

CONSIDERATION OF POTENTIAL PARASITE FOOD HAZARDS¹

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Health authorities sometimes underestimate the potential threat of parasitic infections in places where good health conditions prevail. Though current infection rates may be near the vanishing point, many parasite species not listed in official reports are often present in small numbers, so that a drop in public health standards could prompt a rapid rise in these rates of infection.

Introduction

The extensive international trade and human travel of our jet age means that both human and animal disease problems in developing countries can have profound effects upon more industrialized and urbanized populations. Therefore, in order to deal with parasite food hazards in relatively developed countries, such as the United States of America, international as well as national and local food safety must be considered. For example, meals served aboard international airliners should be regarded as a potential health hazard because of

the many food sources involved and the conditions under which such meals are prepared, distributed, and maintained.

It is also necessary to keep in mind the many ways parasites can be transmitted to food. For example, there is an increasing potential for food contamination by solid wastes (feces) in some parts of the world. In general, infective stages of parasites in feces can come in contact with food when feces are used as fertilizer or when an infected food processor—who may be anyone from a field worker to a food handler, cook, waiter, or housewife—does not practice good hygiene.

Tables 1-3 show many of the parasites which man can acquire from contaminated food.

Table 1 includes those parasites which use an animal consumed by man as an intermediate host. They are listed in either column one or

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TABLE 1—Genera of human parasites using an animal eaten by man as an intermediate host.

Parasites with terrestrial intermediate hosts		Parasites with aquatic intermediate hosts	
Protozoa:	* <i>Toxoplasma</i>	Trematodes:	* <i>Paragonimus</i> , * <i>Heterophyes</i> , <i>Metagonimus</i> , * <i>Phagicola</i> , <i>Clonorchis</i> , <i>Opisthorchis</i> , <i>Nanophyetus</i> , * <i>Dicrocoelium</i> , <i>Echinochasmus</i> , * <i>Echinostoma</i> , <i>Echinoparyphium</i> , <i>Himasthla</i> , <i>Paryphostomum</i> , <i>Plagiorchis</i> , and <i>Isoparorchis</i>
Cestodes:	* <i>Taenia saginata</i> and <i>Taenia solium</i>		
Nematodes:	* <i>Trichinella</i>		
Arthropods:	<i>Linguatula</i>	Cestodes:	* <i>Diphyllbothrium</i> , * <i>Spirometra</i> , <i>Diplogonoporus</i> <i>Digramma</i> , <i>Ligula</i> , and * <i>Mesocostoides</i>
		Nematodes:	<i>Angiostrongylus</i> , <i>Anisakis</i> , and <i>Diectophyma</i>

*Reported in the United States.

TABLE 2—Genera of human parasites whose infective stages are transmitted in fomite or by invertebrate vectors.

Transmitted in fomite		Transmitted by invertebrate vectors	
Protozoa:	* <i>Isospora</i>	Cestodes:	* <i>Dipylidium</i> , * <i>Hymenolepis</i> , * <i>Bertiella</i> , <i>Raillietina</i> and <i>Digramma</i>
Nematodes:	* <i>Enterobius</i>	Nematodes:	* <i>Gnathostoma</i> , * <i>Gongylonema</i> , <i>Physaloptera</i> , <i>Spirocerca</i> , and <i>Metastrongylus</i>

*Reported in the United States.

column two, depending on whether the intermediate host is terrestrial or aquatic.

Table 2 includes those parasites which may be airborne on a fomite,³ or which may be transmitted by some intermediate invertebrate host that accidentally falls or crawls into food.

Table 3 lists parasites contained in excreta which may reach human food by way of sewage, polluted water, or fertilizer. Either irrigation or flooding can lead to food contamination from polluted water; and in view of increasing pollution and recycling activities, this poses a definite potential danger of contamination involving vegetable and other field crops (4, 9-11, 25, 29, 35, 37-38, 41).

Another important way in which excreta-borne parasitic infections can be spread is in

drinking water contaminated with sewage (11, 15, 21, 31, 38, 41).

Specific Examples of Parasite Transmission

To illustrate these general transmission pathways, several specific examples have been selected.

Taenia

Taenia saginata, the beef tapeworm, provides a good example of the pathways employed by a human parasite that uses a common food animal as an intermediate host. The life-cycle of *Taenia*, shown in Figure 1, is self-explanatory.

