food, water, or by transfer from fecally-contaminated surfaces to the mouth.
<b>Symptoms:</b>	Fever, sore throat, nausea, headaches, stomachache, and stiffness in the neck, back, and/or legs.
<b>Possible Complications:</b>	Paralysis that can lead to permanent disability and possibly death.
<b>Death Rate:</b>	5 (children)-30 (adults) per 100 cases.
<b>Vaccine:</b>	Injectable Poliovirus Vaccine (IPV); Oral Poliovirus Vaccine (OPV) outside the U.S. Polio vaccination is given four times, at two months, four months, and six months of age, with a final dose prior to starting school, at four to five years of age.
<b>Recommendations</b>	
Children:	For those over six weeks old.
Adults:	For international travelers traveling to countries where poliovirus is endemic; those working in polio laboratories; persons changing diapers of children receiving the oral poliovirus vaccine (OPV).

#### Poliomyelitis (paralytic), United States, 1950-1999



## Overview of Vaccine-Preventable Diseases

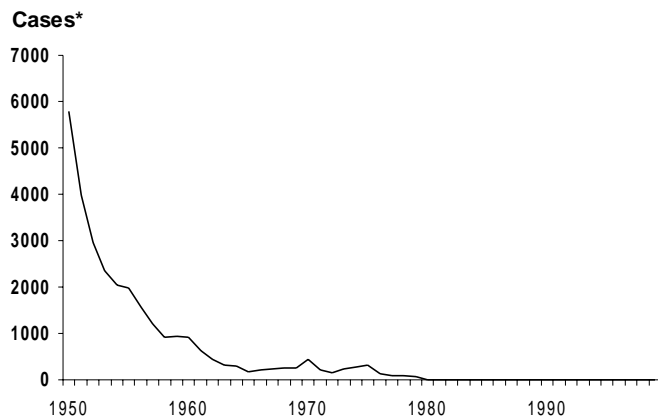
# Diphtheria

### Epidemiology:

Like many vaccine-preventable diseases, diphtheria was a major cause of illness and death for children in the U.S. in the early 1900's; the number of U.S. cases began declining in 1923 with the introduction of diphtheria vaccine. Only one case of diphtheria was reported in the U.S. in 1998. The most recent report of diphtheria in Michigan was in 1980.

Because there are high rates of susceptibility among adults (41%-48% of adults age 60 years and over lack protective levels of circulating antitoxin against diphtheria), and because diphtheria is common in other parts of the world, the U.S. is at continued risk for an outbreak of diphtheria.

### Diphtheria, United States, 1950-1999



\*Widespread use of Diphtheria vaccine began in the 1940's.

<b>Organism:</b>	Bacterial toxin.
<b>Transmission:</b>	By contact with respiratory droplets (from coughing and sneezing) of an infected individual.
<b>Symptoms:</b>	Gradual onset of a sore throat and low grade fever
<b>Possible Complications:</b>	Airway obstruction, inflammation of the heart, paralysis, and death.
<b>Death Rate:</b>	5 (children)-20 (adults) per 100 cases.
<b>Vaccine:</b>	Diphtheria toxoid (contained in DTP, DTaP, DT or Td vaccines).

The diphtheria vaccine is given in a 'cocktail' vaccine that also contains tetanus and pertussis vaccine. The DTaP (diphtheria-tetanus-[acellular] pertussis) vaccine is given five times, at two, four and six months of age, a 12 to 15 months of age, and finally prior to starting school, when a child is four to five years of age. (Note that the 'DTaP' vaccine is also commonly referred to simply as 'DTP.')

The Td (tetanus, diphtheria) vaccine is given to adults, every 10 years, throughout life.

### Recommendations

**Children:** For those over six weeks old.

**Adults:** For all previously unvaccinated or who have not had a booster in 10 or more years.

## Overview of Vaccine-Preventable Diseases

### Tetanus (Lockjaw)

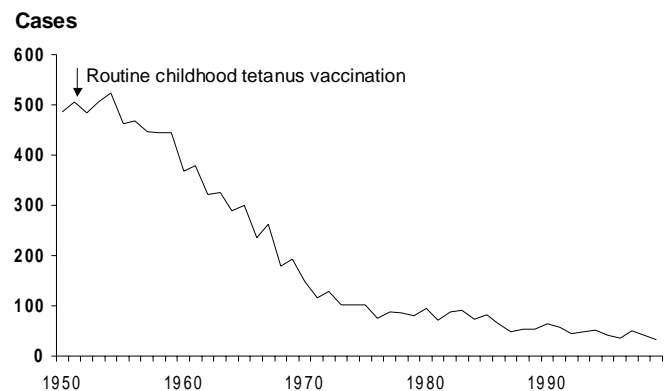
#### Epidemiology:

Tetanus is the only vaccine-preventable disease that is infectious, but not contagious. The organism that causes tetanus is found widely in soil and street dust and in the waste of many animals. Following the development of tetanus vaccine in the late 1940's, the number of cases in the U.S. decreased substantially. Tetanus vaccination must be repeated every seven to 10 years during adulthood to ensure protection from tetanus disease. However, because the organism is found in our environment, adults who do not receive tetanus vaccination every 10 years are at risk of becoming infected; cases of tetanus continue to be reported in the U.S.

A total of 41 cases were reported in the U.S. in 1998, two of which were reported in Michigan. Almost 40% of tetanus cases in the U.S. in 1998 occurred in adults aged 60 years and older, while 40% of cases were in adults between the ages of 20 and 59. Improved vaccination compliance among adults will help reduce the number of cases in the U.S. further.

<b>Organism:</b>	Bacterial toxin.
<b>Transmission:</b>	Enters the body through a break in the skin.
<b>Symptoms:</b>	<u>Early:</u> lockjaw, stiffness in the neck and abdomen, and difficulty swallowing; <u>Later:</u> fever, elevated blood pressure, and severe muscle spasms.
<b>Possible Complications:</b>	Spasms of the vocal chords, fractures of spine and long bones, pneumonia, and death.
<b>Death Rate:</b>	30 per 100 cases, especially in people over 50.
<b>Vaccine:</b>	Tetanus toxoid (contained in DTP, DTaP, DT or Td vaccines).
<b>Recommendations</b>	
Children:	For those over six weeks old.
Adults:	For those previously unvaccinated or who have not had a booster in 10 or more years.

