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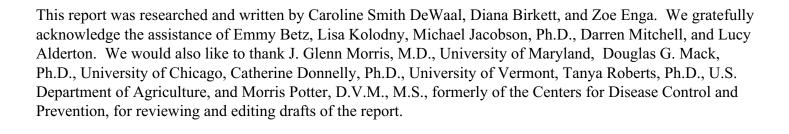
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Unexpected Consequences

Miscarriage and Birth Defects from Tainted Food

Center for Science in the Public Interest January 2000



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EXECUTIVE SUMMARY

Everyone's had food poisoning. The symptoms are a temporary nuisance for most people: vomiting, diarrhea, fatigue, and pain. But some food-poisoning cases can be far more serious.

In December 1998, the Bil Mar meat plant in Zeeland, Michigan, owned by the Sara Lee Corporation, recalled over 30 million pounds of fully cooked meat after it became clear that the meat was making people sick. In all, 100 people became ill and 21 died -- including six miscarriages -- from meat contaminated with *Listeria monocytogenes*. The Sara Lee outbreak alerted the public to a little-known risk: for pregnant women, some cases of food poisoning can kill the fetus or cause birth defects in the infants who survive.

Experts believe that tens of thousands of women may be exposed each year to *Listeria monocytogenes* (*Listeria*) and to another deadly micro-organism, the parasite *Toxoplasma gondii* (*T. gondii*). *Listeria* and *T. gondii* cause nearly half of all food-related deaths each year from known causes. These foodborne hazards are particularly harmful to the fetus, resulting in miscarriages or severe congenital problems. And the infection can be so mild that the pregnant woman is totally unaware that she has been infected and is passing the infection to her unborn child.

Action is needed to minimize the risk posed by *Listeria* and *T. gondii* in the food supply. The government, the food industry, medical professionals, and pregnant women can all play a role. Preventing exposure of pregnant women and other high-risk consumers to *Listeria* and *T. gondii* should be a top priority for federal food-safety officials.

KEY RECOMMENDATIONS

The following recommendations would help to minimize the risk to pregnant women and their unborn children -- and to other consumers -- from exposure to *Listeria* and *T. gondii*:

- 1. The government should maintain its zero-tolerance policy for *Listeria* and strengthen its enforcement activities. The government should mandate systematic microbial testing for products that are frequently linked to *Listeria* outbreaks, such as processed meat products and soft cheeses. Testing should target both the processing plant environment and the products. Until effective monitoring and verification systems are in place, foods that have been linked to *Listeria* outbreaks, like hot dogs, deli meats, and soft cheeses, should carry a warning label.
- 2. Surveillance activities for *Listeria*, *T. gondii*, and other non-diarrheal foodborne diseases should be **expanded**. The Centers for Disease Control and Prevention (CDC) should track the number of miscarriages and birth defects caused by these pathogens.
- 3. The food industry should develop new contol systems to reduce *Listeria* and *T. gondii* levels both on the farm and in the processing plant environment.
- 4. Research should focus on developing better detection methods for *Listeria* and vaccines against *T. Gondii* for cats and for food animals, such as pigs, sheep and cattle.
- 5. Doctors, nurses, and midwives need to inform pregnant women about how to protect themselves from the risks of *Listeria* and *T. gondii* infections.

- **6.** Pregnant women should report even mild cases of suspected food poisoning to their doctors and make sure that their doctors follow up with appropriate tests. Symptoms of infection with *Listeria* or *T. gondii* can be non-specific, mimicking mild cases of the "flu." Physicians can test for those infections, and women at high-risk (pregnant women who have consumed raw milk, soft cheese, or undercooked meat) who experience symptoms can ask for a diagnostic test.
- 7. To reduce their risk of exposure to *Listeria* and *T. gondii*, pregnant women should follow these common-sense precautions:
- Consume only milk products made from pasteurized milk.
- Avoid pâtes and soft cheeses, such as Brie, Camembert, Mexican-style, feta, and blue-veined cheeses, which can carry Listeria. Hard cheeses, yogurt, and cream cheese are safe.
- Cook all raw meat thoroughly; do not sample meat while cooking.
- Wash hands, knives, and cutting boards with hot soapy water after handling raw meat or other uncooked foods.
- Reheat leftovers and ready-to-eat foods, like hot dogs, deli meats, and cold cuts, until they are steaming.
- Keep raw meats separated from vegetables, cooked foods, and ready-to-eat foods.
- Wash fruits and vegetables thoroughly under running water.
- Avoid cleaning cat litter boxes, or wear gloves when doing so.
- Wear gloves when gardening or doing other activities that could involve contact with dirt that may contain cat feces.

