Chapter 10

• THE RESURGENCE OF INFECTIOUS DISEASES
More than 200 children and adults have fallen ill with a mystery virus in central Puerto Rico, forcing officials to close down a local school, officials said Friday.

Four parents and two teachers sickened by the virus were hospitalized, the Education Department said. Another four parents and 197 students at the Escuela Federico Degetau I in Aibonito had caught the virus - the origin of which was not known.

Most of the children had diarrhea and a fever, and were vomiting, said Evelyn Rivera, the Education Department's student health director. Classes were suspended Thursday afternoon and officials hoped they would resume next week.

The school's principal was drafting a plan with the teachers and maintenance staff to disinfect the site, which has an enrollment of 560 students.

The Health Department will send an epidemiologist to the school.
HIV/AIDS

- First recognized in U.S. in 1981. Now a world-wide killer
- Caused by a retrovirus (copying RNA into the DNA of the cell)
- Attacks the immune system (CD4-T)
- After exposure: mild flu-like symptoms, weeks, easily transmitted
- Latent period, virus hidden in the DNA of the T4 cells, person quite healthy, less likely transmit
- Screening test recognizes antibodies (2-6 months after the original exposure), sensitivity
- Window: initial two-month period after infection, false sense of security
- Can measure viruses in the blood (more accurate tests)
- Now many drugs are available, but no cure
HIV/AIDS Transmission

- Sexual contact
  - Homosexual – most common in U.S.
  - Heterosexual – most common around the world
- Sharing needles (Russia, Former eastern Europe)
  - Intravenous drug use
  - Medical use of unsterile needles
- Mother to infant
- Blood transfusions
  - No longer in U.S.
Where Did HIV Come From?

- Probably originated in Africa
- Cross-species transmission from monkeys or apes
- Spread in human populations due to disruption of traditional lifestyles
- Spread to Western countries due to changing patterns of sexual behavior and international travel
Other Emerging Viruses

- Ebola (fever, bleeding from various bodily orifices) 1995 in Zaire, 2004 Central Africa
- Monkey pox (2003, Illinois, Wisconsin, contact prairie dog, similar to smallpox, rodents, exotic pets from Africa
- Hantavirus
- Other hemorrhagic fevers (Bolivian hemorrhagic fever - Machupo virus, Argentine hemorrhagic fever-Junin virus, Lassa fever in Sierra Leone, carried by rats)
- West Nile virus (NY, mosquitoes, birds-crows, encephalitis)
- SARS (severe acute respiratory syndrome), 2002 South China
Factors that Lead to Emergence of New Infectious

- Human activities that cause ecological damage and close contact with wildlife
- Modern agricultural practices
- International travel
- International distribution of food and exotic animals
- Breakdown of social restraints on sexual behavior and intravenous drug use
Influenza

- Virus is constantly mutating
- Vaccine must be changed frequently
- New, lethal strains appear periodically
- Epidemic of 1918-1919 killed 20 million to 40 million worldwide
- Concern about bird flu in Asia
New Bacterial Threats

• Legionnaire’s Disease
• Lyme Disease (1982, reservoir is mouse, deer tick feeds, infected dear tick)
• Streptococcus A, (strain B milder)
• E. coli O157:H7 in food (shiga toxin)
• Antibiotic resistance
  – From improper medical use
  – Use in agriculture
  – Example: ATB use in Europe
Tuberculosis

• Leading cause of infectious–disease death worldwide; one third of world population is infected
• There was a resurgence in the U.S. in early 1990s
• Much higher risk for people with HIV
• Transmitted by aerosol
• 50% fatality rate for untreated TB
Tuberculosis, ctd

- Antibiotics are effective, but must be taken for several months
- Improper use of antibiotics leads to resistance, including multidrug resistance, when mortality rate can be 50%
- Directly observed therapy works – best approach to preventing antibiotic resistance
Prions – particles contain protein

- Creutzfeld-Jacob disease (CJD) – sporadic, in older people (dementia, example from Europe)
- Bovine spongiform encephalopathy (BSE) or “mad cow disease” in Britain
- New variant CJD in Britain in younger people, thought to be caused by eating infected beef
- Regulations have been tightened on animal feed
Public Health Response to Emerging Infections

