CHAPTER 14

Zoonotic infections – an overview

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14.1 INTRODUCTION

Zoonotic infections can be defined as infections of animals that are naturally transmissible to humans. As such they are worldwide and often spread with humans through their companion and domestic animals. However, when humans move to new areas or come into contact with different animal species (eg moving into newly cleared natural forest areas), then new zoonoses may emerge or are recognised, and it is significant that many of the new or newly recognised emerging infections of humans are zoonotic in origin[1]. The probable reasons for the emergence of new zoonotic diseases are many and include, as described by McCarthy and Moore[2] for the Helminth zoonoses: "changes in social, dietary or cultural mores, environmental changes, and the improved recognition of heretofore neglected infections often coupled with an improved ability to diagnose infection". Zoonotic infections may be very localised in their distribution and often reflect particular associations between the natural reservoir hosts and humans – they are thus often influenced by human dietary habits, behaviour and relationships with different animal species.

For the practising physician, the knowledge that a disease is zoonotic, is of particular significance in the differential diagnosis (hence the need in all history taking, of asking the question of contact with animals), and in the prevention and control of such diseases.

A list of the more important/significant zoonotic infections is given in Table 1 which also outlines the aetiological agent of the disease; its usual animal reservoir host and rough geographical distribution. In some cases, where the vector may serve as a reservoir, it is included under reservoir hosts.

Succinct coverage of clinical and control aspects of these and many other communicable diseases are given by Chin[3] and Guerrant, Walker and Weller[4] while the foodborne parasitic zoonoses are covered by Goldsmid, Speare and Bettiol[5] and the problem of emerging helminth zoonoses is discussed by McCarthy and Moore.[2]

Further clinical and other more detailed information of many of the more important zoonotic infections can be found in Chin[3] and in the various specific chapters in this Primer, and thus most of the significant zoonotic infections of the tropics are covered in other chapters under the appropriate clinical category, but a few are worthy of further consideration here either because of their medical importance or because their basics and epidemiology may not fit anywhere else.

Table 14.1. Important zoonoses and potential zoonoses[2-14]

Disease	Aetiological agent	Reservoir (Vector)	Distribution
Actinomyces pyogenes abscess	*Actinomyces pyogenes*	Cattle	Widespread
Angiostrongyliais	*Angiostronylus cantonensis*	Rodents	Asia; Australia; Africa; America
Anisakiasis	*Anisakis* spp; *Pseudoterranova* spp *Contracaecum* spp	Porpoises; whales; sea lions; fish	Widespread
Anthrax	*Bacillus anthracis*	Cattle; sheep	World wide
Australian encephalitis	See Murray Valley Encephlitis		
Babesiosis	*Babesia* spp	Cattle; rodents (Ixodid tick)	Worldwide
Balantidiasis	*Balantidium coli*	Pigs; baboons	Worldwide
Baylisascariasis	*Baylisascaris* sp	Racoons; skunks	USA
Barmah Forest	Alphavirus	? Birds; mammals (Mosquitoes)	Australia
Bird mites	*Ornithonyssus* spp	Birds	Worldwide
Bovine spongiform Enceph.	Prion	Cattle	Widespread
Brucellosis	*Brucella* spp	Goats; cattle; pigs;seals	Worldwide
Bubonic plague	*Yersinia pestis*	Rodents (Flea)	Widespread
Calif. Enceph.	Bunyavirus	? Birds; ? mammals (Mosquitoes)	USA
Campylobacteriosis	*Campylobacter* spp	Mammals; birds	Worldwide
Capillariasis			
- hepatic	*C. hepatica*	Rats	Worldwide
- intestinal	*C. philippinensis*	Water birds	Asia; SE Asia; Egypt
- pulmonary	*C. aerophilia*	Cats	Worldwide
Capnocytophagosis	*Capnocytophaga canimorsus*	Dogs	Widespread
Vet. Caseous lymphadenitis	*Corynebacterium pseudotuberculosis*	Goats, sheep	Widespread
Cat-scratch disease	*Bartonella henselae*	Cats	World wide
Cercarial dermatitis	*Schistosoma* spp	Birds; rodents	World wide
Chikungunya	Alphavirus	Primates (Africa)	Africa; Asia;

