Published in final edited form as:

Int J Parasitol. 2008 September ; 38(11): 1209–1210. doi:10.1016/j.ijpara.2008.05.005.

Zoonotic Parasitic Diseases: Emerging issues and Problems

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Several hundred infectious diseases are classified as zoonotic diseases as they are caused by bacteria, virus, fungi or parasites that can be transmitted from animals to humans. These zoonotic diseases include many of the classic infectious diseases such as rabies and rickettsia (e.g. Rocky Mountain Spotted Fever), as well as most of the “new” emerging infectious diseases such as HIV, Lyme, SARS, Ehrlichiosis and Nipah virus. Zoonotic infections can be significant pathogens, with a more severe outcome, in patients with various forms of immune suppression due to infection, i.e. HIV, or immune suppressive drugs, i.e. monoclonal antibodies to TNF α . A number of parasitic zoonoses such as cryptosporidiosis, toxoplasmosis and leishmaniasis have gained in importance as human pathogens due to their ability to cause disease in patients with immune suppression due to HIV. The majority of the classic parasitic diseases due to helminthes, trematodes, cestodes, pentastomids and protozoa are zoonotic (Krauss et. al., 2003).

There are increasing numbers of cases of zoonotic infections being recognized. A number of factors underlie this emergence of zoonotic disease including overpopulation, disruptions due to military action, mass migrations of populations due to natural or man-made disasters, the migration of populations into large urban centers, and inadequate food and water supplies. The clearing of new areas for the cultivation of food and other land uses has resulted in human settlement in areas where animal populations and parasites were previously isolated from humans (Chomel et al, 2007). In addition, displacement and stress of wildlife through development as well as global warming (Hoberg, et. al. 2008) can lead to epidemics of wildlife disease with resultant overflow infections into domestic animals and humans as well as bring additional zoonotic infections into contact with human hosts. The use of bushmeat as a food source has been linked to the emergence of several zoonotic diseases such as SARS and HIV (Van Heuverswyn and Peeters, 2007; Wolfe et al., 2005). Worldwide tourism and adventure travel has resulted in the exposure of new groups to “exotic” zoonotic pathogens. The popularity of exotic pets has resulted in several reports of zoonotic infections, such as human Monkeypox transmission linked to Prairie dogs which were infected due to exposure to an exotic rodent while being housed at an animal dealer’s facility (Centers for Disease Control and Prevention, 2003). Advances in medical progress such as xenotransplantation or the use of various animal cells in the production of therapeutic agents has the potential to result in the emergence of new zoonotic infections. Both organ transplantation and blood transfusion have been associated with the transmission of zoonotic infections such as Leishmaniasis and *Trypanosoma cruzi* due to these infections being present in donors. This issue of the International Journal for Parasitology includes a special series of review articles on emerging zoonotic diseases due to parasites.

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As pointed out in Dr. Chomel's (2008) article on emerging parasitic zoonoses, emerging infectious diseases are dominated by zoonoses and the majority of these infections originate in wildlife. While protozoa are more likely to account for emerging parasitic infections, there are clear examples of metazoan infections as emerging or re-emerging diseases. Interactions of wildlife and human populations often drive this process as illustrated by the increase in *Echinococcus multilocularis* in Europe as a consequence of control of rabies in the red fox population leading to an increase in these animals in urban centers. The fox population may also play a role in increased exposure to *Toxocara canis* and other parasites. Control and prevention of these zoonotic diseases is complex and requires an integrative multidisciplinary approach grounded in careful epidemiological studies understanding the variables that influence disease emergence and transmission. For example, culling of infected dogs does not reduce the risk of human infection from *Leishmania*, but providing insecticide collars has been demonstrated to be an effective strategy (Gavvani et al., 2002).

Drs. Hunfeld, Hildebrandt and Gray (2008) provide a comprehensive review of the phylogeny and biology of *Babesia* spp. These *Ixodid* tick-borne zoonotic infectious diseases associated with infection of erythrocytes resulting in cell lysis leading to anemia, hyperbilirubinuria, hemoglobinuria and other disease manifestations. There are over 100 *Babesia* spp. that have been recognized, infecting many mammalian and some avian species (Gray and Weiss, 2008), of these the *Babesia microti* complex, *Babesia divergens*, *Babesia bovis*, *Babesia canis*, *Babesia duncani*, *Babesia enatorum* and *Babesia* sp. KO1 have been associated with human disease. Blood transfusion has been recognized as an increasing source of transmission and immune compromised patients have been demonstrated to have persistent infections with non-classical presentations. Increases in wildlife animal reservoirs and the expansion of urban environments into undeveloped areas have resulted in increases in these illnesses and the recognition of new species of *Babesia* that can infect humans.

Drs. Fayer and Xiao (2008) provide a comprehensive review of the species and genotypes of *Cryptosporidium* and *Giardia* as they relate to the zoonotic potential of these pathogenic protozoa. *Cryptosporidium* oocysts are often found in water supplies and molecular studies have been applied to allow species recognition, enabling studies of the zoonotic potential of the 18 *Cryptosporidium* spp. currently recognized. Host-adapted genotypes of various *Cryptosporidium* spp. have been described and characterized. Of these, *Cryptosporidium parvum* has a broad host range and molecular studies suggest zoonotic human transmission occurs. In contrast, studies on *Giardia* have suggested that zoonotic transmission is not as common as previously suggested. Overall, they point out the utility of molecular epidemiological tools in dissecting the presence of anthroponotic as well as zoonotic transmission of these parasites.

Drs. Dubey and Jones (2008) discuss the epidemiology of *Toxoplasma gondii* infection in animals and humans in the United States of America. It has been 100 years since the discovery of this pathogenic protozoan associated with infections in both immune competent and immune compromised hosts. It is one of the most ubiquitous zoonotic infections being transmitted through meat via tissue cysts containing bradyzoites and through the contamination of both food and water by oocysts shed by cats. Overall, there has been a decrease in the seroprevalence of this infection in the USA over the last 20 years, most likely associated with changes in food production and consumption. *Toxoplasma gondii* can be divided into three main lineages, types I, II and III, but it has become evident in recent years that zoonotic strains may have atypical types and that these new genotypes can be associated with unexpected disease manifestations (Darde et al 2007). Human and domestic animal diseases can have a profound effect on wildlife populations. An excellent example of this is the ongoing outbreak of *T. gondii* in southern sea otters due to freshwater runoff from urban centers (Miller, et al., 2004).

Given the complex relationships between humans, domestic animals and wildlife, as well as the profound alternations in the environment due to human interventions, we can expect to see changes in the epidemiology of zoonotic parasitic infections with increasing importance being paid to the emergence of these zoonotic infections. Control strategies for these emerging infections will require the use of molecular techniques and traditional epidemiological investigations to define the problem, and management strategies that will be effective for these infections.

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