INTRODUCTION

Although the hazards associated with eating meat cooked "rare" are well known, many Americans continue the practice. Other people enjoy eating soft cheeses like Brie or Camembert. What do those two practices have in common? For a pregnant woman, eating undercooked meat or soft cheese can mean the difference between a healthy baby and a failed pregnancy.

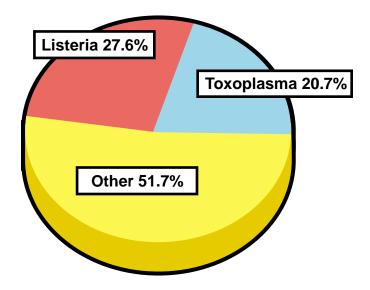
Soft cheeses can be laced with the bacterium *Listeria monocytogenes (Listeria)*, while meat can carry both *Listeria* and the parasite *Toxoplasma gondii (T. gondii)*. While those pathogens cause -- at most -- only mild infections in healthy adults, they can be devastating to the fetus, causing birth defects and miscarriages.

Listeria causes approximately 2,500 illnesses and 500 deaths per year.² Some experts estimate that one-third of all cases occur in pregnant women,³ which would mean about 825 illnesses and 165 deaths each year. Listeria contaminates foods processed or packaged in unsanitary conditions. It is a hardy bacterium that can survive and even grow at the low temperatures that would normally halt the growth of other bacteria. Listeria has been found in soft cheeses (feta, Brie, Mexican-style, etc.), pasteurized milk, hot dogs, undercooked chicken, beef and pork, smoked salmon and shellfish, tabouli salad, and semi-dry sausages.

While most healthy people who are exposed to *Listeria* do not become sick, for the elderly, children, pregnant women, and consumers with compromised immune systems, *Listeria* can cause a particularly severe infection. *Listeria* infection can lead to meningitis, blood poisoning, and encephalitis. In pregnant women, the infection can be passed to the fetus through the mother's bloodstream.

Figure 1
Estimated Deaths by Known Foodborne Diseases

Listeria and Toxoplasma gondii account for almost 50% of total



Another serious hazard for pregnant women is *T. gondii*, a parasite that lives in cats and other animals. Contaminated food is a largely unrecognized cause of exposure to *T. gondii*. While pregnant women are frequently warned to avoid cleaning litter boxes to prevent exposure to the parasite from cats, they are seldom

warned against the risks posed by handling and eating infected meat. Yet the problem is indeed widespread. It is estimated that 25 percent of pigs, 10 percent of sheep, and 5 percent of beef cattle are infected with the parasite.⁴ Many cases of human illness are caused each year by undercooked meat containing *T. gondii* cysts.

Experts at CDC estimate that foodborne *T. gondii* causes 112,500 illnesses and 375 deaths each year.⁵ Between 400 and 6,000 infants are born infected with *T. gondii* annually,⁶ as many as 80 of whom die.⁷ Infants with congenital toxoplasmosis often need a lifetime of special care, with costs estimated by U.S. Department of Agriculture (USDA) to total between \$3.3 billion and \$7.8 billion per year.⁸ This makes toxoplasmosis one of the single most expensive forms of food poisoning.

Many people who get toxoplasmosis don't feel sick at all, while others may get only mild symptoms that can easily go unrecognized. If a pregnant woman passes the parasite to her fetus, it can result in miscarriage, or central nervous system disorders, mental retardation, and blindness for many surviving infants.

Four million women give birth each year, but few are informed that some foodborne hazards can affect their developing fetus. Pregnancy is a great time to teach women the safe food-handling steps that will help ensure a safe pregnancy and protect their future children from food poisoning. This report describes the foodborne risks *Listeria* and *T. gondii* can pose to developing fetuses. Although the detrimental effects of those pathogens have been documented in the scientific literature for years, little information has reached the general public.

LISTERIA: THE KILLER FROM THE COLD

Three things make *Listeria* a particularly challenging food hazard. Foremost, *Listeria* poses a very serious hazard for a growing number of consumers. While consumers with fully functioning immune systems can handle *Listeria* with no ill effects, for susceptible consumers, like pregnant women and the elderly, the bacterium can cause extraordinarily severe infections, frequently leading to miscarriage or death. Second, *Listeria* can grow in processed foods, even if they are refrigerated. Third, *Listeria* is found in a wide variety of foods, including many ready-to-eat varieties.

