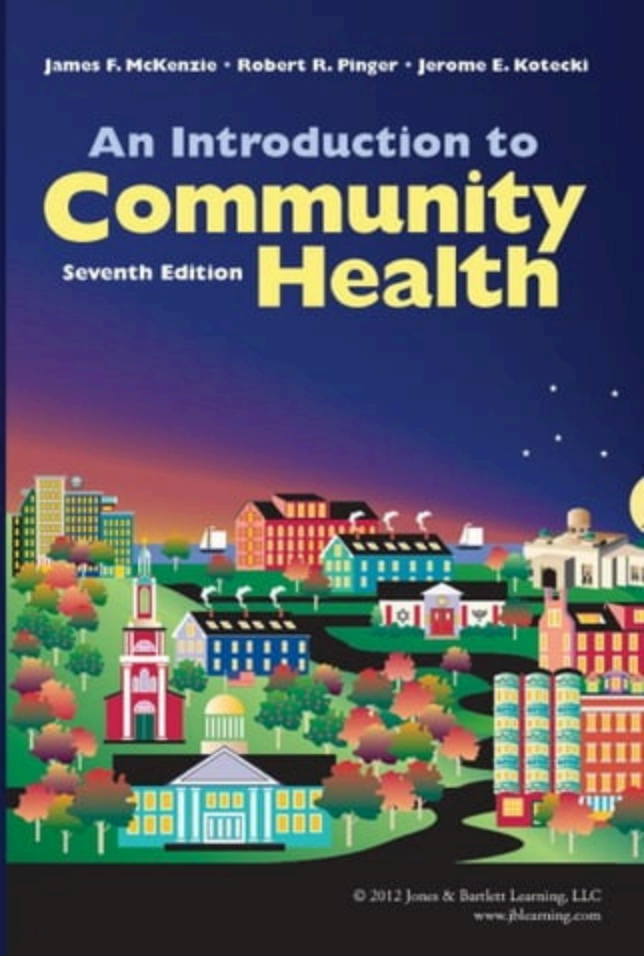
Epidemiology: Prevention and Control of Diseases and Health Conditions

Chapter 4



Introduction

- Disease classification can lead to prevention and control strategies
  - In community health, classification is usually
    - Acute or chronic (<3 or >3 months)
    - Communicable (infectious-caused by a specific biological agent/pathogen) or noncommunicable (noninfectious-cannot be transmitted from one person to another)

Classification of Diseases

Table 4.2
Classification of Diseases

Types of Diseases	Examples
Acute diseases	
Communicable	Common cold, pneumonia, mumps, measles, pertussis, typhoid fever, cholera
Noncommunicable	Appendicitis, poisoning, injury (due to motor vehicle crash, fire, gunshot, etc.)
Chronic diseases	
Communicable	AIDS, Lyme disease, tuberculosis, syphilis, rheumatic fever following streptococcal infections, hepatitis B
Noncommunicable	Diabetes, coronary heart disease, osteoarthritis, cirrhosis of the liver due to alcoholism

Communicable Diseases

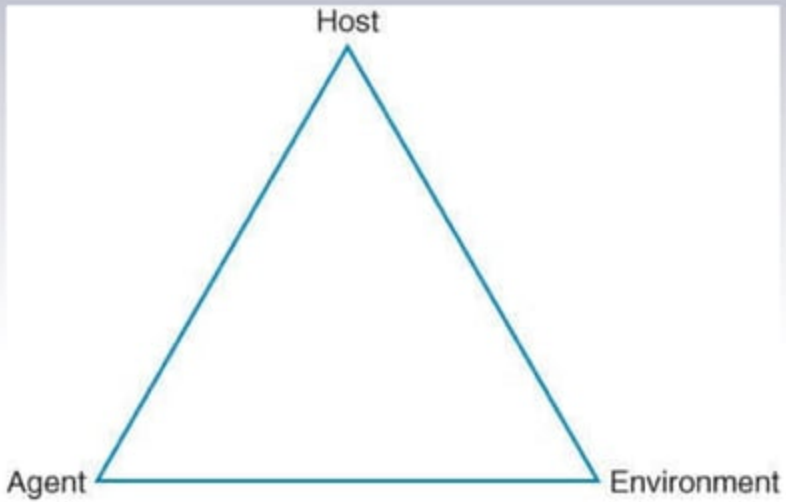
- Infectivity: ability of a biological agent to enter and grow in the host
  - Agent: cause of disease or health problem
  - Host: susceptible person or organism invaded by an infectious agent
  - Environment: factors that inhibit or promote disease transmission
- Pathogenicity: capability of a communicable agent to cause disease in a susceptible host