### Tetanus, United States, 1950-1999





Overview of Vaccine-Preventable Diseases

## Pertussis (Whooping cough)

**Epidemiology:**

Before pertussis vaccine was available, nearly all children developed whooping cough. In the U.S., between 150,000 and 260,000 cases of pertussis were reported each year, with up to 9,000 pertussis related deaths. After introduction of the vaccine in the 1940's, the case rate declined to approximately 8 cases per 100,000 population by 1960. From 1980 to 1990, the national case rate for pertussis was approximately 1 case per 100,000 population, similar to that reported in Michigan and Kent County during that time. Between 1995-1999, 60% of pertussis cases reported in Kent County were children under 10 years of age.

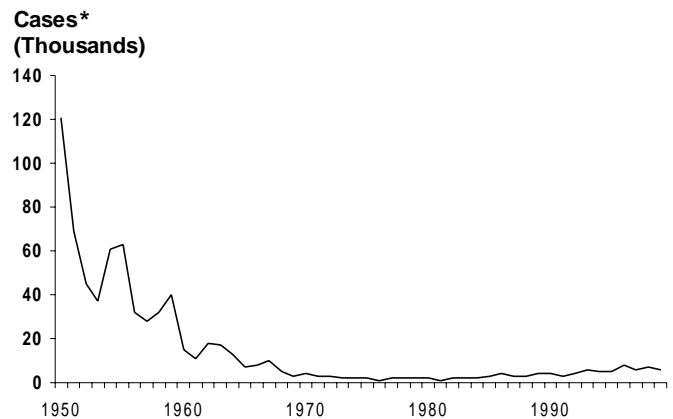
A gradual increase in reported cases of pertussis has been identified nationwide since 1990, a trend that has also been observed nationally, in Michigan, and in Kent County (see chart, page 4). While the exact cause of this increase is not fully understood, increased detection and reporting, as well as an observed three to five year cycle of pertussis, may be contributing factors.

<b>Organism:</b>	Bacteria
<b>Transmission:</b>	By contact with respiratory droplets (from coughing and sneezing) of an infected person.
<b>Symptoms:</b>	Severe spasms of coughing that can interfere with eating, drinking, and breathing.
<b>Possible Complications:</b>	Pneumonia, seizures (due to lack of oxygen), and death, especially in infants.
<b>Death Rate:</b>	2 per 1000 cases (84% of deaths in 1990-1996 occurred in infants less than six months old).
<b>Vaccine:</b>	Pertussis vaccine (contained in DTaP vaccine).

**Recommendations**

Children: For those six weeks of age and older.  
 Adults: No licensed vaccine for children over seven years old.

**Pertussis, United States, 1950-1999**



\*Widespread use of Pertussis vaccine began in the 1940's.

## Overview of Vaccine-Preventable Diseases

### Measles (Rubeola; Hard measles; Red measles; Morbilli)

#### Epidemiology:

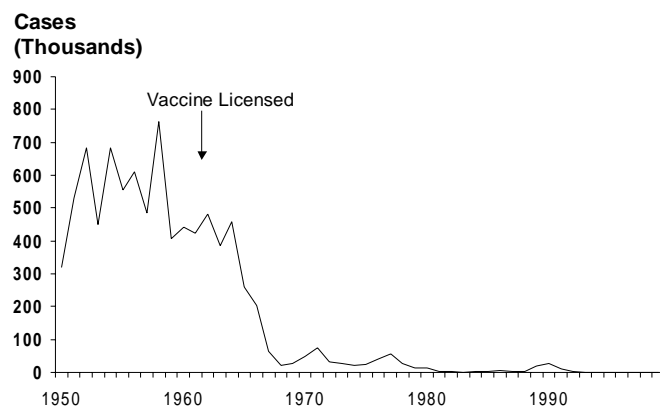
Before measles vaccine was available, nearly everyone in the U.S. contracted measles. There were approximately 3 to 4 million measles cases each year, and an average of 450 measles-associated deaths were reported each year between 1953 and 1963.

Following licensure of measles vaccine in 1963, the incidence of measles decreased by more than 98% in the U.S. In 1978, a Measles Elimination Program was instituted to eliminate indigenous measles, and by 1983, the total annual number of cases reported was the lowest ever (0.6 cases per 100,000 population or 6 cases per 10,000,000 people). Unfortunately, measles cases then began to increase, more than doubling to 1.5 cases per 100,000 by 1988. No substantial declines were reported between 1983 and 1989.

From 1989 to 1991, a dramatic increase in measles nationwide — and globally — was also seen in both Michigan and Kent County (3.8 and 1.6 cases per 100,000 population, respectively, 1988-1991) (see charts, page 4). During this time, a total of 123 measles-associated deaths were reported; 90% of fatal cases had no history of measles vaccination.

As a result of this outbreak, vaccination efforts were intensified and focused on preschool aged children, and measles cases, again, dropped dramatically. In 1998, only 100 cases of measles were reported in the U.S., an all-time low. The 1997-1999 three-year average case rates are currently 0.06 per 100,000 population in Michigan, and 0.05 cases per 100,000 in Kent County. The majority of cases reported currently are generally a result of the virus being ‘imported’ from abroad by an infected international traveler.

#### Measles, United States, 1950-1999



**Organism:** Virus.

**Transmission:** By contact with respiratory droplets (from coughing or sneezing) of an infected person.

**Symptoms:** Rash, high fever, cough, runny nose, and red, watery eyes (lasts about a week).

**Possible Complications:** Diarrhea, ear infections, pneumonia, encephalitis, convulsions, and death.

**Death Rate:** 1 to 2 per 1,000 cases

**Vaccine:** Measles vaccine (contained in MMR)

The measles vaccine is given in a ‘cocktail’ vaccine that also contains mumps and rubella vaccine. The MMR (measles-mumps-rubella) vaccine is given twice, first when a child is 12 to 15 months old, and again when a child is four to five years old.

