Journal of the Egyptian Society of Parasitology, Vol.43, No.2, August 2013
J. Egypt. Soc. Parasitol., 43(2), 2013: 429 – 446

ZOONOSES FROM CATS: WITH SPECIAL REFERENCE TO EGYPT

By
ABDEL-HAMEED A. SABRY[1*], MAHMOUD A. H. FOUAD[2] AND AYMAN T. A. MORSY[3]
Faculty of Medicine, Al-Fayoum University, Al-Fayoum[1] (*President, Al-Fayoum University), and Department of Medical Microbiology and Parasitology, Faculty of Medicine, King Abdulaziz University[2], Jeddah, Saudi Arabia, and Tropical Medicine Unit, The Ministry of Interior Hospitals[3], Cairo, Egypt

Abstract

A zoonosis is an animal disease that is transmissible to humans. Humans are usually an accidental host that acquires disease through close contact with an infected animal, who may or may not be symptomatic. Children are at highest risk for infection because they are more likely to have close contact with pets. Cats are responsible for transmission of an extensive array of bacterial, fungal, and parasitic zoonotic pathogens. The route of transmission can be through the saliva (e.g., bites or contaminated scratches), feces, respiratory secretions, direct contact, or by the cat acting as a vehicle and source of tick or flea exposure.

Although cats have been implicated in transmission of zoonosis to their owners, risk of transmission from contact with cats is low and may be further reduced by simple precautions. There is a need for education on zoonotic disease prevention practices for pet-owning households with individuals at higher risk of infection, and to educate future veterinarians during their early years in veterinary school about the risks associated with their future jobs. Also, zoonotic disease awareness training is a valuable service to animal shelter workers.

Key words: Cats, zoonosis, Prevention, Egypt.

Introduction

A zoonosis is an animal disease that is transmissible to humans. Humans are usually an accidental host that acquires disease through close contact with an infected animal, who may or may not be symptomatic (Parslow and Jorm, 2003). The pets whether dog, cat or others serve valuable social roles in society. Pets may lower blood pressure, reduce cholesterol and triglyceride levels, and improve feelings of loneliness, while increasing opportunities for exercise, outdoor activities, and socialization (Chomel and Sun, 2011)

In a small, randomized, controlled study of 28 patients with chronic age-related disabilities living in a nursing home, patients were randomly assigned to animal interaction compared with usual activities (control group). The pet therapy group patients had improved symptoms of depression and a significant decrease in blood pressure values as compared with the control patients (Stasi *et al*, 2004). Despite these bene-

fits, pets present zoonotic risks, especially for immunocompromised hosts. The epidemiology of pet-related zoonoses other than cats is well documented (Trevejo *et al*, 2005).

Incidence:

The American Pet Association estimates that there are 77 million cats in the United States (www.apapets.org/petstats2.htm). The most common route of infection related to cat contact is through bites and scratches, especially in children.

Cats can harbor many of the same infections as dogs. In addition, cats may transmit zoonoses specific to felines, such as cat-scratch disease, toxoplasmosis, and *Sporothrix schenckii* infections.

Risk Factors:

Clinicians should ask about pets when taking a medical history and formulating a differential diagnosis. Many of the risks posed by pet ownership can be reduced by good hygiene after handling pets, careful pet selection, and proper pet care. New pets can pose more of a health risk because health history and vaccination records may not be known. Adult pets are generally safer than younger animals, since they are less likely to be involved in playful activities that include scratching and biting. Children are at highest risk for infection because they are more likely to have close contact with pets.

Transmission: Cats are responsible for transmission of an extensive array of bacterial and parasitic zoonotic pathogens. Many different routes of transmission can cause infections related to pets including: Infectious saliva that contaminate bite wounds, skin abrasions, or mucous membranes The hand-to-mouth transfer of microorganisms, cysts, or oocysts (eggs) from feces of an infected animal Aerosol from body fluids (e.g., respiratory secretions, placenta) Tick or flea bites when these vectors are carried into the home by pets Direct contact with an infected cat

I- **Infectious saliva:** Saliva can transmit and contaminate bite wounds, skin abrasions, or mucous membranes. Cat bites are particularly problematic in that the cat's teeth are slender and sharp and can produce the deep puncture wounds. Because of the penetrating capabilities of the teeth, contamination of bone and joint can occur and result in osteomyelitis or septic arthritis; infection complicates cat bites in about 50% of cases (Anderson and Neuman, 1997).

Bartonella henselae: The etiologic agent of cat scratch disease (CSD) can cause disease in both normal and immunocompromised hosts. However, 80% of cases occur in children, with a peak in the incidence of cases between ages 2 and 14 years. In the United States, approximately 40 percent of cats have serologic evidence of past or current *B. henselae* infection (Chomel *et al*, 1995). However, incidence in cats varies geographically, in one study of 255 cats in Northern California, *B. henselae* bacteremia was documented in 56 and 34% of cats less than one year and at least one year of age, respectively. Individual reports from numerous countries suggest a worldwide distribution. Infection in cats, including

bacteremia, is asymptomatic. Preliminary data suggested that asymptomatic bacteremia in cats can be successfully treated with antibiotics, this practice is not recommended. CSD can result from a cat scratch or bite, as well as possibly from a fleabite. CSD is more likely to be transmitted by kittens than adult cats, as kittens are more likely to be bacteremic (Koehler *et al*, 1994). Human CSD most often presents as a localized cutaneous and lymph node disorder near the site of organism inoculation. In some individuals, the organisms disseminate and infect the liver, spleen, eye, or central nervous system.