Biological Agents of Disease

Table 4.3
Biological Agents of Disease

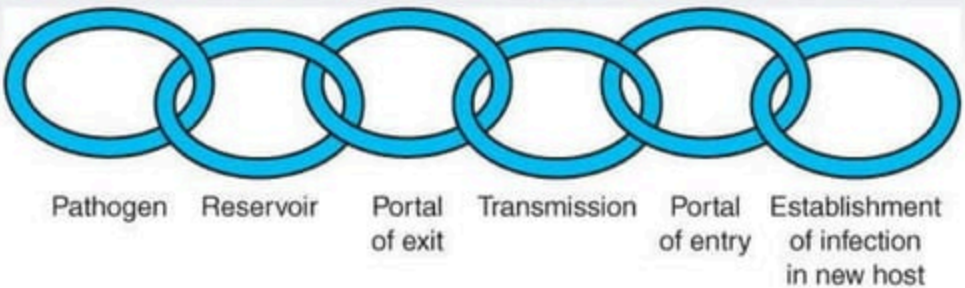
Types of Agent	Name of Agent	Disease
Viruses	Varicella virus	Chickenpox
	Human immunodeficiency virus (HIV)	Acquired immune deficiency syndrome (AIDS)
	Rubella virus	German measles
Rickettsiae	*Rickettsia rickettsii*	Rocky Mountain spotted fever
Bacteria	*Vibrio cholerae*	Cholera
	Clostridium tetani	Tetanus
	Yersinia pestis	Plague
	Borrelia burgdorferi	Lyme disease
Protozoa	*Entamoeba histolytica*	Amebic dysentery
	Plasmodium falciparum	Malaria
	Trypanosoma gambiense	African sleeping sickness
Fungi and yeasts	*Tinea cruris*	Jock itch
	Tinea pedis	Athlete's foot
Nematoda (worms)	*Wuchereria bancrofti*	Filariasis (elephantiasis)
	Onchocerca volvulus	Onchocerciasis (river blindness)

Communicable Disease Model



Chain of Infection

- Step by step model to conceptualize the transmission of a communicable disease from its source to a susceptible host



Chain of Infection

- Pathogen: disease causing agent (virus, bacterium, etc.)
- Reservoir: favorable environment for infectious agent to live and grow (human, animal, etc.)
- Portal of exit: path by which agent leaves host (blood, respiratory system, digestive system, etc.)

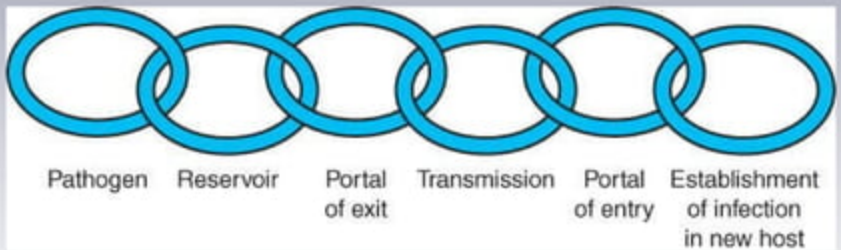
Chain of Infection

- Mode of transmission: how pathogens are passed from reservoir to next host
- Portal of entry: where agent enters susceptible host (blood, respiratory or digestive system, etc.)
- New host: susceptible to new infection being established

Modes of Transmission

- Direct transmission
  - Immediate transfer of disease agent between infected and susceptible individuals
    - Touching, biting, kissing, sexual intercourse
- Indirect transmission
  - Disease transmission involving an intermediate step
    - Airborne, vehicleborne, vectorborne, biological

