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INFORMATICS TOOLS FOR FOOD SAFETY AND DEFENSE

Project Leads

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Statement of Problem

Our national security depends on a safe and secure food supply that is free of contamination, whether unintentional or the result of a terrorist act. In December 2006, Congress and the White House passed the Pandemic and All-Hazards Preparedness Act (PAHPA), establishing the goal of near-real-time electronic situational awareness to enhance early detection of, rapid response to, and management of public health threats in order to minimize their impact. Meeting this challenge for food safety depends on our ability to collect, interpret, and disseminate electronic information across organizational and jurisdictional boundaries. While events such as 9/11 have elevated the need to share critical intelligence related to security threats, these events have also promoted the proliferation of multiple data systems and tools whose lack of interoperability hinders effective intelligence gathering and timely response. Further, most of the public health and food safety informatics work¹ in the

¹ While many use the terms *informatics* and *information science* interchangeably, we use the term *informatics* to refer specifically to the resources, devices, and methods used in the acquisition, storage, retrieval, and use of information. The term was coined as a combination of *information* and *automatic* to describe the science of automating information interactions.

United States—from early detection of food-related outbreaks by local and state health departments to confirmation by the Centers for Disease Control and Prevention (CDC) through “fingerprinting” of pathogenic contaminants—takes place at different local, state, and federal jurisdictional levels. As a result, large gaps exist in our ability to meet the challenge of food safety in the United States with regard to PAHPA.

Background

While we have yet to experience major food terrorism in the United States, many feel that it is only a matter of time (Cramer, 2001; Liu & Wein, 2008; Rainey & Nyquist, 2002; Sobel, Khan, & Swerdlow, 2002; Strongin, 2002; Wein & Liu, 2005; Rigoglioso, 2005). There have been several incidents worldwide, including an incident in 2002 in which three individuals were arrested for planning a mass poisoning of a Jerusalem café; another 2002 incident in which a Chinese restaurant owner added chemicals to a competitor’s food, killing dozens; and finally the 2003 plot to add ricin to the food supply of a British military base. In 1984 an intentional *Salmonella* contamination was designed to disrupt voting in the United States (Török et al., 1997). Some distinguish between *food safety* (defined as the protection of our food supply against unintentional contamination) and *food defense* (defined as protection against intentional contamination). The line is clearly blurring, however, as the recent milk scandal in China indicates. This intentional addition of melamine to milk products—although not by terrorists but by poor farmers—resulted in five deaths and more than 60,000 cases of kidney stones in children. While unintentional, the recent U.S. peanut butter contamination could serve as a model for a broad, product-based, intentional contamination because it was an ingredient-driven outbreak in which contaminated peanuts and peanut butter paste made their way into a broad swath of derivative products (e.g., cakes, cookies, ice cream).

The impacts of food contamination include loss of consumer confidence, medical costs, and lost productivity—but especially the potentially devastating loss of human life and the damage to entire industries and regional economies. Although the final tally of costs due to the recent peanut contamination is not yet available, estimates of nearly \$1 billion have been suggested (including \$500 million due to a 25% decline in peanut sales) as well as loss of consumer confidence in the government’s ability to protect its citizens. The Kellogg Company has estimated its losses alone to be more than \$75 million. Moreover, significant death tolls can result from intentional contamination of food products. A 2005 study from Stanford University estimated that the addition of only 4 grams of *botulinum* into a milk production facility could cause as many as 50,000 fatalities even if the latency between confirmation of the contamination and public notification to stop drinking milk was only 24 hours (Wein & Liu, 2005).