Pasteurella multocida: Cats are the source of infection in 60 to 80 percent of human *P. multocida* infections (Talan *et al*, 1999). P. multocida are commensals in the upper respiratory tracts of >90% of felines and are the major pathogen causing infection as a result of a cat bite (Hirsh *et al*, 2004). *Pasteurella* are found worldwide. Both healthy (eg, cats and dogs) and diseased (eg, rabbits) wild and domestic animals are the main reservoirs for the organism. *Pasteurella* infection is most often secondary to a bite or scratch from a cat, although a lick has also caused infection. *Pasteurella* can cause serious soft-tissue infections and less commonly septic arthritis, osteomyelitis, sepsis, and meningitis particularly in infants and other immunocompromised hosts (Ashley *et al*, 2004).

Rabies: Rabies is a fatal disease in cats. In the United States in 2004, of 7170 cases in nonhuman animals, 281 (4.1%) cases occurred in cats. Human rabies is rare in the United States, with only 47 cases reported between 1990 and 2005 (Krebs *et al*, 2005). However, rabies should be considered in the differential diagnosis of patients presenting with acute progressive encephalitis regardless of a history of an animal bite. Because of the nonspecific early symptoms, other more common infectious and noninfectious disorders (e.g., encephalitis caused by arboviruses or enterovirus and Guillain-Barré syndrome or vasculitis) should be ruled out (show algorithm).

***Capnocytophaga*:** It was first isolated in 1976 from the blood and CSF of a patient who had received a dog bite (Bobo and Newton, 1976). Although more commonly associated with dog bites, *C. canimorsus* (formerly CDC group DF-2) is a fastidious, gram-negative rod that forms part of the normal oral flora of dogs and cats. Human infection with two species, *C. canimorsus* and *C. cynodegmi*, can follow a cat bite or scratch (McLean *et al*, 2004). *C. canimorsus* can cause fulminant sepsis and meningitis, particularly in asplenic patients or alcoholics. Human corneal infection with *C. canimorsus* has occurred following eye trauma due to a cat bite (Chodosh, 2001).

Tularemia: Tularemia is a zoonosis caused by the gram-negative bacterium, *Francisella tularensis*. Cats may develop potentially fatal infection (Woods *et al*, 1998). Humans are accidental hosts following contact with infected animals or vectors. In the United States, tularemia has been reported from all 49 continental states, but the majority of cases occur in the south central states, mainly Arkansas,

Missouri, and Oklahoma. Vector-borne disease, especially by ticks, is the most common way the disease is transmitted in the United States. The rare transmission of tularemia from a cat bite has been reported, patients presented with the abrupt onset of fever, chills, headache, and malaise, after an incubation period of 2 to 10 days (Arav-Boger, 2000).

Cowpox: Despite its name, domestic cats, not cattle, are the most commonly reported source of human cowpox infection; wild rodents are thought to be the principal reservoir of infection (Baxby *et al*, 1994). In cats, ulcerated, crusted focal skin lesions can occur, sometimes with mild systemic illness and concurrent oral lesions; young or immunosuppressed animals may develop severe systemic illness (Godfrey *et al*, 2004). Transmission of cowpox from a domestic cat to a human was first reported in 1985, but cases are still observed, mainly in European countries (Haenssle *et al*, 2006). In humans, cowpox is an uncommon and probably underdiagnosed infection that may mimic anthrax with its painful, hemorrhagic pustules or black eschars (Lawn *et al*, 2003).

II- Fecal transmission: Common zoonotic pathogens causing feline gastroenteritis include *Salmonella, Campylobacter, Cryptosporidium* and *Giardia*; cats with diarrhea should have a stool specimen examined for these pathogens. In addition, numerous parasitic diseases can be transmitted from cats to humans through feces, including toxocariasis, cutaneous larva migrans (e.g., *Ancylostoma braziliense*), echinococcosis, and toxoplasmosis (Davis *et al*, 2012).

Salmonella: Although most cases of salmonellosis in humans are due to foodborne illness, salmonellosis may also be transmitted from contact with animals, such as turtles and lizards. Contact with cats is an uncommon way that humans get salmonellosis. An *S. typhimurium* outbreak associated with a veterinary clinic in New York State identified seven human cases and a case in a diabetic cat. The cat had chronic intermittent diarrhea attributed to diabetes-related dietary changes and, in retrospect, may have contaminated the clinic. *Salmonella* spp. infections transmitted to humans usually result in the mild, self-limiting gastroenteritis. However, severe invasive illness, such as septicemia or meningitis, can occur especially in infants and immunocompromised persons (Friedman *et al*, 1998).

