

The threat of bioterrorism to the food supply: Public health preparedness

Jeremy Sobel, MD MPH

Foodborne and Diarrheal Diseases Branch
Centers for Disease Control and Prevention

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Biological weapons: Paradigms and goals

- **Military biowarfare paradigm**

- **Disable largest possible number of combatants as quickly as possible**

- **Bioterrorism against civilians**

- **Priority is fear, not necessarily casualties**
- **Generate panic, civil disorder**
- **Undermine confidence in government**
- **Inflict economic losses**

Biological terrorism and food: Objectives

- **Attack on food supply could fulfill terrorist objectives**
 - **Could affect thousands of citizens**
 - **Panic, civil disorder**
 - **Undermine confidence in government's ability to protect populace**
 - **Could cause severe damage to US agriculture and food industries**

Episodes of biological terrorism in US

- The Dalles, Oregon, 1984
 - Religious cult contaminates restaurant salad bars
 - 751 culture-confirmed cases of *S. Typhimurium*
 - "Trial run" for more extensive attack to disrupt local elections
 - Cult had microbiologist, laboratory with various pathogenic microorganisms
- Dallas, Texas, 1996
 - Hospital lab worker feeds colleagues pastries laced with *S. dysenteriae* Type 2

Biological terrorism and food

"Although few actual incidents or threats of deliberate food contamination with a biological agent have occurred to date, there is little assurance that this track record will continue."

**US General Accounting Office Report
GAO/RCED-00-3, October 27, 1999**

Vulnerability of food supply

- Centralized production, wide distribution
 - 1994: 224,000 infected with *S. Enteritidis* from contaminated ice cream
 - 1996: Over 7,000, mostly children, infected with *E. coli* O157:H7 in Sakai City, Japan, from contaminated radish sprouts
 - 1985: 170,000 infected by MDR *S. Typhimurium* from contaminated pasteurized milk in Chicago
 - 1997: Nation-wide recall of 25,000,000 lb ground beef contaminated with *E. coli* O157:H7

Bioterrorism and the food supply: Potential biological agents

- Critical biological agents for public health preparedness
 - ➔ "Highest priority" category includes botulinum toxin
 - ➔ "Second most critical priority" category has a subset of foodborne, waterborne pathogens, including
 - Salmonella spp, Shigella spp,
 - E. coli O157:H7, V. cholerae, others

Bioterrorism and the food supply: Potential biological agents

- ***C. botulinum toxin***

- Descending paralysis; 95% hospitalized, 60% respirator dependent, 5% die
- Organism ubiquitous in environment, toxin produced with basic microbiology methods
- Most lethal known substance
LD50=0.001 mcg/Kg
- Iraq had >10,000 liters of solubilized toxin in 1990
- Aun Shirikyo cult in Japan had stocks of toxin

Bioterrorism and the food supply: Potential biological agents

- ***Salmonella* spp.**

- Transient GI syndrome, low mortality
- Accessible: clinical & research labs, culture collections, poultry, environment
- Hardy organism, survives in environment

- ***Salmonella Typhi***

- Severe illness, long incubation period, 1% severe sequelae, protracted recovery
- Accessible: clinical, research labs, collections
- 3% asymptomatic carrier state, potential for propagation

Bioterrorism and the food supply: Potential biological agents

- ***Shigella spp.***

- ➔ *S. sonnei*: transient GI syndrome, low mortality
- ➔ Accessible: clinical & research labs, culture collections
- ➔ Fragile organism, limited survival in environment
- ➔ Secondary transmission common

- ***Shigella dysenteriae* Type 1**

- ➔ Severe illness, dysentery, toxic megacolon, seizures (children), hemolytic uremic syndrome
- ➔ Accessible: clinical & research labs, culture collections
- ➔ Secondary transmission common

Bioterrorism and the food supply: Potential biological agents

- ***E. coli O157:H7***

- Bloody diarrhea, 5% hemolytic uremic syndrome (children) --> hypertension, stroke, renal failure, neurologic complications
- Accessible: clinical & research labs, culture collections, cattle, farms
- Very low infections dose, secondary transmission likely

Food and bioterrorism: the public health response

- Detection of an attack
- Identification of biological agent
- Response
 - Epidemiologic: identify contaminated food, remove from distribution, advise the public
 - Medical: Ability to augment medical services to absorb sudden mass casualties

Bioterrorism and food:

Recognition of an attack

- Announced or threatened attack:
 - ➔ Law-enforcement/Public health approach
 - ➔ Assess credibility of attack
 - ➔ Enhance security along production/distribution chain
 - ➔ surveillance for human cases
- Covert attack:
 - ➔ Initially, response by public health infrastructure
 - ➔ Will be detected as if unintentional outbreak
 - ➔ Rapidity of response will depend on robustness of public health infrastructure

