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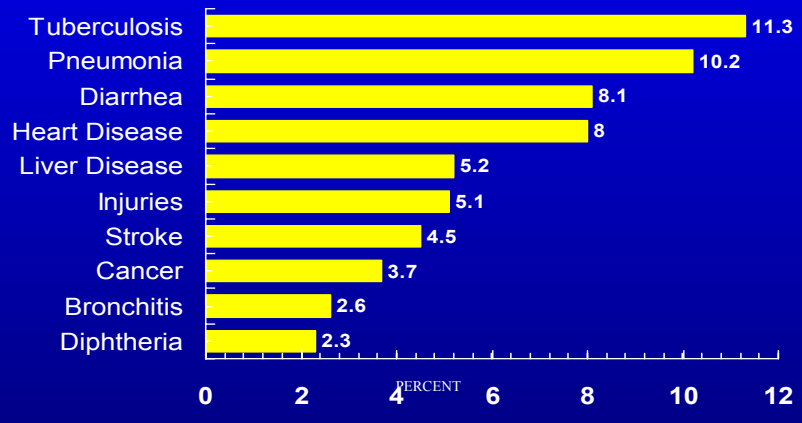
Current State of Foodborne Illness

Arthur P. Liang, MD, MPH
Director, Food Safety Office
National Center for Infectious Diseases
Centers for Disease Control & Prevention

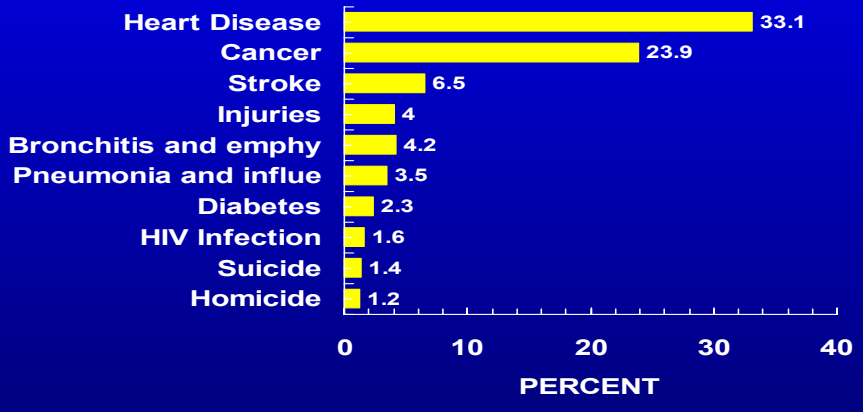
Conclusions

- **We are not losing the "war."**
- **Unfortunately, we probably can't win it either.**
- **Food Safety folks will always have a job.**

Causes of Death, United States, 1900



Causes of Death, United States, 1992



It is "time to close the book" on the problem of infectious diseases. *(1969)*
Jesse Steinfeld, MD, U.S. Surgeon General, 1969-73

"The future of infectious diseases will be very dull. *(1972)"*
Macfarlane Burnet, 1960 Nobel Prize Winner In Medicine

Told students that there were "no new diseases to be discovered. *(1976)"*
Lewis Thomas, Dean Yale Medical School