Chain of Infection Example

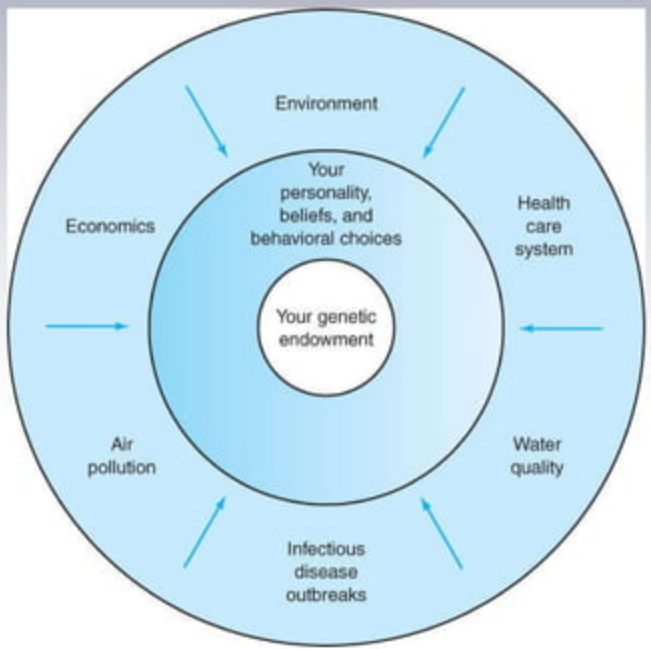


- Agent (cold virus), leaves reservoir (throat of infected person), when host sneezes (portal of exit-nose and mouth). Direct transmission (saliva droplets) enter respiratory tract of susceptible host at close range (portal of entry-mouth). New infection possibly established.
- If one link is missing, chain is broken

Noncommunicable Diseases

- Nation's leading causes of death
  - Heart disease, stroke, cancer
- Complex etiologies (causes)
- Multicausation disease model
  - Host: inalterable, unique genetic endowment
  - Personality, beliefs, behavioral choices: impact host
  - Complex environment: exposes host to risk factors

Multicausation Disease Model



Noncommunicable Disease Problems

- Coronary heart disease
- Malignant neoplasms (cancer)
- Stroke
- Chronic obstructive pulmonary disease
- Diabetes
- Alzheimer's disease

Prioritizing Prevention and Control Efforts

- Criteria used to judge importance of disease to a community
  - # of people who will die from a disease
    - Leading causes of death
  - # of years of potential life lost
    - Captures issues affiliated with various groups
  - Economic costs associated with disease
    - $ spent at various levels of government; ex: alcohol and other drugs

Prevention, Intervention, Control and Eradication of Diseases

- Prevention: planning for and taking action to prevent or forestall onset of disease or health problem
- Intervention: effort to control disease in progress; taking action during an event
    - Control - Containment of a disease; prevention and intervention measures
- Eradication: total elimination of disease from human population

BOX
4.1

Ten Great Public Health Achievements, 1900–1999: Decline in Deaths from Coronary Heart Disease and Stroke

You Gotta Have Heart

Since 1921, heart disease has been the leading cause of death, and since 1938, stroke has been the third leading cause of death. However, since 1950, age-adjusted death rates from cardiovascular disease (CVD) have declined 60%, representing one of the most important public health achievements in the twentieth century. This decline was made possible through a better understanding of disease epidemiology and advances in prevention techniques, diagnoses, and treatment.

Disease Epidemiology

The risk-factor concept—the idea that particular biologic, lifestyle, and social conditions were associated with an increased risk for specific disease—developed as a result of population-based research into the causes of CVD.

Advances in Prevention, Diagnoses, and Treatment

Prevention efforts and improvements in early detection, treatment, and care have resulted in several beneficial trends that have likely contributed to declines in CVD.