Foodborne bioterrorism: Preparedness

**Preparedness for covert bioterrorist
attack on the food supply =**

1. Robust public health infrastructure

rapidly identify contaminated food(s), remove from
circulation, prevent new infections

**2. Emergency medical response capacity to
absorb sudden mass casualties**

prevent complications and death among victims

Foodborne disease: public health infrastructure

- Surveillance
- Laboratory diagnosis
- Epidemiologic investigation
- Traceback/recall

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Foodborne diseases: surveillance tools

- Outbreak reporting
- Botulism surveillance system
- Notifiable disease surveillance
- Salmonella Outbreak Detection Algorithm (SODA)
- PulseNet
- FoodNet

Foodborne disease: Outbreak reporting

- Astute clinicians, laboratorians, local public health officials detect cluster of illness related in space and time
- Investigation may be local or involve state or federal agencies depending on size, organism, syndrome, public concern and local resources

Foodborne disease: Botulism surveillance system

- CDC maintains national stock of botulism antitoxin
- Clinician suspecting case and seeking antitoxin call state DOH which contacts CDC
- CDC clinical consultant available 24 hrs
- If indicated, antitoxin released, lab testing arranged
- State DOH investigates
- Every case is a public health emergency

Foodborne disease: Notifiable disease surveillance

- Laboratory-based electronic reporting of notifiable enteric diseases to states, CDC
- When subtyping of isolates not done by clinical labs, isolates shipped to PH labs
- Periodic analysis of data for trends
- Inherently incomplete -- only cases where test ordered are captured
- Foundation for "2nd generation" systems

Foodborne disease:

Salmonella outbreak detection algorithm (SODA)

- ***Salmonella: common foodborne pathogen, has 2,000 serotypes***
- **All human *Salmonella* isolates in US are serotyped**
- **SODA: computerized algorithm comparing current weekly count of each serotype to summary historical data by location**
- **Increased rate of serotype over expected reported, can be investigated**
- **Several large outbreaks detected by SODA**

Foodborne disease: PulseNet

- **Network of public health & vet labs conducting molecular subtyping on foodborne pathogens**
- **Pulsed-field gel electrophoresis pattern, "molecular fingerprint"**
- **Electronic transmission of patterns between network labs**
- **Isolates with identical pattern identified, investigated as possible outbreak**
- **36 state PH labs in PulseNet, eventually all 50**

PulseNet gel patterns slides

Foodborne disease: FoodNet

- Foodborne component of CDC's Emerging Infections Program
- Population-based foodborne disease surveillance in select geographic areas
- 9 sites, about 24 million people
- Ongoing data collection allows rapid detection, investigation of increases
- Area under surveillance to expand

FoodNet site map slide

Foodborne disease: public health infrastructure

- Surveillance
- Laboratory diagnosis
- Epidemiologic investigation
- Traceback/recall

Foodborne disease: laboratory diagnosis

- Most foodborne pathogens detectable by routine culture practices in state PH labs
- Botulism diagnosis at CDC and 17 state PH labs
- National Laboratory Response Network being developed for rapid diagnosis of suspected bioterror agents, and referral to appropriate specialty laboratories

Foodborne disease: public health infrastructure

- Surveillance
- Laboratory diagnosis
- Epidemiologic investigation
- Traceback/recall

Foodborne Disease: Epidemiologic investigation, traceback, recall

- **Resembles unintentional outbreak**
 - **Interview cases to identify common food exposures**
 - **Analytic study to statistically implicate a food**
 - **Traceback of implicated food to retailer(s), distributor(s), producer(s), processor(s), farmer(s) (CDC, FDA, USDA)**
 - **Recall of implicated food**
 - **Collection and disposal of contaminated food(s)**
 - **In bioterrorism event, law enforcement involved**
- **Speed of response reduces casualties**

Foodborne disease: Communications

- **Public health network: local, state, federal**
- **Federal public health/regulatory agencies: CDC, FDA, USDA**
- **Law enforcement: FBI**
- **Medical response: DHHS, DoD**
- **Food industry**
- **The public, the media**
- **Healthcare providers**

Conclusions

- **Bioterrorist attack on the food supply is a genuine threat**
- **Common foodborne pathogens could be used as biologic agents**
- **Initially, bioterrorist event may be indistinguishable from an unintentional outbreak**
- **Preparedness requires robust standing public health infrastructure to respond to unintentional and intentional outbreaks**
- **Rapid epidemiologic response may limit the number of victims**

Conclusions II

- **Preparedness requires medical response capability to handle mass casualties**
- **The robustness of the medical response may improve medical outcome for victims**