Examples of Pathogenic Microbes Identified Since 1973

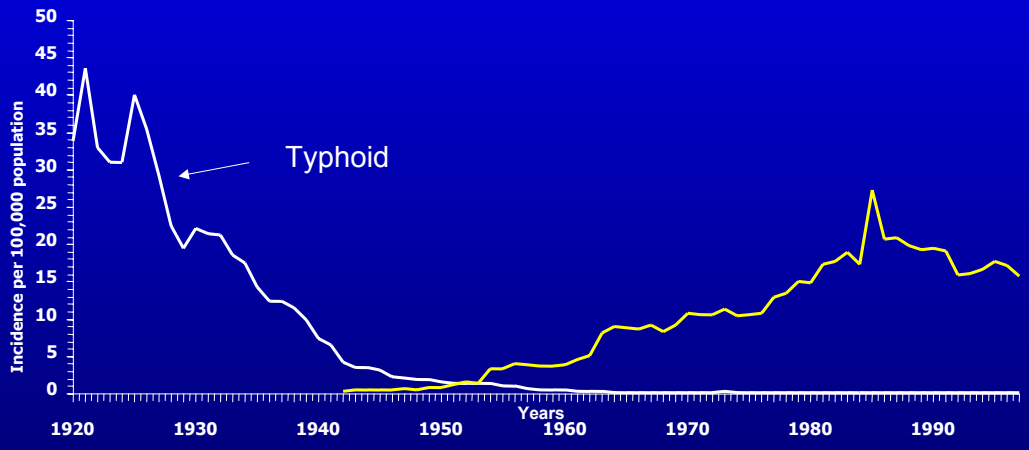
- 1973 Rotavirus
- 1977 Ebola virus
- 1977 Legionella pneumophila
- 1980 Human T-lymphotrophic
- 1981 Toxin-producing Staph aureus
- 1982 Escherichia coli O157:H7
- 1982 Borrelia burgdorferi
- 1983 HIV
- 1983 Helicobacter pylori
- 1989 Hepatitis C Virus
- 1992 Vibrio cholerae O139
- 1993 Hantavirus Virus
- 1994 Cryptosporidium
- 1995 Ehrlichiosis
- 1996 nvCJD Prion
- 1997 HVN1 Virus Influenza
- 1999 Nipah Virus

Source: US Institute of Medicine, 1997; WHO, 1999.

Emergence of non-typhoid *Salmonella:*

Reported infections USA, 1920-1997

CDC, National surveillance data



Emergence of Foodborne Pathogens

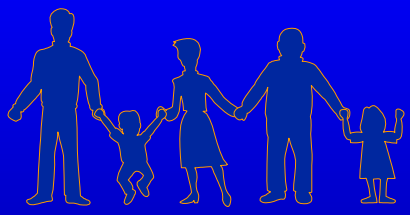
1900

- *Botulism*
- *Brucellosis*
- *Cholera*
- *Hepatitis*
- *Scarlet fever (streptococcus)*
- *Staphylococcal food poisoning*
- *Tuberculosis*
- *Typhoid fever*

1975-1995

- Norwalk-like viruses
- *Campylobacter jenjuni*
- *Salmonella Enteritidis*
- *Shiga toxin-producing E. coli O157:H7, O111:NM, O104:H21*
- *Listeria monocytogenes*
- *Clostridium botulinum* (infant)
- *Vibrio cholerae 0139*
- *Vibrio vulnificus*
- *Yersinia enterocolitica*
- *Arcobacter butzleri*
- *Hepatitis E*
- *Cryptosporidium parvum*
- *Giardia lamblia*
- *Cyclospora cayetanensis*
- *Toxoplasma gondii*
- BSE prion
- *Nitzchia pungens (dinoflagellate)*

Why Foodborne Diseases Emerge?



HOSTS

MICROBES

ENVIRONMENT

Microbe factors

- Norwalk-like virus: person-to-person, hardy, low dose
- *E. coli* O157:H7 - Acid tolerant
  Apple cider, salami, mayonnaise
- Listeria & Yersinia - refrigeration
- Antibiotic resistance

Environment factors

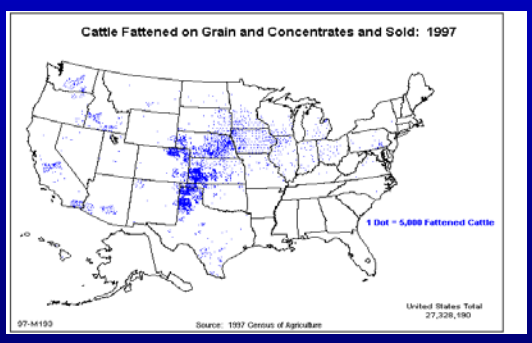
Changes in food production

- **CAFOs & Manure glut**
- **Globalization of food supply**
- **Centralized production**

