Food Safety Efforts Accelerate in the 1990's

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Awareness of the health risks from foodborne disease has increased over the past 10 years. Although the Nation's food supply remains among the safest in the world, widely publicized outbreaks of foodborne illness caused by such sources as *Escherichia coli (E. coli)* O157:H7 in hamburger, *Listeria monocytogenes* in hot dogs, and *Salmonella* in poultry and eggs have raised the public's concerns about risks from microbial pathogens in food.

The Federal Government and the private sector have responded with a variety of efforts to protect and enhance the safety of the foods we eat. This article reviews the important events in food safety of the last decade and looks ahead at new efforts to reduce microbial contamination of foods.

Foodborne Illness Outbreak Raises Concern and Action

In 1993, an outbreak of foodborne illness attributed to *E. coli* O157:H7 in undercooked hamburgers from fast-food restaurants in several western States led to 700 illnesses and 4 deaths. Although not the largest outbreak of foodborne illness in the Nation's history, it had an important impact on public awareness of the risks from microbial pathogens. The outbreak received wide publicity because the source of the illness was a frequently consumed food (hamburgers) and because children were particularly susceptible.

The Federal Government responded in several ways. The Food and Drug Administration (FDA) raised the recommended internal temperature to which restaurants cook hamburgers to 155º F. USDA's Food Safety and Inspection Service (FSIS) responded by declaring *E. coli* O157:H7 an adulterant in raw ground beef and implementing a sampling program to test for the pathogen in raw ground beef prepared in federally inspected establishments and in retail stores. FSIS also required a label with safe food handling instructions be placed on consumer packages of raw meat and poultry. The label emphasizes cooking foods thoroughly, storing foods in the refrigerator, discarding leftovers if not refrigerated immediately, and washing surfaces, utensils, and hands after touching raw meat or poultry. USDA also responded with an information campaign in schools to alert children not to eat hamburgers that are still pink inside after cooking. This advice was subsequently changed due to new scientific findings, and consumers are now encouraged to use food thermometers to ensure that hamburgers reach an internal temperature of 160º F.

Food Inspection Systems Are Modernized

Increasing concerns about foodborne illnesses linked to microbial pathogens in meat and poultry accelerated efforts to modernize and strengthen the Nation's meat and poultry inspection system. Since the turn of the century, national food safety laws have required inspection of all carcasses and meat products in interstate commerce; poultry was added in 1957. Inspection ensured meat and poultry products were sound, healthful and wholesome, with no dyes, chemicals, preservatives, or ingredients that would render products unfit for people to eat.

In federally inspected meat and poultry slaughterhouses, FSIS conducted a labor-intensive examination of each carcass, its lymph nodes, and its internal organs. If there was no evidence of disease, the animal was considered suitable for human consumption. In all meat and poultry establishments, inspectors also checked the operation of equipment (such as verifying refrigeration and cooking temperatures); oversaw plant sanitation during processing and cleanup; and in processing plants, inspectors checked labels, product net weight, and the

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ingredients used in making the products.

This inspection system removed diseased animals from the food supply and enforced sanitary standards in slaughter and processing, but a serious gap remained. Today, we know that some human pathogens live in the gastrointestinal tract of food animals without harming them. The former inspection system relied largely on organoleptic (sensory) methods—sight, smell, and sense of touch—to identify unsafe products. This method of inspecting raw meat and poultry missed microbial pathogens, such as *E. coli* O157:H7 or *Salmonella*, that did not cause illness in animals.

To close this gap, FSIS strengthened the meat and poultry inspection process. On February 3, 1995, FSIS published a proposal for a new inspection system for all federally inspected meat and poultry plants. The new system was implemented in stages. By January 1998, plants with more than 500 employees, which slaughter 75 percent of U.S. meat and poultry, were using the new system. Plants with 10 to 500 employees came under the new regulations in January 1999. Very small establishments, those with fewer than 10 employees or annual sales of less than $2.5 million, had until January 2000 to comply.

The new system required all regulated plants to adopt Hazard Analysis and Critical Control Points (HACCP) procedures. Plants had to develop HACCP plans to monitor and control production operations. Plants first identify food safety hazards and critical control points in their production, processing, and marketing activities. Plants then establish critical limits, or maximum or minimum levels, for each critical control point. Finally, plants develop monitoring procedures to ensure the critical limits are met.