		(Mosquito)	Philippines
Clonorchiasis	*Clonorchis* spp	Dogs; cats; pigs fish	Asian Pacific
Coccidiomycosis	*Coccidioides immitis*	Soil; mammals	West. Hemisphere
Coenuriasis	*Taenia multiceps*		
	T. serialis	Dogs	Widespread
Congo-Crimean Fever*	Nairovirus	Cattle; sheep; ostriches; (Ixodid tick)	Russia; China Africa; Mid East
Cowpox	Poxvirus	Cattle	Worldwide
Cryptococcosis	*Cryptococcus neoformans*	Birds; (Rivergums)	Worldwide
Cryptosporidiosis	*Cryptosporidium* spp	Many animal species	Worldwide
Cutaneous larva migrans	*Ancylostoma braziliense*; *A. caninum*	Dogs; cats	Worldwide
Dermatophilosis	*Dermatophilus congolensis*	Domestic stock	Worldwide
Dermatophytosis	Dermatophytes	Many mammals	Worldwide
Diphyllobothriasis	*Diphyllobothrium latum*	Fish eating mammals	Widespread
	D. pacificum	" ?	Japan; Peru
Dicrocoeliasis	*Dicrocoelium* spp	Herbivores	Worldwide
Diplogonoriasis	*Diplogonorus grandis*	?	Japan
Dirofilariasis			
- pulmonary;CNS	*Dirofilaria immitis*	Dogs (Mosquito)	Widespread
- subcutaneous	*Dirofilaria* spp	Dogs;cats (Mosquito)	Europe; Africa; Asia
Dog tapeworm	*Dipylidium caninum*	Dogs (Flea)	Worldwide
Dog whipworm	*Trichuris vulpes*	Dogs	Worldwide
E.Equine Enceph	Alphavirus	? Birds; ? mammals (Mosquito)	Americas
Ebola Fever*	Filovirus	Chimpanzees?	Tropical Africa
Echinostomiasis	*Echinostoma* spp	Rats; pigs	Asia; SE Asia; Russia
Ehrlichiosis	*Ehrlichia* spp	Dogs (Ixodid tick)	USA
Haemolytic uraemic syndrome	*Escherichia coli* O157	Meat	Worldwide
Viral encephalo-myocarditis	Picornavirus	Rodents	Widespread
Eosinophilic gastroenteritis	*Ancylostoma caninum*	Dogs	Australia
Epidemic Polyarthritis	See Ross River Infection		
Equine infectious anaemia	Retrovirus	Horses	Widespread