#### Recommendations

**Children:** For those 12 months of age and older.

**Adults:** Not recommended for individuals with blood tests that show immunity; men born before 1957; women born before 1957 and not having more children; those who have already had one dose of MMR and are not at high risk of measles exposure; those who already had two doses of MMR or one dose of MMR plus a second dose of measles vaccine.

Recommended for individuals not in the above category and a college/trade student beyond high school; work in a hospital or medical facility; travel internationally or are a passenger on a cruise ship; and are women of childbearing age.

Overview of Vaccine-Preventable Diseases

# Mumps (Infectious parotitis)

**Epidemiology:**

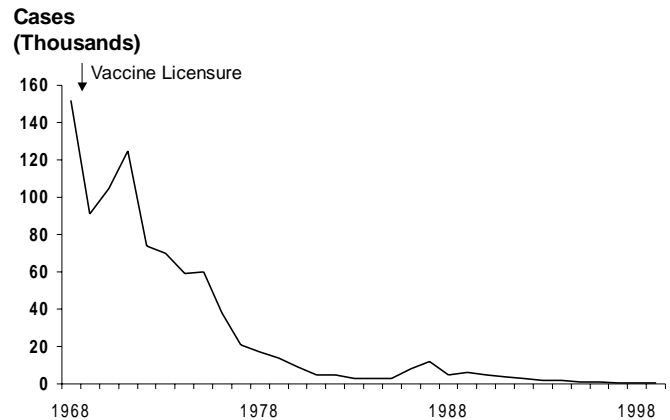
As with other vaccine-preventable diseases, the number of mumps cases dropped substantially following introduction of the mumps vaccine, in 1967. By 1985, the case rate was as low as 1.4 cases per 100,000.

However, as had been the case with measles, there was a resurgence of mumps cases nationwide that peaked in 1987. This resurgence was related primarily to cases of mumps in older school-age children and college-age youth (10-19 years of age) who were born before routine mumps vaccination was recommended, and mumps incidence in this period correlated with an absence of comprehensive state requirements for mumps vaccination.

The addition of a second dose of mumps vaccine has likely contributed to the continued decline in reported cases of mumps: only 666 cases of mumps were reported in the U.S. in 1998. The 1997-1999 three-year average case rates are 0.3 per 100,000 (3 cases per million) population in Michigan (down from 2.1 in 1989), and 0.2 cases per 100,000 in Kent County (down from 0.6 in 1989) (see chart, page 4). Vaccination levels within the community will need to be monitored and maintained – a task made easier by the Michigan Childhood Immunization Registry – to prevent another resurgence of mumps and other vaccine-preventable diseases.

<b>Organism:</b>	Virus.
<b>Transmission:</b>	By contact with respiratory droplets (from coughing or sneezing) of an infected person.
<b>Symptoms:</b>	Fever, headache, muscle ache, and swelling of the salivary glands close to the jaw.
<b>Possible Complications:</b>	Meningitis, inflammation of the testicles or ovaries, inflammation of the pancreas and hearing impairment (usually permanent).
<b>Death Rate:</b>	1-3 per 10,000 cases.
<b>Vaccine:</b>	Mumps vaccine (contained in MMR).
<b>Recommendations</b>	See Measles vaccine recommendations.

Mumps, United States, 1968-1999



## Overview of Vaccine-Preventable Diseases

### Rubella (German measles; Congenital rubella syndrome)

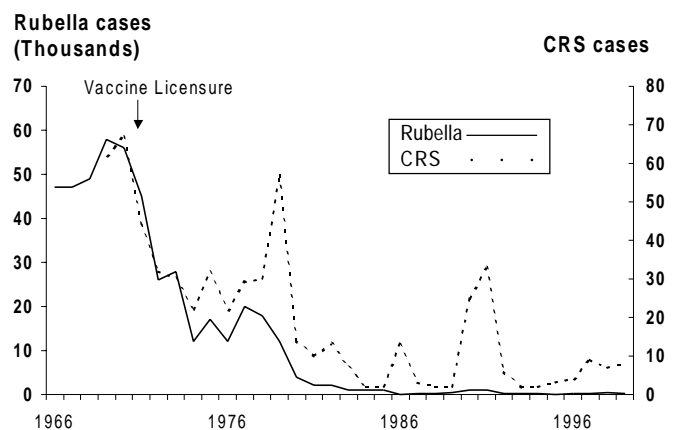
#### Epidemiology:

In 1964-1965, there was an epidemic of rubella in the U.S. that caused an estimated 20,000 infants to be born with congenital rubella syndrome (CRS), as well as 2,100 neonatal deaths, and 11,250 miscarriages. Of the 20,000 infants born with CRS, 11,600 had hearing impairment, 3,580 had vision impairment, and 1,800 had other mental disabilities.

Following vaccine licensure in 1969, rubella incidence fell rapidly. By 1983, fewer than 1,000 cases per year were reported (fewer than 0.5 cases per 100,000 population). The most recent case of congenital rubella syndrome in Michigan occurred in 1996; the most recent case of rubella in Michigan was reported in 1998. The case rate in Michigan and Kent County has been below 0.5 per 100,000 population since at least 1987 (see chart, page 4).

<b>Organism:</b>	Bacteria.
<b>Transmission:</b>	By contact with respiratory droplets (from coughing or sneezing) of an infected person.
<b>Symptoms:</b>	Rash and fever for two to three days (mild disease in children and young adults).
<b>Possible Complications:</b>	Arthritis, encephalitis; if acquired by a pregnant woman birth defects to fetus can include: vision, hearing, and cardiac impairments, and other physical and mental impairments, and death.
<b>Death Rate:</b>	Deaths from rubella number too few to calculate a statistically valid rate; primarily neonatal.
<b>Vaccine:</b>	Rubella vaccine (contained in MMR)
<b>Recommendations</b>	See Measles vaccine recommendations.

