


ENVIR 202: Lesson No. 13



Food & Health

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ENVIR 202: Lesson 13 1

Overview

- ❖ Food Quantity Problems
- ❖ Food Requirements
- ❖ Food Quality Problems
 - Foodborne Disease

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Food Properties

- ❖ Food should be . . .
 - Safe
 - Attractive
 - Abundant
 - Nutritious



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Food Quantity

- ❖ Production:
 - World-wide, most suitable land is already under cultivation
 - Yield per acre - increasing, but at slower rate
 - Yield per unit of energy consumed in production - fishing, livestock are very costly in energy, produce high energy density but low quantity; food webs differ markedly in this respect.
 - Effects of over-harvesting: exceed rate of reproduction
 - Effects of habitat destruction

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Food Quantity

- ❖ Storage:
 - Spoilage (oxidation, microbial decay): salting, smoking, refrigeration, chemical antioxidants (preservatives), irradiation
 - Damage by vermin: rodents, arthropods
 - Other mechanisms: dehydration

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Food Quantity

- ❖ Distribution:
 - Transportation - dependent on local organization and infrastructure
 - Cost to consumer - poverty, influence of intermediate participants

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Food Requirements

- ❖ **Metabolic (Energy) Demand:**
 - Depends on age, gender, body surface area, physical activity
 - Common units for:
 - measuring energy: joules, ergs, kilowatt-hours, foot-pounds, British Thermal Units, kilocalories;
 - for measuring rate of energy consumption: [watts, horsepower]

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Basal (Resting) Metabolic Rate

Kcal/(m²-hr)

Age	Male	Female
5	53.0	51.6
20-24	41.0	36.9
40-44	38.3	35.3
50-54	37.2	34.5

Body Surface Area(m²) = 0.202 x BW(kg)^{0.425} x H(m)^{0.725}

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Examples

- ❖ **Example 1:**
 - 21 year old female, 5'6" tall, 61 kg (134 lbs.)
 - Body surface area = 1.667 m²
 - Resting metabolic rate = 1476 Kcal/day
- ❖ **Example 2:**
 - 57 year old male, 6'1.5" tall, 82 kg (180 lbs.)
 - Body surface area = 2.067 m²
 - Resting metabolic rate = 1845 Kcal/day

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Effect of Exercise

Activity	Energy Rate* (Kcal/m ² -hr)
Sleeping	35
Sitting	50
Standing	85
Walking at 3 mile/hour	140
Bicycling	250
Swimming	350
Running	600

*20 year old male

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Calories in Food

Component	Kcal/g
Carbohydrate	4
Fat	9
Protein	4
Ethanol	7

Note: 1 metabolic Kcal = 1 dietary Calorie

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Example

- ❖ For a diet including 36% of total calories as fat:
 - 500 g of food components (1.10 lb) provides 2500 Kcal.
 - The balance between intake of food and energy consumption determines storage and weight stability.

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Body Mass Index (BMI)

❖ BMI (kg/m²) = weight (kg) / height (m²)

- > Underweight: BMI <20
- > Overweight: BMI >25
- > Obese: BMI >30
- > Health risks for those overweight:
 - diabetes
 - heart disease

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Food Quantity

❖ Conditions resulting from deficiencies:

- > Protein (8 essential amino acids) -kwashiorkor
- > Total calories - marasmus
- > Iron - anemia
- > Iodide - goiter
- > Vitamin A - blindness
- > Vitamins B - beri-beri, pellagra
- > Vitamin C - scurvy
- > Vitamin D - ricketts
- > Other essential trace components:
 - cobalt, zinc, magnesium, selenium, folic acid

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Energy Density in Foods:

❖ Energy density = total calories/g food

❖ Includes effects of bone, water, non-digestible components such as fiber

Food Energy Density

- ❖ **Low energy density foods:**
Contain relatively large amounts of air (popcorn, ice cream), water (soft drinks, fresh fruits and vegetables), or fiber (fruits and vegetables)
- ❖ **High energy density foods:**
Contain relatively large amounts of fat (animal meats), and are heavily processed to remove air, water, fiber (TV dinners, Powerbars).
- ❖ These properties have important considerations for world-wide nutrition and health.