Erysipeloid	*Erysipelothrix rhusipathiae*	Pigs, birds, fish etc	Widespread
Fascioliasis	*Fasciola gigantica*	Sheep; bovines	Africa; Hawaii
	F. hepatica	Sheep; cattle	Widespread
Fasciolopsiasis	*Fasciolopsis buski*	Pigs	SE Asia; China; India
False hookworm	*Ternidens deminutus*	Baboons; monkeys	C. Africa,Mauritius; Comoros Is.
Gastrodisciasis	*Gastrodiscoides hominis*	Herbivores; pigs	India; SE Asia
Giardiasis	*Giardia duodenalis*	Mammals; birds	Worldwide
Glanders	*Pseudomonas mallei*	Horses	Asia; Mediterranean
Gnathostomiasis	*Gnathostom*a spp	Dogs; cats; pigs; fish; rodents	Asia; SE Asia Americas
Gongylonema infection	*Gongylonema pulchrum*	Ruminants (cockroaches)	Worldwide
Guanarito*	Arenavirus	Rodents	Venezuela
Halzoun	*Fasciola hepatica*	Cattle	Mid. East
Hantavirus*	Bunyavirus	Rodents	Worldwide
Haverhill Fever	See Rat-bite Fever		
Haycocknemiasis	*Haycocknema perplexum*	?Wallabies	Tasmania
Hendraviral disease	Paramyxovirus	Flying foxes	Australia
Heterophiasis	*Heterophyes* spp	Fish-eating mammals	Asian Pacific; Middle East
Histoplasmosis	*Histoplasma capsulatum*	Bats	Widespread
	H. duboisii	?	Tropical Africa
Hydatidosis	*Echinococcus granulosus*	Canids	Widespread
	E. multilocularis	Foxes	N. Hemisphere
	E. vogeli	Dogs	C/S America
Hymenolepiasis	*H. diminuta* (Mealworm)	Rodents	Worldwide
Influenza	Paramyxovirus	Birds; pigs	Worldwide
Jap. B. Enceph.	Flavivirus	Water birds; pigs (Mosquito)	Asia; Pacific; N.Australia
Johne's Disease	*Mycobacterium pseudotuberculosis*	Sheep	V. rare zoonosis
Junuin*	Arenavirus	Rodents	Argentina
Kennel cough	*Bordetella bronchiseptica*	Dogs	Worldwide
Kokobera infection	Flavivirus	Macropods, horses, Cattle (Ixodid ticks)	Australia
Kunjin infection	Flavivirus	Birds, mammals *Culex* mosquito)	Australia
Kyansanur Forest*	Flavivirus	Domestic stock; Monkeys; (Ixodid tick)	India
Lassa fever*	Arenavirus	Rodents	Tropical Africa
Lagocheilascariasis	*Lagocheilascaris minor*	Opossums	S. America

LCM	Arenavirus	Rodents	Worldwide
Leishmaniasis	*Leishmania* spp	Rodents; dogs (*Phlebotomus)*	Tropics
Leptospirosis	*Leptospira interrogans*	cattle; pigs;;rodents dogs	Worldwide
Listeriosis	*Listeria monocytogenes*	milk; cheeses Smoked fish; mussels	Worldwide
Louping Ill	Flavivirus	Sheep; deer (Ixodid tick)	UK; Europe
Lyme disease	*Borrelia burgdorferi*	Rodents; deer dogs; cattle; horses (Ixodid tick)	USA; Asia; Europe
Lymphatic filariasis	*Brugia malayi*	Dogs	SE Asia
Lyssavirus	Rhabdovirus	Flying foxes	Australia; Philippines
Machupo*	Arenairus	Rodents	Bolivia
Marburg*	Filovirus	?monkeys	Central Africa; ?Philippines
Melioidosis	*Burkholderia pseudomallei*	Soil; animal species	Tropics
Metagonimiasis	*Metagonimus* spp	Dogs; cats; pigs Sea birds; fish	Asian Pacific
Milker's nodes	Poxvirus	Cows	Worldwide
Monkey B virus	Herpes virus	monkeys	Widesprread
Monkeypox	Orthopox virus	monkeys	Central Africa
Monkey tapeworm	*Bertiella studeri*	monkeys? (mites?)	Africa; Asia; Latin America
Mouse piworm	*Syphacea obvelata*	Mice	Worldwide
Murine typhus	*Rickettsia typhi*	Rodents (Flea)	Widespread
Murray Valley Encephalitis	Flavivirus	Birds (Mosquito)	Australia; PNG
Nepah virus	Bunya virus	Flying foxes	SE Asia
Newcastle disease	Paramyxovirus	Fowls	V. rare zoonosis
Nodular worm	*Oesophagostomum* spp	Mammals	Worldwide
O'nyong-nyong	Alphavirus	? Birds;? mammals (Mosquito)	Africa
Opisthorchiasis	*Opisthorchis felineus*	Dogs; cats; pigs	E. Europe; Russia; India
Orf	Poxvirus	Sheep	Worldwide
Ornithosis	*Chlamydia psittaci*	Birds	Widespread
Paragonimiasis	*Paragonimus* spp	Fish eating mammals	Africa; Asia; Latin America
Parapox	See Orf (Contageous pustular dermatitis)		