SYNTHESIS

The Twin Challenges: Early Detection and Rapid Response

Our ability to respond to intentional or unintentional foodborne outbreaks is hampered by two factors—high latencies between outbreak confirmation and identification of the contaminant and high latencies between contaminant identification and marshalling an appropriate response. The recent peanut butter contamination provides an excellent example of these twin challenges, as shown in Table 1 below. The CDC first confirmed clusters of *Salmonella* Typhimurium in November 2008, nearly 2 months after substantial numbers of laboratory-confirmed cases were first reported. Another 2 months elapsed before investigations indicated an association with peanut butter consumption. Nearly 3 months after peanut butter was identified as the culprit, the recalls were still ongoing. As of April 15, 2009, there had been 691 confirmed cases of *Salmonella* Typhimurium poisoning due to peanut butter in nearly all 50 states. The large number of products and brands recalled (numbering in the thousands), and the large quantities of some products recalled, make this one of the largest food recalls ever in the United States.

Table 1. Timeline of *Salmonella* Typhimurium Outbreak

EVENT	DATE	NOTE
Contamination and Initial “Case” Reports	Mid-September 2008	First laboratory-confirmed cases reported October 2008 by state health agencies. (Latency 4 months.)
Identification of Pathogen/Agent	November 2008	CDC confirms cluster of <i>Salmonella</i> Typhimurium.
Confirmation of Outbreak	December 3, 2008	CDC holds a nationwide conference call to confirm national pattern of outbreaks. No connection to any product has been determined.
Possible Source of Contamination Identified	January 7, 2009	CDC, FDA, and Minnesota Department of Health discuss peanut butter as the possible source.
Source of Contamination Confirmed	January 9, 2009	FDA tests of peanut butter from King Nut confirm source as Peanut Corporation of America (PCA). (Latency 3-5 months.)
Response (Alert, Recall, Intervention)	January 10, 2009	First recalls and alerts are issued. Other PCA facilities (e.g., Texas) and products implicated. CDC and FDA investigate outbreaks in other states (e.g., Georgia and Connecticut).
PCA Files for Bankruptcy	March 8, 2009	PCA files for bankruptcy. Product recalls still being announced by FDA as of this writing (April 15, 2009).

CURRENT LANDSCAPE OF FOOD SAFETY AND DEFENSE

Currently, 15 federal agencies collectively administer at least 30 laws related to food safety—a situation that has prompted calls for consolidation of all food safety responsibilities into a single agency (Dyckman, 2004; Halperin, 2004; Schmidt, 2001).² The respective roles of the primary departments or agencies that share responsibility for the safety of our nation's food supply are provided in Appendix A. Within this landscape, food safety and defense are complicated by the large number of different information systems managed across and among different local, state, and national entities that tend to maintain their own data structures. Delays of 6 months or more from outbreak to elimination of threat are due, in large part, to the “linear” as opposed to “simultaneous” processing of information, the incomplete participation of a majority of states in national efforts, and the lack of interoperability across distinct information systems. Although systems have become more Web-enabled, thereby allowing access to more stakeholders, they do not address the basic issue of interoperability at the systems level that would enable new informatics tools with greater power. The current processes of *surveillance* to detect and confirm foodborne disease and *response* or intervention to a confirmed food contamination are described below (McCabe-Sellers & Beattie, 2004).

Surveillance (Detection, Investigation, Reporting, and Confirmation). The CDC—working with the U.S. Department of Agriculture (USDA), U.S. Food and Drug Administration (FDA), and often the Department of Homeland Security (DHS)—is responsible for foodborne disease surveillance in the United States through its FoodNet, PulseNet, and OutbreakNet systems (Lynch et al., 2006; Marvin et al., 2009). The Foodborne Diseases Active Surveillance Network (FoodNet) is the principal foodborne disease component of CDC's Emerging Infections Program (EIP) (Allos, Moore, Griffin, & Tauxe, 2004; CDC, 2008; Hardnett et al., 2004; Jones et al., 2004; Jones, Scallan, & Angulo, 2007; Scallan, 2007). Established in 1996, FoodNet is a collaborative project of the CDC, 10 EIP sites (California, Colorado, Connecticut, Georgia, New York, Maryland, Minnesota, Oregon, Tennessee, and New Mexico), the USDA, and the FDA. The project consists of active surveillance for foodborne diseases and related epidemiologic studies that help public health officials monitor trends. FoodNet conducts population-based surveillance at 10 sites for laboratory-confirmed cases of infection caused by nine pathogens (*Campylobacter*, *Cryptosporidium*, *Cyclospora*, *Listeria*, *Salmonella*, Shiga-toxin-producing *Escherichia coli* O157, *Shigella*, *Vibrio*, and *Yersinia*). In 2006, the catchment area of FoodNet represented 44.1 million persons—or only 15% of the U.S. population. Unlike passive surveillance systems that rely upon reporting of foodborne diseases by clinical