***Campylobacter* species:** Like salmonellosis the mode of transmission of Campylobacter infection is most often foodborne. However, in a substantial proportion of Campylobacter cases the source of infection is unknown. In a survey of 218 human cases of infection that identified the source, 6 percent were due to exposure to an animal with diarrhea (Saeed *et al*, 1993). (Direct zoonotic transmission of Campylobacter from contact with infected cats and kittens has been documented. A microbiologic survey of 152 cats found 37 (24%) positive for *Campylobacter* organisms in three private veterinary clinics and an animal shelter in Minnesota; carriage was higher in cats ≤ 1

year old compared with those >1 year (30 versus 3%). There was no correlation between positive cultures and clinical disease. The median duration of carriage was 44 days for nine cats surveyed. Campylobacter enteritis in humans presents after an incubation period of one to seven days as a syndrome most commonly characterized by the prominent abdominal pain and profuse diarrhea that is often bloody (Bender *et al*, 2005).

***Cryptosporidium*:** Cryptosporidium is an intracellular protozoan parasite that is associated with gastrointestinal diseases in all classes of vertebrates including mammals, reptiles, birds, and fish. Infected cats are asymptomatic or have a mild gastroenteritis. Fecal shedding of *Cryptosporidium* spp. in cats ranges from 1 to 8 % (Nutter *et al*, 2004). *Cryptosporidium* infection in immunocompetent individuals has a variable presentation, it can be asymptomatic, cause a self-limited gastroenteritis (usually resolving in 10 to 14 days without treatment), or can cause more severe diarrhea. In immunocompromised hosts, the illness is more frequently protracted and severe, and can lead to significant malabsorption and weight loss. *Cryptosporidium parvum* and *C. hominis* are the usual pathogens in humans; immunocompromised hosts can also be infected by other *Cryptosporidium* spp. (Eligio-Garcia *et al*, 2005)

Giardia lamblia: Also known as *G. duodenalis* or *G. intestinalis,* is a flagellated protozoan parasite and one of the most common gastrointestinal parasites in the United States. Water is the major source for the endemic or epidemic spread of giardiasis. However, there is some evidence supporting the zoonotic transmission of Giardia, with the greatest risk from pets, especially dogs and cats. The spectrum of clinical disease includes asymptomatic infection, self-limited acute giardiasis, and chronic infection (Thompson, 2004).

Toxocara cati: Cat roundworm cause visceral larva migrans and ocular larva migrans in humans. These roundworms live in the small intestine of the cat in the adult stage, where eggs are passed in the feces. A seroprevalence study in North Carolina found that of 100 feral and 76 domestic cats examined, 21 and 18%, respectively, were positive. Human infections are caused by ingestion of eggs from contaminated hands, soil, or fomites and are usually asymptomatic to mild and accompanied by a persistent eosinophilia. The larvae penetrate the intestinal wall but are unable to complete their life cycle and produce eosinophilic granulomas in host tissues. Infection produces a syndrome in humans termed visceral larva migrans or toxocariasis. This disorder may be subclinical; or may present primarily as an ocular form. Systemic toxocariasis most often affects children aged one to four. Clinical manifestations include eosinophilia, rash, fever, cough, weight loss, hepatosplenomegaly, pulmonary infiltrates, seizures, and behavior disorders. Ocular larva migrans often presents in older children with a unilateral reduction in vision or strabismus and often with retinal involvement but without the systemic symptoms or eosinophilia seen in visceral disease (El-

Dakhly *et al*, 2012).

***Echinococcus* species:** Dogs and other carnivorous mammals are the definitive hosts for the tapeworm echinococcus. Cats appear to have only a minor role in the maintenance of *E. multilocularis* in endemic areas, and infections in cats are of minimal public health significance (Thompson *et al*, 2006).

Toxoplasma gondii: It is an intracellular parasite with a worldwide distribution. In the United States, *T. gondii* infects 30 to 40% of domestic cats (Ladiges *et al*, 1982). Felines of all types are the only host animals in which the sexual form of *T. gondii* can develop. Following feline ingestion of any form of *T. gondii,* the parasite infects the gut epithelial cells and reproduces. The feline then excretes infectious oocysts in feces. Despite the high prevalence of *T. gondii* infection in cats, most cats are asymptomatic. Clinical disease is rare, but more common in young cats (≤ 2 years of age) and in older cats where it may be associated with co-infection with feline leukemia virus or feline immunodeficiency virus. Human infection is caused by ingestion of cysts from raw or undercooked meat of infected animals, ingestion of sporulated oocysts from cat feces (primarily through environmental exposure), and through transplacental transmission. If the non-felines, including humans and other mammals, ingest *T. gondii* oocysts, the organisms invade intestinal epithelium and disseminate throughout the body. They then encyst and can lie dormant (but viable) in any nucleated cells within tissues for the life of the host (Tenter *et al*, 2000).

Approximately one-third of the United States population is *T. gondii* seropositive (latent infection). The rates of toxoplasmosis infection differ by population, being higher with increasing age and in those persons born outside the United States (Falusi *et al*, 2002).

The proportions of infection in the United States related to different forms of transmission have been difficult to determine. The CDC estimates that about 50% of human infection is related to ingestion of contaminated meat (Lopez *et al*, 2000). The proportion associated with exposure to cats or cat feces is not known. However, a study in HIV-positive, *T. gondii*-seronegative patients, found that only 13 of 650 (2%) patients followed for a mean duration of 2.1 years, seroconverted during the study. A pet history was available on 12 of the 13 patients and only one had owned or lived in a household with a cat during the period of seroconversion (Wallace *et al*, 1993).