Pasteurellosis	*Pasteurella multocida* *Pasteurella haemolytica*	Dogs; cats	Worldwide
Pentastomiasis	*Armillifer armillatus*	Snakes	
Widespread *Physaloptera* Infection	*Physaloptera* spp	Rodents,Baboons	Widespread
Pneumocystosis	*Pneumocystis carinii*	Cattle, dogs, rodents etc	Worldwide
Pustular dermatitis	See Orf		
Psittacosis	*Chlamydia psittaci*	Birds	Widespread
Q Fever	*Coxiella burnetii*	Cattle	Widespread
Rabies	Rhabdovirus	Mammals	Widespread
Rat bite fever	*Streptobacillus moniliformis*; *Spirillum* spp	Rats	Worldwide
Rat tapeworm	*Inermicapsifer madagascariensis*	Rodents (Africa) (Oribatid mites)	Africa; Cuba
Relapsing fever	*Borrelia recurrentis* (*B. duttonii*)	Rodents (Body louse; Argassid tick)	Africa; Asia;Spain; N/S America
Rhodococcosis	*Rhodococcus equi*	Horses	Widespread
Rift valley*	Phlebovirus	Sheep; cattle; goats (Mosquito)	Sub-Saharan Africa
Ross River	Alphavirus	Wild vertebrates (Mosquito)	Australia; S. Pacific
Salmonellosis	Non-typhoidal salmonellae	Many animals	Worldwide
Sarcosporidiosis	*Sarcocystis* spp	Pigs, cattle	Worldwide
SARS	Coronavirus	? Civet cats	China
Schistosomiasis	*Schistosoma mattheei*	Cattle (Snail)	Africa
	S. margrebowei	Antelope (Snail)	Africa
	S. bovis	Cattle (Snail)	Africa
	S. japonicum	Rodents (Snail)	Asia; SE Asia
Scrub typhus	*Orientia tsutsugamushi*	Rodents (Animal mites)	Asia; SE Asia; Australia
Sindbis	Alphavirus	Birds (Mosquito)	Africa; Asia; SE Asia; Europe;Philippines
Sparganosis	*Diphyllobothrium* spp	Fish; amphibians	Widespread

Spirocerca infection	*Spirocerca lupi*	Dog (beetle)	V. rare zoonosis
Spotted fevers	*Rickettsia* spp	Wild mammals (Ixodid tick)	Widespread
St Louis Enceph.	Flavivirus	? Birds; ? mammals (Mosquito)	Americas
Taeniasis	*Taenia asiatica*	Pigs	Taiwan
	T. saginata	Cattle	Worldwide
	T. solium	Pigs	Widespread
	T. taeniaeformis	Cats	V. rare zoonosis
Thorny-headed worm infection	*Macracanthorhynchus hirudinaceus*	Pigs	E. Europe;Thailand ?Brazil
	Moniliformis moniliformis	Rats	Worldwide
Tick borne enceph	Flavivirus	Small mammal; (Ixodid tick)	Europe; Asia
Toxocariasis	*Toxocara* spp	Dogs; cats	Worldwide
Toxoplasmosis	*Toxoplasma gondii*	Cats; meat mammals	Worldwide
Trichinellosis	*Trichinella spiralis*	Mammals	Widespread
	T. nativa	Bears; foxes	Arctic
	T. nelsoni	Wild carnivores; wild pigs	Africa
	T. pseudospiralis	Mammals; birds	Worldwide
Trichostrongyliasi	*Trichostrongylus* spp	Herbivores	Worldwide
Trichuriasis	*Trichuris vulpes*	Dogs	Worldwide
(animal whipworm)	*T. suis*	Pigs	Worldwide
Trypanosomiasis	*Trypanosoma cruzi*	Wild mammals (Reduviid bugs)	Latin America
	T.b. gambiense	Pigs (Tsetse fly)	W. Africa
	T.b. rhodesiense	Antelope (Tsetse fly)	E. Africa
Tuberculosis (bovine)	*Mycobacterium bovis*	Cattle; seals	Worldwide
Tularemia	*Francisella tularensis*	Rodents; lagomorphs (Ixodid tick)	W. Hemisphere
Venez. Equine. Enceph.	Alphavirus	Small mammals (Mosquito)	Americas
Vibriosis	*Vibrio parahaemolyticus*	Seafood (Shellfish)	Worldwide
Visceral larva migrans	*Baylisascaris* spp	Wild mammals	USA
	Toxocara spp	Dogs; cats	Worldwide
West Nile	Flavivirus	Birds	Africa; India; USA;