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Food Properties

- ❖ However, food is susceptible to:
 - Spoilage
 - Contamination
 - Adulteration
- ❖ which can render it unfit to eat



E. coli Bacterium

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Food Quality

- ❖ **Deliberate Additives**
(regulated by Food and Drug Administration and the US Dept. of Agriculture, based on risk assessment)
 - Preservatives - eg, benzoic acid, sorbic acid, propionic acid
 - Flavorings - natural, artificial
 - Texture Modifiers - eg, gums, emulsifiers
 - Genetically Modified Organisms (GMO) - pest resistance, flavor

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Food Quality

- ❖ Unintentional Contaminants (FDA, USDA, US Environmental Protection Agency, State and Local Health Departments)
 - Pesticides, fertilizers, pollutants in soil and water
 - Antibiotics and other animal feed additives

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Unintentional Contaminants

- ❖ Microbiological contaminants - from animals, water, human food handlers (preparation, serving)
 - Infectious agents - food borne infection
E.g., salmonella, campylobacter, *E. coli*
 - Microbial toxins - food borne intoxication
E.g., botulism, staphylococcal enterotoxin, *bacillus cereus* toxin, aflatoxin

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Foodborne Disease



- ❖ There are two types of foodborne illness
 - Infections
 - Intoxications

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Foodborne Disease *Continued*

- ❖ **Infections** are caused by:
 - The presence of micro-organisms in large numbers which multiply in the gut and overwhelm the body's defenses

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Foodborne Infections


- ❖ Amebic Dysentery
- ❖ Brucellosis
- ❖ Campylobacter enteritis
- ❖ Diarrhea(Acute)
- ❖ Viral gastroenteritis



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Foodborne Infections *Continued*

- ❖ Salmonellosis
- ❖ Shigellosis
- ❖ Trichinosis
- ❖ Typhoid Fever
- ❖ Infectious Hepatitis



Mallon as she was portrayed in an illustration in the June 20, 1909, edition of The New York American. 24


Foodborne Disease *Continued*

- ❖ **Intoxications** are caused by chemicals or "toxins"
 - Produced by micro-organisms, *or by*
 - Contamination with natural or manufactured chemicals

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Foodborne Intoxications

- ❖ Botulism
- ❖ Staphylococcal food poisoning
- ❖ Clostridium perfringens
- ❖ Bacillus cereus



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Foodborne Toxins *Continued*

- ❖ Scromroid fish poisoning (Histamine)
- ❖ Ciguatera fish poisoning
- ❖ Paralytic shellfish poisoning (PSP)
- ❖ Amnesic shellfish poisoning (domoic acid)
- ❖ Puffer fish poisoning (tetrodotoxin)

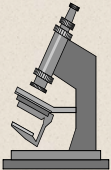


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Types of Pathogens

- ❖ Sporeforming Bacteria
 - > Clostridium botulinum
 - > Clostridium perfringens
 - > Bacillus cereus
- ❖ Non-sporeforming Bacteria
 - > Salmonella spp.
 - > Campylobacter
 - > E. coli O157:H7
 - > Staphylococcus aureus
 - > Listeria monocytogenes


- ❖ Viruses
 - > Hepatitis A
 - > Norwalk Virus



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Normal Symptoms of Foodborne Disease

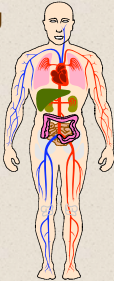
- ❖ Nausea
- ❖ Vomiting
- ❖ Diarrhea
- ❖ Cramps
- ❖ Headache
- ❖ Fever
- ❖ Chills
- ❖ Body Aches



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Complications of Foodborne Illnesses

- ❖ Kidney Damage
- ❖ Blood Poisoning
- ❖ Pneumonia
- ❖ Arthritis (2% will trigger)
- ❖ HUS (5-20K cases/yr)
- ❖ Guillian Barre Syndrome