Democratic Staff Report, US Senate Agriculture Committee (1998) "Animal Waste Pollution in America, An Emerging National Problem"

US Manure Estimates, 1997

- **5 tons of animal manure / person / year**
- **130 times greater than amount of human waste**



CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

E. coli O157

Scotland (JE Coia et al, J. Infect 36:317, 1998)

- ✓ Handling / preparing raw food (40%)
- ✓ Gardening / garden play (36%)
- ✓ Lived on / visited farm (20%)
- ✓ Direct / indirect contact with manure (17%)
- ✓ Private H_20 supply (12%)
- ✓ Recent high coliform counts in H_20 supplies (12%)

FoodNet Case-control:

✓farm animals

*Campylobacter**

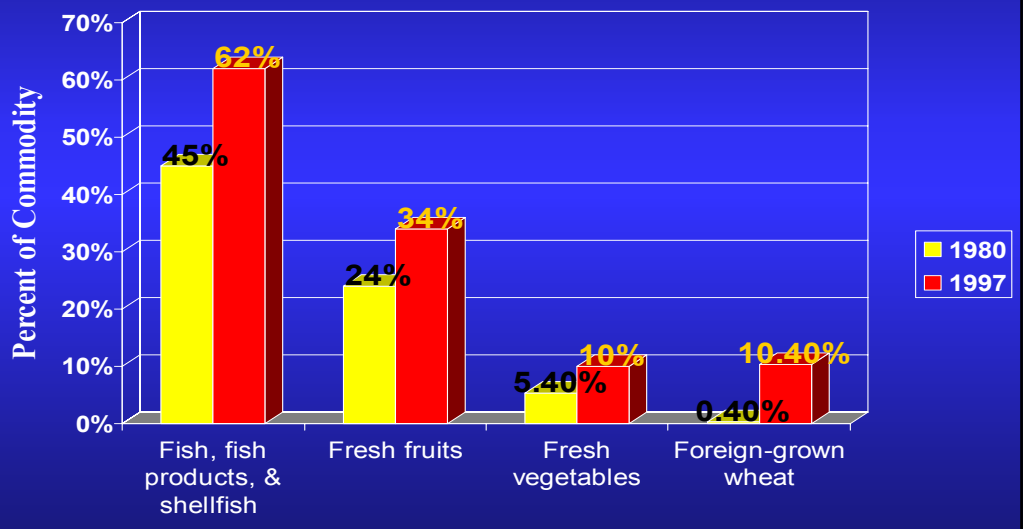
FoodNet Case-control:

✓Living on or visiting a farm

✓Contact with farm animals

Imported Food Consumption on the Rise

Source: USDA Agricultural Research Service



Examples of U.S. outbreaks traced to foods from other countries

- Norwalk-like virus & Raspberries (Europe and Canada)
- Seafood salad on an airplane from Peru caused cholera
- Cyclospora & Raspberries from Guatemala
- Salmonella & OJ from Mexico
- Alfalfa seeds shipped from Netherlands caused *Salmonella* diarrhea in persons who ate alfalfa sprouts