² On February 9, 2009, Secretary of Agriculture Tom Vilsack advocated consolidation of all food safety responsibilities into a single agency. On March 14, 2009, President Obama announced the creation of a Food Safety Working Group to advise him on which regulations need to be changed in order to foster coordination across federal agencies.

laboratories to state health departments, which then report to CDC, FoodNet is an active surveillance system, meaning public health officials contact laboratory directors to find new cases of foodborne diseases and report these cases electronically to CDC.

After CDC receives information through FoodNet that two or more clusters of foodborne diseases have been detected, PulseNet determines, through analysis of genetic subtypes, whether these clusters are due to the same pathogen (Swaminathan et al., 2001; Swaminathan et al., 2006; Gerner-Smidt et al., 2006; Bhagwat & Bhagwat, 2008). The PulseNet network consists of state and local health departments and federal agencies (CDC, USDA's Food Safety and Inspection Service, FDA). PulseNet participants perform standardized molecular subtyping (or "fingerprinting") of foodborne disease-causing bacteria isolated from ill persons or suspected food. Pulsed-field gel electrophoresis (PFGE) (Parsons et al., 2007) is used to distinguish different strains of organisms such as *Escherichia coli* O157:H7, *Salmonella*, *Shigella*, *Listeria*, or *Campylobacter* at the DNA level (Swaminathan, Barrett, & Fields, 2006). Once these PFGE patterns are generated, they are entered into an electronic database of DNA fingerprints at local, state, and federal laboratories. At the local level, the granularity of data is often insufficient to determine clusters or trends. The patterns are also uploaded to the CDC's national database. These databases are available on demand, allowing comparison of the patterns at the national level.³ Database managers at CDC perform regular searches, looking for clusters of patterns that are indistinguishable from one another. If clusters are found, the results are reported back to the labs, CDC epidemiologists, and if relevant, to the WebBoard (the PulseNet listserv⁴) in a time-consuming process.

Response (Investigation and Intervention). After a pathogen responsible for an outbreak has been confirmed, CDC's OutbreakNet team then coordinates a national network of epidemiologists and state public health officials to conduct investigations into possible food and other sources of the contamination and to coordinate detection and response—especially across state boundaries.⁵ The OutbreakNet team uses time-consuming and standardized interviews to assess whether there are statistically significant common exposures among the patients. Information is shared via e-mail, conference calls, and Web site postings. As illustrated by the peanut butter case, the latency associated with tracking down the contaminated food product is still quite large, in spite of current efforts at the federal and state levels. FDA is responsible for investigations for most food products. However, USDA's Food Safety and Inspection Service (FSIS) is responsible for testing for food contamination involving meat, poultry, or eggs once the pathogen has been identified. The FDA has worked closely

³ In 2003 USDA established VetNet, modeled after PulseNet, to use PFGE to subtype zoonotic pathogens submitted to the National Antimicrobial Resistance Monitoring System (NARMS).