#### Rubella and Congenital Rubella Syndrome (CRS), United States, 1968-1999



Overview of Vaccine-Preventable Diseases

## Varicella (Chicken pox)

### Epidemiology:

Prior to the licensing of the Varicella (chicken pox) vaccine in 1995, virtually all persons in the U.S. would acquire varicella by adulthood. Chicken pox was responsible for an estimated 4 million illnesses, 11,000 hospitalizations, and 100 deaths each year. In 1990 in the U.S., the cost of caring for children who contracted chicken pox was estimated to be \$918 million annually. Chicken pox is typically described as a childhood illness because adults account for only 5% of reported cases. However, adults account for approximately 35% of mortality. Adults as well as children should be educated on the importance of varicella vaccination.

From March 1995 to August 1999, a total of 18.5 million doses of chicken pox vaccine were distributed in the U.S. Nationwide, vaccine coverage among children 19 to 35 months was 43% in 1998. Although chicken pox has not been a nationally notifiable condition since 1991, a school-based reporting system is still used to monitor the incidence of chicken pox in Michigan and Kent County. Using this reporting system, the three-year average case rate of chicken pox was cut in half between 1993 and 1999, due largely to varicella vaccination among infants. Eventually, it is hoped chicken pox will be considered a rare condition in the U.S., one that, like measles, is only brought into the country by international travelers who become infected abroad.

**Organism:** Virus.

**Transmission:** By contact with respiratory droplets (from coughing or sneezing) of an infected person.

**Symptoms:** An itchy skin rash of blister-like lesions, usually on the face, scalp, or trunk.

**Possible Complications:** Bacterial infection of the skin, swelling of the brain, and pneumonia (usually more severe in children 13 or older and adults).

**Death Rate:** 1 (children)-25 (adults) per 100,000.

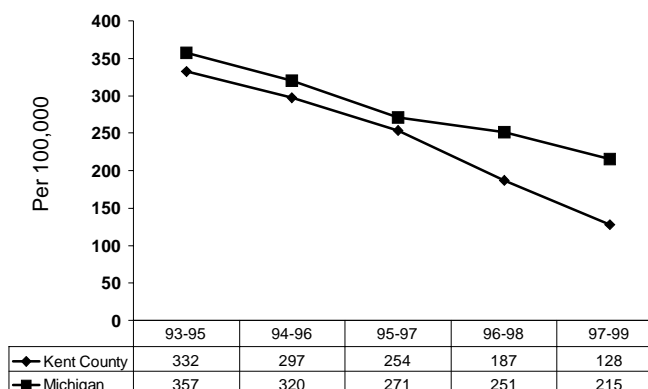
**Vaccine:** Varicella vaccine.  
Varicella vaccine is given one time, at age 12 to 15 months, or at age 11 to 12 years if a child has never had chicken pox.

### Recommendations

Children: For those 12 months of age or older.

Adults: For those at any age who lack a reliable history of having chicken pox; health care workers; persons who teach young children or work in a child care setting; resident or staff member in an institutional setting; college students; inmate or staff member of a correctional institution; members of the military; international travelers; women of childbearing age who are not pregnant.

Chicken Pox Case Rate, by Year, Kent County and Michigan, 1995-1999 (3-year averages)



## Overview of Vaccine-Preventable Diseases

# Haemophilus Influenzae Type b (Hib)

### Epidemiology:

Before a vaccine became available, Haemophilus influenzae type b (Hib) was the most common cause of bacterial meningitis (inflammation of the covering of the brain and/or spinal cord) in infants and children in the U.S. The national Hib case rate in children five years of age was 40-50 cases per 100,000 population, prior to introduction of Hib vaccine. When Hib vaccine was licensed in the later 1980's, the incidence of invasive Hib disease began to fall dramatically, decreasing by over 99% compared to the prevaccine era. Since the late 1980's, the Hib case rate reported in Michigan has declined from 2.1 to 0.3 per 100,000 population, and from 2.8 and 0.1 per 100,000 in Kent County.

Hib disease was a common, devastating illness as recently as 1990; now, many pediatricians coming out of medical school and residency have never seen a case. Decreased immunization in the community would likely contribute to a return in prevaccine numbers of invasive Hib disease cases and deaths.

**Organism:** Bacteria.

**Transmission:** By contact with respiratory droplets (from coughing or sneezing) of an infected person.

**Symptoms:** Throat swelling, fever, decreased mental status, stiff neck (can be serious in children under age one; little risk of getting the disease after age five).

### Possible

**Complications:** Brain damage (15%-30% of Hib meningitis survivors), airway obstruction, skin infection, pneumonia, bone infection.

**Death Rate:** 2-5 per 100 cases with Hib meningitis.

**Vaccine:** Hib vaccine.

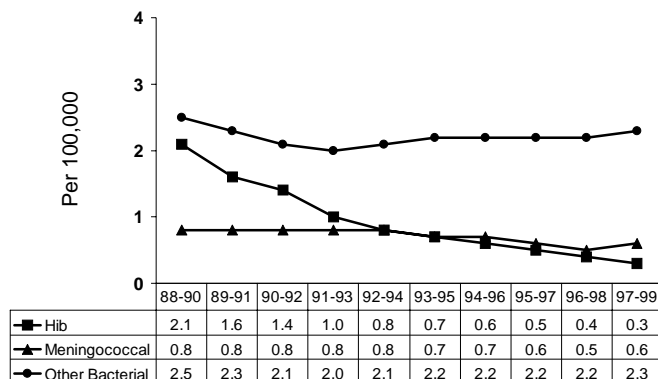
The Hib vaccine is given four times, at two months, four months, and six months of age, and again when a child is 12 to 15 months of age.

