TABLE 2.—MEDICAL COSTS AND PRODUCTIVITY LOSSES ESTIMATED FOR SELECTED HUMAN PATHOGENS, 1993—Continued

Pathogen	Foodborne illness		Foodborne* costs (bil $)	Percent from meat/poultry (%)	Meat/poultry related		Total costs* meat/poultry (bil $)
	Cases (#)	Deaths (#)			Cases (#)	Deaths (#)	
Parasite:							
Toxoplasma gondii	3,056	41	2.7	100	2,056	41	2.7
Total	3,606,582–7,133,823	2,695–6,587	5.6–9.4	N/A	2,149,569–4,968,940	1,436–4,232	4.5–7.5

The costs of the foodborne illnesses (see Table 2, above) are borne by those who become ill and their families, coworkers, and employers, as well as the food industries, and taxpayers. Costs to stricken individuals include medical bills, time lost from work, pain and inconvenience. Food industry costs include possible product recalls, establishment closings and cleanup, and higher premiums for product liability insurance. Perhaps most costly in the long term is loss of product reputation and reduced demand when an outbreak is traced back and publicized. These and other ''defensive'' industry costs of foodborne disease run in the millions of dollars annually and are, for the most part, entirely avoidable. Taxpayer costs include medical treatment for those who cannot afford it and higher health insurance premiums.

Other taxpayer costs include public health-sector expenses to operate a disease surveillance system and to investigate and eliminate disease outbreaks. Approximately $300 million is spent on microbial foodborne disease annually by the Federal public health-sector. Federal costs average about $200,000 per foodborne illness outbreak.

The Department's Economic Research Service and CDC estimate the cost of all foodborne illness in 1993 to have been between $5.6 and $9.4 billion. Meat and poultry products were associated with approximately $4.5–$7.5 billion; the remaining $1.1 to $1.9 billion was associated with non-meat and poultry sources. Table 2 summarizes data on a pathogen-by-pathogen basis.

Foods contaminated with pathogenic microorganisms can lead to infection and illness in two major ways. The first is by direct consumption of the contaminated food under conditions that allow the survival of the pathogen or its toxin, such as when a meat or poultry product is consumed raw or undercooked, or products precooked during processing are recontaminated and consumed directly. The second is through cross-contamination in the kitchen or other food-handling areas, for example, when raw chicken or beef with a *Salmonella*-contaminated exterior contaminates a person's hands, a cutting board, countertop, or kitchen utensil, which then comes into contact with cooked product or foods consumed raw, such as salad. For some pathogens, such as *Salmonella,* it is likely that more cases of illness result from cross-contamination than from direct consumption of undercooked product.

Microbiological surveys of meat and poultry products have been conducted by FSIS over several decades. In cooked, ready-to-eat products, the frequency of pathogenic microorganisms has been relatively low. In regulatory testing programs of domestically produced, cooked, ready-to-eat meat and poultry products, for example, *Salmonella* has generally been found to be present in only about 0.1 percent of the samples tested and *Listeria monocytogenes* in about 1.5–3 percent of samples tested.

The frequency of pathogenic microorganisms in raw, ready-to-cook products has been greater. For example, FSIS has conducted surveys on the prevalence of *Salmonella* in various raw products, including broiler chickens, beginning as early as 1967. In these surveys, *Salmonellae* were isolated from 28.6 percent of 597 samples in 1967; from 36.9 percent of 601 samples in 1979; from 35.2 percent of 1693 samples in the 1982–1984 study; and from approximately 25 percent of the samples in the 1990–1992 study. FSIS studies on fresh pork sausage involved retail-size samples. *Salmonellae* were isolated from 28.6 percent of 566 samples in 1969, and from 12.4 percent of 603 samples in 1979. A benchmark study on raw beef was initiated in January 1987 and completed in March 1990. The prevalence of *Salmonella* in 25 gram portions was found to be 1.6 percent, the prevalence of *Listeria monocytogenes* was 7.1 percent and the prevalence of *E. coli* 0157:H7 was 0.1 percent.

In 1992, FSIS began a series of Nationwide Microbiological Baseline Data Collection Programs designed to provide a microbiological profile of various classes of inspected product. The first, on steer and heifer carcasses, was reported in January 1994. *Clostridium perfringens* was recovered from 2.6 percent of 2,079 carcasses; *Staphylococcus aureus* from 4.2 percent of 2,089 carcasses, *Campylobacter jejuni/coli* from 4.0 percent of 2,064 carcasses; *E. coli* 0157:H7 from 0.2 percent of 2,081 carcasses; and *Salmonella* from 1.0 percent of 2,089 carcasses.

The ongoing outbreaks of salmonellosis, attributed to consumption of contaminated meat, poultry and other food products, and the recent outbreaks of illness caused by *E. coli* 0157:H7 in undercooked ground beef, illustrate how serious the public health threat can be, even when the incidence of contamination of carcasses is relatively low.

For example, on January 13, 1993, a physician in Washington State reported to the Washington State Department of Health a cluster of children with Hemolytic Uremic Syndrome, a serious condition that is the major cause of acute kidney failure in children. Also reported was an increase in emergency room visits for bloody diarrhea. This outbreak was reported to CDC.

Cultures taken from symptomatic patients indicated that *E. coli* 0157:H7 was the causative organism. During January 16–17 an epidemiological case-control study conducted by Washington State and CDC strongly suggested the consumption of hamburgers at a chain of fast food restaurants as the source of the infection. The investigation revealed that the hamburger patties were cooked by the restaurants to a temperature below the Washington State standard of 155°F, and in some instances below the 140°F then recommended by FDA.

By February 4, 350 people in Washington State had contracted illnesses of the kind associated with *E.*