- ❖ Chronic Sporadic Toxoplasmosis
- ❖ Neurological Damage
- ❖ Pancreatic Infections
- ❖ Chronic Illness - likely to occur in 2-3% of FBIs

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High Risk Individuals

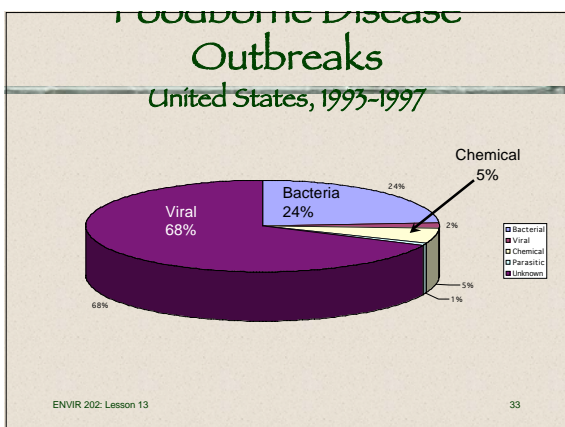
- ❖ Infants
- ❖ Children
- ❖ Pregnant Women
- ❖ Senior Citizens
- ❖ People taking medications:
 - > Antibiotics
 - > Antacids
 - > Immuno-suppressive drugs
- ❖ Immuno-compromised people:
 - > Recent major surgery
 - > Pre-existing or chronic illness
 - > HIV / AIDS
 - > Diabetes
 - > Cancer
 - > Liver or Kidney Damage
 - > Ulcers

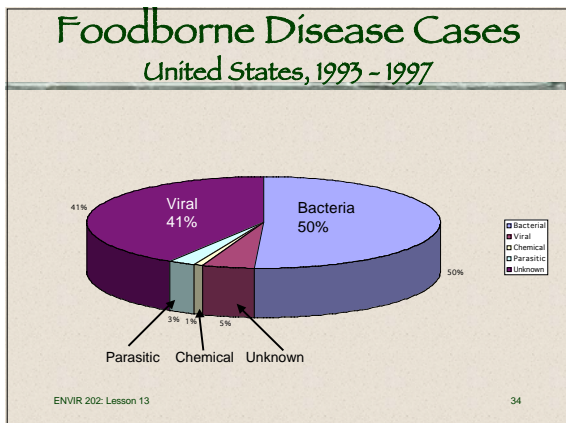
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Contributing Factors

- ❖ Factors Contributing to an increased risk of Foodborne Illness
 - > Aging Populations
 - > Lifestyles of the Public
 - > New and Emerging Pathogens
 - > Increase in High Risk Individuals
 - > New Processing Methods for Foods
 - > New Sources of Foods - Geographic

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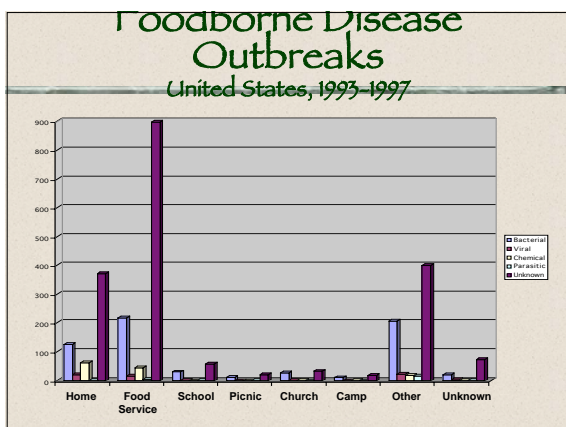
Foodborne Disease