### Recommendations

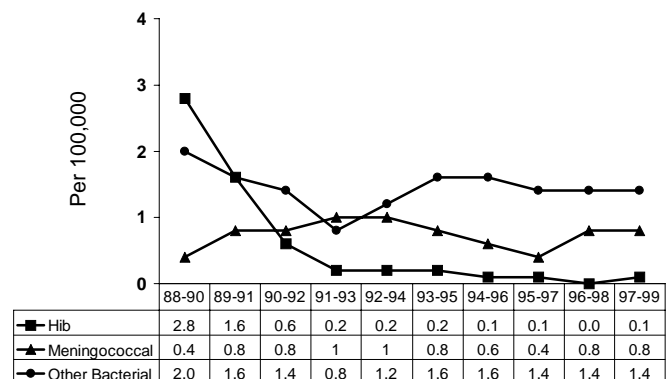
Children: For those six weeks and older.

Adults: For those aged five years and older with a weakened immune system.

**Michigan Meningitis Rates, 1988-1999**  
(3-year averages)



**Kent County Meningitis Rates, 1988-1999**  
(3-year averages)



## Overview of Vaccine-Preventable Diseases

# Meningococcal Meningitis (Cerebrospinal fever)

### Epidemiology:

Since the introduction of *Haemophilus influenzae* type b vaccine for infants, meningococcal meningitis has become the leading cause of bacterial meningitis in older children and young adults in the U.S., causing an estimated 2,600 cases each year. Meningococcal meningitis is a very serious disease: approximately 13% of cases with meningitis and 12% of cases with blood infection will die despite therapy with effective antimicrobial agents. In addition, 11% to 19% of survivors suffer substantial long-term impairment (neurological impairment, limb loss, and hearing loss) as a result of meningococcal disease.

Nationally, the case rate for meningococcal disease in the U.S. ranges from 0.8 to 1.3 cases per 100,000 population. This is consistent with what has been reported in both Michigan and Kent County since 1988 (0.4 to 1.0 cases per 100,000 population). Outbreaks of meningococcal disease were rare in the U.S. in the 1980's, however, since 1991, the frequency of localized outbreaks has increased. Because many of these outbreaks have been identified in college students, it is generally recommended that college students be vaccinated for meningococcal disease.

Comparison of meningococcal meningitis with *H. influenzae* type b invasive disease shows that while Hib has decreased dramatically since 1988, meningococcal disease has remained stable and is now more common than Hib. Because many people can (and do) carry this germ in their nose and throat without any signs of illness, close contacts of anyone with meningococcal disease may be at increased risk for developing infection and should be assessed to determine if post-exposure antibiotics are indicated.

<b>Organism:</b>	Bacteria.
<b>Transmission:</b>	By contact with respiratory droplets (from coughing or sneezing) of an infected person.
<b>Symptoms:</b>	Fever, chills, rash, intense headache, stiff neck, vomiting.
<b>Possible Complications:</b>	Delirium, coma, death.
<b>Death Rate:</b>	5-15 per 100 cases, with supportive treatment.
<b>Vaccine:</b>	Meningococcal vaccine.
<b>Recommendations</b>	
Children:	Routine vaccination not recommended unless high risk (e.g., no spleen or immune system deficiencies); for international travel to epidemic areas.
Adults:	For college students or persons living in a dormitory setting; military recruits; international travelers.

## Overview of Vaccine-Preventable Diseases

# Pneumococcal Meningitis (Meningitis, bacterial other)

### Epidemiology:

Pneumococcal pneumonia is the most common clinical presentation of infection with *Streptococcus pneumoniae*, and pneumococci bacteria cause 13% to 19% of all cases of bacterial meningitis in the U.S. (and 44% of 'Bacterial, other' cases of meningitis). Although pneumococcal disease is not reportable in the U.S., it has been estimated that 3,000 to 6,000 cases of pneumococcal meningitis occur each year; it is the leading cause of bacterial meningitis among children under 5 years of age in the U.S. Children less than one year of age have the highest rate of pneumococcal meningitis, approximately 10 cases per 100,000 population. Outbreaks of the disease occur rarely and are generally associated with crowded environments when they do.

In the state of Michigan, pneumococcal meningitis is included in the reporting category "Meningitis, Other Bacterial." The majority of reports of meningitis caused by bacteria other than those causing Hib or meningococcal meningitis are related to pneumococcal bacteria. Case rates for "Other Bacterial" causes (i.e. pneumococcal and others) of meningitis have been higher than both Hib or meningococcal meningitis in both Michigan and Kent County. The 1997-1999 three-year average case rate for "Other Bacterial" meningitis in the U.S. was 14 times higher than Hib in Michigan (eight times higher than Hib in Kent County), and four times higher than meningococcal meningitis in Michigan (two times higher than meningococcal meningitis in Kent County).

In 2000, pneumococcal vaccination was added to the schedule of recommended childhood immunizations. As successive cohorts of children receive this vaccination, pneumococcal-associated meningitis will likely begin to decline. In addition, making pneumococcal disease nationally reportable would promote more precise estimates of the impact of this disease and how well vaccine prevention is working.

<b>Organism:</b>	Bacteria.
<b>Transmission:</b>	By contact with respiratory droplets (from coughing or sneezing) of an infected person.
<b>Symptoms:</b>	High fever, chills, and stabbing chest pain, bacteremia, stiff neck, and meningitis.
<b>Possible Complications:</b>	Death (one of the most common causes of death from a vaccine-preventable disease in the U.S.).
<b>Death Rate:</b>	30 per 100 cases (may be up to 80 per 100 cases among elderly persons).
<b>Vaccine:</b>	Pneumococcal conjugate vaccine.  Pneumococcal vaccine is given four times, at two, four, and six months of age, and at 12 to 15 months of age.
<b>Recommendations</b>	
<b>Children:</b>	For those under five years of age; children two and over with long-term illnesses associated with a high risk of infection or complications (e.g. no spleen, sickle cell disease, etc.), reduced resistance to infection (e.g. HIV/AIDS); those living in special environments or social settings with an identified increased risk.
<b>Adults:</b>	For those aged 65 years and over; persons with serious long-term health problems (e.g., heart disease, diabetes, lung disease), reduced resistance to infection (e.g., cancer treatment, kidney failure, HIV/AIDS, etc.); those living in special environments or social settings with an identified increased risk .