• Global surveillance
• Improve public health capacity
• Veterinary surveillance
• Reduce inappropriate use of antibiotics
• Need for new vaccines
• Need for new antimicrobial drugs
• Control of vector-borne and animal-borne diseases
• ?Future: Improve personal health-use lifestyle medicine in public health?
Threat of Bioterrorism

• Approach to bioterrorism is the same as that for natural disease outbreaks
• Will probably first be recognized by surveillance
• Best defended against by same methods as natural outbreaks
Discussion Question 1

• What are three public health measures that could reduce the probability that bacteria will develop resistance to antibiotics?
Chapter 11

• The Biomedical Basis of Chronic Diseases
• www.americanheart.org
• www.cancer.org
• www.diabetes.org
• www.nhlbi.nih.gov
• www.cancer.gov
• www.niddk.nih.gov
• www.cdc.gov/nccdphp/
Chronic Diseases

• Now leading causes of death and disability
• Multiple causes – risk factors
• Long period of onset
• Possibility of secondary prevention
• Important: primary prevention

• Dr. Dean Ornish: Reversing Heart Disease
• Leonardo Da Vinci:

• “Death in old men, when not from fever, is caused by veins…

• Which thicken so much in the walls that they become closed up and leave no passage for the blood….”
RESEARCH STUDIES

• 60% of cancers in women by unhealthy dietary habits
• women who are lean and regularly exercise have a 72% reduced risk of breast cancer
• Postmenopausal women who gain 22-44 pounds after age of 18 are 61% more likely to develop breast cancer
• 4 hours of exercise /week can reduce estrogen in the blood and cut breast cancer by 32-72%
10 million people in the US suffer from regular migraine headaches
55% migraine sufferers miss 2 workdays/month
88% migraine sufferers work more than 5 days/month with migraine
78% of women and 68% of men suffer from headaches (1985 survey US, N=1254)
the highest prevalence in men and women in ages 35-45
John Fothergill (British Physician, 1712)

“...There are some things which seldom fail to produce
the sick headache
such as a larger proportion than usual of melted butter,
fat meats, meat pies often contain all these things united,
and are as fertile a cause of this complaint as anything I know,
so are rich baked puddings and everything of similar nature.”
“The most ignored fact of all about pain is that the best way to eliminate it is to eliminate the abuse. Instead, many people reach almost instinctively for the painkillers - aspirin, barbiturates, codeine, tranquilizers, sleeping pills and dozen of other analgesics or desensitizing drugs”

- Norman Cousins (Anatomy of an illness, 1979)
Headaches as early warning signals of potential biochemical imbalances in the body.

- Recurrent headaches - Early warning signal
- High prevalence of headache under age 45
- After age 45 chronic diseases begin to become apparent
- Common Lifestyle factors:
  - high dietary fat intake
  - high saturated fat
  - high refined and processed food
  - high sugar intake, low fruit, vegetables, grains, legumes
  - lack of physical activity
  - excessive stress
  - excessive consumption of alcohol, caffeine
Cardiovascular Disease, ctd.

- Total cholesterol level – low is better
  - Low density lipoprotein (LDL) – low is better
  - High density lipoprotein (HDL) – high is better
- Genetics are a major factor (BUT if we know it..)
- Exercise lowers total cholesterol and increases HDL
- Smoking lowers HDL
- Widespread use of Statins for secondary prevention
Cardiovascular Disease

- Atherosclerosis
- Heart disease and stroke
- Plaque begins at an early age in U.S.
- American diet raises risk
- Diet, high blood pressure, diabetes, smoking interact to cause injury of artery walls
Hypertension -- High Blood Pressure

• Important risk factor for cardiovascular disease
• Essential hypertension” – no known cause
• Obesity, smoking, stress may be risk factors
• Role of salt
• 140/90 was considered borderline of high blood pressure; guidelines have been lowered to 120/80.
• Secondary prevention is effective

- **Cardiovascular diseases/hypertension**
- Prospective study, Oxford study
- 11,000 men and women, age 20-78, BP measurements
- The age adjusted

- Hypertension = 15.0% in male meat eaters ~ 5.8% in male vegans and 12.1% in female meat eaters ~ 7.7% vegan female with fish eaters and vegetarians having similar results

