Challenges to Global Foodborne Disease Surveillance

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Outline

- Surveillance and surveillance systems
- Surveillance in selected countries including those that are developed and developing
- Problems and issues identified in outbreak investigations and reporting
  - Under-reporting and unknown etiology
  - Priority setting
- Conclusions and recommendations

Foodborne Disease Surveillance Systems - Purpose

- Alert of illnesses or potential illness to prevent further spread of disease
- Reporting of notifiable diseases and reports of laboratory isolations of enteric pathogens
- Investigation of incidents of foodborne illness and reporting of results on a regular basis
- Use of special epidemiological studies to determine a more realistic level of morbidity of a foodborne disease, and for more specific information on how illnesses occur
- Estimation of health and economic impacts and setting directions for control programs

Reasons for Better Surveillance and Control

- Trade issues with WTO and SPS
- Major changes through new food standards agencies or authorities because of “food scares”, e.g., BSE, dioxins in animal feed, *E. coli* O157 infections
- Bioterrorism/biosecurity
- Public expectations for improvements in the overall systems for foodborne disease detection and control at governmental levels in some countries

Relations Between Surveillance Systems, Determining Burden of Illness and Prevention Strategies (WHO, 2003)

Action	Surveillance Systems	Burden of Disease
Identification of risk-based mitigation strategies at some points on the food chain	**Integrated Surveillance**	Burden of pathogen specific disease according to food commodities
Identification of food at risk – prioritization of pathogen specific disease among foodborne disease	**Laboratory based surveillance**	Burden of pathogen specific disease
Prioritization of diarrhea among other diseases	**Syndromic Surveillance**	Burden of diarrhea
Limited strategy options	**None**	Unknown

Surveillance Approaches (Davies et al.)

Traditional Surveillance	**Syndromic Surveillance**
Rely on confirmed diagnoses	Rely on syndromes, before a diagnosis is available
Traditional function of public health	Emerging function of public health
Use data from death records, reportable cases, and confirming diagnostic tests	Use data from non-traditional sources 911 calls, nurse-line calls, OTC drug sales ED chief complaints

GI Syndromes in Walkerton-Resident Children seen in any Grey Bruce Area, Ontario, Emergency Room (Davies et al.)

46 days prior to Boil Water Advisory				Alert threshold (Mean + 3 SD)	Observed frequency on 4 days before advisory given on May 21, 2000*			
Min	Max	Mean	SD		May 17	May 18	May 19	May 20
0	**3**	**0.24**	**0.51**	**1.77**	**0**	**5**	**2**	**9**

***Sunday, May 21**

- **Outbreak number assigned, Outbreak Management Team formed, boil water advisory**
- ***E. coli* confirmed, presumptive water samples, cultures obtained**

UK Food Standards Agency

- Advice and information to the public and Government
  - food safety from farm to fork, nutrition and diet
  - protects consumers through effective food enforcement and monitoring
- Devolved administrations in Scotland, Wales and Northern Ireland
- Aim to reduce foodborne illness by 20% between 2001 and 2006

Northern Europe (Hatakka and Pakkala, 2003)