Overview of Vaccine-Preventable Diseases

# Hepatitis A (Infectious hepatitis; Epidemic jaundice; Type A hepatitis; HAV)

**Epidemiology:**

Hepatitis A is the most common type of hepatitis reported in the United States. Although 23,229 cases of hepatitis A were reported in the U.S. in 1998, it has been estimated that there are actually between 125,000 and 200,000 cases of hepatitis A each year, with approximately 100 deaths. Hepatitis A is associated with significant economic losses: an adult infected with hepatitis A virus loses an average of 30 days of work and about \$2,600 in wages, while medical care can cost \$2,800 for each hospitalized case. In addition, for each case of hepatitis A diagnosed, an average of 11 persons are identified as close contacts (having the potential to become infected through contact with the primary case) and are offered or provided the recommended post-exposure prophylaxis (immune globulin) paid for by the public health system. The annual cost associated with hepatitis A is estimated at \$200 million in the U.S.

For the past 5 years, there has been an average of 930 cases of Hepatitis A reported annually in Michigan, and 26 cases reported annually in Kent County. The 1995-1999 average case rate in Kent County (5 per 100,000 population) is half of the rate reported for Michigan (10 per 100,000 population). The 1992-1994 average national rate for adults was slightly over 10 cases per 100,000 population. In Kent County, over half (63%) of hepatitis A cases occur in persons between the ages of 20 and 50 years of age: 20% of cases are 20-29 years old, 22% of cases are 30-39 years old and 21% of cases are 40-49 years old.

Hepatitis A vaccines were licensed in 1995 and 1996. Vaccination is recommended on a community-wide basis only in populations and states where case rates of hepatitis A reach 50-700 cases per 100,000 population on a repeated basis. In many of these areas, the vaccine is now required for school entry. Since 1997, an outbreak of hepatitis A in southeastern Michigan has contributed to an increase in the overall case rate for Michigan. However, because the outbreak has not experienced extremely high case rates and the outbreak was not sustained, community-wide vaccination has not been implemented.

**Organism:** Virus.

**Transmission:** Most often spread by transferring virus from a fecally contaminated surface to the mouth; less often by swallowing food or water that contains the virus.

**Symptoms:** Potentially none (likelihood of symptoms increases with a person’s age); if present: yellow skin or eyes, tiredness, stomachache, loss of appetite, or nausea.

**Possible Complications:** Acute, severe symptoms, and possible death.

**Death Rate:** 3 per 1,000 cases.

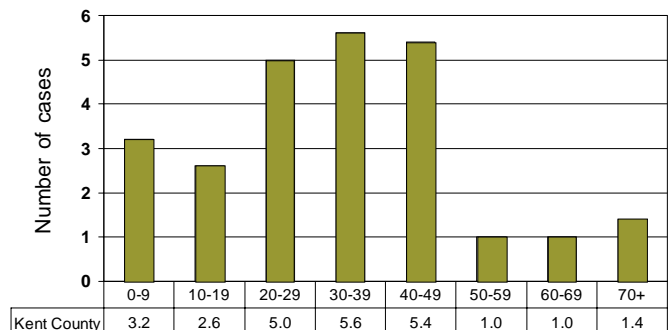
**Vaccine:** Hepatitis A vaccine.

**Recommendations**

**Children:** For those two years of age or older in states, counties, or communities where the average annual incidence is 10-20 cases per 100,000 population (twice that of the U.S. nationwide rate).

**Adults:** For those with long-term liver disease; persons who travel to areas with high rates of hepatitis A; men who have sex with other men; users of street drugs; persons who live in a community with high rates of hepatitis A; individuals who receive blood products.

**Hepatitis A, Average Annual Cases by Age Group, Kent County, 1995-1999**



## Overview of Vaccine-Preventable Diseases

# Hepatitis B (Type B hepatitis; Serum hepatitis; HBV)

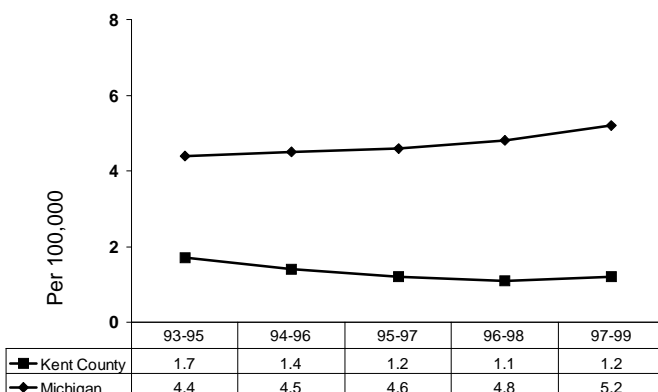
### Epidemiology:

The incidence of hepatitis B virus (HBV) in the U.S. peaked in the mid-1980's, with about 26,000 cases reported each year. Since that time, the number of HBV cases reported has declined, falling below 10,000 cases for the first time in 1996. The decline in cases during the 1980's and early 1990's is generally attributed to reduction of transmission among homosexual men and injecting drug users as a (secondary) result of HIV prevention. From these data, it has been estimated that approximately 180,000 persons become infected each year.

Approximately one million persons are chronically infected with HBV in the U.S., and each year 10,000 additional persons become chronically infected. Perinatal transmission accounts for a disproportionate 24% of chronic infections; estimates show that up to 12,000 children born to hepatitis B virus-infected mothers were infected each year before implementation of infant HBV vaccination programs.

The five-year average HBV case rate is 4.8 per 100,000 population in Michigan, and 1.2 per 100,000 in Kent County. Approximately 25 pregnant women are enrolled each year in the Kent County Perinatal Hepatitis B Prevention Program, which coordinates HBV vaccination and testing for infants and family members of known HBV-infected mothers.

### Acute Hepatitis B Case Rate, by Year, Kent County and Michigan, 1995-1999



**Organism:** Virus.

**Transmission:** Spread through contact with the blood of an infected person or by having sex with an infected person.

**Symptoms:** Potentially none when first infected (likelihood of early symptoms increases with the person's age). If present, yellow skin or eyes, tiredness, stomachache, loss of appetite, nausea, or joint pain.