Anisakis

Many parasites normally occurring in wild

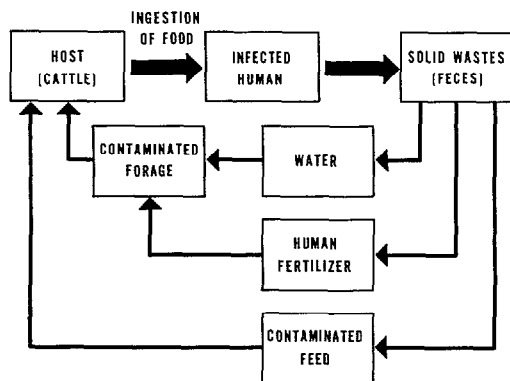
TABLE 3—Genera of human parasites whose infective stages are transmitted in sewage or polluted water.

Protozoa:	* <i>Entamoeba</i> , <i>Endolimax</i> , <i>Isospora</i> , <i>Iodamoeba</i> , <i>Dientamoeba</i> , * <i>Toxoplasma</i> , * <i>Giardia</i> , * <i>Trichomonas</i>	Nematodes:	* <i>Strongyloides</i> , * <i>Trichuris</i> , * <i>Capillaria</i> , * <i>Ancylostoma</i> , <i>Necator</i> , <i>Haemonchus</i> , <i>Oesophagostomum</i> , <i>Ternideus</i> , * <i>Trichostrongylus</i> , <i>Syngamus</i> , * <i>Syphacia</i> , * <i>Ascaris</i> , * <i>Toxocara</i> , * <i>Toxascaris</i> , <i>Lagochilascaris</i> , <i>Dracunculus</i> , <i>Acanthocephala</i> : <i>Macracanthorhynchus</i> , <i>Moniliformis</i>
Trematodes:	<i>Schistosoma</i> , <i>Fasciola</i> , <i>Fasciolopsis</i> , <i>Watsonius</i> , <i>Gastrodiscoides</i>		
Cestodes:	* <i>Cysticercus</i> (larva of <i>Taenia</i>), * <i>Hydatid</i> (larva of <i>Echinococcus</i>), * <i>Coenurus</i> (larva of <i>Multiceps</i>), <i>Drepanidotaenia</i>	Arthropods:	<i>Porocephalus</i>

*Reported in the United States.

³Fomite = Any substance other than food that may harbor and transmit infectious organisms.

FIGURE 1—Transmission pathways of the beef tapeworm, *Taenia saginata*.

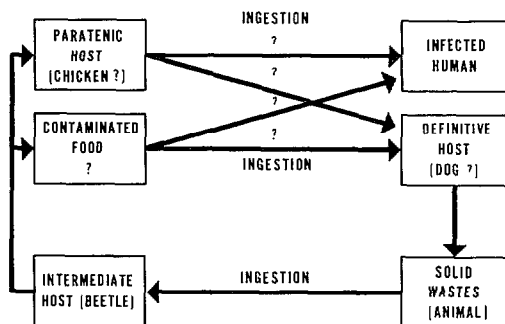


and domesticated animals can infect man when given the opportunity. One example of this is *Anisakis*, a nematode parasite whose adult form is normally found in marine mammals (27, 28). The intermediate host of *Anisakis* is a fish, and man acquires the infection by ingesting raw infected fish (see Figure 2).

Spirocerca lupi

Another example of an animal parasite occurring abnormally in man is the nematode *Spirocerca lupi*, which provides an illustration of parasitism involving an insect vector. Figure 3 shows possible ways in which man may acquire this parasite.

FIGURE 3—Postulated transmission pathways of *Spirocerca lupi*. The known life-cycle of *S. lupi* suggests that a definitive host, such as the dog, passes eggs via its excreta to one of several coprophagous (dung-feeding) beetles. Infected beetles may either get into food eaten by man or they may infect a paratenic host (the chicken). In the latter case, *S. lupi* larvae encysted in the chicken's alimentary tract may then infect man.



Entamoeba histolytica

A good example of a parasite whose infective stage is found in both animal excreta and polluted water is *Entamoeba histolytica*. Figure 4 shows several of the known ways in which the *Entamoeba* cyst may reach and contaminate human food.