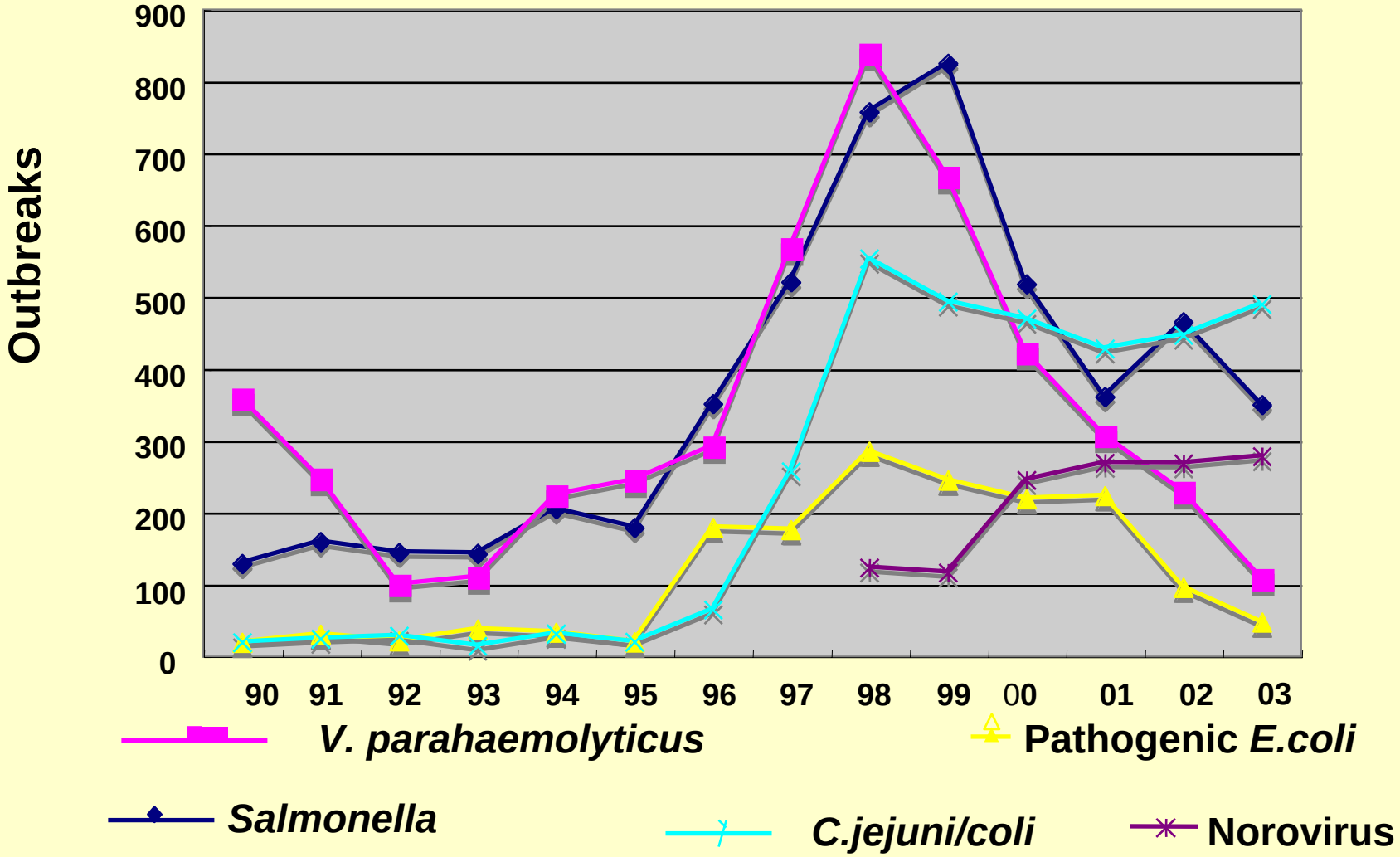
- Denmark had three waves of salmonellosis: chicken in the late 1980s, pork in the mid 1990s, and eggs in the mid to late 1990s
- *Campylobacter* infections increased significantly in Denmark, Finland, Iceland, Norway, and Sweden from 1985 till 1999: raw milk, poultry and pork
- Salmonellosis decreased in Sweden and increased in Denmark
- Salmonellosis decreased in Finland from 1990 till 1993 because fewer traveled abroad