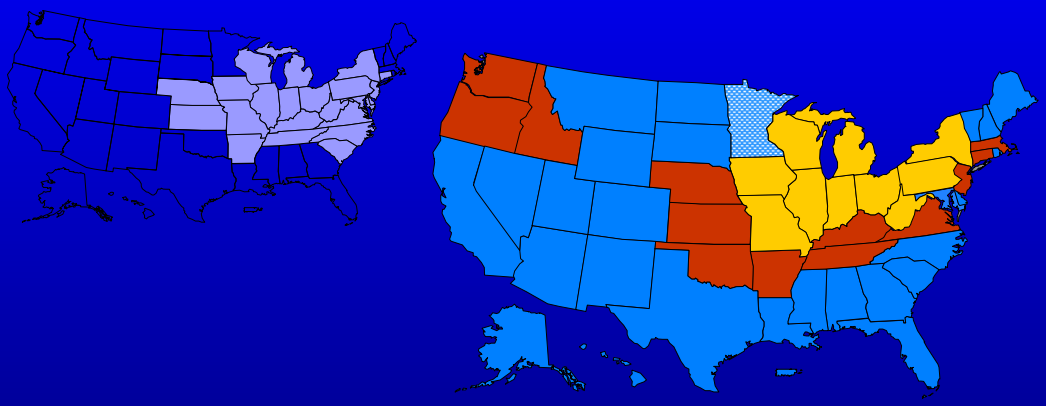
1999 FDA Imported Produce Sampling, n=1003

- **4.4% positive**
- **No *E. coli* 0157:H7**
- ***Salmonella* - 80% of violations**

Domestic Produce Sampling Program

Contamination Rate: 1.6% (as of July 2001)

•Mass production & distribution



- 215 (65%) of 331 tested patient isolates from 23 states matched by PFGE
- 675 cases were reported to PHLIS
- 432 cases (64%) over expected baseline

Large, multi-state outbreaks

▪ 1990 Salmonella & Cantaloup	295 infections in 28 states
▪ 1991 Salmonella & Salads	400 infections in 23 states & Canada
▪ 1993 E. coli 0157 in hamburger	>700 cases, 4 died in four states.
▪ 1994 Salmonella in ice cream	~ 224,000 ill in 41 states
▪ 1995 S. Stanley in Alfalfa sprouts	242 ill in 17 states
▪ 1996 Cyclospora & raspberries	>1000 ill, 22 hospitalizations
▪ 1997 E. coli 0157 & alfalfa sprouts	108 ill in 2 states
▪ 1998 Listeria in hotdogs	>100 ill, 21 deaths in 21 states
▪ 1999 Salmonella & OJ	360 ill in 16 states and Canada
▪ 2000 Norwalk-like virus & pasta salad	333 ill in 13 states

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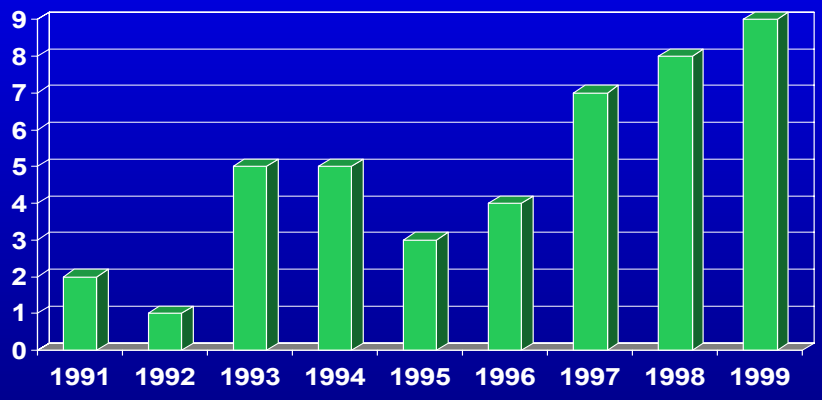
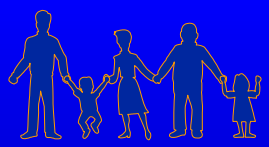
Number of multi-state outbreaks, 1990-1999



Host factors



- Increased numbers of susceptible persons
  Aging , HIV infection, immunosuppressive drugs
- Changing eating habits
  Dietary, "fast food", eating out,...
- Improved surveillance & detection
- Bioterrrorism

Changing eating habits

- changes in types of foods consumed:
  - ↑ turkey, chicken, fruits & vegs, ground beef
  - ↓ beef, eggs
- popularity of "fast food" & salad bars
- increased availability of ready-to-eat
- increased spending outside the home