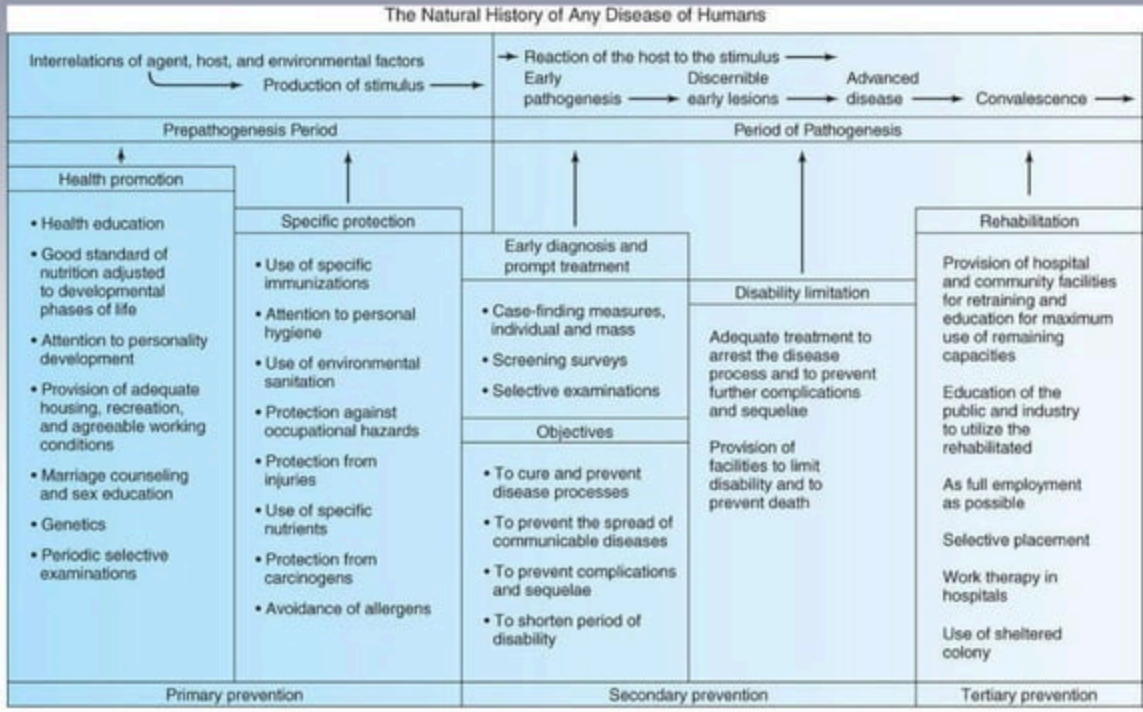
Trends That Have Likely Contributed to Declines in Cardiovascular Disease

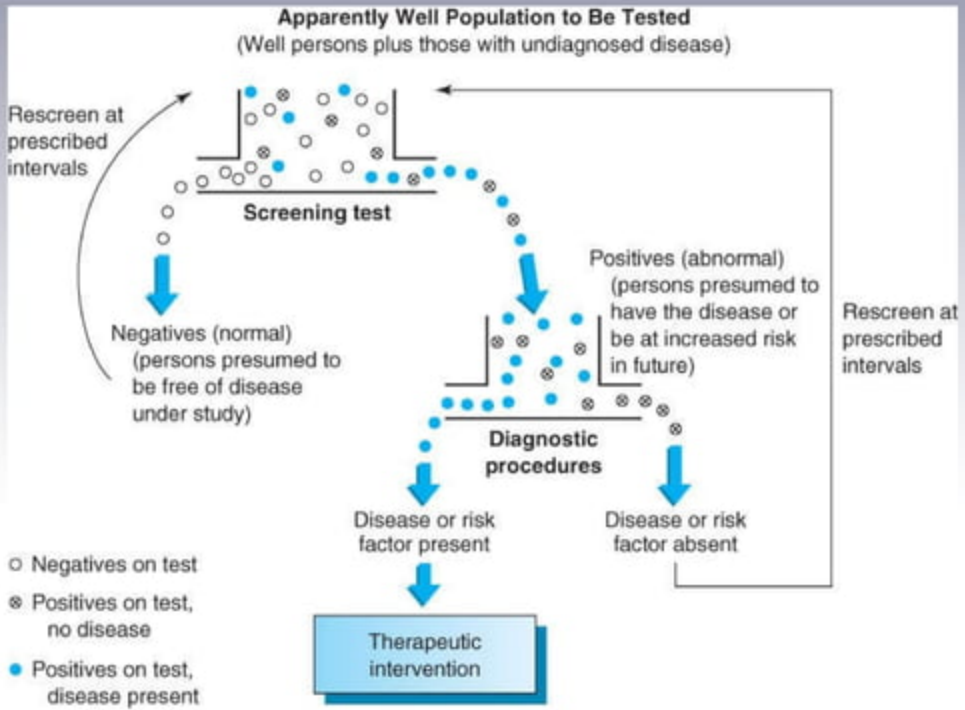
- A decline in cigarette smoking among adults
- A decrease in mean blood pressure levels
- A decrease in mean blood cholesterol levels

Source: Centers for Disease Control and Prevention. (1999). "Ten Great Public Health Achievements—United States, 1900–1999." *Morbidity and Mortality Weekly Report* 48(12): 241–242. Available at www.cdc.gov/mmwr/PDF/wk/mm4812.pdf. Accessed October 26, 2010.

