Immunization and Infectious Diseases

Brief Overview

All-cause mortality in the United States decreased dramatically during most of the twentieth century through current times. In the year 1900, the crude death rate for all causes was 1,719.1 per 100,000 population; by 1980 the rate had fallen to 878.3 per 100,000. Nearly all of that decrease can be attributed to reductions in deaths due to infectious diseases.

Figure 1: Crude Mortality Rates for All Causes, Noninfectious Causes, and Infectious Diseases
Although these reductions represent tremendous successes for public health, infectious diseases remain serious threats to the health of the population. From 1980 to 1992, deaths due to infectious diseases increased by 58 percent in the U.S. Even after adjusting for age, the infectious disease death rate increased by 39 percent during this time period.\(^3\) Taken together, pneumonia and influenza have remained among the top 10 leading causes of death in the U.S. and in Kansas.

Emerging infectious diseases are of global concern, as high-speed travel makes it possible to get from one inhabited place on the earth to just about any other in less time than the incubation period for most diseases, and pathogens are not impeded by international borders. In the U.S., poliovirus was estimated to cause between 13,000 and 20,000 cases of paralytic polio prior to the availability of polio vaccine. Through successful vaccination campaigns, wild poliovirus transmission was eliminated from the U.S. in 1979, but remains endemic in Afghanistan, Nigeria, and Pakistan.\(^4\) West Nile virus (WNV), which is transmitted by mosquitoes, was first discovered in Uganda in 1937.\(^5\) It was not until 1999 that WNV first appeared as an indigenous disease in the U.S., in New York City.\(^6\) Since that time, WNV has become endemic and enzootic throughout the 48 contiguous United States and first appeared in Kansas in 2002.

Other global threats have included highly pathogenic influenza, such as avian influenza A strains H5N1 and, most recently, H7N9; the influenza A H1N1 pandemic of 2009; two unique novel coronavirus infections causing severe acute respiratory syndrome (SARS) and Middle East Respiratory Syndrome (MERS-CoV); the ongoing cholera epidemic in Haiti that began in 2010 following a massive earthquake earlier that year; and chikungunya virus, another mosquito-borne disease found mainly in Africa and Asia that has recently spread to Europe and the Americas.\(^7\)

Chronic infection with hepatitis B virus or hepatitis C virus is one of the most common causes of primary liver cancer, which causes approximately 23,000 deaths each year in the U.S. The most common risk factor cervical cancer, one of the most common cancers among women and which caused nearly 4,000 deaths among U.S. women in 2010,\(^8\) is infection with certain types of human papilloma virus (HPV).

Persons with chronic conditions such as asthma, diabetes and obesity are at higher risk of complications and death from influenza. This interplay between infectious agents and chronic diseases has important implications for public health; immunization and other prevention strategies will help to not only reduce the incidence and prevalence of infections in the near term, but will also reduce complications and mortality in the long term.

This section will focus on:

- Influenza and other vaccine-preventable diseases
- Health care-associated infections
- Human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS)
- Sexually transmitted infections
From 2002 through 2011, influenza and pneumonia, as underlying cause of death, accounted for 2.3 percent to 3.0 percent of all deaths in Kansas (range 555 to 740 deaths). For 2011, 2.6 percent of all deaths in Kansas were due to influenza and pneumonia. As shown in Figure 3, the age-adjusted mortality rate for influenza and pneumonia (as underlying cause of death) ranged from a low of 16.5 per 100,000 to a high of 22.4 per 100,000.\textsuperscript{10}
Many other infectious diseases that were once common, particularly among young children, have been greatly reduced through successful immunization programs in the United States and elsewhere. However, threats from these diseases remain. The U.S. and other developed countries have experienced resurgences of diseases such as measles, pertussis (whooping cough) and mumps.

Despite the benefits of immunization against influenza and other vaccine-preventable diseases, immunization rates often fall short of optimal rates to reduce disease transmission or prevent outbreaks. In some respects, the very triumphs of public health immunization campaigns, which have made many vaccine-preventable diseases very rare in the U.S., have led to concerns about complacency. The ever-increasing complexity of recommended immunization schedules and stories – most often unfounded – of adverse effects of vaccines have led many parents to question whether or not to vaccinate their children. Like infectious diseases themselves, these concerns tend to cluster in communities, thereby increasing the risks of outbreaks. The public health and healthcare systems must work together to ensure high vaccination rates to help prevent and control such diseases.