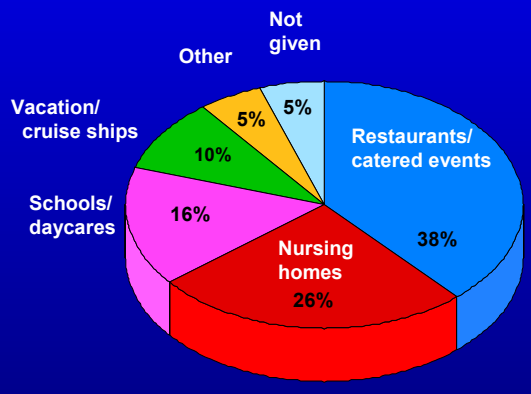
Eating Habits: Restaurants?

- *Salmonella* Enteritidis & *Salmonella* Heidelberg*
  - –Eating chicken outside home
- *Campylobacter**
  - –Turkey or chicken cooked outside the home
  - –Other meat cooked outside the home

* FoodNet case-control studies

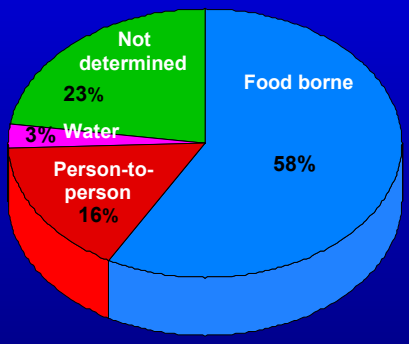
Norwalk-like virus Outbreaks, 1997 – 2000

Settings



Total: 229

Mode of transmission



Total: 172

E. coli O157 case-control study, 1996-1997

Previously Identified Risk Factors for Sporadic Infection

- ✓**Eating at a table service restaurant**

E. coli O157 Study, 1999-2000

- ✓**Restaurant consumption of pink hamburger was NOT associated with infection**

* **FoodNet case-control studies**

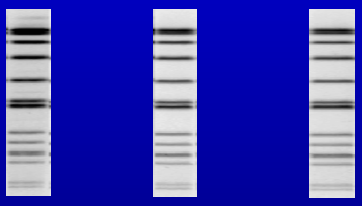
Improved surveillance & detection

Molecular subtyping "DNA Fingerprinting"

- Converts genetic material into a "bar code"
- Identifies hundreds of different strains
- Can be scanned & transmitted electronically

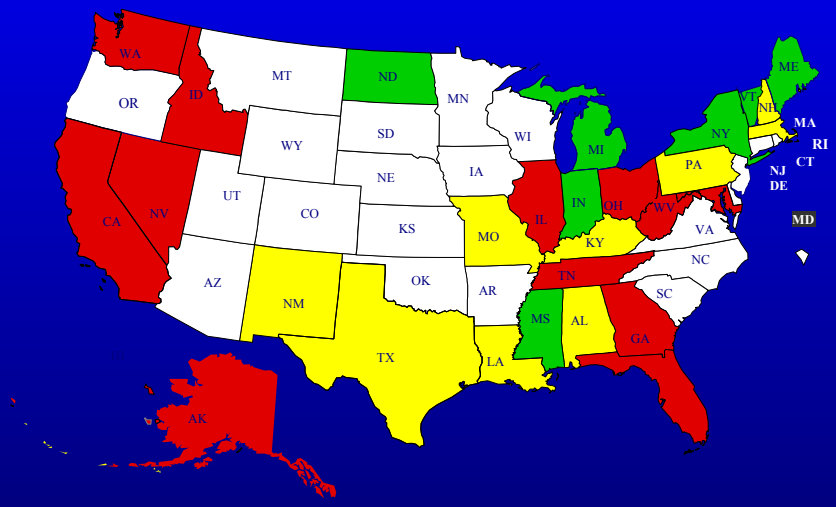
PFGE: Strains of patients' isolates, cereal & production line indistinguishable