Foodborne Disease in Japan

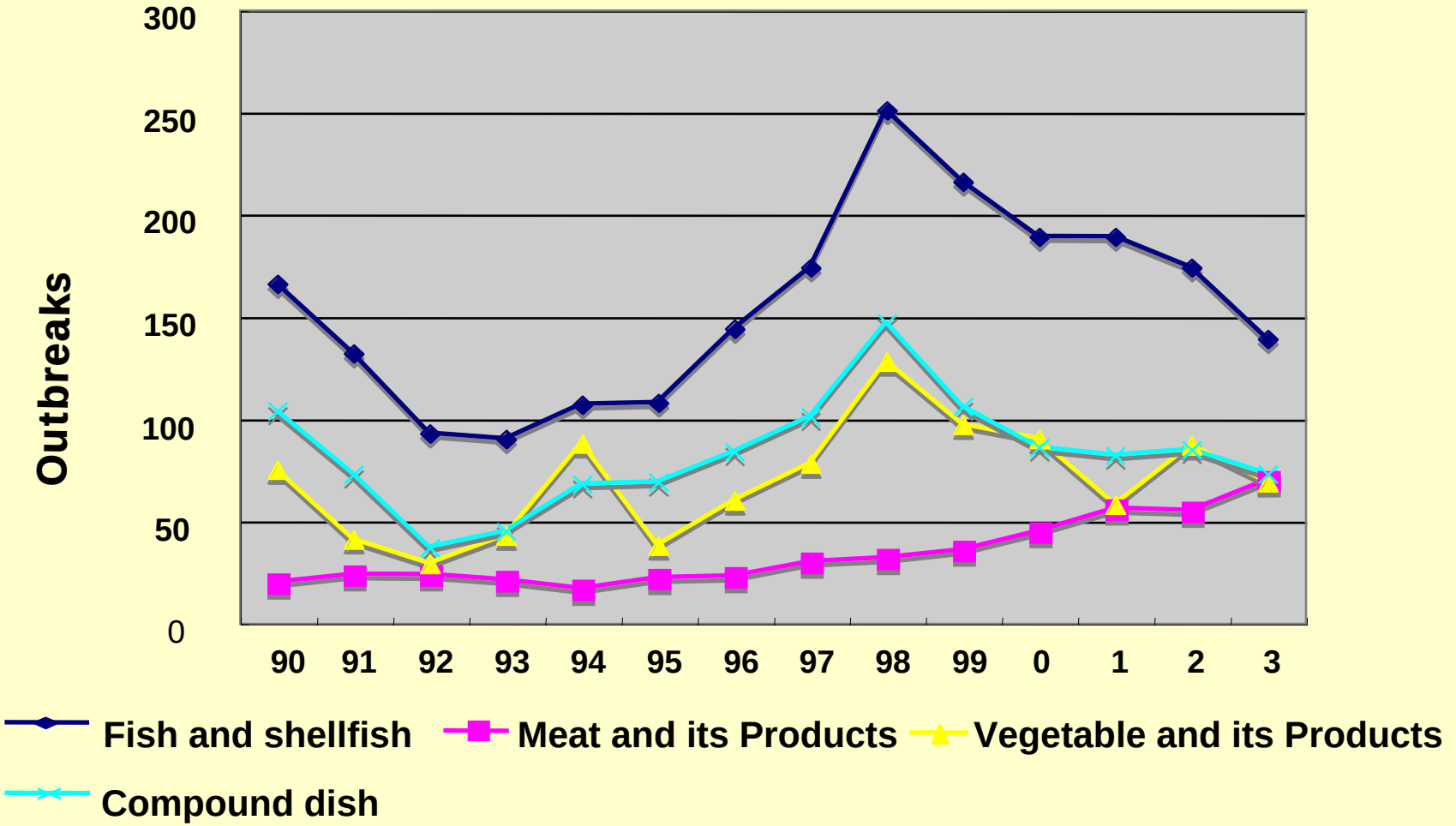
- 1960s: 1,700 cases (2.0 per 100,000)
- 1990s: 700 cases (0.6 per 100,000)(except 1996)
  - *Vibrio* and *Salmonella* most important
- 1996: 16 outbreaks (11,826 cases, 12 deaths) of *E.coli* O157:H7
  - Catered food mainly in schools and hospitals
  - 200 different PFGE patterns indicate that outbreaks and sporadic cases of *E. coli* O157:H7 were not due to single clone