### Possible

**Complications:** Acute, severe symptoms, and possible death; life-long liver problems, such as scarring of the liver and liver cancer. The younger a person is when infected with HBV, the more likely the person will develop chronic infection.

**Death Rate:** 15-20 per 100 chronically infected will die prematurely.

**Vaccine:** Hepatitis B vaccine.

### Recommendations

Children: All children at birth, or later.

Adults: For those who: have had sex with more than one person in the past six months; have had a sexually transmitted disease; are men who have sex with other men; are a household contact or sex partner of a person with long-term hepatitis B; have a job that involves contact with human blood, are on the staff or a client in an institution for the developmentally disabled; are the recipient of certain blood products; are a dialysis patient; live or travel for more than 6 months a year in countries where hepatitis B is common; are a prisoner in a long-term correctional facility and/or use street drugs.

### A Note on Hepatitis C

Although currently not as widely recognized as Hepatitis A and Hepatitis B, Hepatitis C is a growing problem. Hepatitis C is not vaccine-preventable, but can be transmitted by sharing needles, and to a lesser extent, sexual contact. Hepatitis C is discussed in detail in Part III of this report, *Sexually Transmitted Diseases*.

Overview of Vaccine-Preventable Diseases

# Influenza (Flu; Flu-like illness)

**Epidemiology:**

At least four influenza pandemics, or worldwide outbreaks, occurred in the 19<sup>th</sup> century, and three occurred in the 20<sup>th</sup> century. The 1918-1919 “Spanish flu” is believed to have resulted in 21 million deaths worldwide, at least 500,000 of them Americans, in less than a year. It has been estimated that another influenza pandemic could affect up to 200 million people, and result in up to 400,000 deaths.

As with chicken pox, influenza is primarily reported locally through a school-based surveillance system. School-based surveillance of “flu-like” illness shows relatively steady rates of “flu-like” illness in both Michigan and Kent County since 1995. Differences in rates between Michigan and Kent County are probably attributable to variations in the quality of reporting, rather than a true difference in case rate. What is important is that the rates do not reflect sharp increases attributable to the occurrence of outbreaks. When rates are assessed by the month, influenza in Kent County (as well as in Michigan and across the U.S.) is generally seasonal. The Michigan Department of Community Health has implemented a new reporting system, based on confirmed laboratory reports, which will continue to enhance flu surveillance in Michigan.

Identification of an influenza outbreak will be critical to mounting an appropriate public health response. Because of globalization and rapid international travel, another influenza pandemic is imminent. Surveillance for rapid increases in influenza cases (school, nursing home, and laboratory-based), promotion of effective annual influenza vaccination programs, and continued work with partners state-wide on an influenza pandemic response plan will be critical to prevent illness and reduce loss of life in future flu epidemics or pandemics.

**Organism:** Virus.

**Transmission:** Spread by contact with an infected person or the airborne virus (highly contagious).

**Symptoms:** Fever and chills, dry cough, runny nose, body aches, headache, sore throat (Note: Adults rarely have upset stomachs or diarrhea from influenza. The “stomach flu” is not influenza)

**Possible Complications:** Pneumonia.

**Death Rate:** 0.5-1.0 cases per 1,000 population, especially in adults 65 years and older.

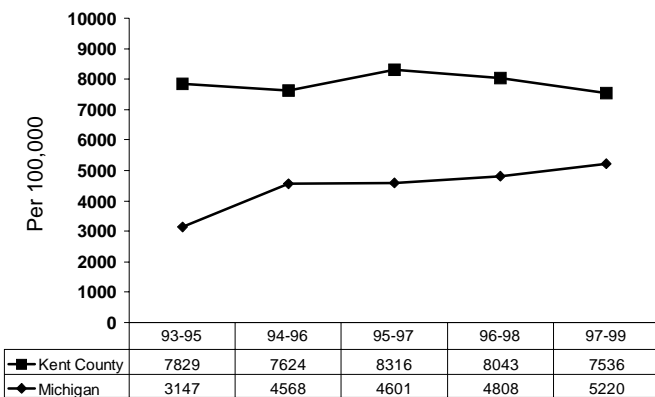
**Vaccine:** Influenza vaccine will help prevent this disease (The vaccine is not perfect in preventing all flu symptoms, however, it is excellent in preventing severe flu, hospitalization, and death among the elderly.)

**Recommendations**

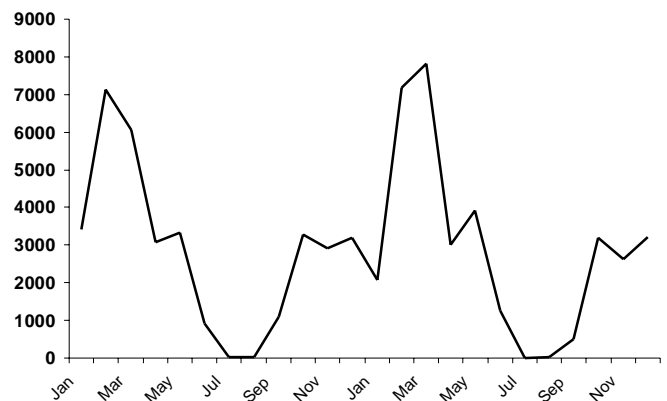
**Children:** For those 6 months of age and older with chronic illness and for those 6 months to 18 years receiving chronic aspirin therapy.

**Adults:** For those 50 years of age and older, and/or residents of long-term care facilities; pregnant women; health care workers in contact with persons at risk of flu; persons providing essential community services; students, inmates, or staff in institutional settings.