⁴ <http://www.cdc.gov/pulsenet/>

⁵ <http://www.cdc.gov/foodborneoutbreaks/>

with the CDC and the USDA to establish the Food Emergency Response Network (FERN)—a national network of federal, state, and local testing laboratories that is responsible for testing potentially contaminated food products for the responsible pathogen. The FDA is also currently working with the USDA and other federal and state agencies on the Electronic Laboratory Exchange Network (eLEXNET), the first integrated, Web-based data exchange system for sharing food-testing information. eLEXNET will allow multiple agencies engaged in food safety activities to compare and coordinate findings of laboratory analyses.

Emerging Information Environment and Informatics Tools

As described above, the information environment and informatics tools that have been developed to date have tended to follow jurisdictional boundaries, leading to a “siloe” landscape that spans many local, state, and national agencies, information systems, and individuals and that works against efforts to reduce inherent latencies—as the recent peanut butter example illustrated (Sobel et al., 2002). In addition, the current system also has a considerable “human element” where public health officials at all levels often share information on an informal basis outside the system to “get the job done” because the systems are not responsive to their need for information in a timely manner.

Enabled by new digital technologies and the systematic application of information processing and computer technologies, a new information-rich distributed environment is emerging that is characterized by increased sharing of near-real-time⁶ data electronically across agencies and among federal, state, and local agencies. This development is significant because it portends the development of a new class of informatics tools that are better able to detect “signals,” interpret their meaning, and even make recommendations about appropriate responses and interventions. It also is significant because it gives those who are “in the loop” the ability to act on the most recent information, and it enables feedback between the surveillance and response functions that has the potential to significantly reduce the scale and scope of an outbreak.

This emerging information-rich environment will be composed of a large number of geographically distributed and heterogeneous data stores. In addition to data managed by CDC, FDA, and USDA, it can include other relevant and contextual data provided by pharmacies, hospitals, and private testing laboratories, as well as retailers of food and health products. It also includes terabytes (or even petabytes) of data collected by remote sensing and other survey technologies—often in near-real time. These data stores are not located in a single database, but rather are distributed and accessible across the Internet (Wethington & Bartlett, 2006). Centralizing this data would be difficult because it would require transmitting

⁶ Real-time is defined by the CDC as anytime between 15 minutes and 24 hours, depending on the nature of the event.

multi-terabyte data sets quickly over very long distances. Centralization can also violate individual privacy and HIPAA rules and expose business secrets of drug companies.

New “grid” technology can provide effective data storage and computational infrastructure for public health applications in this new distributed information environment (Cannataro & Talia, 2003). Initially developed for high-performance computing in the physical sciences, grid technology was first applied to public health during the 2003 SARS outbreak. Data grids, a kind of grid technology, allow access to locally stored data by authorized users in different locations. Authorizations may vary across data sources, depending on the authorized person and sensitivity of data. These various data sources form a federated data grid, enabling federal, state, and local health agencies to share data and collaborate. Analytical and computational applications can be built on top of the data grid—including surveillance searches, statistical analyses, and other intelligent tools—to create knowledge grids.

New informatics tools are needed for the grid environment. Current data mining tools, referred to as *knowledge discovery in databases*, or KDD, while well suited to centralized and smaller data stores, are not equipped to manage and decipher increasingly larger volumes of data at the speed necessary to avert a major food threat. Broadly, knowledge discovery refers to a large class of methods that attempt to make sense of these data. Individual data elements, when viewed in isolation, may not contain much information. However, when they are combined with other data elements using various informatics and data mining tools, useful patterns or trends emerge. The process of mapping such low-level data, which are too numerous to comprehend, to a higher-level form that contains actionable knowledge is referred to as *knowledge discovery*. New tools suitable for large-scale, distributed, event-driven knowledge discovery are emerging and are referred to as *distributed data mining* (Cannataro, Talia, & Trufio, 2002).