In addition to annual influenza immunization, the United States Advisory Committee on Immunization Practices (ACIP) recommends routine vaccination against 15 diseases from birth through 18 years of age on a specified schedule. Data from the Retrospective Kansas Immunization School Survey conducted during the 2011-2012 school year, which assessed immunization coverage levels among kindergartners at school entry and retrospectively when they were 24 months of age, indicated that the Healthy People 2020 target of 90 percent was being met for only three vaccines: hepatitis B, polio, and measles-mumps-rubella. (Figure 4)
Figure 4: Immunization Coverage Levels at 24 Months of Age by Vaccine, Kansas 2000 - 2007

- DTaP4: 4 doses of diphtheria and tetanus toxoids and acellular pertussis vaccines including diphtheria and tetanus toxoids (DTaP/DT) vaccine
- HepB3: 3 doses of hepatitis B vaccine
- Hib3: 3 doses of Haemophilus influenzae type b vaccine
- MMR1: 1 doses of measles, mumps, and rubella vaccine
- PCV4: 4 doses of pneumococcal conjugate vaccine
- Polio3: 3 doses of polio vaccine
- Var1: 1 dose of varicella vaccine
- 4-3-1-3-3: DTaP4-Polio3-MMR1-Hib3-HepB3
- 4-3-1-3-3-1-4: DTaP4-Polio3-MMR1-Hib3-HepB3-Var1-PCV4
Health Care-Associated Infections

Health care-associated infections (HAI) are infections that patients acquire when receiving health care for other conditions. They can occur in any setting of care – hospitals, long-term care settings, outpatient or ambulatory care clinics, and others. The U.S. Centers for Disease Control and Prevention estimates that approximately 1 in 20 hospitalized patients acquires an infection from receiving medical care, and in 2002 more than 98,000 deaths were caused by HAIs in hospital settings. Depending on the method of consumer price adjustment used, in the U.S. direct medical costs for HAIs in hospitals alone range from $28.4 billion to $45 billion annually. Prevention of HAIs has been identified as one of CDC’s Winnable Battles for improving the nation’s health.

Two of the most costly and preventable types of HAIs can occur when a person has a central-line or urinary catheter. A central line is a tube placed in a large vein to access the bloodstream. A urinary catheter is a tube placed in the bladder to drain urine. Patients with these devices have a much higher chance of getting an infection, yet in many circumstances the devices are essential in the course of treatments. These infections are largely preventable when healthcare providers use CDC-recommended infection prevention steps.

Using a statistical measure called the standardized infection ration (SIR), participating Kansas hospitals reported approximately 67 percent fewer central line-associated bloodstream infections (CLABSI) in 2011 among patients in adult intensive care units than would be expected based on national baseline data (SIR = 0.329). For catheter-associated urinary tract infections (CAUTI), participating Kansas hospitals reported 26 percent fewer infections in 2011 among patients in adult intensive care units than would be expected based on national baseline data (SIR = 0.744).

Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS)

The CDC estimates that there are approximately 1.1 million people living with HIV infection in the U.S., with 50,000 new infections occurring each year. Since the recognition and emergence of HIV and AIDS in the late 1970’s and early 1980’s in the U.S., treatment advances have helped substantially improve life expectancy and quality of life among people living with HIV infection. However, almost 1 in 6 Americans living with HIV is unaware of their infection, thereby increasing the risk of further transmission and delaying effective care and management of their infection.