		(Mosquito)	Mid. East, Europe
West. equine enceph.	Alphavirus	Small mammals (Mosquito)	Americas
Yellow Fever*	Flavivirus	Monkeys;) (Mosquito)	C. Africa; Latin America
Yersiniosis	*Yersinia enterocolitica*	Pigs; rodents	Worldwide
	Yersinia pseudotuberculosis	Birds; mammals	Worldwide

* Haemorrhagic Fevers

14.2 VIRAL ZOONOTIC INFECTIONS

Recent emergence of such conditions as bovine spongiform encephalopathy due to beef ingestion has alerted the medical profession to the dangers to humans of poor animal husbandry practices (eg feeding meat offal waste to cattle). Initially these Creutzfelt-Jacob organisms were believed to be "small" viruses but it is now known that they are abnormal proteins – sometimes termed "prions"[15]

Rabies infects all mammal species and is present on all continents (but not all countries) except Australia and Antarctica. The lyssavirus is a rhabdovirus related to rabies which has been found in Australia and the Philippines infecting fruit-eating bats (flying foxes)[13]. People at risk are mainly those handling the bats in whom infection may result from a scratch or bite - a number of human cases have been recorded from Australia. As in rabies, there is no specific treatment other than supportive treatment but lyssavirus infection can be prevented using the available rabies vaccines for people potentially exposed to infection. Immunization for rabies must be started prior to the development of symptoms, with the incubation period varying between 3-8 weeks, but sometimes extending to 7 years[3]. Pre-exposure, prophylactic immunisation may be desirable for animal handlers (including bat-handlers in Australia).

Cercopithecine virus 1 is a herpes virus of monkeys which can infect exposed humans – particularly following a monkey bite. It is a sporadic but widespread threat to humans in contact with monkeys – especially stressed monkeys. The infection is known as monkey (or Simian) virus B infection.

There are many haemorrhagic viral infections world-wide[3,4] and they can be harboured by a range of mammal and bird species. Although the clinical picture of haemorrhagic fevers vary depending on the virus involved, most present with fever, extensive haemorrhaging and some degree of pulmonary involvement. The presence of a rash, jaundice, renal involvement and encephalopathy are more variable.[4.] Some are spread by insect or tick vectors, others from contact with the normal host or its urine. In some of these viruses, infection may spread from person to person through skin contact or from body fluids or faeces. These infections are usually sporadic but large outbreaks may

occur at times - thus significant hospital outbreaks have occurred in Africa from Ebola. Viral haemorrhagic fevers have no specific treatment and in most cases there are no effective vaccines for prevention.