Infection in immunocompetent persons is asymptomatic in 80 to 90% of cases; when symptomatic infection occurs, the most common manifestation is bilateral, symmetrical, non-tender cervical adenopathy. Clinical disease is much more likely in immunocompromised patients (e.g., HIV-infected or solid organ transplant recipients) and in infants of mothers infected during pregnancy. People who are seronegative for *T. gondii* and who are immunocompromised or pregnant should be counseled to eat only the well-cooked meats, wash fruits and vegetables before eating, wash their hands after outdoor activities involving soil contact,

and avoid changing the cat litter (Richards *et al*,1995).

Ancylostoma braziliense: The hookworm, *A. braziliense*, is an agent of cutaneous larva migrans. The eggs are shed in the feces of infected dogs or cats. Although adult animals are usually asymptomatic, puppies and kittens develop diarrhea, weight loss, and anemia. *A. braziliense* is found in temperate climates, including southern and Eastern Europe, the Mediterranean, North Africa, the Middle East, Pakistan and northern India, northern Australia, and parts of South America. Humans (and pets) are infected when bare skin comes in contact with soil contaminated with the larvae. The second-stage larvae are able to penetrate the intact skin of humans and the footpads of dogs and cats.

A pruritic erythematous papule develops initially at the site of each larval entry. Two to three days later and at times weeks later, severely pruritic, elevated, serpiginous, reddish-brown lesions appear as the larvae migrate at a rate of several millimeters per day.

Dipylidium caninum: The dog and cat tapeworm, *D. caninum,* commonly infects domestic cats and dogs and may also accidentally infect humans. Fleas usually serve as the intermediate hosts and contain cysticercoids. If a human (usually a child) ingests cysticercoids (larva), an adult tapeworm can develop in the intestine. This infection is usually asymptomatic. However, abdominal pain, diarrhea, pruritus ani, and urticaria can develop. In addition, parents may notice the passage of proglottids (eg, body segments of the adult tapeworm, which have a complete set of reproductive organs) that resemble cucumber seeds in their children's stool.

III- Aerosol:

***Bordetella bronchiseptica*:** *B. bronchiseptica* causes a mild respiratory infection in cats, although the life-threatening pneumonia may occur in kittens. The disease occurs worldwide in rodents, swine, dogs, cats and non-human primates. Although rare, human infection with *B. bronchiseptica* has been documented in both healthy and immunocompromised individuals (Lo Re *et al*, 2001). Of nine HIV patients from whom *B. bronchiseptica* was isolated, respiratory illnesses ranged from mild upper respiratory tract infections to pneumonia. Two of these persons had household contact with dogs prior to their illnesses, and one had household contact with cats (Dworkin *et al*, 1999).

Coxiella burnetii: The etiologic agent of Q fever is a worldwide zoonosis. The most common animal reservoirs are goats, cattle, sheep, cats, and occasionally dogs (Marrie, 2003). Infected mammals shed *C. burnetii* in urine, feces, milk, and birth products. In humans, exposure results from inhalation of contaminated aerosols from parturient fluids of infected mammals, which can be present in the environment, on the coats of newborn animals, or from the placenta. A case report describes 15 members of a family who attended a reunion in Maine where they were exposed to a parturient cat. Two weeks later, all 11 adults and older children developed symptoms consistent with

acute Q fever. Clinical signs of Q fever are often extremely mild or absent. Patients may be asymptomatic or can present acutely with one of three clinical presentations: A self-limited flu-like illness Pneumonia Hepatitis Chronic infection most commonly involves the heart as endocarditis (Pinsky *et al*, 1991).

VI-Arthropod-ectoparasites: Cats as other pet animals are infected with the ticks, mites and fleas (Morsy, 2012).

Tick or fleabites: Cats can transport ticks and fleas, which subsequently can bite a human host and transmit infectious diseases. Ticks can carry many disease-producing pathogens, including *Borrelia burgdorferi* (Lyme disease), *Ehrlichia* (ehrlichiosis), *Babesia microti* (babesiosis), and *Francisella tularensis* (tularemia). Fleas carried by cats can bite a human host and transmit plague (Overgaauw *et al*, 2012).

Lyme disease: It is caused by *B. burgdorferi*, which is spread by the bite of infected *Ixodes* ticks. Approximately 95% of cases of Lyme disease in the United State are reported from twelve states: Massachusetts, Connecticut, Maine, New Hampshire, Rhode Island, New York, New Jersey, Pennsylvania, Delaware, Maryland, Michigan, and Wisconsin. In highly endemic areas, owners of cats who go outdoors should inspect their cats regularly for ticks, as tick collars have a variable efficacy. The owners should inspect their cats for ticks for two reasons. First, cats can develop symptomatic Lyme disease with painful or stiff muscles and joints, fatigue, fever, and loss of appetite. Second, cat may carry ticks indoors, and if these ticks carry *B. burgdorferi* and attach to a human, they may then transmit Lyme disease to the pet's human family.

Human Lyme disease is a multisystem inflammatory disease. One of the first clinical manifestations is the classic erythema migrans (EM) skin lesion that occurs in up to 90%of patients.