HACCP includes steps for recordkeeping and verification, including some microbial testing of meat and poultry products to ensure that the system meets the target level of safety. Plants and FSIS share responsibility for verifying the effectiveness of the HACCP system. FSIS tests for *Salmonella* on raw meat and poultry products, and slaughter plants test for generic *E. coli* on carcasses. Another component of the new system requires federally inspected meat and poultry plants to develop written sanitation standard operating procedures to show how they meet daily sanitation requirements.

USDA's Economic Research Service (ERS) conducted a benefit/cost analysis of the new inspection system. The estimated savings in medical costs and productivity losses due to prevention of foodborne illnesses caused by four microbial pathogens (*E. coli* O157:H7, *Salmonella, Listeria monocytogenes*, and *Campylobacter*) were compared with the Federal and industry costs involved with assessing and developing control procedures, antimicrobial treatments, recordkeeping, employee training, and microbial testing. ERS found that the public health benefits of the new system, even under low-range assumptions about the effectiveness of the rule, were greater than its costs.

New Regulations Cover Seafood and Juice

In December 1995, FDA announced a rule requiring seafood processors to identify hazards that, without preventive controls, are reasonably likely to affect the safety of seafood products. If at least one such hazard can be identified, the seafood firm is required to adopt and implement an appropriate HACCP plan. In addition to helping ensure that seafood products are free of contaminants, this process helps processors who subsequently have food safety problems determine how and when those problems could have occurred. Seafood processors using a HACCP plan continue to be monitored under FDA surveillance and inspection programs. This rule was implemented in stages, with complete implementation effective in late 1997.

Outbreaks of foodborne illness associated with contaminated fruit juices led to new safety rules for juices. In October 1996, at least 66 people in the Western United States and Canada became ill after drinking unpasteurized apple juice contaminated with *E. coli* O157:H7. In response, FDA proposed regulations to increase the safety of fresh and processed juices. Initially, in 1998, FDA began requiring warning labels on all unpasteurized juice or juice not otherwise treated to control illness-causing pathogens. The labels allow consumers to avoid unpasteurized or untreated juices, thereby lessening risk. On January 18, 2001, FDA published final regulations requiring that all domestic and foreign fruit and vegetable processors use HACCP procedures to prevent, reduce, or eliminate hazards in juices. Depending on size, companies have 1 to 3 years to implement HACCP programs. Processors must continue to use the previously required warning label statement until they implement HACCP programs.

Food Safety Initiatives Bring New Resources

On January 25, 1997, President Clinton announced the National Food Safety Initiative, a multiagency effort to strengthen and improve food safety in the United States. The initiative included several new programs to promote food safety, including improved inspection and preventive systems, such as HACCP, new tests to detect pathogens, and increased funding for FDA inspections and for food safety research. This research would include ways to assess risks in the food supply, improve response to

foodborne illness outbreaks, and improve coordination among the Federal agencies responsible for food safety.

The initiative established a national educational campaign for safer food handling practices in homes and retail outlets. The Fight BAC!™ campaign is the product of the Partnership for Food Safety Education, a unique public-private partnership of industry, Government, and consumer groups dedicated to increasing the awareness of food safety and reducing the incidence of foodborne illness. This education effort augmented efforts by farmers, processors, and retailers to reduce risk of foodborne hazards. Through this public education campaign, a focused and more unified program is available to consumers, who share in the responsibility of safe food handling. The core message of the Fight BAC!™ campaign is similar to the food handling message for meat and poultry:

1) Clean: Wash hands and surfaces often.
2) Separate foods: Don't cross-contaminate.
3) Cook: Cook to proper temperatures.
4) Chill: Refrigerate foods promptly after cooking.

This campaign has been implemented in brochures, outreach efforts, TV and radio spots, and through the Internet. This campaign is very successful and widely used in schools.

In the past few years, there have been some highly publicized cases of foodborne disease outbreaks linked to fruits and vegetables, and some linked to imported foods. In response, the Clinton Administration announced the Produce and Imported Food Safety Initiative on October 2, 1997. This initiative aimed to upgrade domestic food safety standards and to strengthen domestic inspection and food safety systems in foreign countries to ensure that foods coming from overseas are as safe as those produced at home. The initiative enhanced FDA oversight for imported foods, improved inspection activities abroad, and provided guidance about good agricultural and manufacturing practices.