Better informatics tools offer not only enhanced “signal” detection but also the ability to provide situational awareness that merges global and local perspectives simultaneously. During emergencies, multidisciplinary teams need access to a common display of relevant information, or a “common operating picture,” to gain understanding of the current situation, make sound judgments, and ensure a timely, efficient, and coordinated response. The growing use of real-time sensor-based technologies in the last 5 years (e.g., radio frequency identification, or RFID) has triggered the development of new software solutions that allow automatic data collection, transmission, and processing. These data streaming technologies lend themselves to new types of decision-support tools. Many of the situational awareness and “command-and-control” decision support tools developed by the defense community have the potential for adaptation and adoption for food defense.

As a first step, the CDC is implementing *BioSense*—an interoperable system-of-systems that creates a national network for health situational awareness and possible early event

detection for biologic terrorism and other events of national concern.⁷ Launched in 2003 in response to the anthrax attacks, the BioSense system will ultimately collect more than one million de-identified data elements from state/regional surveillance systems, local and regional hospitals and health care systems, national laboratories, the Departments of Defense and Veterans Affairs, and outpatient pharmacies. At full implementation in 2012, it is expected that BioSense will receive data streams from emergency departments, primary care physicians, poison control centers on a real-time basis. Data are submitted to BioSense through the Web-based reporting system Public Health Information Network Messaging System (PHINMS), either in near-real time or in daily batches uploaded through the Internet.⁸ BioSense is expected to provide simple data analysis and reports to state and local health officials on a near-real-time basis using time series graphs and geospatial maps and will identify anomalies that may be of potential significance. The availability of BioSense will lay the foundation for new informatics tools. One proposed platform is the BioPHusion program under the purview of the CDC's Office of Critical Information Integration and Exchange (OCIIX) to meet the agency's need for real-time information exchange and rapid decision-making. The BioPHusion program, which draws on methodologies from other domains such as national intelligence, is not designed to replace the existing programs but rather to pull together their complementary capabilities and offer a new platform for more advanced informatics tools.

FUTURE DIRECTIONS

As the efforts described above suggest, there is wide recognition not only that the food safety system needs reform but also that new informatics tools are an essential component of that reform (Yasnoff, O'Carroll, Koo, Linkins, & Kilbourne, 2000). Table 2 below provides a summary of the current state of food safety informatics and the research gaps that stand in the way of achieving our collective future vision.

⁷ In 2004, DHS launched the National Bio-Surveillance Integration System (NBIS) with the goal of integrating all of the biosurveillance programs across the United States into a single system by aggregating and integrating information from food, agricultural, public health, and environmental monitoring and the intelligence community from federal and state agencies and private sources to provide an early warning system for an outbreak or possible bioterrorism attack.

⁸ CDC applications within the Public Health Information Network (PHIN) include BioSense for early event detection, the National Electronic Disease Surveillance System (NEDSS) for electronic laboratory reporting on 140 notifiable diseases, and the Laboratory Response Network (LRN).

Table 2. Summary of Informatics Gaps

ELEMENT	CURRENT STATE	FUTURE VISION	INFORMATICS GAP
Information Environment	Siloed data at state and local level; limited Web-enabled.	Virtual communities, interoperability, Web-enabled; federated data grids.	Privacy assurance consistent with HIPAA; establishment of standards; data security safeguards; interoperability.
Information Sources	State and local epidemiological, syndromic, and health data (hospital, laboratory, poison centers, etc.).	Remote-sensing of food chain; real-time data streaming of syndromic, epidemiological, and health data.	New non-traditional (e.g., news sources, border food turn-backs, food labels). Private sector food chain data.
Informatics Tools	Informatics tools suitable for centralized and limited data processing; traditional data mining tools.	System-of-systems approach; collaboration; informatics tools suitable for large, heterogeneous distributed data sets.	Data fusion for situational awareness; visualization tools; better predictive analytics; inclusion of contextual information; autonomous control.
Information Flows	Passive (flows up from local and state); limited querying capability; linear processes.	Active (bi-directional information flow); query capability.	Common (relative) operating picture on a need-to-know basis; situational awareness of both local and global perspectives; public-private sector information flows.

