A Logical Approach To Preventing Foodborne Illness

by

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The nation's food safety system consists of activities carried out by several federal, state and local government agencies that inspect, test, research, and monitor the food supply. For the most part, these agencies monitor whether food manufacturers are adhering to their legal responsibility of assuring the production of safe food. However, reported occurrences of outbreaks of foodborne illnesses have been increasing, and current safety efforts are not providing the confidence in the food supply that U.S. consumers demand. There are three interventions that need priority if the trend in foodborne illnesses are to be reversed, a) improve surveillance, b) mandate irradiation procedures and c) require all food handlers to demonstrate their knowledge in proper food handling

Surveillance

Comprehensive enteric disease surveillance strategies are essential for meeting the challenges in the years ahead. The issue of surveillance must be among our highest priorities if we are to understand the role that foodborne disease plays as an emerging infectious disease problem in the United States.

In 1996, the Administration initiated Pulse Net, a system for linking electronically investigators at CDC, FDA, and USDA to public health laboratories in 50 states. This network of laboratories is designed to rapidly identify strains of all food-borne pathogens, including the bacterium *E. coli* O157:H7, by matching DNA "fingerprints" of pathogens

found both in food and in people stricken with gastrointestinal illness. (8) These data are collected in addition to data under FoodNet, a cooperative active surveillance project for foodborne disease in eight targeted locations in the United States. Food Net, also supported by CDC, USDA, and FDA, began in 1995 because public health officials, who rely on epidemiology to identify and track the source of outbreaks of foodborne illness, did not have an accurate accounting of outbreaks. Many times, when people are diagnosed with a foodborne illness, their doctor or the laboratory that detects a pathogenic organism in a fecal sample may or may not report the incident to the local county health department. That department only reports periodically cases that it knows about to the state department of health. States collect local data and send reports to CDC, which updates a national surveillance database. Preliminary data from Food Net for 2000 indicate a slight decline in several of the major bacterial and parasitic causes of food-borne illness. (5)

Currently, our routine domestic surveillance captures a very small percentage of gastrointestinal illnesses in our communities and rarely captures foodborne illnesses that mimic other conditions. Extensive community-based studies are needed to truly assess the problem. When a pathogen cannot be detected, it is important to go back and attempt to identify the cause of an illness.

Surveillance of foodborne illness is complicated by several factors. The first is underreporting. Although foodborne illnesses can be severe or even fatal, milder cases are often not detected through routine surveillance. Second, many pathogens transmitted through food are also spread through water or from person to person, thus obscuring the

role of foodborne transmission. Pathogens or agents that have not yet been identified and thus cannot be diagnosed cause a proportion of foodborne illness. The importance of this final factor cannot be overstated. Many of the pathogens of greatest concern today (e.g., Campylobacter jejuni, Escherichia coli O157:H7, Listeria monocytogenes, Cyclospora cayetanensis) were not recognized as causes of foodborne illness 20 years ago.

North American outbreaks of cyclosporiasis provide another example of a new agent. The infection is caused by a coccidian like organism that produces prolonged watery diarrhea after incubating in the host for more than a week. Routine ova and parasite studies often do not identify this organism, and few healthcare providers would know what test to request if cyclosporiasis was suspected.

Outbreaks of cyclosporiasis in 1996 and 1997 were associated with consumption of Guatemalan raspberries. How these raspberries became contaminated remains unknown, but research showed that rinsing the fruit did not reduce the risk of infection. Such *Cyclospora* outbreaks again highlight the role of international distribution of food, in addition to the emergence of previously unknown pathogens.

Discovery of foodborne microorganisms that have acquired pathogenic characteristics raises concerns over whether the current food safety system is adequate to detect and identify new pathogens and their sources before they reach consumers. In July 1998, the National Research Council released a report entitled *The Use of Drugs in Food Animals: Benefits and Risks*. According to the report, bacteria that resist antibiotics can be passed from food animals to humans, but it does not appear to constitute an immediate public health concern. The report recommends increased research and monitoring of drug

resistance, usage, and residues in farm animals. The report recommends that the federal government form an oversight panel to monitor information on resistance and develop recommendations on how antibiotics should be used in the future in humans and animals.

Most of us worry more about pesticide and chemical residues on fruits and vegetables than disease-causing bacteria. We trust that our regulatory system and sanitation standards protect us from that particular danger. In the past, they have. Now however, more of our produce comes from countries with different regulatory regimes and where sanitation standards are much lower than ours.