FoodNet System Increases Scientific Knowledge

The early-warning surveillance system called FoodNet was established in 1996 to monitor illness due to foodborne pathogens in five areas around the country. FoodNet is a joint effort by the Centers for Disease Control and Prevention (CDC), USDA, FDA, and State health departments to capture a more accurate and complete picture of foodborne illness trends and to gather data necessary to prevent outbreaks.

In 1997, FoodNet was expanded to monitor illness due to nine pathogens in eight sites: Connecticut, Georgia, Minnesota, Oregon, and selected counties in California, Maryland, New York, and Tennessee. In 2000, additional counties in Tennessee were added to the FoodNet surveillance area. The program currently surveys a population of 29 million people. Colorado will join FoodNet surveillance in 2001.

The FoodNet surveillance system has led to a more comprehensive assessment of the scope and extent of foodborne disease in the United States. Using surveillance data from FoodNet, researchers in 1999 estimated that foodborne diseases cause approximately 76 million illnesses, 325,000 hospitalizations, and 5,200 deaths in the United States each year. Known pathogens account for an estimated 14 million illnesses, 60,000 hospitalizations, and 1,800 deaths. Unknown agents account for the remaining illnesses, hospitalizations, and deaths. Three pathogens, *Salmonella*, *Listeria monocytogenes*, and *Toxoplasma*, are responsible for 1,500 deaths each year. ERS has used these new estimates of the number of cases and deaths to revise its estimate of the annual costs of foodborne disease (see box).

The 1999 FoodNet data suggest that foodborne diseases cause more illnesses but fewer deaths than previously thought. CDC estimated in 1994 that 6 million to 33 million cases of foodborne illness occur each year, resulting in 4,000 to 9,000 deaths.

Data from the last few years show that private and public efforts to promote safer food are beginning to show results. Due in part to the implementation of HACCP systems in meat and poultry processing, progress is being made in reducing the presence of microbial pathogens in the food supply. Data from USDA show a reduction of up to 50 percent in *Salmonella* in meat and poultry in recent years. Preliminary data from CDC show a decline in the incidence of several foodborne diseases. FoodNet data show that from 1997 to 1999, illness from the most common bacterial foodborne pathogens declined nearly 20 percent. This decline represents at least 855,000 fewer Americans each year suffering from foodborne illness caused by bacteria since 1997. Between 1998 and 1999, the data show a 25-percent decline in the number of *E. coli* O157:H7 infections, although there

are year-to-year fluctuations in the number of infections and it may be too early to tell if this represents a permanent decline. The data also show a 41-percent drop in the incidence of *Shigella* infections and a 19-percent decline in the number of illnesses caused by *Campylobacter.*

The incidence of infections by *Salmonella* Enteritidis, a serotype of *Salmonella* infection often associated with egg consumption, declined 7 percent during 1998-99, according to the FoodNet data. However, overall incidence of *Salmonella* infection increased from 1998 to 1999, due to several large outbreaks of salmonellosis from other sources, including unpasteurized orange juice, imported mangos, and raw sprouts.

Possible Future Direction for Meat and Poultry Safety

Government and industry continue to look for ways to increase the safety of our foods. Several techniques are being explored, including irradiation. Irradiation, a process that exposes products to ionizing radiation, can control or reduce microbial pathogens that may cause foodborne disease. Use of this technology on foods requires approval by FDA. FSIS must also approve its use on meat and poultry. FDA approved the use of irradiation to control microbial pathogens on poultry in 1990 and on meat in 1997. USDA granted its approvals in 1992 and 1999.

Although scientific evidence indicates that irradiation is safe and effective for these uses, few processors or retailers offered irradiated foods during the 1990's. Many food processors and retailers were concerned that some consumers would not buy irradiated foods. Retailers and processors were also reluctant to supply such foods for fear of boycotts by groups opposed to food irradiation.

Limited markets for irradiated poultry developed in the mid-1990's, primarily selected hospitals and nursing homes feeding people at risk for foodborne disease, such as the elderly. Huisken Meats, a Minnesota-based food manufacturer, began marketing irradiated hamburger patties in the Minneapolis-St. Paul area in May 2000, and other firms have since introduced irradiated beef products in additional markets.

Still, the potential for widespread use of irradiation is uncertain. Surveys of consumers in the FoodNet sites indicate that about half of consumers questioned had heard about food irradiation, and that about half would buy irradiated meat or poultry. Education about the potential benefits of irradiation might promote consumer acceptance. According to the FoodNet survey, the most frequent reason respondents gave for not being willing to buy irradiated meat or poultry was "insufficient information" about food irradiation.