Table 4.4
Some Noncommunicable Health Conditions That Affect Americans

Allergic disorders	Endogenous depression	Multiple sclerosis
Alzheimer's disease	Epilepsy	Osteoporosis
Arthritis	Fibrocystic breast condition	Premenstrual syndrome
Cerebral palsy	Lower back pain	Sickle cell trait and sickle cell disease





BOX 4.5

Healthy People 2020: Objectives

OBJECTIVES HIV-3, HIV-4, HIV-5, HIV-6, HIV-7, HIV-11, HIV-12, HIV 14.1, HIV-17.1, HIV-17.2. Reduce the number new AIDS cases, reduce the number of deaths from AIDS, increase survivorship of those diagnosed with AIDS, increase HIV testing, and increase condom use.

Target setting method: Consistent with the National HIV/AIDS Strategy; or 10% improvement

Data Sources: HIV Surveillance System, CDC, NCHHSTP

Targets and baselines:

Objective	2006 Baseline	2020 Target
HIV-3 Reduce the rate of HIV transmission among adolescents and adults	New infections per 100 persons living with HIV	
	5.0	3.5
HIV-4 Reduce the number of new AIDS cases among adolescents and adults	New cases of AIDS per 100,000 age 13 years and older	
	15	10
HIV-5 Reduce the number of new AIDS cases among heterosexual adolescents and adults	New cases of AIDS among heterosexuals	
	11,110	10,000
HIV-6 Reduce the number of new AIDS cases among adolescent and adult men who have sex with men	New cases of AIDS among males aged 13 years and older who have sex with men or with men and women	
	16,749	15,074
HIV-7 Reduce the number of new AIDS cases among adolescents and adults who inject drugs	New cases of AIDS among injection drug users 13 years and older	
	6,010	5,409
HIV-11 Increase the proportion of persons surviving more than 3 years after diagnosis with AIDS	Persons diagnosed with AIDS surviving more than 3 years after diagnosis	
	82% (diagnosed in 2002)	90.2%
HIV-12 Reduce deaths from HIV infection	Deaths from AIDS per 100,000 population	
	3.7	3.3
HIV-13 Increase the proportion of people living with HIV who know their serostatus	Persons 13 years and older living with HIV who are aware of their HIV infection	
	79.0% (in 2006)	90.0%
HIV-14.1 Increase the proportion of adolescents and adults who have been tested for HIV in the past 12 months	Persons 15–44 years of age reporting that they had an HIV test in the past 12 months (outside of blood donation)	
	15.4%	16.9%
HIV-17.1 Increase the proportion of sexually active females using condoms	Unmarried females aged 15–44 years	
	54.5%	58.0%
HIV-17.2 Increase the proportion of sexually active males using condoms	Unmarried males aged 15–44 years	
	55.2%	60.7%

For Further Thought

Reducing the rate of HIV transmission is the best way to reduce both the number of persons living with HIV infection and the number of new AIDS cases. Reducing the number of new AIDS cases reduces the number of deaths from AIDS. Unprotected sexual contact, whether homosexual or heterosexual, with a person infected with HIV is one of the most important ways HIV infections are transmitted. An important way to slow the rate of HIV transmission and the occurrence of new AIDS cases is to increase the proportion of sexually active females and males who use condoms. Can you think of ways to increase the rate of condom use in sexually active persons in your community?

Source: U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion (2010). *Healthy People 2020*. Available at http://www.healthypeople.gov/2020/default.aspx. Accessed December 2, 2010.