Clean water and education go a long way toward ensuring food safety. Both are usually deficient in countries that export fresh produce. Irrigation water can contain pathogens and parasites. Poorly educated workers may not understand the importance of hand washing. If they do, there may be no clean water with which to do it. Inspection criteria may be less stringent and inspectors may be less educated than they would be here. (6)

Clearly food trade increases the risk of foodborne illness. Since it seems unlikely that trade in food will decrease, at least in the short term, we need to reduce the threat to our food supply. We need to harmonize standards between exporting and importing nations. And we need a system that shows the 'who, what, how, where and when' of food products as they travel from field to table.

We need to improve our ability to respond to all outbreaks, not just those that occur when a large group of people becomes ill after a single event. With extensive state or national

testing programs using molecular sub typing methods, we can increase our ability to detect and respond to multi-state and even multi-national outbreaks.

We have begun to investigate the scope of the problem through initiatives such as the national pulsed-field gel electrophoresis sub typing system. This system is being coordinated by the Centers for Disease Control and Prevention working with state public health laboratories. Foodborne disease outbreaks may be widely disseminated throughout the population and are very difficult to pick up. But with molecular sub typing investigators can link these fingerprints together to find out if a number of widely separated cases are actually all related. For example in Minnesota, most outbreaks of confirmed viral gastroenteritis have been traced to infected food workers. Recently, four outbreaks of *Salmonella typhimurium* infection were identified by molecular sub type-specific surveillance of such workers. These outbreaks occurred as apparently sporadic infections over several weeks to months, rather than as a cluster of cases closely linked by time and location. Traditional surveillance systems often miss this type of outbreak. Using the Internet can speed up the process. (4)

Nonetheless, we are currently missing many more illnesses than we are detecting. It should be evident that, given our global food supply, international outbreaks will hit home. Comprehensive surveillance of all foodborne pathogens is the only way to determine whether our food protection activities are truly working.

Irradiation

Foodborne disease prevention involves a thorough understanding of the production chain, the implementation of hazard analysis critical control point (HACCP) strategies, and use of terminal pasteurization methods, including ionizing radiation. We need to look at each food product from its first possible ingredient to its eventual consumption. For example, today we share a growing concern about the quality of produce grown in other countries. It is important to worry about such things as water quality, pesticides, fertilizers, and the health of the field workers but does any of that matter if a food handler in your neighborhood restaurant puts his or her unwashed hands into a bag of lettuce transmitting enteric pathogens to the customers.

The recent movement by regulatory agencies to implement HACCP programs for food safety in this country is a step in the right direction. This science-based approach for reducing the risk of foodborne disease identifies critical control points where problems can arise. However, these control points are not "kill steps." Even when every possible effort is made to reduce the risk of contaminating a carcass as it goes through a meatpacking plant, some contamination is still inevitable.

The regulatory agencies could take a big step forward in protecting the public from food-borne disease by requiring the food irradiation process known as ionizing pasteurization. This is a kill step for much of our food supply that will adequately get rid of bacterial and parasitic pathogens before they get to the consumer. It is similar to two technologies developed in the early 20th century, milk pasteurization and retort canning, that were developed, promoted and virtually canonized as prevention measures against foodborne

diseases. Fear of contracting typhoid fever from watered milk and outbreaks of botulism from commercially canned products are now part of the distant past, controlled by these food industry processes. (11)

Beef is one of the U.S. food industry's hottest sellers, to the tune of 8 billion pounds a year, according to trade figures. Whether a fast-food meal, a dinner on the town, or a backyard barbecue, beef is often center stage on America's tables. But in recent years, beef, especially ground beef, has shown a dark side: It can harbor the bacterium E. coli O157:H7, a pathogen that threatens the safety of the domestic food supply. If not properly prepared, beef tainted with E. coli O157:H7 can make people ill, and in rare instances, kill them. In 1993, E. coli O157:H7 contaminated hamburgers sold by a fast-food chain were linked to the deaths of four children and hundreds of illnesses in the Pacific Northwest. (2)

In 1997, the potential extent of E. coli O157:H7 contamination came to light when Arkansas-based Hudson Foods Inc. voluntarily recalled 25 million pounds of hamburger suspected of containing E. coli O157:H7. It was the largest recall of meat products in U.S. history. (2)

Nationally, E. coli O157:H7 causes about 20,000 illnesses and 500 deaths a year, according to the Centers for Disease Control and Prevention. Scientists have only known since 1982 that this form of E. coli causes human illness. It became one of the emerging pathogens we talk about today.