Parasites in Economically Developed Regions

Chandler (16) has stated that "Improved water supplies and good sewage disposal are

FIGURE 2—Transmission pathways of *Anisakis*.

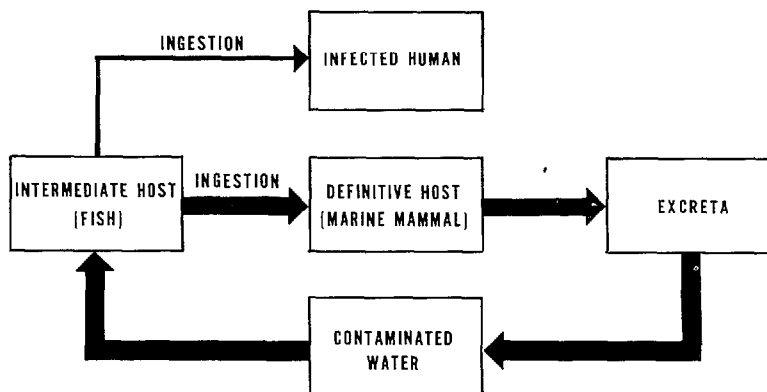
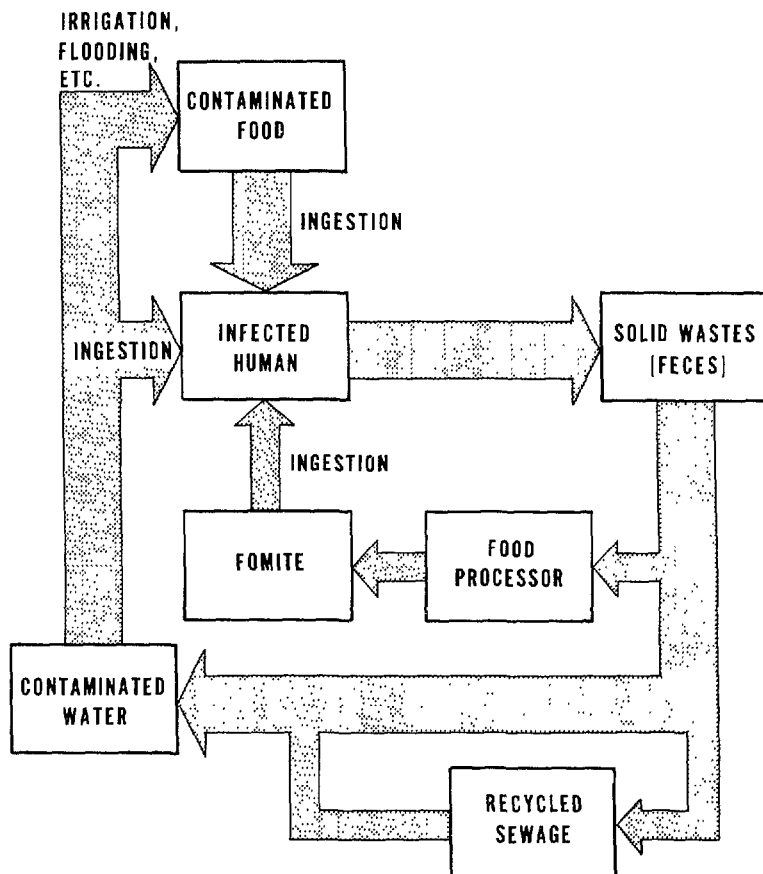


FIGURE 4—Some of the known transmission pathways of *Entamoeba histolytica*.



dangerous to most intestinal infections. To the extent that these concomitants of civilization have become part of the way of life of a people, parasitic infections have decreased even without new insecticides, new chemotherapeutics, or new vaccines. These specifically developed weapons have practically completed the white man's freedom from most of the infectious diseases that he once justifiably feared. . . .

"For our domestic animals, on the other hand, domestication and increasing concentration have meant increasing parasitization, for they soil their table with their feces, they eat uncooked food, they drink contaminated waters from ponds and streams, they bathe only by accident. . . . For human parasites, increased concentration had an opposite effect

owing to better opportunity for improved water, control of foods, and sanitary sewage disposal." However, due to the increasing world population and the recycling of waste products, including sewage, the benefits of civilization that Chandler so eloquently described may not be assured. I propose that one of the greatest potential hazards to highly industrialized nations is a false sense of security.