Although as many as one out of eight Americans may be exposed to *Listeria* each year, ¹⁰ people with healthy immune systems can fight off the bacteria with few problems. Those at risk of getting sick include the elderly, children, pregnant women, and people with compromised immune systems, which totals over 50 million people in the US. ¹¹ As the population ages, more and more consumers will be at-risk from *Listeria*.

According to CDC, about 2,500 people become sick each year after exposure to *Listeria* in food, and 500 die. Ninety-two percent of diagnosed listeriosis cases require hospitalization, and the average hospital stay is almost two weeks. Listeriosis is especially deadly, resulting in death in 20 to 40 percent of the cases. Those figures make *Listeria* potentially far more hazardous than better-known foodborne pathogens, such as *E. coli* O157:H7, which causes about one-tenth the fatalities annually. Indeed, in a report prepared by the General Accounting Office for Congress, *Listeria* was cited as the leading cause of death among foodborne pathogens.

Most Americans know that perishable food should be stored in a refrigerator, where low temperatures slow bacterial growth and food spoilage. What consumers don't know is that while most foodborne bacteria are controlled by chilly temperatures, at least one bacterium -- *Listeria monocytogenes* -- is not. *Listeria* can

continue multiplying in contaminated food in a refrigerator or cooler -- even at 1° C $(33^{\circ}$ F) 18 -- possibly reaching levels high enough to sicken the unsuspecting diner. It can grow rapidly at temperatures between 35° F and 40° F, the temperature of most home refrigerators. 19

Not only can *Listeria* survive at low temperatures, it also can grow in a wide variety of foods, including many with a long refrigerated shelf-life and some that are eaten raw or unheated. Past outbreaks and illnesses have been linked to soft cheeses such as feta or Brie,²⁰ cabbage in coleslaw,²¹ pasteurized milk,²² chocolate milk,²³ hot dogs and deli meats,²⁴ raw vegetables,²⁵ and undercooked chicken.²⁶

Listeria is also found in many raw animal products. Researchers have detected *Listeria* in up to 77 percent of ground beef and 95 percent of ground pork sampled.²⁷ *Listeria* has also been found in 14 percent of smoked fish and smoked shellfish in a survey of products obtained from Canada, Norway, the United Kingdom, and the United States.²⁸

The U.S. food-safety agencies, the Food and Drug Administration (FDA) and the USDA, currently ban *Listeria* in any ready-to-eat foods, such as hot dogs, deli meats, and cheese. However, federal regulatory agencies do not have the legal authority to compel companies to recall tainted products. The government enforces the *Listeria* ban by conducting random tests and then asking companies to voluntarily recall any contaminated products. Voluntary *Listeria* recalls in 1999 included over 30 million pounds of meat;²⁹ milk products;³⁰ chocolate ice cream;³¹ smoked salmon and salmon dip;³² ricotta cheese;³³ about 26,500 pounds of chicken burritos;³⁴ over 126,000 pounds of bacon chips;³⁵ 80,000 pounds of pâte-like products;³⁶ and over two million pounds of beef franks,³⁷ to name a few. While those hazards were caught early, some consumers who ate Sara Lee hot dogs and luncheon meats were not so lucky. The Sara Lee outbreak, which sickened 100 consumers and killed 21,³⁸ demonstrated again that the government and the food industry need to take tougher action to combat this deadly foodborne hazard before it reaches consumers.

Listeria: Risks to Pregnant Women

Listeriosis can quickly transform the excitement and happiness of pregnancy into suffering and sorrow. In contrast to many foodborne hazards, *Listeria* is a particular danger in pregnancy, especially for the fetus.

One 1985 outbreak in Southern California caused by Mexican-style soft cheese sickened 142 people and killed 46. Eighty-five percent of the outbreak victims were pregnant women or their fetuses.³⁹ According to experts, this outbreak was critical in identifying foodborne *Listeria* as the cause of miscarriage. Researchers at the Los Angeles County USC Medical Center, the largest birthing center for Hispanic women in the U.S., were studying factors causing spontaneous abortion and stillbirth. When the incidence increased suddenly during the course of the study, researchers began questioning women to find out why. Many women recalled eating a specific

brand of Mexican-style soft cheese, which led to the identification of the Listeria strain causing the epidemic.⁴⁰

An infected woman may experience only mild, flu-like symptoms, like fever, chills, headache, backache, and diarrhea, days or weeks after exposure to Listeria. What she does not feel is the damage being done to her fetus. *Listeria* can cause miscarriage, stillbirth, pre-term labor, and severe mental and physical damage in the fetus. According to a French study, the disease is responsible for approximately three percent of all second-trimester miscarriages. A British study found that about one in 7,000 conceptions results in a miscarriage or stillbirth because of a *Listeria* infection. If the mother's infection is diagnosed quickly, antibiotic treatment not only cures her infection but can also prevent transmission to the fetus.