14.3 BACTERIAL ZOONOTIC INFECTIONS

Lyme disease is worth mention, although it does not appear to have been commonly found in the tropics. Main foci of infection seem to be North America, Europe, China and Japan.. It has been reported from North Africa[6] but it's occurrence as an endemic infection in Australia[6] has been the subject of some debate. The natural reservoirs of Lyme Disease are rodents and deer and it is transmitted by such Ixodid ticks as *Ixodes scapularis* (= *damminii*) (USA), *I. persulcatus* (Asia) and *I.. ricinus* (Europe)[3]. The aetiological agents of Lyme disease are the spirochaetes *Borrelia burgdorferi, B. garinii* and *B. afzelii*. It presents with flu-like symptoms, typical skin lesion(s) termed an erythema chronicum migrans (ECM) lesion and may go on to develop neurological or cardiac features and even an aseptic meningitis.[3]

While tetanus is always to be considered following an animal bite, bacterial zoonoses following animal bites and of world-wide distribution, include infections with *Pasteurella multocida*, *P. haemolytica*, and cat scratch fever (*Bartonella henselae*). In the immunocompromised, infection with *Capnocytophaga canimorsus* (CDC Group DF-2) from a dog or cat bite, lick or scratch can lead to septicaemia.[3]

Other important bacterial zoonoses which remain problems in many tropical and Third World countries include brucellosis (often presenting as a PUO) and bovine tuberculosis – often contracted from unpasteurised dairy products, also a source of listeriosis. Seals may also serve as a source of infection with brucellosis and tuberculosis to seal handlers[10]. Of particular importance to farmers, veterinarians and abattoir workers are Q fever (*Coxiella burnetii*) and anthrax (*Bacillus anthracis*). The latter has received much publicity of late due to its potential as a biological warfare/terrorism agent, enhanced by having long-lived, resistant spores and by its high level of pathogenicity. Anthrax has a significant mortality and clinical presentation depends on the mode of transmission. If spores are inhaled, pulmonary anthrax (Woolsorter's disease) can result, while entry through the skin results in malignant pustule and ingestion causes intestinal anthrax. All can lead rapidly to septicaemia and death.

Leptospirosis is another bacterial zoonosis of worldwide distribution. Various serovars of *Leptospira interrogans* infect humans. In tropical regions, the severe Weil's disease is caused by *L. icterohaemorrhagiae* - carried by rodents and passed in their urine onto soil, water etc with humans being infected through the skin. Weil's disease may present with fever, jaundice, haemorrhages into the conjunctivae and renal failure and is a major hazard for banana farmers and sugar cane workers. Severe leptospirosis outbreaks have also been recorded in army personnel and water sport enthusiasts (e.g. rafters). In temperate regions, leptospirosis tends to present as a flu-like illness in dairy farmers,

veterinarians and abattoir workers due to such serovars as *L. hardjo*. *L. canicola* from dogs may also infect humans and, like many leptospires may cause aseptic meningitis.

The spotted fevers and tick bite fevers (tick typhus) are all rickettsial diseases harboured in a wide range of mammals, including marsupials. In Australia, the species known to be involved in spotted fevers is extending rapidly[10] and, as well as *Rickettsia australis*, (the cause of Queensland Tick Typhus), include *Rickettsia honei* (the cause of Flinders Island Spotted Fever) and the newly described species of *Rickettsia marmionii*, the cause of Australian Spotted Fever). All the spotted fevers are transmitted by ixodid ticks[16] as is the related but more severe Rocky Mountain Spotted fever (*R. rickettsii*). *R. honei* seems unusual in that it is harboured by blue tongue lizards and transmitted by the lizard/snake tick, *Aponomma hydrosauri*[17] Murine typhus (*R. typhi*) is carried by rodents and transmitted by *Xenopsylla* fleas while *Orientia tsutsugamushi*, the cause of Scrub typhus in tropical Australia, SE Asia and Asia, is transmitted from rodents to humans by the mite, *Leptotrombidium*. Other rickettsial organisms from animals that cause disease in humans are *Ehrlichia chaffensis* (USA), *E.sennetsu* (Senetsu fever in Japan) and *E. canis* which cause ehrlichiosis an acute febrile illness and probably all transmitted by ixodid ticks[3].