Foodborne Disease in Japan

- 1997: Large foodservice ops save portions for 2 weeks
- 2001: BSE incident causing economic loss
- 2003: New Food Sanitation Law, information on foodborne illnesses is gathered nationally
- July 2003: Food Safety Council responsible for evaluating the safety of food products



Incidence of Bacterial and Viral Foodborne Disease Outbreaks in Japan (1990-2003)



Foods Implicated in Foodborne Disease Outbreaks in Japan (1990-2003)

US Passive Surveillance

- Outbreak passive system:
  - 489 in 1993
  - 653 in 1994
  - 628 in 1995
  - 477 in 1996
  - 504 in 1997

- Bacterial pathogens caused 75% of outbreaks and 86% of cases
- *Salmonella* Enteritidis associated with eggs
- 60 and 69 outbreaks of ciguatera poisoning and scombroid poisoning, respectively (502 cases total)

US Active Surveillance

- FoodNet population-based, active surveillance: estimated 76 million cases, 325,000 hospitalizations and 5,000 deaths annually
  - only 14 of 76 million cases of known etiology *Salmonella, Listeria*, and *Toxoplasma*, are responsible for 1,500 deaths each year
- Norwalk-like viruses accounted for > 67% of all cases, 33% of hospitalizations, and 7% of deaths
  - assumptions underlying the Norwalk-like viruses figures are most difficult to verify
- No estimate for acute toxin illnesses
- Successful in monitoring, tracking trends, and defining risk factors for causes of illnesses

2001-05 Incidence per 100,000 Compared with 2010 50% Reduction Objective

Agent	1997	2001	2004	2005	2010
Salmonella	13.70	15.1	14.7	14.6	6.8
Campylobacter	24.60	13.8	12.9	12.7	12.3
Shigella	NA	6.4	5.1	4.7	NA
E. coli O157	2.10	1.6	0.9	1.1	1.0
Cryptosporidium	NA	1.5	1.32	3.0	NA
Listeria	0.5	0.3	0.27	0.3	0.25
Vibrio	NA	0.2	0.28	0.3	NA
Cyclospora	NA	0.1	0.03	0.2	NA

Surveillance Weaknesses in Developing Countries

- Outdated food laws, standards and regulations
- No centralized approach or coordination among departments and agencies to food control
- Lack of adequately trained personnel
- Limited capacity for food control laboratories
- Food industry is familiar with terms like GMPs, GHPs and HACCP systems but lacks ability or will to do these

Surveillance Weaknesses in Developing Countries

- Countries cannot compete effectively in the export market to be in compliance with the SPS agreement
- Conflict between public health objectives and facilitation of trade and tourism
- Limited opportunities for appropriate scientific inputs in decision-making processes

Utility of Outbreak Data (WHO)

- Outbreak investigations allow collection of data to add to the knowledge of different pathogens, the vehicles of illness, and the common or novel errors or factors that contribute to outbreaks
- Fundamental source of information to design food safety policies, e.g.,
  - *Clostridium botulinum:* baked potatoes, garlic in oil
  - *E. coli:* sprouts, apple juice
  - Salmonella: pepper, chocolate, tomatoes, melons
  - Hepatitis A: green onions, strawberries, raspberries
  - *Listeria monocytogenes* in deli meats, soft cheese, smoked salmon

Multiplication Factors for Cases with Pathogens in US, UK, France and Canada

Agent	US	UK	
Campylobacter spp.	38	7.6/10.3	
Clostridium perfringens	38	342	
Listeria monocytogenes	2	2	1.1 France
Salmonella non-typhoidal	38	3.2/3.9	
Shigella	20	3.4	
Staphylococcus aureus	38	237	
VTEC/STEC	20 O157	2	4-8 Canada
Yersinia enterocolitica	38	1,254.3	
Cryptosporidium parvum	38	26.9	
Norovirus	1,562	275.5	
Hepatitis A virus	3	-	