With respect to the emerging **information environment**, we need to move from fragmented data stores to new federated data grids that allow fast sharing and situational awareness but avoid the technical and privacy problems of centralized data. Most important, this information environment can provide a common operational picture for public health officials at the local, state, and national levels. These new federated data grids allow for the inclusion of and fast access to new and non-traditional **information sources**. For example, FSIS personnel routinely inspect federal slaughter, food processing, and import establishments across the United States. However, the latency with which information about border refusals or safety violations are made available for surveillance is currently too great to be useful in containing an outbreak. New **informatics tools** could also link surveillance with other intelligence tools that are currently being used by agencies such as DHS for tracking terrorists. In addition, these tools could make it possible to utilize contextual information such as national intelligence information, scientific knowledge about the vectors and risks of spread, as well as product information such as ingredient lists that would help to target food inspections in the event of a confirmed contamination. Finally, **information flows** must transcend current

jurisdictional and organizational boundaries. In particular, a major factor in the large latency between confirmation and response is the lack of communication and cooperation among government agencies and the private sector. New “track-and-trace” technologies for food chains has made it increasingly possible for the private sector to “see” into their food chains. This information could be effective in tracing possible outbreaks and reducing latencies. Further, the private sector has a vested interest in protecting their brand in the event of an outbreak. The FDA Food Safety Modernization initiative proposed by President Obama would impose new duties on the FDA and new responsibilities on the private sector. While they are designed to give the FDA more regulatory power over industry, it is also important that these policies provide incentives and opportunities to the private sector to work with governmental agencies toward the common goal of making sure that, through the sharing of information, our food supplies are well protected from intentional or unintentional contamination.

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Monica Nogueira, PhD, MS, Monica Nogueira is director of the Intelligent Systems Laboratory (ISL) of the Center for Logistics and Digital Strategy at Kenan-Flagler Business School (KFBS) at UNC. In this capacity, she is responsible for overseeing the projects developed by the ISL for its corporate and institutional clients, and she works closely with UNC professors and students and the KFBS staff. Dr. Nogueira is an expert in data modeling and analysis, which she applies to design and build decision support tools that mine and correlate information from large and diverse datasets to extract relevant knowledge that enables users to act on the problems that are most significant to them. She uses her computer science expertise to design and implement new software applications that utilize state-of-the-art technologies to solve practical problems for ISL external and internal customers. Her primary research interests include new technologies and their practical uses to create new methodologies that support “intelligent” tools and their application to everyday problems in logistics and supply chains, data and text mining methodologies, and tools for knowledge discovery and extraction. Dr. Nogueira has developed a number of projects and tools that demonstrate the use of radio frequency identification (RFID) technology for controlling the safety of perishable products (i.e., cold chain for food and medical drugs). In these projects, RFID is used as the integrator element that allows the tracking and tracing of the perishables and total visibility throughout the supply chain to guarantee their safety.

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Appendix

Table information obtained from FDA's Center for Food Safety and Applied Nutrition Web site, located at <http://www.cfsan.fda.gov>, accessed on March 16, 2009.

U.S. DEPARTMENT	MONITORING AGENCY	FOOD OVERSEEN	FOOD SAFETY ROLE
U.S. Department of Health and Human Services	Food and Drug Administration	All domestic and imported food sold in interstate commerce, including shell eggs, but not meat and poultry Bottled water Wine beverages with less than 7 percent alcohol	<ul style="list-style-type: none"> • Inspect food manufacturing plants and warehouses • Review safety of food and color additives before marketing • Review drugs for both animals and humans • Request and monitor recall of unsafe food products • Monitor safety of animal feeds used in food-producing animals • Develop codes, ordinances, guidelines and interpretations and work with states to implement them in regulating milk, shellfish, and retail food establishments • Take appropriate enforcement actions • Work with foreign governments to ensure safety of certain imported food products • Conduct research on food safety
U.S. Department of Health and Human Services	Centers for Disease Control and Prevention	All foods	<ul style="list-style-type: none"> • Investigate sources of food-borne outbreaks • Maintain nationwide system of food-borne disease surveillance • Develop and advocate public health policies to prevent food-borne diseases • Conduct research to help prevent food-borne illness • Train local and state food safety personnel



