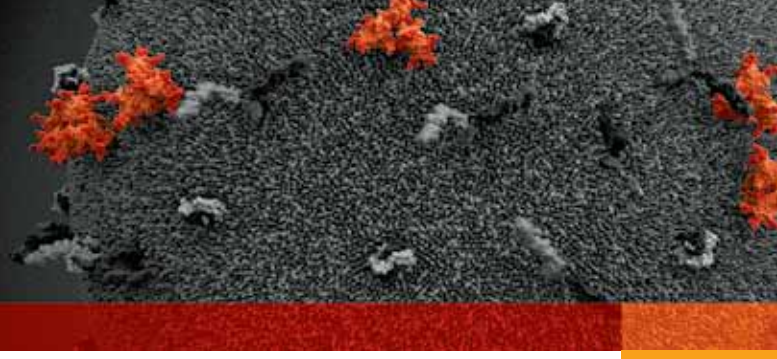
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

NATIONAL INSTITUTES OF HEALTH

Fact Sheet



How AIDS Research Benefits Other Diseases

AIDS is one of the most complex diseases ever targeted by biomedical research. Investments in AIDS research have transformed the disease from a mysterious and uniformly fatal infection into one that can be accurately diagnosed and effectively managed with treatment. Research also has led to the development of numerous approaches to slow the epidemic's spread.

Similarly, AIDS research pays extensive dividends in multiple other areas of biomedical research, including in the prevention, diagnosis, and treatment of many other infectious, malignant, neurologic, autoimmune, and metabolic diseases; and in deepening our understanding of immunology, virology, microbiology, molecular biology, and genetics. This overview provides just a few examples of how investments in AIDS research advance other areas of scientific research.

Improving Therapies for Other Diseases

AIDS treatment research has accelerated efforts to develop more effective drugs for multiple bacterial, mycobacterial, and fungal diseases. AIDS research has fostered significant improvements in drug design technologies such as **X-ray crystallographic methodologies, nuclear magnetic resonance techniques, computational approaches to medicinal chemistry, and new animal models of viral diseases** that are advancing efforts to develop new drugs for other diseases, including:

- Chronic **hepatitis B virus** (HBV) infection: Previously, HBV infection could be treated only with injections of alpha-interferon, and many HBV-infected persons progressed inexorably to cirrhosis, liver failure, and liver cancer, which affect 300 million people worldwide. The HIV drug lamivudine (3TC) is now approved by the U.S. Food and Drug Administration for the treatment of chronic HBV infection, and is expected to lead to the development of more effective therapies to treat, and perhaps even cure, chronic HBV infection. Another HIV treatment, tenofovir (Viread), is also now approved to treat chronic HBV disease.
- **Hepatitis C virus** (HCV): Experience with HIV protease inhibitors and nucleoside polymerase inhibitors has informed the development of HCV inhibitors that are transforming HCV care.
- **Breast cancer:** HIV drugs that block the CCR5 receptor on cells also may help prevent aggressive breast cancers from metastasizing.
- **Osteoporosis and heart disease:** Experience gained from the development of HIV protease inhibitors is being applied to efforts to combat osteoporosis and the heart muscle damage that can result from a heart attack.
- **Smallpox:** Experience gained from the development of HIV protease inhibitors also is being applied to efforts to develop antiviral drugs against smallpox.
- **Cytomegalovirus** (CMV): Techniques used to derive inhibitors of HIV protease are leading to new candidate drugs to treat CMV, a significant cause of birth defects.
- **Influenza:** Techniques developed and validated through HIV drug development are leading to progress in inhibiting influenza.
- **Malaria:** A recent study in Uganda showed that protease inhibitors significantly increase the effectiveness of drugs used to prevent malaria in children. Malaria is the leading cause of death in children in many malaria-endemic areas and a significant cause of illness and death in people living with HIV.

Understanding the Origins and Manifestations of Other Diseases

- **Cancer:** Strategies to block natural body hormones called growth factors, which promote the activity of HIV, also are helping researchers understand how to inhibit the growth of certain cancers.

- **Cervical cancer:** Studies of HIV-associated cervical cancer have stimulated new research and therapeutic strategies that likely will benefit all women at risk of cervical cancer.
- **Cancer cachexia:** Approaches developed to treat HIV-associated wasting may benefit persons with cancer-related weight loss and wasting.
- **Diabetes:** Studies of metabolic abnormalities associated with HIV disease and treatment may provide crucial insights into type 2 diabetes and obesity and advance efforts to prevent cardiovascular disease in patients with diabetes.
- Research into HIV disease provides new information on viral latency and the susceptibility of the nervous system to infection and inflammatory processes, with important implications for research on **Alzheimer's disease, dementia, multiple sclerosis, neuropsychological disorders, encephalitis,** and **meningitis.**
- Research to support AIDS vaccine studies and other large-scale clinical trials in developing countries builds research capacity to address a broad variety of health conditions; produces valuable information on the prevalence and incidence of other diseases beyond HIV; adds to strategies to address hard-to-reach populations; provides valuable data on health and risk-taking behaviors; and helps to shape a broad range of health interventions and policies.