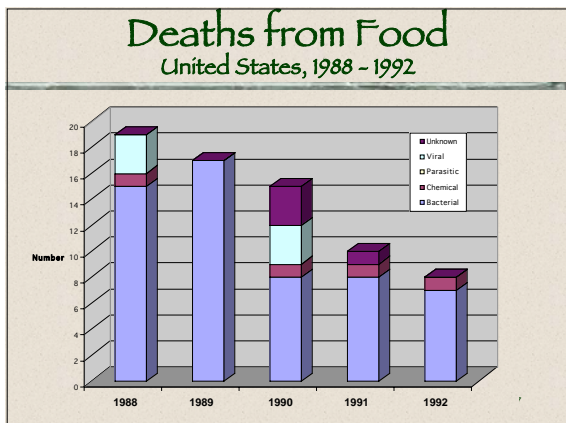
Reported Incidence

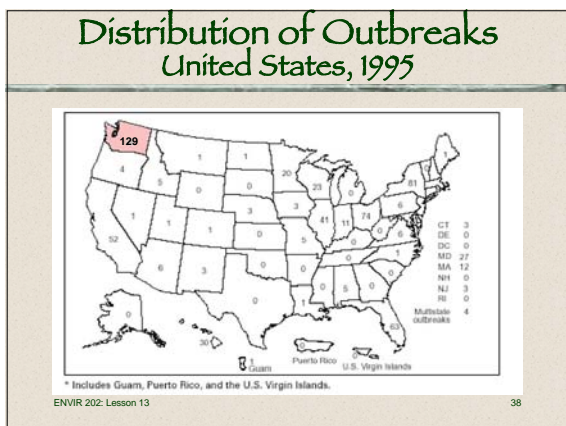
- ❖ Believed to be only the tip of the iceberg
- ❖ 1% or less are even reported
- ❖ 76 million cases annually

Image courtesy of Douglas Armand Digital Imaging
Used with permission

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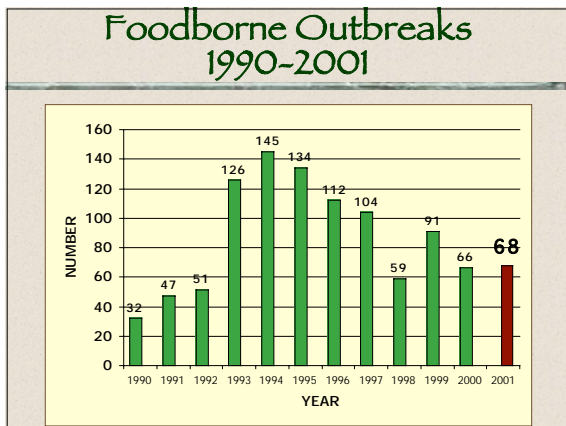