Ehrlichiosis: The most important human ehrlichial diseases are human monocytic ehrlichiosis (HME), which is caused by *E. chaffeensis*, and human granulocytic anaplasmosis (HGA), which is caused by *Anaplasma phagocytephilum*. The principle vector of *E. chaffeensis* is thought to be the Lone Star tick (*Amblyomma americanum*). *A. phagocytophilum*, in contrast, may be transmitted by *Ixodes scapularis*, the tick that is also the vector of Lyme disease and babesiosis. Most cases of HME have occurred in the southeastern, south-central, and mid-Atlantic regions of the United States. States with the highest incidence of HGA during 2001 to 2002 were Rhode Island, Minnesota, Connecticut, New York, and Maryland. HGA is also reported in Western Europe. A cat that goes outdoors should be inspected for ticks, as a tick carrying HME or HGA may infect the animal or the tick may attach to a human once brought indoors by the cat. Infection with *A. phagocytophilum* is associated with clinical illness in some cats. A report describes five cats with fever, anorexia, and lethargy from Massachusetts and Connecticut who had positive antibody titers to *A. phagocytophilum* and responded to treat-

ment with doxycycline or tetracycline. The clinical manifestations of HME and HGA in humans are variable. Most patients are febrile with nonspecific symptoms including malaise, myalgia, headache, and chills (Lappin *et al*, 2004).

Babesiosis: Babesiosis is the tick borne illness caused by malaria-like parasites that infect red blood cells and result in hemolysis. Human disease is most commonly due to *B. microti* (United States) or *B. divergens* (Europe). The Ixodid tick is the vector of babesiosis, the same vector as Lyme disease and anaplasmosis. Babesiosis occurs predominantly on the Northeast coast of the United States. A cat that goes outdoors should be inspected for ticks, as a tick carrying babesiosis may attach to a human once brought indoors by the cat (Hüe *et al*, 2013).

The clinical manifestations of disease can range from asymptomatic infection to severe hemolytic anemia associated with jaundice, hemoglobinuria, renal failure, and death (El-Bahnasawy and Morsy, 2008).

Yersinia pestis: It is the etiologic agent of plague. Cats can become severely ill from *Yersinia pestis* (plague) after been bitten by rodents' fleas. They can carry the infected fleas, which can spread disease to humans through a fleabite. Rarely, ill cats have spread pneumonic disease to man by aerosol; or bubonic disease by a bite (Lowell *et al*, 2005).

Foci of plague are present on most continents other than Australia. In the United States, plague is endemic in all of the western states and has extended north and east over the years. Ninety percent of human cases in the United States have occurred in four states: Arizona, California, Colorado, and New Mexico. The three generally recognized clinical syndromes are associated with human plague: bubonic, septicemic, and pneumonic (Doll *et al*, 1994).

V- Contaminated urine:

Leptospirosis: *Leptospira interrogans*, human etiologic agent of leptospirosis, infects a variety of both wild and domestic mammals, including cats. The animals can be asymptomatic or develop clinical infection, which can be fatal. Transmission to humans occurs by contact with water or soil contaminated with the urine of infected animals (predominantly rats). One study in Baltimore found that cat ownership may be protective against leptospirosis, perhaps because cats reduce human contact with rodents (Childs *et al*, 1992). Leptospirosis in humans may manifest as a subclinical illness followed by seroconversion, a self-limited systemic infection, or a severe, potentially fatal illness accompanied by the multiorgan failure. Leptospirosis usually presents with the abrupt onset of fever, rigors, myalgias, and headache, after an incubation period of 2 to 26 days (average 10 days). Many patients have an associated nonproductive cough, nausea, vomiting, and diarrhea.

VI- Direct Contact

Corynebacterium ulcerans: Some strains of *C. ulcerans* produce diphtheria toxin, which can cause the life-threatening cardiopathies and neuropa-

thies in humans, which is a very rare disease that mimics classical cutaneous diphtheria. Carriers and potential infectious sources of infection include not only domestic livestock but also pet animals (Corti *et al*, 2012)

Microsporum canis: *M. canis* is a fungus (e.g., dermatophyte) that causes skin and nail infections in animals and humans. *M. canis* is the cause of from three to 13% of human ringworm (*Tinea capitis*) infections. The disease in cats is similar to that seen in humans and occurs with a variable prevalence of four to 47 % (Weitzman *et al*, 1998).

Sporothrix schenckii: Sporotrichosis is the subacute to chronic infection caused by the dimorphic fungus *Sporothrix schenckii*. The fungus is found worldwide in climates ranging from temperate to tropical. Most cases are reported from the Americas and Japan. Disease in humans is usually localized to cutaneous and lymphatic structures and runs a subacute to chronic course. Infected cats develop disease similar to that seen in humans (Schubach *et al*, 2005).

Clusters of cases have been reported in veterinarians, family members, and groomers who have handled cats with chronic ulcerated skin lesions. Transmission of infection to humans can occur even without an associated penetrating injury (Naqvi *et al*, 1993).

Prevention

Although cats have been implicated in the transmission of zoonoses to their owners, risk of transmission from contact with cats is low and may be further reduced by simple precautions. Cats should be seen by a veterinarian on a regular basis, treated promptly for diarrhea and dermatoses and should be vaccinated for rabies. Cats who are confined indoors present a lower risk than those who roam outdoors Effective flea control requires treatment of affected cats, their environment, and other animals they contact. Cats should be fed high quality commercial food and should not eat raw meat or eggs. They should not be allowed to eat garbage, feces, or hunt. They should not be allowed to drink non-potable water (e.g., surface water or toilet water). Cats claws should be clipped to reduce the risk of cat scratches to owners Outdoor cats should be inspected for ticks regularly Young cats present a greater risk for disease (e.g., cat scratch disease) than older cats owners should wash their hands following contact with or cleaning of litter boxes (Glaser *et al*, 1994).