- Non-meat eaters have lower prevalence of hypertension and lower systolic and diastolic pressure
The diagram shows the blood pressure readings for Vegans/Macrobiotics, Lacto-Vegetarians, and Nonvegetarians. The readings are:

- **Vegans/Macrobiotics**: Diastolic 65.3 mmHg, Systolic 112.5 mmHg
- **Lacto-Vegetarians**: Diastolic 68.8 mmHg, Systolic 111.8 mmHg
- **Nonvegetarians**: Diastolic 76.4 mmHg, Systolic 120.8 mmHg
Evidence-based health benefits of vegetarian diet

• Differences between vegetarians and non-vegetarians:
  • Lower in fat (saturated), proper ratio omega6/omega3
  • Lower in total protein, animal protein, proper ratio,
  • Higher in fiber, complex carbohydrates, antioxidants, phytochemicals

• Vegetarian diets:
  • important contributing factor for lower rates in chronic diseases
  • similar to the diets of populations with reduced chronic disease risk…
Cancer

- Not one disease, but many; each has different risk factors, treatments, etc.
- Arises from mutations in DNA
- Mutations caused by chemicals, viruses, radiation….lifestyle???
- Diet and hormones play a role
- Tobacco use causes one-third of cancer deaths
- Testing chemicals for carcinogenicity
Do Vegetarians get less cancer?

- **Eat less fat:** 10% less, vegans 20% less, USA 40%, Japan 10%, balanced fat omega6/3 = 5:1
- **Don’t eat meat:** (less mutagenic compounds)
- **Eat more:** fruit, vegetables, grains, beans
- **Consume more:** more antioxidants, 50% more vit.C, 2x as much vit.E,A and variety
- **Eat more:** phytochemicals, soybeans product frequently and others
- **Less obese, exercise more, smoke less**
- **Eat more:** fibers 30-45 gm/day
Caloric intake
How may caloric restrictions inhibit tumor-genesis

- 1. Reduce mitotic activity, cell proliferation
- 2. Prolong and increase immune response
- 3. Starvation of preneoplastic cells
- 4. Influence of specific hormones (estrogens)
- 5. Influence peptide growth factors or receptors
- 6. Modulation and repair DNA damage
- 7. Influence on oncogene or proto-oncogene expression
- 8. Elevated glucocorticoid levels, leading to growth inhibition
Diabetes

- Major cause of disability
- Prevalence is rising in US along with obesity
- Deficiency in the body’s ability to metabolize sugar
- Type 1 diabetes – childhood onset; failure of insulin-producing cells of pancreas
- Type 2 diabetes – “adult onset;” insulin resistance
- Type 2 diabetes closely correlated with obesity
- Treatable, but need long-term monitoring; need good access to medical care

• Diabetes II:
• Improved glycemic control (fiber, restricted fat)
• Delayed glucose absorption
• Lowered insulin requirements
• Increased peripheral tissue insulin sensitivity
• Decreased renal hyperfiltration, proteinuria, and renal acid load (plant protein versus animal protein)
• Decreased serum cholesterol and TG
• 40% reduction in insulin doses
• 6-27% reduction in fasting serum glucose values
• 10-32% reduction in serum cholesterol values

Complications of Diabetes

- Blindness
- Kidney Failure
- Poor wound healing
- Amputations of the extremities
Other Chronic Disease of Public Health Importance

- Alzheimer’s disease and other dementias
- Arthritis

- Rheumatic Arthritis
- Uncooked vegan diet rich in lactobacilli decreases symptoms
- Measurements: health Assessment Q., duration of morning stiffness, pain at rest and pain in movement, change in the disease activity score (DAS)
- .. No need for gold, methotrexate, or steroid medication
Cognitive decline defined

- **Known Risk Factors:**
  - Chronic stress
  - Atherosclerotic disease
  - Diet high in saturated fat, low in omega-3 fatty acids
  - Lack of physical and cognitive exercise
  - History of head trauma
  - Poor education
Antioxidants and cognitive function

• *J Nutr Health Aging, 2003*
• Homocysteine concentration – risk factor for cognitive decline
• 144 subjects, age 30-80, Follow up after 6 years
• Cognitive speed test (Letter-Digit Coding test)
• Attention and information processing (Stroop test)
• Verbal learning and memory (World learning Test Total, Delayed Recall)
• Serum concentrations of homocysteine correlated negatively with cognitive performance
Position of the American Dietetic Association and Dietitians of Canada: vegetarian diets.