The timing of the infection can determine its impact on the mother and the child. Compared to an infection later in pregnancy, listeriosis during the first trimester of pregnancy usually results in spontaneous abortion and is more likely to cause severe illness in a surviving infant. An infection early in pregnancy may lead to septicemia, or blood poisoning, in the mother and increase the likelihood of maternal complications. Mothers face a higher risk of delivering a low-birth-weight infant, and infant death rates can climb as high as 30 percent. When mothers have an infection later in their pregnancy, it has fewer effects on the delivery or birth weight. The infant death rate drops to 10 percent.⁴⁵ But babies who survive a late infection may suffer from a wide range of ailments, including mental retardation, paralysis, seizures, blindness, and impairments of the brain, heart, or kidney.⁴⁶

The Government's Response to Listeria

The government responded to the deadly 1985 outbreak of listeriosis from Mexican-style soft cheese with a complete ban on ready-to-eat products that contain harmful strains of *Listeria*. This is called the "zero-tolerance" policy. First, the FDA began inspecting dairy products -- and later, ready-to-eat foods like seafood, prepared salads, and sandwiches -- for *Listeria*.⁴⁷ The CDC started active surveillance and research into risk factors for sporadic listeriosis in 1986. In 1989, after a CDC report linking listeriosis to turkey franks, the Food Safety and Inspection Service (FSIS) of the USDA introduced the zero-tolerance policy for meat products.⁴⁸

Between 1987 and March 1992, the FDA and FSIS initiated voluntary recalls for 543 products from 132 firms because of contamination with *Listeria*.⁴⁹ In 1992, after a CDC case-control study linked sporadic illnesses of listeriosis with consumption of delicatessen-counter foods and soft cheeses, recommendations for avoiding exposure to *Listeria* were distributed, and the food industry strengthened its efforts to minimize contamination of food with *Listeria*. The zero-tolerance policy, along with various reforms initiated by the food industry to respond to it, reduced listeriosis illnesses by 44 percent and deaths by 48 percent between 1989 and 1993.⁵⁰

Food industry officials have argued that the government's zero-tolerance policy for *Listeria* is unrealistic because the soil-based bacterium is ubiquitous in the environment.⁵¹ However, the bacterium's ability to grow at refrigeration temperatures, combined with the fact that it is often linked to foods eaten cold or raw, means that even with proper food handling, any amount of Listeria can pose a risk to consumers that frequently will not be cooked away. Therefore, controlling or eliminating the hazard must occur at the processing plant.

The zero-tolerance policy was developed because of a combination of factors: the high fatality and hospitalization rates in listeriosis cases; the long time period before the illness becomes apparent; the lack of information about early symptoms; and the lack of information on how much *Listeria* is needed to cause illness. ⁵² In measuring the value of the zero-tolerance policy, it is important to recognize that those factors are all still valid. Until a better solution is developed, USDA and FDA should continue monitoring foods for *Listeria* and initiating voluntary recalls whenever it is found in processed ready-to-eat food.

While the zero-tolerance policy is one of the toughest weapons in a food-safety regulator's arsenal, one reserved for pathogens that are known killers, its enforcement is weak. The two separate food-safety agencies conduct only occasional random sampling of ready-to-eat foods, which leaves gaping holes in consumer protection against *Listeria*.

USDA's Program for Listeria Control

USDA's Food Safety and Inspection Service (FSIS) tests approximately 3,500 ready-to-eat meat samples for *Listeria* each year, including beef jerky, cooked beef, sliced ham and luncheon meat, sausages, cooked poultry, meat or poultry salads, and spreads. In 1998, approximately 2.5 percent of the samples tested positive for *Listeria*.⁵³ Some products have higher contamination rates, including sliced ham and luncheon meats, which have a positive rate of 5.7 percent.⁵⁴

Whenever ready-to-eat meats are found to contain *Listeria*, USDA asks the processors to recall those foods voluntarily. USDA lacks the authority to make recalls of contaminated meat legally enforceable. While USDA's random sampling program for *Listeria* has resulted in numerous recalls of contaminated meat and poultry products, the Sara Lee outbreak demonstrates that occasional random sampling can't identify all hazardous products.