The immunocompromised hosts and pets: Groups at high risk for serious infection from pets include: Persons with waning immunity (e.g., older adults), children less than five years old and pregnant women Immunocompromised patients The last group may include patients with AIDS and those taking immunosuppression or without a functioning spleen. Numerous reports exist of the transmission of zoonoses to humans during and after solid organ and hematopoietic stem cell transplantation. Most zoonoses present as a primary infection in the post-transplant period; immunocompromised patients are more likely to experience signifi-

cant morbidity and mortality from these infections (Kotton, 2007).

To avoid infections, people at higher risk should take particular precautions with any animal contact. In addition to thorough and frequent hand washing, these precautions might include avoiding contact with animals and their environment (e.g., pens, bedding, and manure). For children, risk for exposure might be reduced if they are closely supervised by adults, carried by adults in animal areas, or have animal contact only over a barrier. These measures discourage animals from jumping on or nuzzling children and minimize contact with feces and soiled bedding.

The United States Public Health Service and the Infectious Diseases Society of America have issued formal recommendation for HIV positive people who desire pet contact. The guidelines specify: When obtaining a new pet, HIV-infected persons should avoid animals aged <6 months or <1 year for cats (Robinson and Pugh, 2002). HIV-infected persons should be cautious when obtaining a pet from pet-breeding facilities, pet stores, and animal shelters, because of highly variable hygienic and sanitary conditions. Stray animals should be avoided. HIV-infected persons should avoid contact with any animal that has diarrhea. HIV-infected pet owners should seek veterinary care for animals with diarrheal illness, and a fecal sample from such animals should be examined for the *Cryptosporidium*, *Salmonella*, and *Campylobacter*. The HIV-infected patients should well wash their hands after handling pets, including before and after eating, and should avoid contact with feces of pets (Kaplan *et al*, 2002). HIV-infected persons should avoid contact with reptiles (e.g., snakes, lizards, iguanas, and turtles) as well as chicks and ducklings because of the risk for salmonellosis. Gloves should be used during aquarium cleaning to reduce the risk for infection with *Myc- obacterium marinum*. The contact with exotic pets (e.g., nonhuman primates) should be avoided.

What about Egyptian cats?

Many authors dealt with cats and zoonosis from cats. Khalil *et al.* (1976) in Cairo and Giza Governorates reported *Toxocara canis* and *T. cati* infections among stray dogs and cats. Rifaat *et al*. (1976) sero-examined cats for *Toxoplasma* antibody reported a high infection rate, without significant difference between males and females or between rural and urban areas, although acute infection seems to be more prevalent in males and in rural areas. Infection was prevailing more during the warm rather than the hot season of the year being favored by the milder temperature and higher relative humidity and rainfall in the former season. They added that the *Toxoplasma* antibody in the young ages was related to maternal origin

Morsy *et al*. (1981) detected *Trichinella spiralis* in stray cats in the vicinity of Cairo. Rifaat *et al*. (1981) reported antibodies against some parasites in stray cats mainly *Toxoplasma gondii.* Michael *et al*. (1982) in Ismailia Governorate found high anti-*Leishmania* antibodies in stray cats. Abo-Shady *et al*. (1983) in Dakahlia Governorate reported many gastro-intestinal parasites (cestodes and nematodes) in stray cats.

Makhlouf *et al.* (1989) during a survey for helminth parasites among stray cats in Assiut area, microfilariae were detected.

Morsy and Abou el Seoud (1994) reported that two cases of ZCL have been parasitologically detected among 720 of the outpatients attended the Primary Health Care Units in three villages in Imbaba rural area; those two pet cats had ZCL lesions. Besides, 60 pet and stray cats showed antibodies against cutaneous leishmaniasis in five cats at a dilution of 1/32 and one at dilution 1/128. The 2 positive cats showed IHA positivity at dilution 1/256.

Amer *et al*. (2001) examined 60 dermatosis patients clinically, epidemiologically, histopathologically, and ultrastructurally, reported that specific dermatosis was due to human cowpox infection, passed by cats to humans and carried by rodents.

Fahmy and el-Dien (2002) reported the cat flea; *Ctenocephalides felis* on stray dogs and cats.

Elsheikha *et al*. (2006) studied *S. felis* sarcocystosis in muscles of the domestic cats (*Felis domesticus*) reported multiple protozoan elliptical cysts were in the skeletal muscles, heart, and diaphragm muscles of 3/17 (17.6%) adult cats. The clinico-pathological studies showed hypertrophy cardiomyopathy and lymphosarcoma. The tissue samples showed a spectrum of pathological changes such as multi-focal subacute myocarditis and multi-focal subarachnoid lymphocytic infiltration. The DNA extracted from muscles diaphragm with cysts was tested by PCR and sequence analyses of ssurRNA gene. The phylogenetic reconstructions using neighbor-joining method showed that *S. felis* is closely related to *S. neurona*. Elsheikha *et al*. (2009) assessed the phylogenetic position of four clinical isolates of *S. felis* using ssurRNA and ITS1 gene sequences in the context of a wide array of other *Sarcocystis* sp. High ssurRNA sequence similarity (> or =99%) and the resulting phylogeny proved that *S. felis* and *S. neurona* are significantly closely related to each other. Two *Sarcocystis* formed a monophyletic group distinct from the other *Sarcocystis* sp., irrespective of alignment algorithms or tree-building method used. *S. felis* sarcocyst DNA sequence was quite dissimilar over the ITS1 region when compared to *S. neurona*.