Worldwide, human infection with Enterohaemorrhagic *Escherichia coli* (EHEC) due to *Esch. coli* O157 and other serotypes of this pathotype have caused human infection related to poor meat preparation and hygiene (eg in sausages). This *Esch. coli* pathotype can cause a serious bloody diarrhoea and can progress to the often fatal, haemorrhagic uraemic syndrome.

14.4 MYCOTIC ZOONOTIC INFECTIONS

Probably, the best known mycotic zoonoses are the ringworms, causing tinea – a condition due to infection with moulds belonging to the dermatophyte genera *Microsporum*, *Trichophyton* or *Epidermophyton.*[3,8,9] While some derive from human hosts (e.g. *Microsporum rubrum; M. audouini)*) or soil (*M. gypseum*) most dermatophyte species of the genera *Microsporum* and *Trichophyton* are zoonotic from a large number of domestic (e.g. cattle; horses), companion (eg dogs; cats) and wild mammal sources. Probably the commonest species on a worldwide basis is *M. canis* contracted from puppies or kittens and which infects prepubertal children. The basic clinical features of all ringworm species are essentially the same as is the diagnosis and treatment. However, a knowledge as to the species involved will tell the physician whether it is anthropophilic (from a human source) geophilic (from soil) or zoophilic (from an animal source) and in many cases from which animal species – this information can be essential in controlling an outbreak of tinea.

Other mycotic infections which originate from an animal source include cryptococcosis[12] (*Cryptococcus neoformans* – a yeast*)* from inhalation of bird droppings (e.g. pigeons); histoplasmosis (*Histoplasma capsulatum* – a dimorphic fungus) from inhalation of bat droppings in caves.

14.5 PROTOZON ZOONOTIC INFECTIONS

Important protozoan zoonotic infections include the human trypanosomiases. The African forms (*Trypanosoma brucei rhodesiense* and *T. b. gambiense* are transmitted by the bite of the tsetsefly (*Glossina* spp) while the South American form (Chagas' disease, due to *T. cruzi*) is transmitted by triatomid bugs. Human trypanosomiasis has recently been reviewed in detail by Hyde[19] and by Maudlin, Holmes and Miles[20] This latter monograph, together with the older monograph by Hoare[21] provide valuable and detailed coverage of all aspects of these important zoonoses – the latter concentrating on the trypanosomes rather than the disease as covered in the former volume.

Toxoplasmosis is a worldwide zoonosis. Clinical features of toxoplasmosis due to the protozoan, *Toxoplasma gondii*, are covered in other relevant chapters. This zoonotic infection is virtually world-wide in distribution. The cat is the definitive host, harbouring the parasite in the gut and shedding oocysts with the faeces for transmission by the oral route, to other cats to complete the life cycle. When the oocysts are ingested by rodents, birds, pigs, sheep and to a lesser extent cattle, these and a range of wild mammals including marsupials, can serve as intermediate hosts, harbouring tissue cysts in their tissues[5]. When eaten by a cat, an intestinal infection develops in the cat with oocyst excretion as before[7]. Unfortunately, if humans ingest the cat oocysts with contaminated water or salad plants, ingested meat infected with tissue cysts of *Toxoplasma*, (or rarely from oocysts on the cat's fur[22]), then they can become infected[6], tissue cysts developing in the tissue (muscles, CNS etc). Most infected humans show no, or very mild flu-like, clinical disease the evidence of infection being seroconversion. Thus world-wide, antibody positivity in humans to *Toxoplasma* varies from 20-98%. When the infection does become symptomatic, the commonest presentation is as a self-limiting Glandular Fever Syndrome (See Chapter 6).