patients cereal production line



Improved surveillance & detection

CaliciNet



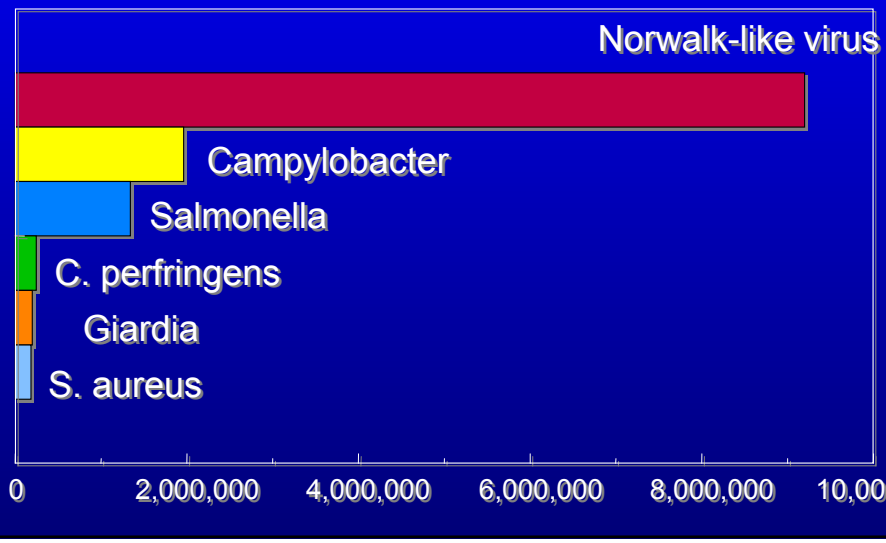
Burden of Foodborne Disease, 21st Century

- **Estimated 76 million cases resulting in 323,000 hospitalization & 5000 deaths each year in the U.S.**
- **1 in 4 Americans will develop a foodborne illness**
- **1 in 1000 will be hospitalized**
- **Cost: an estimated $6.5 billion per year**

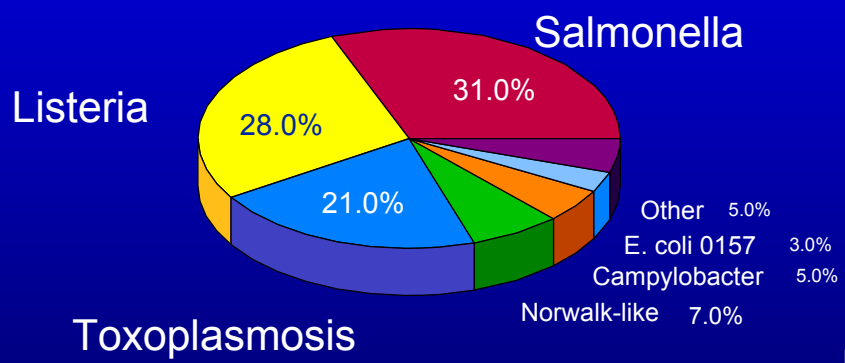
  ~CDC Annual budget

Most common causes of foodborne Illness

Mead et al, 1999



Deaths due to Foodborne Illness



Where do the microbes come from?

Agent	# of cases	resevoir	% food
Norwalk-like viruses	9,200,000	**man**	40
Campylobacter spp	1,963,141	poultry	80
Salmonella, nontyphoidal	1,341,873	animal	95
Clostridium perfringens	248,520	soil, man, animal	100
Giardia lamblia	200,000	Man, animal	10
Staphylococcal	185,060	man	100
Toxoplasma gondii	112,500	cat	50
Shigella spp.	89,648	man	20
Yersinia enterocolitica	86,731	pig	90
Escherichia coli O157:H7	62,458	cow	85

Mead, et al, *Emerging Infectious Diseases* 1999:5(5); 607-625

Are we winning the war against foodborne disease?