**Influenza-like Illness, by Year, Kent County and Michigan, 1995-1999 (3-year averages)**



**Influenza-like Illness in Kent County, by Month, 1998-1999**



## Overview of Vaccine-Preventable Diseases

### Lyme Disease (Lyme borreliosis; Tickborne meningopolyneuritis)

#### Epidemiology:

In 1998, a total of 16,801 cases of Lyme disease were reported in the U.S., the highest number ever. The CDC suggests that this increase could be caused by an increase in human contact with infected ticks, and also may reflect growing awareness and enhanced reporting of cases. The 1995-1999 average case rate for Lyme disease in Michigan is 0.7 per 100,000 population, and 0.5 per 100,000 in Kent County (the true rate in Kent County is probably somewhat lower than the reported rate because many of the cases reported have not been confirmed by laboratory testing).

Results of a study conducted in the state of Michigan in 1999 suggest that of the 11 cases that met the national Lyme Disease case definition, 4 were attributed to an out-of-state exposure and five had reported in-state exposure. Of these Michigan exposures, three were from the Upper Peninsula and two from the Lower Peninsula. Lyme disease continues to be rare however: two years of active surveillance in four Michigan counties found no clear evidence of Lyme disease (no infected ticks), suggesting that continued surveillance will be necessary to identify risk factors associated with the occurrence of Lyme disease in Michigan.

<b>Organism:</b>	Spirochete.
<b>Transmission:</b>	Spread by the bite of certain kinds of tick.
<b>Symptoms:</b>	Rash that can be accompanied by fever, tiredness, headaches and muscle or joint aches. (Note: Some people have no symptoms at all.)
<b>Possible Complications:</b>	Problems with nerves, muscles, joints, or heart. Some people may experience tiredness, personality changes, or problems with thinking, learning, or sleeping.
<b>Death Rate:</b>	Deaths from Lyme disease are rare, and number too few to calculate a statistically valid rate.
<b>Vaccine:</b>	Lyme Disease vaccine. After three doses, this vaccine protects three out of four people from this disease.
<b>Recommendations</b>	
Children:	<u>Not</u> for those under 15 years of age.
Adults:	For those 15 to 70 years of age who live, work, or play in areas surrounded by woods or overgrown brush infested by certain ticks. (The disease is most common in the northeastern, mid-Atlantic, and upper north-central regions of the U.S., and in some parts of northwestern California.)

Overview of Vaccine-Preventable Diseases

# Rabies (Hydrophobia; Lyssa)

**Epidemiology:**

Since the 1950's human rabies deaths in the U.S. have been gradually decreasing, both as a result of routine rabies vaccination of domestic dogs and cats, and due to the increasing effectiveness of post exposure prophylaxis (PEP). Rabies among wildlife — especially raccoons, skunks, and bats — has become more prevalent since the 1950's, accounting for 85% of all reported cases of animal rabies every year since 1976. In Michigan and Kent County, bats are the animals most frequently identified with rabies. Each year from 1995 to 1999, 1-3 bats have been found that are infected with rabies in Kent County. Since 1990, 27 cases of human rabies have occurred in the U.S., 20 of which have been attributed to bat variants of the rabies virus. These data have prompted new CDC recommendations for PEP related to bat contact.

Although rabies among humans is rare in the U.S., every year approximately 16,000 to 39,000 persons receive post-exposure vaccination (PEP), a number that is expected to increase with newly-developed PEP recommendations. However, to manage potential human exposures to rabies, the risk of infection must be accurately assessed. Decisions to begin PEP should be well founded, as any vaccination is not without potential adverse reaction and the treatment series can cost between \$1,600 and \$2,000 per person.

Because of the large number of animal bites and bat exposures reported, and the associated medical costs for treatment and rabies PEP, animal bite prevention is one way to reduce the costs related to animal bite treatment and potential rabies exposure. In Kent County there are an average of 1155 animal bites reported annually: 70% of reported bites are in persons under 40 years of age, with 43% of the total occurring in children 14 and under. In 1998-1999, almost 40% of animal bites were from unneutered male animals, followed by neutered males (21%) and unneutered females (19%). When evaluating dog bites by breed or breed mix, Shepards, Labradors and Golden Retrievers have the highest total number of bites reported. However, rates of bites, based on the 1999 Dog License Census, revealed that the breeds reported as most likely to bite include Pit Bulls, Rotweillers, and Shepards.

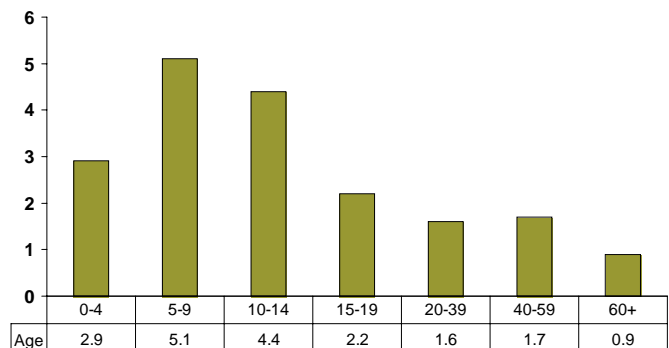
Reducing the costs associated with animal bite assessment, treatment, and rabies PEP will require continued promotion of dog and cat rabies vaccination, bite prevention and bat avoidance education (especially for children), promotion of pet neutering, and educating future dog owners on finding suitable pets.

- Organism:** Virus.
- Transmission:** Spread through introduction of virus-containing saliva into the blood stream, usually by a bite from an infected animal. Rare airborne transmission from bats has been reported in caves with bats and in laboratories.
- Symptoms:** A neurological illness that is almost always fatal without timely treatment.
- Possible Complications:** Death.
- Death Rate:** Approximately 100%.
- Vaccine:** Rabies vaccine.

**Recommendations**

Preexposure vaccination for individuals at high-risk of exposure (e.g. veterinarians, wildlife conservation personnel in endemic areas, staff of quarantine kennels, laboratory and field personnel working with rabies, and long term travelers to rabies endemic areas). Post exposure treatment using rabies vaccine is available.

**Animal Bites by Age of Victim, Case Rate per 1,000, Kent County, 1998-1999**



Vaccination is one of the most effective (and cost-effective) ways of protecting your health, the health of your children, and the health of the community as a whole.

**Communicable Disease in Kent County  
Part II: Vaccine-Preventable Diseases**

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Grand Rapids, Michigan

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