Limits to Effective Surveillance

- Increased burden on the health system without adequate resources
- Passive systems depend on input from many local sources
- Private and consulting labs being used more but not contributing results to databases
- Industry information on contaminants not available
- 3rd party certification for imported products replacing government testing

Reasons for Limited or Inaccurate Data on Outbreaks

It is often difficult for investigators to obtain accurate information during an outbreak investigation because:

(1) the person(s) involved are no longer accessible for interview

(2) poor communication during the interview because of language difficulties

(3) poor questioning by investigators to elicit the appropriate information

(4) workers will give false information so as not to incriminate themselves or

(5) interval too long between start of outbreak and the beginning of investigation

Reasons for Outbreak Underreporting

- Less commonly identified agents implicated, e.g., *Coxiella*
- Illnesses with longer incubation periods, e.g., Hepatitis A
- Pathogens usually causing mild illness, e.g., *B. cereus*, gastrointestinal *L. monocytogenes*, *S. aureus*
- Late notification of illnesses to health units
- Unavailability of clinical specimens and/or food samples
- Unsuitability of laboratories or methods to detect and identify the pathogen
- Insufficient resources and trained staff to conduct investigations
- Lack of cooperation between the different disciplines/agencies
- Failure of investigators to write the final report and submit data to higher authorities

Cases of Unknown Etiology

- If the data are available, these are determined by:
  - [total number of acute GI illnesses - number of cases accounted for known foodborne pathogens] x [estimated percentages of foodborne transmission]
- US
  - 78-81% of foodborne illnesses (183,000,000 cases annually)
  - 50% hospitalizations
  - 64% of deaths
- UK
  - 74% of illnesses

Cases of Unknown Etiology

- Reasons
  - appropriate specimen for testing was not collected
  - specimen negative for all pathogens tested for in the laboratory because
    - many pathogens are not routinely tested for
    - an unknown pathogen causative agent
- UK study (1994-1995) (Tompkins et al., 1999)
  - 2,264 stools samples were tested for 18 bacteria, 2 protozoa and 6 viruses
  - No pathogens detected in 45% of samples

On-going Issues for Priority Setting

- Magnitude of sequelae
  - GBS (*Campylobacter*), HUS (*E. coli* O157), RA (*Campylobacter, Salmonella, Shigella, Yersinia*)
  - Possible IBS (*Salmonella, Shigella, Campylobacter*),
  - Possible lactose intolerance (rotavirus)
  - Possible diabetes mellitus (enteric viruses)
- Determining impact of foodborne disease on deaths
- Economic and/or social burden
  - HALYs, Cost-of-illness estimates, industry losses, deaths
- Food attribution
  - No agreement on methodology
  - Outbreak data plus case-control studies

Use of Surveillance For Better Food Control

- Surveillance is a key component to show a link between government policy and reduction of illness, and:
  - Shows which problems have or have not been solved
  - Contributes to risk analysis to develop policy strategies
  - Directs required research and surveys
  - Leads to multidisciplinary research conducted by academia, government and industry to determine solutions
  - Since it is people that allow the situations to occur that result in illnesses, the social sciences need to be brought in as to why errors are made

Recommendations

- Consolidate databases to generate one set of national data for each agent (e.g., notifiable diseases vs. lab isolations)
- Focus more on active surveillance
  - population-based studies to capture sporadic cases
  - identify risk factors for each type of foodborne illness
  - incorporate data into risk analysis framework
  - intervention strategies for prevention and control
  - assist in educational programs
- Cooperation among government agencies for investigation, control and policy, and promotion of targeted research

Recommendations

- Integration of food safety and food sanitation related laws (from farm to fork) including HACCP, GMP and SSOP in each phase of food production
- Integrate bioterrorism/biosecurity into surveillance
- Set public health goals for countries and monitor progress with surveillance data
- Have resources to interpret the data for trends and discrepancies
- Develop more global surveillance systems, e.g., Enter-net, Pulsenet, Global-Salm Surv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Thank you for your attention