In immunocompromised patients, however, toxoplasmosis may result in severe or even fatal disease, due to complications such as myocarditis or encephalitis[6]. Also serious is when a pregnant female who has never been previously exposed to *Toxoplasma*, acquires the infection. Under these circumstances, transplacental infection of the foetus may result even if the mother shows no signs or symptoms of disease[7]. The earlier in pregnancy foetal infection occurs, the more severe the consequences, the later in pregnancy, the higher the infection rate, but the milder the foetal damage. Clinical features in transplacental toxoplasmosis include intrauterine death and abortion, mental retardation, blindness, intracerebral calcification, convulsions, hydrocephaly, microphthalmia. Prevention consists of washing hands after handling cats or their litter trays, care that water is not contaminated with cat faeces, washing and peeling salad plants and finally, and most importantly, adequate cooking of meat to kill tissue cysts.

14.6 HELMINTHIC ZOONOTIC INFECTIONS

Helminth infections of animal origin are common worldwide and the book on zoonotic helminthic infections in Africa edited by Macpherson and Craig[23] gives an excellent

overview of the importance of such infections in a tropical environment. Over the past few years, over thirty new / emerging helminthic zoonoses or probable zoonoses have been identified by McCarthy and Moore[2] and additionally, some new species have emerged or been identified as infecting humans - *Meningonema peruzzi* in Zimbabwe; *Haycocknema perplexum* and *Trichinella pseudospiralis* in Tasmania;[5] *Taenia saginata asiatica* in SE Asia.

Human infection with these zoonotic helminths may result from ingesting food as discussed by Goldsmid, Speare and Bettiol.[5] This food may be meat containing the parasite (taeniasis; trichinosis); fish (diphyllobothriasis; *Diplogonorus granidis*; clonorchiasis; anisakiasis); invertebrates (paragonimiasis; angiostrogyliasis) or ingestion of the infective stage of the worm with contaminated soil (toxocariasis; hydatid) water or salad plants (fascioliasis; fasciolopsiasis; hydatid; toxocariasis); skin contact with contaminated soil / water containing active infective larvae and subsequent skin penetration (cutaneous larva migrans; cercarial dermatitis); from direct animal contact (hydatid; toxocariasis) or through insect vectors/intermediate hosts by ingestion (dipylidiasis; *Hymenolepis diminuta* or *Inermicapsifer* infection) or injection by a mosquito (dirofilariasis; *Brugia* infection).

14.7 ZOONOTIC ARTHROPOD INFESTATIONS

Some arthropod ectoparasites of animals can infest humans. Thus parasitic mites from companion animals, rodents and birds (eg *Cheyletiella* spp; *Dermanyssus* spp and *Ornithonyssus* spp) are quite frequently reported as biting humans – often resulting in the development of severe and extensive allergic rashes. Strains of *Sarcoptes scabiei* from companion or even wild animals, can also occasionally infest humans.

Myiasis due to *Cordylobia anthropophaga* (the Putsi or Tumbu fly) in Africa and *Dermatobia hominis* in Latin America are other zoonotic arthropod infections of humans which are being increasingly reported in travellers and refugees from these areas and the same applies to *Tunga penetrans* (the Jigger Flea) from Latin America, tropical Africa and India.

It is worth noting here, however, that lice are very host specific and thus animal lice do not attack humans (and *vice versa*). Ticks, however, are mostly not very host specific, and thus they may often attack humans, some species causing tick paralysis and many species transmitting viral, bacterial and protozoan diseases of animals to humans (See Chapter 14 for detail).

14.8 CONTROL OF ZOONOTIC INFECTIONS

Control methods for zoonotic infections may target the human host (treatment; immunization); insect, tick or mite vectors (repellents; insect sterilization; insect traps; insecticidal sprays; bed nets; naturalistic methods such as drainage; vegetation clearing;

biological control methods using bacteria or viruses pathogenic for the vector) or the animal reservoir (treatment; elimination; immunization). Control of foodborne parasitic zoonotic infections is discussed by Goldsmid, Speare and Bettiol[4] and the topic is extended in a number of other chapters in the book edited by Hocking which contains this paper.

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