To help combat this public health problem, the Food and Drug Administration, in December 1997, approved treating red meat products with a measured dose of radiation. This process has drawn praise from many food industry and health organizations because it can control this terrible demon E. coli O157:H7 and several other disease-causing microorganisms.

Even previously recognized pathogens pose new problems. For example, we know that the increasing consumption of chicken in this country has been accompanied by an increased incidence of Campylobacter jejuni infection. Campylobacter now exceeds Salmonella as the most common bacterial foodborne pathogen. The picture is further complicated by the emergence of fluoroquinolone-resistant Campylobacter species. Findings from one study indicate that the proportion of C jejuni isolates resistant to nalidixic acid (NegGram) increased in one population from 1.8% in 1992 to more than 10% in 1998(4).

FDA has evaluated irradiation safety for 40 years and found the process safe and effective for many foods. Before approving red meat irradiation, the agency reviewed numerous scientific studies conducted worldwide. These included research on the chemical effects of radiation on meat, the impact the process has on nutrient content, and potential toxicity concerns.

In this most recent review and in previous reviews of the irradiation process, FDA scientists concluded that irradiation reduces or eliminates pathogenic bacteria, insects and parasites. It reduces spoilage, and in certain fruits and vegetables, it inhibits sprouting and delays the ripening process. Also, it does not make food radioactive, compromise

nutritional quality, or noticeably change food taste, texture or appearance as long as it's applied properly to a suitable product.

Critics of meat irradiation are concerned that some producers and processors, assuming that the irradiation treatment will destroy harmful pathogens, will not be careful with sanitary foodhandling practices. Also, critics say that the treatment kills helpful bacteria that the human body uses to aid digestion; also according to critics irradiation may alter the nutritional value of a food. For example, a small percentage of vitamin B1 is lost when pork is irradiated. Supporters, however, see this approval as giving the industry another "safety" tool to control foodborne pathogens. Irradiation may also become a primary tool in ensuring the safety of fresh produce such as alfalfa sprouts.

However, food manufacturers have been slow to adopt irradiation, partly because of the perception that relatively few consumers are willing to buy irradiated foods. A recent survey by the Food borne Diseases Active Surveillance Network (FoodNet) confirmed this perception: only half of the adult residents of the FoodNet sites were willing to buy irradiated ground beef or chicken, and only a fourth were willing to pay a premium for these products, which cost more to produce than comparable non irradiated products. These findings suggest that the impact of food irradiation on public health will be limited unless consumer preferences change, perhaps in response to educational messages about the safety and benefits of food irradiation. (1)

A Louis Harris poll released in 1986 found that 76 percent of Americans considered irradiated food a hazard. But later studies have shown that consumer attitudes can be changed through education. (2)

In 1995, researchers at the University of Georgia reported that 87.5 percent of consumers had heard of irradiation but knew little about it. So the university set up a "simulated supermarket setting" and labeled irradiated products, put posters at the point of sale, and developed a slide show explaining irradiation. "Our goal was to see which one of those techniques was most effective in changing people's attitudes," says Kay McWatters, agricultural research scientist and one of the study authors.

The study found that any kind of education helps convey the benefits of irradiation, McWatters says. "But the one that turned out most effective was the slide show, because visual images and [narration] are much more attention-getting than just a static label or poster."

After the study's education strategy, about 84 percent of participating consumers said irradiation is "somewhat necessary" or "very necessary." Fifty-eight percent said they would always buy irradiated chicken if available, and 27 percent said they would buy it sometimes.

Another study in 1997 by the Food Marketing Institute had similar results. After receiving education about the process, 60 percent of those in the study said they would buy irradiated foods.

Health experts say that in addition to reducing E. coli O157:H7 contamination, irradiation can help control the potentially harmful bacteria Salmonella and Campylobacter, two chief causes of foodborne illness. The Centers for Disease Control and Prevention estimates that Salmonella--commonly found in poultry, eggs, meat, and milk-- sickens as

many as 4 million and kills 1,000 per year nationwide. Campylobacter, found mostly in poultry, is responsible for 6 million illnesses and 75 deaths per year in the United States.