The government doesn't rely solely on random sampling programs to ensure the safety of meat products. For decades, all meat and poultry plants have been subject to continuous USDA inspection and, beginning in 1998, USDA added mandatory process control systems, called HACCP (which stands for "Hazard Analysis and Critical Control Point"). Those systems are supposed to control hazardous contaminants in meat and poultry products. Less than one year after HACCP implementation began, however, the Sara Lee outbreak proved that the system wasn't foolproof. Further, the magnitude of the outbreak was alarming. If 21 people can die from exposure to a single contaminated food source, does the new HACCP program really provide adequate protection?

Mandatory industry testing for *Listeria* in all ready-to-eat meat and poultry plants is urgently needed so that companies catch more contaminated food before it leaves the processing facilities, instead of waiting for a random government test or an outbreak to trigger a recall. In addition, testing would facilitate the development of better systems to prevent contamination, which in turn would strengthen the HACCP systems.

Although slaughterhouses operating under HACCP systems are required to test their products for generic *E. coli* (a measure of filth), USDA doesn't require meat processors to test their products or plants to demonstrate that their HACCP systems are controlling *Listeria*.⁵⁵ The Sara Lee outbreak should have provided the impetus to correct that serious gap in consumer protection, but the government has so far failed to act.

FDA's Program for Listeria Control

FDA's program for controlling *Listeria* is considerably weaker than even USDA's flawed program. The FDA, which is responsible for the safety of all foods other than meat, poultry, and egg products, does not mandate HACCP programs for most foods and conducts only infrequent inspections of food processing plants.

A large number of FDA-regulated foods can contain *Listeria*, including soft cheeses, pasteurized and unpasteurized milk products, seafood products, prepared salads, and alfalfa and other sprouts. FDA regularly monitors only one food -- soft cheeses -- for *Listeria*, but it targets testing of those cheeses primarily to imported varieties. Products other than soft cheeses are tested for *Listeria* at the discretion of the FDA inspectors, who rarely visit most food plants. And FDA's testing is minimal: in 1998, for example, FDA tested only about 1,500 products for *Listeria*; it found about 6 percent to be positive.⁵⁶

When a product is found to contain Listeria, FDA asks the company to initiate a nationwide voluntary recall. In addition, FDA can act in response to an outbreak investigation, but that involves recalling contaminated food only after the products have reached consumers and have caused illnesses.⁵⁷

T. GONDII: PARASITE WITH A BITE

While many consumers have heard of *Toxoplasma gondii* and its connection with cats, most are not aware that cats are only part of the problem. *T. gondii* is carried by cats, but the parasite can also infect other animals such as pigs and sheep, can contaminate soil, and can get into food. In fact, the government estimates that up to one-half of illnesses caused by *T. gondii* are foodborne. Toxoplasmosis, caused by infection with *T gondii*, is one of the most hazardous of the foodborne diseases and one that consumers know the least about.

Each year about 112,500 Americans get sick and 375 die from *Toxoplasma gondii* infections caused by eating contaminated food.⁵⁹ *T. gondii* most frequently targets the brain, but it can also infect the eyes, heart, lungs, pancreas, colon, liver, and testes.⁶⁰ Congenital toxoplasmosis, where the parasite is transmitted from the pregnant woman to her fetus, is estimated to affect between 400 and 6,000 children each year.⁶¹ Some experts estimate that it kills as many as 80 infants each year.⁶² The CDC has not yet initiated active surveillance for toxoplasmosis, so it is difficult to know how many cases of illness occur.

Accounting for anywhere between \$3.3 billion and \$7.8 billion per year in health care and other costs, ⁶³ *T. gondii* is ranked by the government as one of the most costly foodborne pathogens. ⁶⁴ Children born infected with *T. gondii* can require years of special care, including special education, ophthalmology visits, foster care, and financial assistance. ⁶⁵

Almost all foodborne cases of toxoplasmosis come from raw or undercooked meat, with pigs, sheep, and goats posing a higher risk than beef cattle or chickens.⁶⁶ It is estimated that 25 percent of pigs, 10 percent of sheep, and 5 percent of beef cattle are infected with the parasite.⁶⁷ Fruits and vegetables can become contaminated from contact with infected manure.⁶⁸ A recent outbreak of toxoplasmosis involving 100 victims in British Columbia was linked to a contaminated municipal water supply,⁶⁹ suggesting that the problem can spread from animals into the water supply.

While scientists hunt for an animal vaccine, and public-health officials search for other solutions, consumers must take steps to protect themselves: by cooking meat thoroughly and following other basic food-safety guidelines, consumers can significantly reduce their risk of *T. gondii* infections. But once again, those precautions will only work if the public -- especially pregnant women, the elderly, and immunocompromised patients -- are properly informed and motivated.