The National HIV/AIDS Strategy in the U.S. has three major goals:

- Reducing new HIV infections
- Increasing access to care and improving health outcomes for people living with HIV
- Reducing HIV-related health disparities

The total number of newly diagnosed HIV/AIDS cases in Kansas increased by 33 percent from 132 cases in 2000 to 169 cases in 2010. Among the 169 newly diagnosed cases of HIV/AIDS in 2010, 49 percent (84) were new AIDS cases and 51 percent (85) were new HIV (non-AIDS) cases.
Sexually Transmitted Infections

Among the most commonly transmitted infections (STI) in the U.S. are those that are sexually transmitted. CDC estimates there are approximately 19 million new sexually transmitted infections each year in the U.S.\textsuperscript{21} Serious complications from STIs include reproductive health problems, fetal and perinatal health problems, and cancer. In addition, STIs can facilitate transmission of HIV. The annual direct medical costs of STIs in the U.S. have been estimated at $15.6 billion.\textsuperscript{22}

In addition to cross-cutting prevention and education activities for all STIs, public health surveillance, investigation, and partner outreach services are targeted to reduce the burden of chlamydia, gonorrhea, syphilis and, through an integrated approach, HIV. Unfortunately, current prevention efforts have been unable to produce significant decreases in chlamydia morbidity. Overall, rates have increased since 2007 to 1,433 per 100,000 in 2011. Women 15 to 44 years old accounted for 76 percent of all reported chlamydia cases in Kansas in 2011.\textsuperscript{23}
Figure 8: Rate of Reported Chlamydia Cases by Race and Ethnicity, Kansas, 2011

<table>
<thead>
<tr>
<th>Race / Ethnicity</th>
<th>Rate per 100,000</th>
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<tbody>
<tr>
<td>Non-Hispanic White</td>
<td>131.9</td>
</tr>
<tr>
<td>Non-Hispanic Black</td>
<td>1051.6</td>
</tr>
<tr>
<td>Hispanic</td>
<td>298.3</td>
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<tr>
<td>Asian / Pacific Islander</td>
<td>75.5</td>
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<tr>
<td>American Indian / Alaska Native</td>
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Figure 9: Early Syphilis Case Rates/100,000 Population in Kansas, 2007-2011

<table>
<thead>
<tr>
<th>Year</th>
<th>Rate per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>1</td>
</tr>
<tr>
<td>2008</td>
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<td>2010</td>
<td>0.7</td>
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<tr>
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Key Disparities

The epidemiology of myriad infectious diseases varies substantially. The burden of specific diseases among subgroups within the population is dependent on a wide range of factors, such as the characteristics of the causative agent, modes of transmission, environmental and social factors, and population characteristics.

Over time, the epidemiology of a given disease can also vary to some degree. In general, the incidence of influenza infection is highest among children, who serve as a major source of transmission within the community. Hospitalization and complication rates are highest among young children, adults 65 years old and older, pregnant women, and persons with chronic conditions such as asthma, neurological and developmental conditions, chronic lung disease, heart disease, blood disorders, endocrine disorders (including diabetes), kidney disorders, liver disorders, metabolic disorders, weakened immune system due to medication or disease, morbid obesity (body mass index of 40 or greater), and people 19 years old and younger on long-term aspirin therapy. However, the 2009 influenza A (H1N1) virus that caused the 2009 pandemic – and has re-emerged as the dominant strain for the 2013/2014 influenza season – seems to disproportionally affect young and middle-aged adults.

Although the risk of HIV infection is linked to sexual contact or sharing drug injection equipment, some groups within the population are affected more than others. Almost 3 in 4 new infections are among men, and more than half of new infections are among men who have sex with men. New HIV infections are disproportionately high among adolescents and young adults. In 2009, 39 percent of all new infections occurred among people 13 to 29 years old. Among racial and ethnic subgroups, the incidence rate of new infections and the prevalence of living with HIV are highest among blacks / African Americans in the U.S. compared to whites, the incidence of new infections is eight times higher among blacks / African Americans. The incidence of new infections among Hispanics / Latinos is more than three times higher than among non-Hispanic whites.