Another influence on foodborne disease is the type of foods Americans now eat. Heart-healthy and cancer-preventing diets present new challenges for the gastrointestinal tract. In 1970, each American ate about 175 pounds of fresh fruits and vegetables a year. By 1995, the number rose to about 220 pounds per person. In the state of Minnesota for example, from 1990 to 1996, fresh produce was the single leading carrier of foodborne disease. Fruits and vegetables accounted for 37 (30%) of 122 confirmed outbreaks. In many instances, contamination probably occurred in the kitchen through handling by an infected food worker or by cross-contamination with other carriers, such as meat or poultry. Since fresh produce is not usually cooked before consumption, it is susceptible to contamination anywhere and anytime from the field to palate. (3)

The increasing demand for fresh produce year-round, combined with the economics of growing these products, has led to increases in imports from developing countries. For example, in 1996, 17% of all cantaloupes, 52% of all green onions, 36% of all cucumbers, and 34% of all tomatoes sold in the United States were grown in Mexico (3). During peak seasons, Mexico alone may supply as much as 70% of selected produce items consumed in the United States. The growing incidence of sporadic diarrheal illnesses in the United States may reflect "traveler's diarrhea" transmitted through these foods, even though the consumer has traveled only to the grocery store.

Another factor likely to affect the epidemiology of foodborne disease is the fact that older people and those with cancer, HIV infection, or other immuno-compromising conditions are at above-average risk for acquiring severe food-borne infection. In fact, one of the most important demographic phenomena in this country is the growth in the aging population and the increase in health problems associated with aging. During the next 25 years, the baby-boomer generation is expected to create an explosion of potentially immuno-compromised persons. By requiring food to be irradiated would help reduce the risk to this highly susceptible population

In addition to eating more fruits and vegetables, Americans now eat out more often than in the past. Between 1970 and 1997, the percentage of food dollars spent away from home increased from 34% to 45%. From 1990 to 1996, 69% of confirmed foodborne illness outbreaks in Minnesota were traced to licensed food service operations.

FDA officials emphasize that though irradiation is a useful tool for reducing foodborne disease risk, it complements, but doesn't replace, proper foodhandling practices by producers, processors and consumers. With the many variables facing the food industry such as imported food, growing number of high risk populations, increased percentage of meals eaten away from home, emerging pathogens and untrained workforce the necessity of a "kill step" such as irradiation in the beginning of the food production is long overdue.

Food handler certification

Today, the average food worker comes from all facets of society. They have little or no sick leave or other health benefits, which can cause them to continue to work when they are ill. These workers, who tend to be young and from low socioeconomic groups, generally work in the food service industry less than a year and have little knowledge of basic foodhandling practices and little appreciation for routine hand washing (4).

A large portion of the employees in foodservice is teenagers with little if any basic knowledge of proper foodhandling practices. Another growing segment of the food employee pool comes from the immigrant population who bring customs and communication barriers that further complicate safe foodhandling practices.

The model food code, which is published by the Food and Drug Administration (FDA) every other year, provides guidance on food safety and sanitation that can be uniformly adopted by jurisdictions for regulating the retail segment of the food industry. The model Food Code is the cumulative result of the efforts and recommendations of many contributing individuals, agencies, and organizations. Currently forty-one states are using the FDA food code or a modified version (13). The Food Code only requires foodhandler certification for the person-in-charge in hopes it will reduce the incidence of foodborne disease. This is a step in the right direction but realistically it should include all employees.

Listed below are the duties of the person-in-charge as described in the Food Code (14):

2-103.11 Person in Charge.

The PERSON IN CHARGE shall ensure that:

(A) FOOD ESTABLISHMENT operations are not conducted in a private home or in a room used as living or sleeping quarters as specified under § 6-202.111;

(B) PERSONS unnecessary to the FOOD ESTABLISHMENT operation are not allowed in the FOOD preparation, FOOD storage, or WAREWASHING areas, except that brief visits and tours may be authorized by the PERSON IN CHARGE if steps are taken to ensure that exposed food; clean EQUIPMENT, UTENSILS, and LINENS; and unwrapped SINGLE-SERVICE and SINGLE-USE ARTICLES are protected from contamination;

(C) EMPLOYEES and other PERSONS such as delivery and maintenance PERSONS and pesticide applicators entering the FOOD preparation, FOOD storage, and WAREWASHING areas comply with this Code;

(D) EMPLOYEES are effectively cleaning their hands, by routinely monitoring the EMPLOYEES' handwashing;

(E) EMPLOYEES are visibly observing FOODS as they are received to determine that they are from APPROVED sources, delivered at the required temperatures, protected from contamination, unADULTERATED, and accurately presented, by routinely monitoring the EMPLOYEES' observations and periodically evaluating FOODS upon their receipt;

(F) EMPLOYEES are properly cooking POTENTIALLY HAZARDOUS FOOD, being particularly careful in cooking those FOODS known to cause severe foodborne illness and death, such as EGGS and COMMINUTED MEATS, through daily oversight of the EMPLOYEES' routine monitoring of the cooking temperatures using appropriate temperature measuring devices properly scaled and calibrated as specified under § 4-203.11 and ¶ 4-502.11(B);