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Emergence of non-typhoid *Salmonella:*

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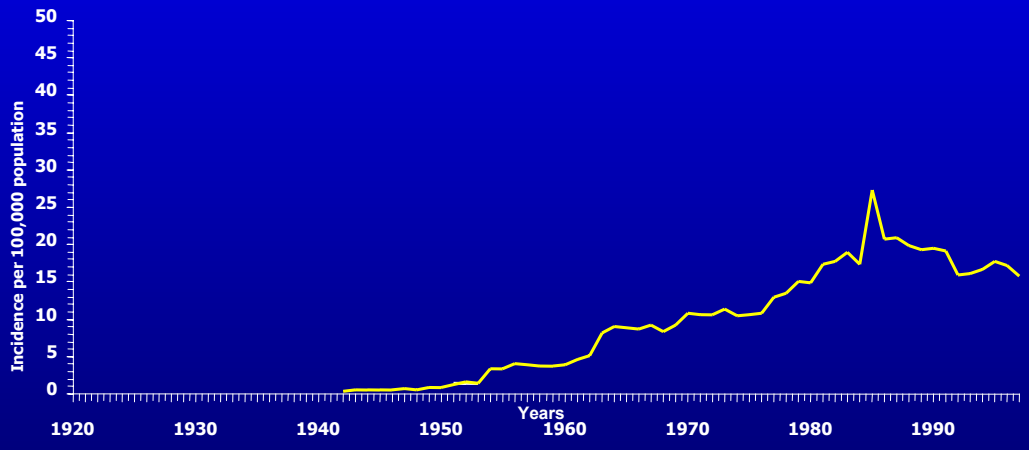

2001 FoodNet Data

23 percent overall drop in 7 bacterial foodborne illnesses since 1996.

- ↓ **27%** **Campylobacter**
- ↓ **15%** **Salmonella**
- ↓ **35%** **Listeria**
- ↓ **49%** **Yersinia**

"Preliminary FoodNet Data on the Incidence of Foodborne Illnesses -- Selected Sites, United States, 2001" Morbidity & Mortality Weekly Report (April 19, 2002) http://www.cdc.gov/mmwr/.

CDC
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Infections Associated with Food, 1900 vs 2000

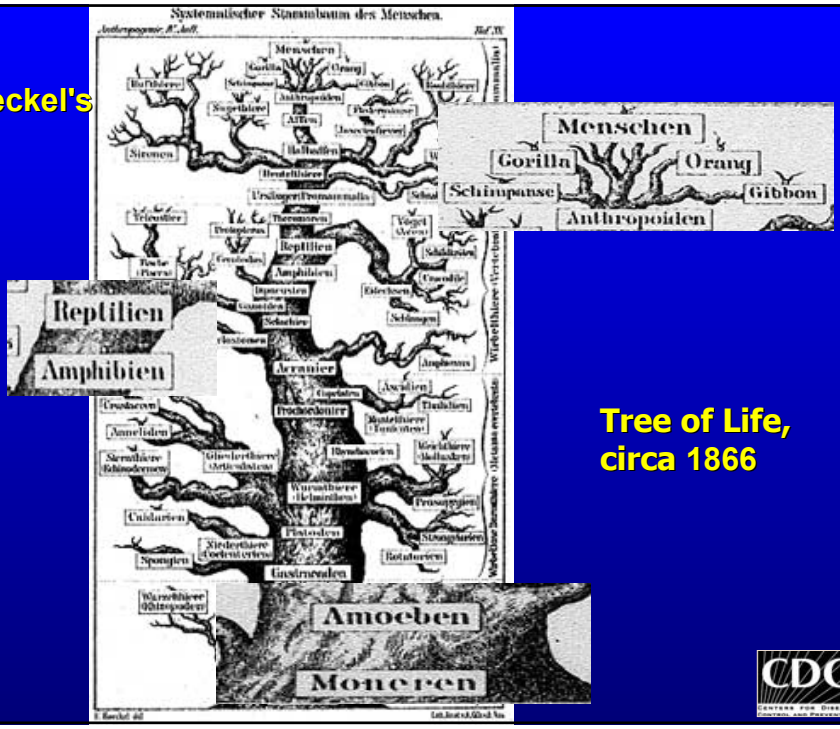
1900s
- Botulism
- Brucellosis
- Cholera
- Hepatitis
- Scarlet fever (streptococcus)
- Staphylococcal
- Tuberculosis
- Typhoid fever