Adham *et al*. (2010) detected tick recovered from pet animals naturally infected with *B. burgdorferi* sensu lato.

Khalafalla (2011) in a survey on gastrointestinal parasites in 113 fecal samples from stray cats collected randomly from Kafrelsheikh province, between January and May 2010, the overall prevalence was 91%. He reported seven helminth species: *Toxocara cati* (9%), *Ancylostoma tubaeforme* (4%), *Toxascaris leonina* (5%), *Dipylidium caninum* (5%), *Capillaria* spp. (3%), *Taenia taeniformis* (22%) and *Heterophyes heterophyes* (3%), four protozoa species: *Toxoplasma gondii* (9%), *Sarcocyst* spp. (1%), *Isospora* spp. (2%) and *Giardia* spp. (2%) and two arthropod species; *Linguatula serrata* (2%) and mites eggs (13%).

Abdel-Moein and Samir (2011) inve-

stigated the prevalence of enterotoxigenic *S. aureus* among pet dogs and cats and its public health implication. For this purpose, nasal, oral, and wound swabs were collected from 70 dogs and 47 cats, whereas nasal swabs were collected from 26 human contacts. All samples were examined for the presence of enterotoxigenic *S. aureus* by isolation of *S. aureus* in culture media and tested by specific ELISA kits to detect the produced toxins in bacterial cultures. *S. aureus* was 10% and 2.1% for pet dogs and cats, respectively, whereas the nasal carriage rate in human contacts was 7.7%. The majority of animal isolates were from mouth of the apparently healthy one. All types of staphylococcal enterotoxins were detected in both animal and human isolates. High prevalence of *S. aureus* among pet dogs highlights the possibility of zoonotic transmission to human contacts leading to nasal and/or hand carriage of such strains; thus, pet animals may be incriminated in the epidemiology of household staphylococcal food poisoning outbreaks.

Al-Kappany *et al*. (2011) reported a high prevalence of *T. gondii, Bartonella* spp., and FIV infections in cats from Cairo, Egypt, which was the first report of *Bartonella* spp., and *D. immitis* infection in cats in Egypt Kurushima *et al*. (2012) reported that ancient Egyptians mummified an abundance of cats during the Late Period (664-332 BC), the overlapped morphology and sizes of developing wildcats and domestic cats confounds the identity of mummified cat species. They extracted the mummy DNA in a dedicated ancient DNA laboratory at the University of California-Davis, then directly sequencing between 246 and 402 bp of the mtDNA control region from each bone. When compared to a dataset of wildcats (*Felis silvestris silvestris*, *F. s. tristrami*, and *F. chaus*) as well as a previously published worldwide dataset of modern domestic cat samples, including Egypt, the DNA evidence suggested the three mummies represent common contemporary domestic cat mitotypes prevalent in modern Egypt and the Middle East. Divergence estimates date the origin of the mummies' mitotypes to between two and 7.5 thousand years prior to their mummification, likely prior to or during Egyptian Predyanstic and early Dynastic Periods. These data are the first genetic evidence supporting that the ancient Egyptians used domesticated cats, *F. s. catus*, for votive mummies, and likely implies cats were domesticated prior to extensive mummification of cats.

Mohamadain and Ammar (2012) estimated the prevalence of Physalopteridae in stray cats in Qena and identify the encountered species and to overview the taxonomic features of different species of the family from which more than 200 species were recovered besides the unnamed species. *Ph. praeputialis* adults and larvae were recovered from the pyloric region of the stomach of 28 (71.2%) of 39 necropsied stray cats (*Felis catus*).

Lastly, Silveira *et al*. (2011) suggested protocol of the animal assisted activity program at a university hospital. It includes: introduction, objectives, inclusion and exclusion criteria for an-

imals, drivers and patients; recommendations to the handlers and the health team, responsibilities of the Nosocomial Infection Control Committee, zoonoses posters, vaccination schedule for dogs and cats, free-informed consent to take part in the program and records with behavioral analysis of the animals.

It is believed that disclosing the protocol, based on scientific studies, favors the implementation of new programs in institutions considering the lack of national publications

Conclusion

A zoonosis is an animal disease that is transmissible to humans. Humans are usually an accidental host that acquires disease through close contact with an infected animal, who may or may not be symptomatic. Children are at highest risk for infection because they are more likely to have close contact with pets. Cats are responsible for transmission of an extensive array of bacterial, fungal, and parasitic zoonotic pathogens.

The route of transmission can be through the saliva (e.g., bites or contaminated scratches), feces, respiratory secretions, direct contact, or by the cat acting as a vehicle and source of tick or flea exposure. Although cats have been implicated in transmission of zoonosis to their owners, risk of transmission from contact with cats is low and may be further reduced by simple precautions.