BOX 4.6

HEALTHY PEOPLE 2020: OBJECTIVES

OBJECTIVES HDS-2, HDS-3, Reduce the heart disease and stroke death rates.
Target setting method: 20% improvement
Data Source: National Vital Statistics System—Mortality (NVSS—M), CDC, NCHS

Targets and baselines:

Objective	2006 Baseline	2020 Target
HDS-2 Reduce coronary heart disease deaths	Coronary heart disease deaths per 100,000 population 126.0	100.8
HDS-3 Reduce stroke deaths	Stroke deaths per 100,000 population 33.8	42.2

OBJECTIVES HDS-4 Increase the proportion of adults who have had their blood pressure measured.
Target setting method: 2% improvement
Data Source: National Health Interview Survey (NHIS), CDC, HCHS

Targets and baselines:

Objective	2008 Baseline	2020 Target
HDS-4 Increase the proportion of adults who have had their blood pressure measured within the preceding 2 years and can state whether it is normal or high	92%	94.9%

OBJECTIVES HDS-5.1, 5.2 Reduce the proportion of adults and children and adolescents with high blood pressure.
Target-Setting Method: 10%
Data Source: National Health and Nutrition Examination Survey (NHANES), CDC, NCHS

Targets and baselines:

Objective	2005–2008 Baseline	Target 2020
HDS-5.1 Reduce the proportion of adults with high blood pressure	Adults 18 years and older with high blood pressure 29.9%	26.9%
HDS-5.2 Reduce the proportion of children and adolescents with high blood pressure	Children and adolescents aged 8–17 years with high blood pressure 3.5%	3.2%

OBJECTIVE HDS-6 Increase the proportion of adults who have had their blood cholesterol checked within the preceding 5 years.
Target setting method: 10% improvement
Data Source: National Health Interview Survey (NHIS), CDC, HCHS

Targets and baselines:

Objective	2008 Baseline	2020 Target
HDS-6 Increase the proportion of adults who have had their cholesterol checked	Adults 18 years and older who had their blood cholesterol checked within the preceding 5 years 74.6%	82.1%

OBJECTIVE HDS-7 Reduce the proportion of adults with high total cholesterol.
Target-Setting Method: 10% improvement
Data Source: National Health and Nutrition Examination Survey (NHANES), CDC, NCHS

Levels of Prevention

- Primary prevention
  - Forestall onset of illness or injury during prepathogenesis period
- Secondary prevention
  - Early diagnosis and prompt treatment before disease becomes advanced and disability severe
- Tertiary prevention
  - Aimed at rehabilitation following significant pathogenesis; retrain, reeducate, rehabilitate

Primary Prevention of Communicable Diseases

- Strategies at each link in chain of infection
  - Individuals
    - Hand washing, using condoms, properly cooking food
  - Communities
    - Chlorinating water supply, inspecting restaurants, immunization programs for all citizens, vector control, solid waste disposal

Secondary Prevention of Communicable Diseases

- Individuals
  - Self-diagnosis, self-treatment w/home remedies
  - Antibiotics prescribed by a physician
- Communities
  - Controlling or limiting extent of an epidemic
    - Carefully maintaining records; investigating cases
- Isolation, quarantine, disinfection

Tertiary Prevention of Communicable Diseases

- Individuals
  - Recovery to full health after infection; return to normal activity
- Communities
  - Preventing recurrence of epidemics
    - Removal, embalming, burial of dead
    - Reapplication of primary and secondary measures

Primary Prevention of Noncommunicable Diseases

- Individuals
  - Education and knowledge about health and disease prevention, eating properly, adequate exercise, driving safely
- Communities
  - Adequate food and energy supplies, efficient community services, opportunities for education, employment, and housing

Secondary Prevention of Noncommunicable Diseases

- Individuals
  - Personal screenings (mammogram, pap test, PSA test), regular medical and dental checkups, pursuit of diagnosis and prompt treatment
- Communities
  - Provision of mass screenings for chronic diseases, case-finding measures, provision of adequate health personnel, equipment, and facilities

Tertiary Prevention of Noncommunicable Diseases

- Individuals
  - Significant behavioral or lifestyle changes, adherence to prescribed medications, following rehabilitation requirements after surgery
- Communities
  - Adequate emergency medical personnel and services: hospitals, surgeons, nurses, ambulance services

Discussion Questions

- Which components of the Multicausation Disease Model can communities most effectively impact?
- Which level of prevention is most important for better community health outcomes and why?
- Who plays a more significant role in preventing diseases, individuals or communities?