(G) EMPLOYEES are using proper methods to rapidly cool POTENTIALLY HAZARDOUS FOODs that are not held hot or are not for consumption within 4 hours, through daily oversight of the EMPLOYEES' routine monitoring of FOOD temperatures during cooling;

(H) CONSUMERS who order raw or partially cooked READY-TO-EAT FOODS of animal origin are informed as specified under § 3-603.11 that the FOOD is not cooked sufficiently to ensure its safety;

(I) EMPLOYEES are properly SANITIZING cleaned multiuse EQUIPMENT and UTENSILS before they are reused, through routine monitoring of solution temperature and exposure time for hot water SANITIZING, and chemical concentration, pH, temperature, and exposure time for chemical SANITIZING;

(J) CONSUMERS are notified that clean TABLEWARE is to be used when they return to self-service areas such as salad bars and buffets as specified under § 3-304.16;

(K) Except when otherwise approved as specified in ¶ 3-301.11(B), EMPLOYEES are preventing cross-contamination of READY-TO-EAT FOOD with bare hands by properly using suitable UTENSILS such as deli tissue, spatulas, tongs, SINGLE-USE gloves, or dispensing EQUIPMENT; and

(L) EMPLOYEES are properly trained in FOOD safety as it relates to their assigned duties.

This can be quite challenging for the person-in-charge due to the many operations that are conducted simultaneously in a food service establishment.

The current recommended or recognized educational philosophy to ensure safe food-handling in the retail food industry is to have a manager or person-in-charge attended a sixteen to twenty hour foodhandling course. These training courses are somewhat in depth and cover all the basics of proper foodhandling and are geared more for management.

Due to the many stages and people involved in food preparation, opportunity for contamination or abuse is more of a risk by individuals involved in the daily operations of the establishment. In addition, the large number of young individuals, immigrants and imported foods only complicate the issue. The importance of these individuals having the knowledge of safe foodhandling cannot be overlooked.

The answer would be to require anyone who is employed in the foodhandling industry demonstrate their knowledge in basic foodhandling by completing a four-hour course and passing a written exam. This course could be provided by the local health jurisdiction and would be self supporting by charging a flat fee of perhaps twenty dollars. Upon passing the exam the individual would be issued a foodhandler's card, which would be valid for three years. Upon expiration of the initial card a renewal examination and fee would be available.

Several states currently have such a program requiring all foodhandlers obtain certification by written examination. Oregon, for example, adopted a statewide program in 1996 patterned after several local municipalities and counties (15). The primary concern is to educate employees on not just cleanliness but proper foodhandling practices. It is important to provide training that is not overkill for the rank and file employee. A uniform training program should include the following topics (15):

(1) Principles of foodborne illness and their transmission

(2) Personal hygiene and handwashing;

(3) Cross contamination;

(4) Safe food sources and wholesomeness of food;

(5) Proper procedures for cooking, cooling, reheating, holding and storing food;

(6) Dish and utensil washing;

(7) Rodent and insect control; and

(8) Injury and accident prevention.

Local health departments could provide instructional sites, times and instructors for the program. The instructors could be Environmental Health Specialist.

The course would place major emphasis on the principles of food temperature, contamination and handwashing. Of course the class time, card expiration date and cost could be decided upon after further study. Licensing individual foodhandlers is comparable to licensing individuals to operate motor vehicles on public highways. Before anyone is allowed to operate a motor vehicle on any public highway they must demonstrate not only their ability to operate the vehicle but also show their knowledge of the laws regarding the use of the highways. Both an uneducated motorist and food-handler can endanger the lives of many people.

A pilot program could be setup using several counties of comparable size and population to evaluate the effectiveness of these interventions.

One way to evaluate the interventions would be to measure the incidence rate of gastrointestinal diseases in these pilot counties and compare them to other counties as well as state and national rates.

The use of data from the states current inspection program could be used to compare the scores of the pilot counties with those of the remaining counties. For example, higher scores could indicate a positive influence of the interventions.

It used to be the consumer who prepared food improperly. Then it was the restaurant that prepared or stored food improperly. Now, however, it is an industry problem. In fact, it is a social problem that will not be solved without major changes in the way we think about food safety. If we attack foodborne illness at the source by irradiating foods, provide

better surveillance of pathogens and properly train all foodhandlers, the risk of food-borne illness would surely decline.

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