U.S. DEPARTMENT	MONITORING AGENCY	FOOD OVERSEEN	FOOD SAFETY ROLE
U.S. Department of Agriculture	Food Safety and Inspection Service	Domestic and imported meat and poultry and related products Processed egg products	<ul style="list-style-type: none"> • Inspect food animals for diseases • Inspect meat and poultry slaughter and processing plants • Collect and analyze food products for microbial and chemical contaminants and infectious and toxic agents • Ensure all foreign meat and poultry processing plants exporting to the United States meet U.S. standards • Seek voluntary recalls by meat and poultry processors of unsafe products
U.S. Department of Agriculture	Cooperative State Research, Education, and Extension Service	All domestic foods, some imported	<ul style="list-style-type: none"> • Develop research and education programs with U.S. universities on food safety for farmers and consumers
U.S. Department of Agriculture	National Agricultural Library; USDA/FDA Foodborne Illness Education Information Center	All foods	<ul style="list-style-type: none"> • Maintain a database of computer software and audiovisuals and other educational materials on preventing food-borne illness • Help educators, food service trainers, and consumers locate educational materials on preventing food-borne illness
U.S. Department of Homeland Security	—	Food Events Related to Terrorism	<ul style="list-style-type: none"> • Overall responsibility for food defense • Monitor for possible attacks related to food terrorism • Apprehend terrorists responsible for attacks of food supplies and food chains
U.S. Environmental Protection Agency	—	Drinking water	<ul style="list-style-type: none"> • Establish safe drinking water standards • Regulate toxic substances and wastes to prevent their entry into the environment and food chain • Assist states in monitoring quality of drinking water and preventing its contamination • Determine safety of new pesticides, set tolerance levels for pesticide residues in foods, and instruct safe use of pesticides



U.S. DEPARTMENT	MONITORING AGENCY	FOOD OVERSEEN	FOOD SAFETY ROLE
U.S. Department of Commerce	National Oceanic and Atmospheric Administration	Fish and seafood products	<ul style="list-style-type: none"> Inspect and certify fishing vessels, seafood processing plants, and retail facilities for federal sanitation standards through fee-for-service Seafood Inspection Program
U.S. Department of the Treasury	Bureau of Alcohol, Tobacco and Firearms	Alcoholic beverages except wine beverages containing less than 7 percent alcohol	<ul style="list-style-type: none"> Enforce food safety laws governing production and distribution of alcoholic beverages Investigate cases of adulterated alcoholic products, sometimes with help from FDA
U.S. Customs Service	—	Imported foods	<ul style="list-style-type: none"> Work with federal regulatory agencies to ensure that all goods entering and exiting the United States do so according to U.S. laws and regulations
U.S. Department of Justice	—	All foods	<ul style="list-style-type: none"> Prosecute companies and individuals suspected of violating food safety laws Through U.S. Marshals Service, seize unsafe food products not yet in the marketplace, as ordered by courts
Federal Trade Commission	—	All foods	<ul style="list-style-type: none"> Enforce variety of laws that protect consumers from unfair, deceptive, or fraudulent practices, including deceptive and unsubstantiated advertising
State and Local Governments	—	All foods within their jurisdictions	<ul style="list-style-type: none"> Work with FDA and other federal agencies to implement food safety standards for fish, seafood, milk, and other foods produced within state borders Inspect restaurants, grocery stores, and other retail food establishments, as well as dairy farms and milk processing plants, grain mills, and food manufacturing plants within local jurisdictions Embargo (stop the sale of) unsafe food products made or distributed within state borders