In the United States the same parasitisms exist, though admittedly to a lesser degree, that existed 30 or 40 years ago. For example, the parasites reported from two states for the years 1969 and 1970 are shown in Table 4.¹

As may be seen, in the southern state only 10 *Entamoeba* cases were reported for 1969 while 24 were reported for 1970. Other intesti-

TABLE 4—Comparison of two states' annual reports of possible food-borne parasites.

Types of infections	Southern state		Southwestern state	
	1969	1970	1969	1970
Protozoan infections with:	10	24	49	54
(1) <i>Entamoeba</i>				
(2) Intestinal protozoa (mainly <i>Giardia</i>)	—	342	—	—
Helminthic infection with:				
(1) <i>Ancylostoma</i>	280	303	—	—
(2) <i>Ascaris</i>	403	199	—	—
(3) <i>Enterobius</i>	—	163	—	—
(4) <i>Strongyloides</i>	16	20	—	—
(5) <i>Trichinella</i>	4	1	0	0
(6) <i>Trichuris</i>	—	80	—	—

nal protozoa were reported for the first time in 1970. When personnel of the state public health department were asked to interpret the situation and to name the genera of parasites involved, they said that the cases were predominantly *Giardia* infections and that the decision to start reporting them had been taken because they were occurring frequently. This therefore does not represent occurrence of a new parasite, but rather of one that has been in the human population all along—but which only now appears in weekly morbidity reports. Intestinal helminths reported in the state included members of the genera *Ancylostoma*, *Ascaris*, *Enterobius*, *Strongyloides*, *Trichinella*, and *Trichuris*.

In the southwestern state the only parasitism reported was amebiasis, presumably caused by *E. histolytica* (22, 23). More amoebic infections were reported for this latter state in both years than were reported for the above-mentioned southern state. When personnel from the southwestern state's public health department were asked whether helminthic infections were diagnosed they said yes, but that they were not considered a major problem and therefore were not reported.

These accounts amply demonstrate that the same parasite prevalent a number of years ago still exists in the United States, although the incidence and prevalence is probably low. The potential exists, therefore, and when a break-

down in public hygiene or in sanitary disposal of human and animal excreta occurs, contamination of food with the infective stages of such parasites could follow. If this unsanitary condition were to go undetected, the affected food would be considered parasite-free, and the number of human infections could reach levels equal to or greater than those of the nineteen-twenties and thirties.

In order to assure that such developments will not occur, there must be a constant striving to maintain the proper perspective on existing and potential problems as they relate to human health and the total environment. And there must be constant communication among all agencies and personnel responsible for the wholesomeness of food used for human consumption.

In the United States, these agencies and personnel include various divisions of the U.S. Public Health Service (such as the Center for Disease Control, the Food and Drug Administration, and the Environmental Protection Agency), the Department of Agriculture (particularly the Quality Meat Control Division), the Department of the Interior (Bureau of Commercial Fisheries), the state public health departments, the medical and veterinary division of the armed forces, the United States Livestock Sanitary Association, food technologists, public health veterinarians, and medical and veterinary parasitologists of universities and

other institutions. Besides communicating at the professional level, activities of these groups must include education of the public at large and adequate surveillance and monitoring of the overall situation.

One measure that could be especially helpful is use of key sentinel animals to provide early detection. For instance, dogs could be used to monitor the prevalence of *E. histolytica* in human populations, since they are vulnerable to infection by this parasite but do not shed cysts

under conditions prevailing in the United States. In general, natural canine infections would reflect the prevalence of human infections as well as possible contamination of the environment by raw human excreta. They would thus help assure proper surveillance and monitoring, which—together with effective communication—are needed to minimize the potential hazards posed by undetected increases of parasitic infections or undetected introduction of exotic parasites.

SUMMARY

No part of the Americas is immune from the health threat posed by human parasites. Even where a particular parasite species is rare, a lowering of public health standards can quickly raise the rate of infection. And even in areas with good health conditions, many species not listed in official reports are likely to be present in small numbers.

For the most part human parasites are restricted to a relatively small choice of transmission "pathways" in going from one host to the next. This article discusses several of the more common pathways, as well as measures needed to help provide continuing high levels of protection for potentially vulnerable human populations.

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