T. gondii: Risks to Pregnant Women

An active case of toxoplasmosis can be difficult to detect. Only 10 percent of women infected with the *T. gondii* parasite have clinical symptoms,⁷⁰ which usually resemble a mild flu. Symptoms typically include swollen lymph nodes, fever, headache, muscle pain, or a stiff neck.⁷¹ A woman can easily expose her fetus to toxoplasmosis without even being aware that she is ill.⁷²

Babies who acquire *T. gondii* infections from their mother can experience a wide range of problems [See Table 1].⁷³ Toxoplasmosis can cause mental retardation, cognitive and motor dysfunction, seizures, hearing

loss, jaundice, pneumonia, cerebral palsy, and other problems.⁷⁴

Table 1

Effects of Fetal Exposure to <i>T. gondii</i>					
Impairment*	1st year (%)	Additional in 2nd year (%)	Additional in years 3 to 17 (%)	Total affected (%)	
Deaths	2	0	0	2	
Severe illness	11	0	0	11	
Severe retardation	11	+2	+20	33	
Moderate retardation	5	+3	+9	17	
Slight retardation	5	+6	+12	23	
Blindness (bilateral)	6	0	+2	8	
Moderate visual impairment	16	+17	+20	53	
Cross-eyed vision	5	+2	+13	20	
Deafness ^b	2	0	0	2	
Hearing loss (moderate unilateral)	0	0	+10	10	
Normal	55°	36°	20°	20°	

^{*}Children often suffer more than one symptom.

Source: Tanya Roberts and J.K. Frenkel, "Estimating Income Losses and Other Preventable Costs Caused by Congenital Toxoplasmosis in People in the United States," *Journal of the American Veterinary Medicine Association*, Vol. 196, No. 2 (1990), p. 251.

Some infants who seem healthy or mildly ill at birth will develop problems weeks or months later. In fact, by age 20, as many as 80 percent of children with untreated congenital toxoplasmosis develop impairments ranging from mental retardation to blindness.⁷⁵ Early identification and treatment of children infected with *T. gondii* is essential to minimize the parasite's effects.

^bDeafness varied widely, from 0 to 13 percent.

^cAfter 20 years.

Luckily, when a woman becomes infected, transmission of the parasite to the fetus occurs in less than 50 percent of cases. The first trimester, the risk that the parasite will infect the fetus is only 25 percent; however, 75 percent of infected fetuses are severely affected, and half of them will die. The Transmission rates increase to 50 percent in the second trimester, but the percentage of children with severe symptoms decreases. In the third trimester, up to 65 percent of babies are infected, but less than 5 percent of the infections are severe [See Table 2]. Immediate treatment of infants with congenital toxoplasmosis can prevent some impairments from developing. Treatment of pregnant women exposed to the parasite can also reduce the likelihood that their children will develop toxoplasmosis.

Table 2

Toxoplasmosis Transmission Rates					
Term of Pregnancy in which Mother is infected	Percent of Babies Infected	Severe Disease at Birth			
1st Trimester	Up to 25%	Up to 75%			
2nd Trimester	Up to 50%	Up to 55%			
3rd Trimester	Up to 65%	Up to 5%			

Source: R.E. Holliman, "Congenital Toxoplasmosis: Prevention, Screening and Treatment," *Journal of Hospital Infection*, Supplement, Vol. 30 (1995), p. 180.

The Government's Response to T. gondii

Despite the high costs of this foodborne hazard, *T. gondii* has received little or no regulatory attention. The government has developed no zero-tolerance standard for *T. gondii*-contaminated food or any other mandatory control mechanisms. While the pork industry has been studying this problem for many years, it has yet to implement voluntary on-farm control programs.⁷⁹ With high percentages of livestock infected with *T. gondii*, more should be done on the farm and in processing plants to reduce this hazard.

CONCLUSION AND RECOMMENDATIONS

Because of *Listeria* and *T. gondii* infections, miscarriage and birth defects can be unexpected consequences of food poisoning during pregnancy. Those hazards are not adequately monitored or controlled today in the food supply. With better information and improved food-handling practices, pregnant women can help protect themselves from exposure to *Listeria* or *T*.

gondii. With better public and medical education to recognize the signs of exposure, women and infants could also be treated earlier to minimize the effects of an infection. In the long run, however, the government and the food industry should implement better practices to monitor and eliminate these hazards from the food supply.