Advancing Understanding of the Human Immune System

- AIDS research has greatly advanced our understanding of the **human immune system** and has allowed more effective approaches to treat diseases in which dysregulated immune responses are either the actual cause of, or a substantial contributing factor to, the fundamental disease process, including **allergies, multiple sclerosis, juvenile diabetes, heart disease, rheumatoid arthritis,** and **systemic lupus erythematosus.**
- The development of effective drugs to prevent and treat opportunistic infections in HIV disease has led to the development of new approaches to reduce illness and save lives among people undergoing **cancer chemotherapy** or receiving immunosuppressive therapy to prevent the rejection of **transplanted organs or tissues.**

Enhancing Our Preparedness for Emerging and Reemerging Infectious Diseases

Studies of HIV infection are improving our understanding of how viral infections cross species to enter human populations (**zoonotic infection**), and how this process can be prevented.

- Studies of HIV-infected individuals have led to the discovery of a number of important new infectious agents, including human herpesvirus 6 (HHV6), which causes illnesses such as **exanthem subitum** in children; human herpesvirus 7 (HHV7); human herpesvirus 8 (HHV8 or KSHV), the likely causative agent of Kaposi's sarcoma; bacteria of the genus also known as *Bartonella*, which causes bacillary angiomatosis and **"cat scratch fever"**; and many others.
- Molecular diagnostic techniques developed in the study of HIV helped Centers for Disease Control and Prevention researchers to rapidly identify **hantavirus** as the cause of an outbreak of fatal pneumonia in the southwestern United States a few years ago, determine its origin in local mice populations, and limit its spread among humans.
- Computational methods and mathematical modeling developed to study HIV transmission also are being used to track the transmission and dissemination of **bovine spongiform encephalopathy** (mad cow disease) and will benefit the study of other infectious agents as well.
- New international collaborations developed to track the natural history and epidemiology of HIV will be of significant value should new epidemic diseases emerge in the future.

Improving the Diagnosis of Other Infections

- The polymerase chain reaction test used to diagnose HIV infection is now also used routinely to rapidly diagnose other infectious diseases, including **HCV, tuberculosis, chlamydia, Lyme disease, and a variety of fungal infections.**
- The development of tests to screen blood for HIV has stimulated advances in technologies to screen the blood supply for other serious infectious diseases, such as HCV, HBV, HTLV-1, and HTLV-2—viruses that are associated with the development of leukemia and serious **neurologic diseases.**

Expanding the Basic Science Knowledge Base

- Biotechnology companies are capitalizing on new basic biomedical information provided by AIDS research, most notably new findings regarding chemokines and **novel proteins as targets for drug and vaccine development.**
- The discovery by AIDS researchers that a large protein molecule can kill HIV-infected cells may lead to similar approaches to **destroying cancer cells** and cells infected with HCV, herpesvirus, and other infectious agents.
- Improved understanding of the mechanism that HIV uses to infect target cells may advance gene therapy for **hemophilia** and other **genetic diseases.**

Enhancing Health Promotion and Disease Prevention

- Increased awareness of and attention to sexual behavior and drug use related to HIV transmission have led to improvements in our understanding of the determinants and consequences of sexual initiation and sexual practices in a range of populations, and have laid the groundwork for improved understanding and more effective prevention of addiction-related behaviors.
- Increased attention to the design and implementation of interventions to prevent HIV-related risk behaviors also has expanded strategies to promote a range of health-improving behaviors, such as **better nutrition, adherence to drug therapies,** and **reductions in smoking and alcohol and drug use.**
- The development of improved methods of measuring and assessing sensitive sexual and drug-using behaviors and the social and sexual networks in which such behaviors occur—which have been instrumental in charting the movement of HIV epidemics in different social groups and communities—is advancing understanding of the social dynamics of sexually transmitted infections, substance abuse, and fertility, and is advancing **social science and behavioral epidemiology** related to other infectious and noninfectious diseases.

Improving Maternal and Child Health in Low-Resource Countries

Research on HIV in children and the prevention of mother-to-child HIV transmission, and the integration of HIV services into maternal-child health settings, have improved maternal-child care and outcomes in developing countries. The benefits from AIDS research and care delivery include:

- **Improved delivery of preventive care to children and prenatal care** in developing countries
- **Increased understanding of the importance of breastfeeding to infant survival** in developing countries and an **increased focus on optimizing infant nutrition**
- Development of **new tools to assess neurodevelopment in children** in developing countries.

New Approaches to More Efficient and Inclusive Drug Trials

AIDS research has led to new models to test treatments for other diseases in faster, more efficient, and more inclusive clinical trials. Advances pioneered in AIDS research include:

- **Community-based clinical trials,** which capture the expertise of community physicians and other health care workers
- **"Parallel-track"** mechanism, which permits preapproval access to promising drug treatments for individuals who would not otherwise qualify for specific clinical studies
- **Community advisory boards,** which are now used to help ensure close coordination between clinical trial sites and community constituency groups in multiple disease areas
- **Ancillary services**—such as general health care, transportation, obstetrical care, daycare for children, and other related services—to recruit and ensure the continued participation of women, children, adolescents, and minorities in clinical trials.

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