Action Plan Announced for Egg Safety

The safety of eggs and egg products remains a concern, particularly the risk of human infection from *Salmonella* Enteritidis. Each year, 100,000 to 150,000 cases of foodborne illnesses are caused by *Salmonella* Enteritidis from shell eggs. A comprehensive risk assessment by USDA in 1998 estimated that of the 47 billion shell eggs consumed annually, 2.3 million are *Salmonella* Enteritidis-positive, exposing a large number of people to the risk of illness. The risk assessment also determined that 8 percent of egg-transmitted *Salmonella* Enteritidis illnesses could be avoided if all eggs are refrigerated at 45º F throughout processing and distribution.

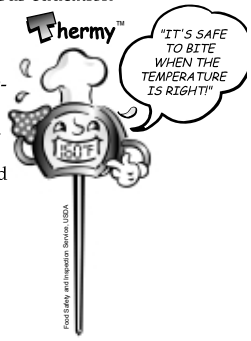
On November 30, 2000, FDA issued a regulation requiring safe handling labels on untreated shell eggs. The regulation also required that, when held by retail establishments, shell eggs be stored and displayed at a temperature of 45º F or lower.

The risk assessment also concluded that a broadly based, 'farm-to-table' approach to reduce risks from *Salmonella* Enteriditis could potentially achieve a 25-percent reduction in human illnesses from this pathogen. Controlling pathogens at the farm level, holding eggs at proper temperature during transport and sale, and safe handling by consumers can all help prevent salmonellosis.

In August of 1999, the President's Council on Food Safety announced an Egg Safety Action Plan. The plan set goals of a 50-percent reduction in egg-associated *Salmonella* Enteriditis illnesses by 2005 and the eventual elimination of *Salmonella* Enteriditis in eggs as an important source of human illness by 2010, through science-based and coordinated regulation, inspection, enforcement, research, and education programs.

New Educational Efforts Underway

Along with farmers, processors, retailers, and foodservice workers, consumers are integral to improving food safety. In May 2000, USDA took two steps to increase consumer awareness of the importance of food safety and to encourage safe food handling and preparation behavior. On May 25, USDA launched a national campaign to promote the use of food thermometers in the home. Previous education stressed the importance of thorough cooking, particularly of hamburgers. Consumers were advised to cook



ERS Updates Foodborne Illness Costs

Using revised estimates of the annual number of foodborne illnesses in 1998 released by CDC in September 1999, ERS updated foodborne illness costs for four major pathogens: *Campylobacter* (all serotypes), *Salmonella* (nontyphoidal serotypes only), *E. coli* O157:H7, and *Listeria monocytogenes*. The new estimates of the number of cases, hospitalizations, and deaths from these foodborne pathogens were derived, in part, from data gathered by the FoodNet surveillance system. For the first time, ERS also included the costs due to other Shiga toxin-producing strains of *E. coli*, collectively known as *E. coli* non-O157:H7 STEC. ERS estimates that the annual economic costs of medical care, productivity losses, and premature deaths due to foodborne illnesses caused by these five pathogens are $6.9 billion (see table next page).

Along with new data on illnesses, cases, and deaths, ERS also revised the methodology for valuing premature deaths. In the past, ERS valued a premature death by using a "risk premium" revealed by labor market studies of the higher wages paid to people employed in high-risk occupations. This single value was applied to all premature deaths, regardless of the age at which the death occurred. The value of a premature death was $6.5 million in August 2000 dollars. Using new data on the age distribution of deaths caused by the five pathogens, ERS now adjusts the economic cost of premature deaths to account for age at time of death. Under the age-adjusted approach, the assumed cost of each death ranges from $8.9 million for a child who dies before his or her first birthday to $1.7 million for a person who dies at age 85 or older.

Because the five microbial pathogens have different health outcomes for different age groups, adjusting for the age of death raises the cost of some foodborne illnesses and lowers the cost of others. For example, the annual cost of foodborne illnesses caused by *Salmonella* decreases from $3.7 billion to $2.4 billion, when adjusted for age at the time of death, because over two-thirds of the deaths from salmonellosis occur in people over 65. On the other hand, adjusting foodborne illness costs for *E. coli* O157:H7 by age at time of death increases the estimates by $68 million because most deaths occur in children under the age of 5.