Recommendations for Food-Safety Regulators and the Food Industry

Because foodborne listeriosis and toxoplasmosis differ in their origins, different control mechanisms are needed to prevent them. *Listeria* is a bacterium that can contaminate food-processing plants. *T. gondii*, on the other hand, is a parasite that lives in the live animal.

1. The government should maintain its zero-tolerance policy for *Listeria* and strengthen its enforcement activities. The government should mandate systematic microbial testing by the industry for products that are frequently linked to *Listeria* outbreaks, such as processed meat products and soft cheeses. Such mandatory testing should target both the plant environment and the food products; the results should be regularly reviewed by the government.

Until routine monitoring is in place, ready-to-eat food products that have been associated with outbreaks and illnesses from *Listeria* should carry a warning label alerting high-risk consumers, including pregnant women, to avoid these foods unless they are fully heated before they are consumed.

2. Surveillance activities to identify illnesses caused by *Listeria*, *T. gondii*, and other non-diarrheal foodborne pathogens should be greatly expanded. CDC should track the number of miscarriages and birth defects caused by these pathogens.

The CDC and state health departments do not regularly monitor miscarriages caused by infectious diseases. Also, the National Birth Defects Prevention Network, comprised of 21 state health departments, focuses only on the incidence of physical malformations, not the underlying causes.⁸⁰ Increased funding for surveillance is needed.

- **3.** The food industry should develop new control systems to reduce Listeria and T. gondii levels in the processing environment and on the farm. On-farm control of cat and rodent populations can reduce livestock's exposure to *T. gondii* and other food safety hazards, and appropriate processing guidelines can also help reduce contamination levels.⁸¹ The high prevalence of *T. gondii* in pork may also justify regular sampling of pork products.
- 4. Research should focus on developing better detection methods for *Listeria* and vaccines against *T. Gondii* for cats and for food animals, such as swine, sheep, and

cattle. Current methods for detecting *Listeria* in foods should be improved to increase recovery rates, so that contaminated foods can be detected before they are released to the public. Development of vaccines for cats, swine, and other animals would also help to reduce the transmission rates of *T. gondii* in animal populations.⁸²

Recommendations for Consumers and Medical Professionals

- **5. Doctors, nurses, and midwives need to inform pregnant women how to protect themselves from Listeria and T. gondii infections.** Pregnant women can do many things to protect themselves against listeriosis and toxoplasmosis but first they need to know they are in danger. The best and most effective messengers are doctors, nurses, midwives, and other health care workers. Pamphlets with background information on ways to avoid infection are an important way to reach a broad audience, but it is critical that doctors explain the potential risks to pregnant women in person, because women are more likely to remember and to follow -- advice they hear from their doctor than recommendations contained in a brochure. In addition, pregnancy is an important time to remind parents of safe food-handling practices that offer protection both during the pregnancy and also afterwards, when they begin preparing food for young children.
- **6.** Pregnant women should report even mild cases of suspected food poisoning to their doctors and make sure that their doctors follow up with appropriate tests. Symptoms of infection with *Listeria* or *T. gondii* can be non-specific, mimicking mild cases of the "flu." Physicians can test for these infections, and women at high-risk (pregnant women who consumed raw milk, soft cheese or undercooked meat, as well as those having contact with cat feces) who experience symptoms can ask for a diagnostic test. Another alternative is to test infants for *T. gondii* so they can receive prompt treatment to prevent symptoms from occurring or worsening.
- 7. Pregnant women, the elderly, children, and people with weakened immune systems can greatly reduce their risk of *Listeria* and *T. gondii* infections by following these common-sense precautions:
- Consume only milk products made from pasteurized milk.
- Avoid pâtes and soft cheeses, such as Brie, Camembert, Mexican-style, feta, and blue-veined cheeses, which can carry Listeria. Hard cheeses, yogurt, and cream cheese are safe.
- Cook all raw meat thoroughly; do not sample meat while cooking.
- •Wash hands, knives, and cutting boards with hot soapy water after handling raw meat or other uncooked foods.
- Reheat leftovers and ready-to-eat foods, like hot dogs, deli meats, and cold cuts, until they are steaming.
- Keep raw meats separated from vegetables, cooked foods, and ready-to-eat foods.
- Wash fruits and vegetables thoroughly under running water.
- Avoid cleaning cat litter boxes, or wear gloves when doing so.
- •Wear gloves when gardening or doing other activities that could involve contact with dirt that may contain cat feces.