![Figure 10: Rates of Newly Diagnosed HIV/AIDS Cases by Race/Ethnicity in Kansas 2005-2010](image-url)
Rates of sexually transmitted infections are also higher among communities of color compared to whites. For example, nearly 70 percent of reported cases of gonorrhea in 2010 occurred among Blacks in the U.S., corresponding to an incidence rate that was more than 18 times higher than among whites. Among Hispanics/Latinos, the incidence of chlamydia was almost three times that of non-Hispanic Whites in 2010.28

Figure 11: Rate of Reported Gonorrhea Cases by Race and Ethnicity, Kansas, 2011

Summary

Despite the tremendous public health successes that have led to overall decreases in morbidity and mortality from infectious diseases, threats remain. There is considerable variability in the epidemiology of, and the measures of prevention, and control for, the myriad infectious diseases with which public health must contend. Regardless of those differences, successful efforts to reduce the burden of infectious disease will depend on successful partnerships between public health, health care systems, and a broad range of other stakeholders.
References


Strengths and Assets

Strengths

Immunization and Vaccination

Immunization and vaccination strengths include the following Kansas initiatives: Immunize Kansas Kids, Kansas WebIZ, Vaccines For Children (VFC) program and the Pertussis Cocoon Pilot Project. The Immunize Kansas Kids project is a unique partnership between KDHE, the Kansas Health Institute and dozens of stakeholder organizations. The goal is to protect every Kansas child from vaccine-preventable diseases.

Kansas WebIZ is the statewide immunization registry. The purpose of Kansas WebIZ is to consolidate immunization information among health care professionals, assure adequate immunization levels and avoid unnecessary immunizations.

The Vaccines For Children (VFC) program is a federally funded program that provides vaccines at no cost to children who might not otherwise be vaccinated because of inability to pay.

For the Pertussis Cocoon Pilot Project KDHE partnered with four hospitals and their associated county health departments in eastern Kansas to vaccinate close contacts of newborn infants, including postpartum mothers. As part of the Cocoon Pilot Program, KDHE encouraged all hospitals to include on their standing orders Tdap vaccination of postpartum women prior to discharge. Studies have shown when hospitals have standing orders, vaccination rates of eligible women increase to more than 80 percent.

In addition to offering postpartum mothers Tdap vaccine, one family member (a primary caregiver to the infant) has the opportunity receive a Tdap vaccination at the local health department. The pilot program has provided vaccine at no cost to the participating hospitals and local health departments. The goal is to reduce barriers for Tdap vaccination, thus enabling the mother and one family member to be vaccinated.

Infectious Disease

KDHE has several programs related to infectious disease reduction, surveillance and investigation including the Healthcare-associated Infections Program, Infectious Disease Surveillance and Investigation, the Kansas Ryan White Program and Foodborne Illness Outbreak Investigation. The Healthcare-associated Infections Program provides state level support to the infection prevention community. The program is charged with quantifying and subsequently reducing the occurrence of hospital acquired infections. Currently 70 facilities are reporting data.

The federal Ryan White HIV/AIDS Treatment Modernization Act is the primary funder for HIV/AIDS health and social services including primary medical care, medication assistance, health insurance assistance, mental health counseling, substance use treatment, home health care, dental care and medical case management. Ryan White CARE funding and administration are managed by the Health Resources and Services Administration (HRSA), which is part of the U.S. Department of Health and Human Services. The Kansas Department of Health and Environment (KDHE) is the state-level agency within Kansas that distributes and manages Ryan White Part B and the AIDS Drug Assistance Program (ADAP) as mandated by the Ryan White HIV/AIDS Treatment Modernization Act.
Assets

- WebIZ Immunization Registry
- Immunize Kansas Kids (IKK) – coalition that supports innovative, collaborative and sustainable methods to increase age-appropriate immunization for Kansas children 0 to 5 years old
- Mobilizing Office Based Immunizations (MOBI) – tool for increasing number of primary care physicians who offer immunizations in their office
- Funding for immunizations through Vaccines for Children (VFC) program
  - People and organizations including:
    - Seasoned infection preventionists within acute care
    - Informed, helpful professionals at the state level in multiple programs
    - Immunization advocates within provider offices and schools
    - Local health departments
    - Good collaboration and networking for infection prevention and immunizations
- Ability to detect and prevent spread of diseases through surveillance and laboratory testing
- School and licensed day care regulations
- Development of surveillance program for health care-associated infections