• Appropriate planned vegetarian diets are healthful, nutritionally adequate and provide benefits in the prevention and treatment of certain diseases.

• Well planned diet vegan and other types of vegetarian diets are appropriate for all stages of the life-cycle including during pregnancy, lactation, infancy, childhood and adolescence.
Discussion Question 1

• How do epidemiology and biomedical science complement each other in improving people’s understanding of chronic diseases?
Discussion Question 2

• Find the Web sites of the American Cancer Society, the American Heart Association, the American Lung Association, and the American Diabetes Association.

• How do these Web sites differ from those of the NIH institutes for the same diseases?
Chapter 12

Genetic Diseases and Other Inborn Errors
Environmental Teratogens

- Infectious pathogens
- Syphilis (bacteria passed through placenta), blindness and mental retardation,
- Rubella (deafness), vaccination
- Toxoplasmosis (parasitic disease, neurological damage), cats are reservoir
• Environmental chemicals – Mercury
• 1950: Minamata disease, Japan, (brain damage, neurological problems)
Drugs

- Drugs – e.g., Thalidomide (1960, sedative, Children born with arms and legs deformities)
- Tetracycline, anti-epilepsy medication, Accutane, hormones (birth defects)
- Alcohol (fetal alcohol syndrome)
• Severity of some genetic conditions may be affected by environment -- e.g. anencephaly and spina bifida
• Folic acid supplements can reduce risk
• Genes influence susceptibility to diseases of adulthood
Genetic Diseases

- Chromosomal abnormalities – e.g., Down syndrome (mental retardation)
- Mendelian genetics
  - Autosomal dominant (one parent have it, non-sex chromosome, 50%)
    Huntington’s disease – mid-life deterioration
    Marfan’s syndrome – extreme high, cardiovascular abnormalities
  - Autosomal recessive (both parents have it), inherit two copies of the gene, Tay-Sachs disease
    http://www.ninds.nih.gov/disorders/taysachs/taysachs.htm
  - X-linked (Hemophilia, Duchenne’s muscular dystrophy)

May be caused by new mutations
Guidelines for Genetic Screening

• Newborn screening only when benefits the newborn, when can confirm diagnosis and when treatment and follow-up are available for infants
• Carrier identification should be voluntary and confidential and include counseling
• Prenatal diagnosis should include education and counseling
• All tests of high quality, evaluated by FDA; government oversight of laboratory proficiency
• More education for the general public about genetics
Newborn Screening

- Test drop of blood from newborns for metabolic abnormalities

- All newborns in US are screened for at least two conditions: PKU (phenylketonuria, metabolism of amino acid phenylalanine) and hypothyroidism (risk of mental retardation)

- States vary in conditions screened for
- Early diagnosis can prevent or reduce permanent damage
Carrier Screening

- Screen for recessive genes in high-risk populations
- Tay-Sachs disease in Jews
  - Encouraged by Jewish leaders
Prenatal Diagnosis

• Only remedy may be abortion
• Down syndrome
• Anencephaly and spina bifida
Genomic Medicine

- Human Genome Project
- Many potential benefits
- Many dilemmas
- Cancer genes: e.g. BRCA1 and BRCA2
- Targeted therapies
- New Science: Nutrigenomics/personalized nutrition (functional medicine)

http://www.functionalmedicine.org/
Discussion Question 1

• What would be the benefits and drawbacks of including tests for BRCA1 and BRCA2 in newborn screening programs?
Discussion Question 2

• Because genes affect people’s risk for many diseases, the Surgeon General is encouraging Americans to learn about their family’s health history. Visit the Family History Initiative Web site (www.hhs.gov/familyhistory/)

• You can download a form for recording your family’s health history. Do you think this information will be helpful to you in understanding your health risks? Can you think of any drawbacks to trying to collect the information?
Discussion Question 3

• Visit the Web site of the National Human Genome Research Institute. ([www.genome.gov](http://www.genome.gov))

• What is the ELSI program? What are some of the ethical, legal, and social issues the program is studying?
• Please see links:
• Minamata disease
• Spina bifida
• Public Health Genomics