2000
- Norwalk-like viruses
- Campylobacter
- Salmonella
- Clostridium perfringens
- Giardia lamblia
- Staphylococcal
- Toxoplasma gondii
- Shigella
- Yersinia enterocolitica
- E coli O157:H7

Addressing Food Hazards in the 21th century

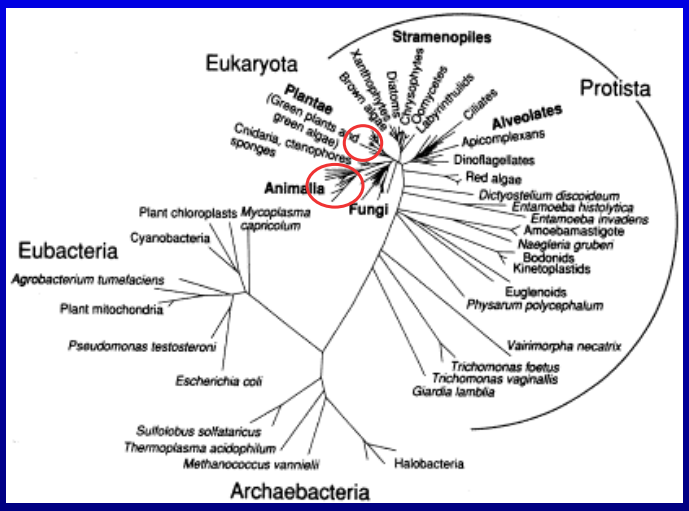
- Inspection & regulation (GAPs, GMPs, HACCP)
- Hygienic processing, Water chlorination
- Refrigeration, safe canning, additives & preservatives
- Pasteurization, monitoring
- Medical advances: antibiotics, vaccines
- Foodhandler education & behavior change

Ernst Haeckel's



Tree of Life, circa 1866

Woesian Tree of Life



Conclusions

- **We are not losing**
- **Microbes rapidly adapt through biologic evolution, transfer of genes.**
- **Microbes appear 3.5 Billion years ago**
- ***Homo sapien* adapts through cultural evolution, transfer of information**
- **The World is counting on you to pass down the lessons of civiliztion to this and future generations**
- **Once you start you can't stop**

The Red Queen Principle

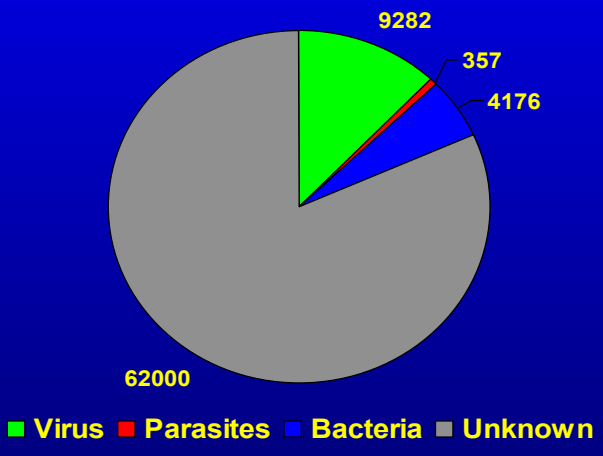
- Leigh van Valen (evolutionary biologist, 1973)

"…in this place it takes all the running you can do, to keep in the same place."

- Red Queen to Alice in *Through the Looking Glass*

Est. Foodborne Illnesses (thousands) by etiology,

Mead et al, 1999



Thinking Globally -- Working Locally

A Conference on
Food Safety Education