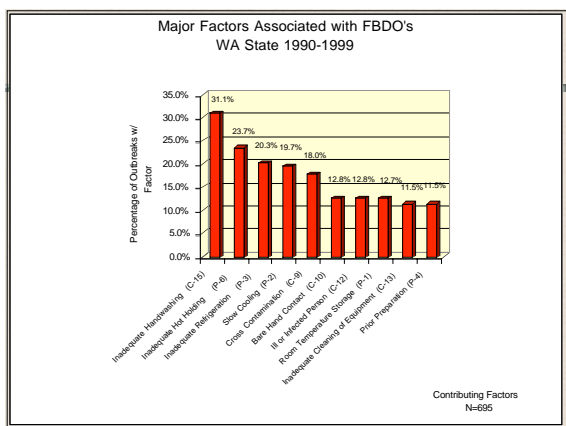


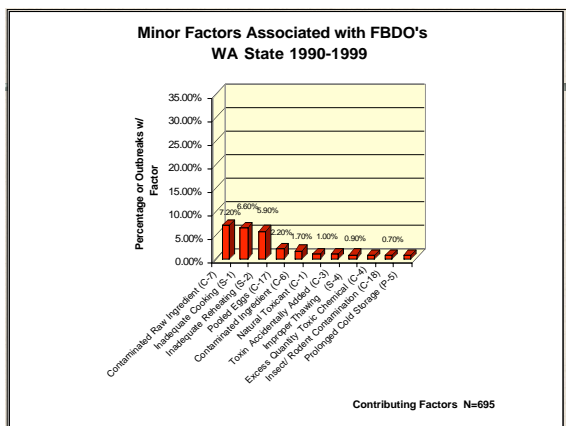


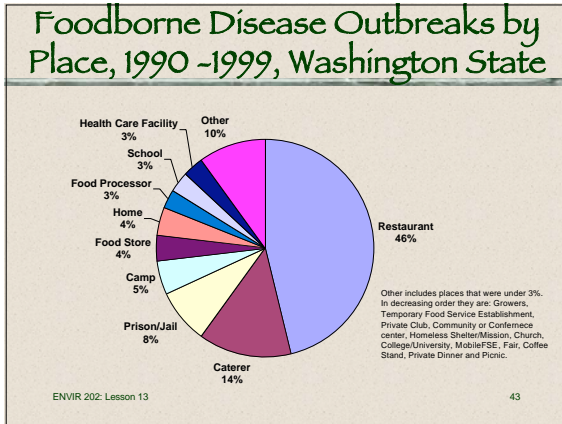
Foodborne Illness in Washington

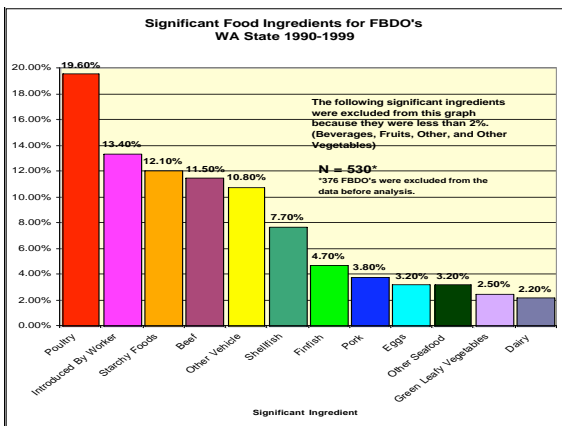
- ❖ Estimated Annual Number of Foodborne Illnesses in Washington State (extrapolated from CDC U.S. estimates - 2000)
 - > 1.5 million illnesses
 - > 6500 hospitalizations
 - > 100 deaths

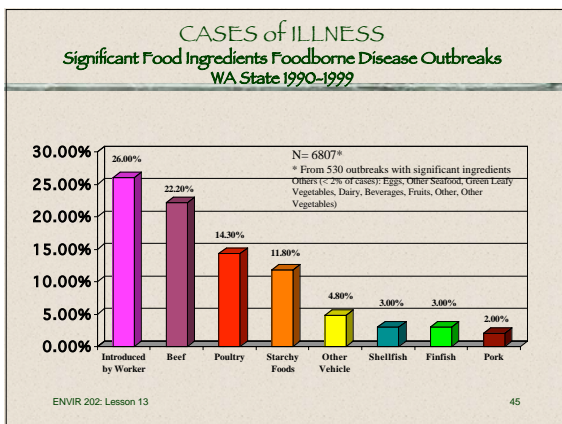












Trends

<ul style="list-style-type: none">❖ In the 80's...> Was beef> Was turkey> Was roast beef and turkey ...> Some viruses> Was Salmonella.....> Some Mex/Chinese.....> Was cooling.....> E. coli emerged.....> No Fruit/Veg outbreaks....	<ul style="list-style-type: none">❖ In the 90's...> Now hamburger> Now chicken> Now RTE foods & Starchy foods> Now nearly 1/2 the cases are viral> Still Salmonella> Increased M/Ch + others> Now handwashing> O157:H7, Crypto, ETEC,> Lots of F/V - sprouts, juice, melons, green leafys, etc...
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Disease Causation Factors

- ❖ Food Handling Practices:
 - > Poor Handwashing
 - > Cross Contamination
 - > Improper Heating
 - > Improper Cooling

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Disease Causation Factors *Continued*

- ❖ Diversity in the Food Industry
 - > Changes in eating habits
 - > More types of foods (ethnic, seasonal)
 - > Greater shelf life (transportation)
 - > More foods are imported
 - > New food products are coming out
 - > New food processes

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