Appendix 1

Listeria monocytogenes: General Information				
Microbiological characteristics	Bacterial pathogen Growth temperatures from 33 to 140° F (Can grow during refrigerator storage) Causes mild to severe disease Can be transferred from a pregnant woman to her fetus Incubation period: one day to several weeks			
Food sources	Cold ready-to-eat meat and seafood products Meat and poultry, cooked rare Pâtes Brie, Camembert, feta, Mexican-style, and blue-veined cheeses Milk and milk products, especially unpasteurized Raw, unwashed fruits and vegetables			
Other sources	Sewage, feces, manure Slaughter-house waste Contaminated stream water			
Medical consequences	Maternal fever, flu-like illness Miscarriage Stillbirth Premature birth Septicaemia, meningitis, mental retardation, other birth defects in newborns			
Safety suggestions	Practice hygenic food-handling Cook all ready-to-eat foods and leftovers until they are steaming Avoid eating raw or undercooked meat or poultry Avoid long periods of refrigerator storage			
Diagnosis and treatment	Blood and other sterile fluid testing Antibiotic therapy for mothers and newborns			

Appendix 2

Toxoplasma gondii: General Information				
Microbiological characteristics	Parasitic pathogen Cannot survive freezing temperatures below 10° F Cannot survive cooking temperatures above 160° F Causes mild to severe disease Can be transferred from a pregnant woman to her fetus			
Food sources	Raw or undercooked meat, especially pork or lamb Unpasteurized milk and milk products Raw eggs and raw egg dishes Fruit and vegetables soiled by animal waste			
Other sources	Direct contact with cat feces Contact with water, soil, or vegetation exposed to cat feces			
Medical consequences	Maternal fever and flu-like illness Miscarriage Stillbirth Birth defects and mental retardation, both early-onset in newborns and delayed-onset in older children			
Prevention	Practice hygenic food-handling Avoid eating raw or undercooked meat, especially pork or lamb Wash hands after handling raw meat Wash fruits and vegetables thoroughly Wear gloves when emptying cat litter trays Cook meat to an internal temperature of 160° F			
Diagnosis and treatment	Maternal blood antibody test Prenatal screening: amniocentesis, ultrasound Medication to reduce severity of symptoms in newborn: pyrimethamine and sulfadiazine			

ENDNOTES

- ¹. *Listeria* is a genus of bacteria, which has many species. One species, *Listeria monocytogenes*, is particularly harmful to humans. *Listeria monocytogenes* can be found normally in the gastrointestinal tract of and in animal feces, but it has also been found as a contaminant in foods, where it can cause the foodborne disease listeriosis. For the sake of simplicity, this bacterium will be referred to as *Listeria* throughout this report, though in each case, *Listeria monocytogenes*, the specific species, is implied. [Source: University of Texas at Houston Medical School, Department of Microbiology, fact sheet on *Listeria*, available at http://medic.med.uth.tmc.edu/path/00001447.htm Internet.]
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- ⁵. Food-Related Illness and Death, Table 3, p. 611.
- ⁶. *Ibid*, p. 621.
- ⁷. Jean C. Buzby and Tanya Roberts, "Guillain-Barré Syndrome Increases Foodborne Disease Costs," *Food Review* (September 1997), p. 40. [hereinafter cited as *Guillain-Barré Syndrome*.]
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- ¹¹. Morton Satin, Food Alert! The Ultimate Sourcebook for Food Safety, (New York, NY: Checkmark Books, 1999), p. 191.
- ¹². Food-Related Illness and Death, Table 3, p. 611.
- ¹³. *Ibid*, Table 3, p. 611. CDC reported 2,518 total illnesses from *Listeria*, 2,332 of which resulted in hospitalization.
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- ¹⁵. Jordan W. Tappero, *et al.*, "Reduction in the Incidence of Human Listeriosis in the United States: Effectiveness of Prevention Efforts?" *Journal of the American Medical Association*, Vol. 273, No. 14 (1995), p. 1118. [hereinafter cited as *Reduction in the Incidence*.] *Food-Related Illness and Death*, Table 3, p. 611. CDC reported 2,518 total illnesses from *Listeria monocytogenes*, 504 of which resulted in death.
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- ³¹. Food and Drug Administration, "Enforcement Report," April 7, 1999, available at http://www.fda.gov/bbs/topics/ENFORCE/ENF00584.html Internet; State of Ohio Department of Agriculture, "Velvet Ice Cream Issues Precautionary Recall for Potential Listeria Contamination," Press Release, February 19, 1999. Velvet Ice Cream Co. of Utica, OH recalled approximately 244 gallons of chocolate ice cream.
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- 62. Guillain-Barré Syndrome, p. 40.
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