ERS currently measures the productivity losses due to nonfatal foodborne illnesses by the value of foregone or lost wages, regardless of whether the lost wages involved a few days missed from work or a permanent disability that prevented an individual from returning to work. Using the value of lost wages for cases resulting in disability understates an individual's willingness to pay to avoid disability because it does not account for the value placed on avoiding pain and suffering.

The willingness-to-pay measure derived from labor market studies that ERS uses to value a premature death is not an appropriate measure of willingness to pay to avoid disability because it measures the higher wages paid to workers to accept a higher risk of premature death, not disability. Methods have been suggested to adjust willingness to pay to reduce the risk of premature death downward to estimate willingness to

ground beef until the meat is no longer pink.

However, more recent research has shown that color alone may not be a good indicator of the presence of potentially dangerous bacteria in hamburger. USDA research shows that as many as one out of four hamburgers turns brown in the middle before reaching a safe internal temperature. Consumers are now encouraged to use food thermometers to ensure that meat and poultry (including ground meats) reaches an internal temperature of 160° F. The campaign features a digital thermometer messenger called Thermy™ that proclaims, "It's safe to bite when the temperature is right!"

Food safety messages are also being incorporated in other food and diet education efforts. In May 2000, USDA released the newest edition of *Dietary Guidelines for Americans* (see "Nutrition Policy in the 1990's" elsewhere in this issue). The 2000 edition of the *Dietary Guidelines* for the first time includes a message on food safety. One of the 10 guidelines says, "Keep food safe to eat," and repeats the message of the FightBAC!™ campaign to "Clean, Separate, Cook, and Chill." The food safety guideline concludes with the sensible message taught to many of us by our parents: "When in doubt, throw it out."

The developments in food safety policy during the last decade have helped the Nation make progress in the goal of ensuring the safest possible food supply. Changes in regulations governing food production and responses by producers have helped control and reduce risks from microbial pathogens. New research and surveillance efforts have helped us better determine the extent of foodborne illness in the United States and the most important sources of food safety risks. Educational efforts have increased public awareness and enabled consumers to protect themselves from foodborne diseases. ERS will continue to assess the economic consequences of public and private efforts to increase the safety of our food supply.

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Estimated Annual Costs of Five Foodborne Pathogens Total $6.9 Billion

Pathogen	Estimated annual foodborne illnesses[1]			Estimated annual foodborne illness costs[2]
	Cases	Hospitalizations	Deaths	
	Number			$ billion[3]
Campylobacter spp.	1,963,141	10,539	99	1.2
Salmonella, nontyphoidal	1,341,873	15,608	553	2.4
E. coli O157:H7	62,458	1,843	52	.7
E. coli, non-O157 STEC	31,229	921	26	.3
Listeria monocytogenes	2,493	2,298	499	2.3
Total	3,401,194	31,209	1,229	6.9

[1]From Centers for Disease Control and Prevention (see Mead et al., 1999).
[2]The total estimated costs include specific chronic complications in the case of *Campylobacter* (Guillain-Barré syndrome), *E. coli* O157:H7 (Hemolytic uremic syndrome), and *Listeria monocytogenes* (congenital and newborn infections resulting in chronic disability or impairment). Estimated costs for *Listeria monocytogenes* exclude less severe cases not requiring hospitalization.
[3]August 2000 dollars.
Source: USDA's Economic Research Service.

pay to avoid disability, but there is no consensus among economists. ERS' conservative estimates of the annual costs due to foodborne illnesses (particularly the chronic conditions associated with *Campylobacter*) would be substantially increased if willingness to pay to avoid disability, pain, and suffering were also taken into account.

As these new estimates of foodborne illness costs are based on new data and improved methodologies for valuing these costs, the estimates presented here are not directly comparable to earlier ERS estimates of the costs of foodborne disease. In addition, because the underlying data are for a single year, the new cost estimates should not be used to infer whether these costs are decreasing or increasing over time. ERS will continue to update and refine these cost estimates. Research is also underway to estimate the costs of arthritis caused by exposure to foodborne pathogens.

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For more information, go to:

http://www.usda.ers.gov/emphases/SafeFood—ERS's website.

http://www.foodsafety.gov—Information about food safety from several U.S. government agencies.

http://www.usda.gov/fsis—Information about food safety from USDA's Food Safety and Inspection Service.

http://www.fightbac.org—Information about the Fight BAC!™ campaign.

http://www.csfan.fda.gov—Information from FDA's Center for Food Safety and Applied Nutrition. ■