No doubt, many human zoonotic infectious diseases are transmitted by the contact with domestic animals (zoonoses), including the household pets. Despite this concern, there is more or less-limited knowledge of the public's pet husbandry and infection control practices.

References

Abdel-Moein, KA, Samir, A, 2011: Isolation of enterotoxigenic Staphylococcus aureus from pet dogs and cats: a public health implication. Vector Borne Zoonotic Dis. 11, 6:627-9.

Abo-Shady, AF, Ali, MM, Abdel-Magied, S, 1983: Helminth parasites of cats in Dakahlia, Egypt. J. Egypt. Soc. Parasitol. 13, 1:129-33.

Adham, FK, Abd El-Samie, M, Gabre, RM, El Hussein, H, 2010: Detection of tick blood parasites in Egypt using PCR assay II- *Borrelia burgdorferi* sensu lato. J. Egypt. Soc. Parasitol. 40, 3:553-64.

Al-Kappany, YM, Lappin, MR, Kwok OC, Abu-Elwafa SA, Hilali M, *et al*, 2011: Seroprevalence of *Toxoplasma gondii* and concurrent *Bartonella* spp., feline immunodeficiency virus, feline leukemia virus, and *Dirofilaria immitis* infections in Egyptian cats. J. Parasitol. 97, 2:256-8.

Amer, M, El-Gharib, I, Rashed, A, Farag, F, Emara, M, 2001: Human cowpox infection in Sharkia Governorate, Egypt. Int. J. Dermatol. 40, 1:14-7.

Anderson, BE, Neuman, MA, 1997: *Bartonella* spp. as emerging human pathogens. Clin. Microbiol. Rev.10:203-11.

Arav-Boger, R, 2000: Cat-bite tularemia in a seventeen-year-old girl treated with ciprofloxacin. Pediatr. Infect. Dis. J. 19:583-4.

Ashley, BD, Noone, M, Dwarakanath, AD, Malnick, H, 2004: Fatal *Pasteurella dagmatis* peritonitis and septicaemia in a patient with cirrhosis: a case report and review of the literature. J. Clin. Pathol. 57:210-9.

Baxby, D, Bennett, M, Getty, B, 1994: Human cowpox 1969-93: a review based on 54 cases. Br. J. Dermatol. 131:598-606.

Bender, JB, Shulman, SA, Averbeck, GA, *et al*, 2005: Epidemiologic features of Campylobacter infection among cats in the upper Midwestern United States. J. Am. Vet. Med. Assoc. 226: 544-50.

Bobo, RA, Newton, EJ, 1976: A previously undescribed gram-negative bacillus causing septicemia and meningitis. Am. J. Clin. Pathol. 65:564-9.

Childs, JE, Schwartz, BS, Ksiazek, T G, *et al*, 1992: Risk factors associated with antibodies to leptospires in inner-city residents of Baltimore: a protective role for cats. Am. J. Pub. Hlth. 82:597.

Chodosh, J, 2001: Cat's tooth keratitis: human corneal infection with *Capnocytophaga canimorsus*. Cornea 20:661-8.

Chomel, BB, Sun, B, 2011: Zoonoses in the bedroom. Emerg. Infect. Dis. 17, 2: 167-72.

Chomel, BB, Abbott, RC, Kasten, RW, *et al*, 1995: Bartonella henselae prevalence in domestic cats in California: Risk factors and association between bacteremia and antibody titer. J Clin Microbiol 1995; 33:2445.

Corti, MA, Bloemberg, GV, Borelli, S, Kutzner, H, Eich, G, *et al*, 2012: Rare human skin infection with *Corynebacterium ulcerans*: transmission by a domestic cat. Infection 40, 5:575-8.

Davis, R, Zivanovic, S, D'Souza, DH, Davidson, PM, 2012: Effectiveness of chitosan on the inactivation of **enteric** viral surrogates. Food Microbiol. 32, 1:57-62.

Doll, JM, Zeitz, PS, Ettestad, P, *et al*, 1994: Cat-transmitted fatal pneumonic plague in a person who traveled from Colorado to Arizona. Am. J. Trop. Med. Hyg. 51:109-16.

Dworkin, MS, Sullivan, PS, Buskin, SE, *et al*, 1999: Bordetella bronchiseptica infection in human immunodeficiency virus-infected patients. Clin Infect Dis 1999; 28:1095.

El-Bahnasawy, MM, Morsy, TA, 2008: Egyptian human babesiosis and general review. J. Egypt. Soc. Parsitol. 38, 1:265-72.

El-Dakhly, K, Abo-Hadid, S, Shimizu, H, El-Nahass, S, Murai, A, *et al*, 2012: Occurrence of *Thelazia callipaeda* and *Toxocara cati* in an imported European lynx (Lynx lynx) in Japan. J. Zoo Wildl. Med. 43, 3:632-5.

Eligio-Garcia, L, Cortes-Campos, A, Jimenez-Cardoso, E, 2005: Genotype of *Giardia intestinalis* isolates from children and dogs and its relationship to host origin. Parasitol. Res. 97:1-8.

Elsheikha, HM, Kennedy, FA, Murphy, AJ, Soliman, M, Mansfield, LS, 2006: Sarcocystosis of Sarcocystis felis in cats. J. Egypt. Soc. Parasitol. 36, 3: 1071-85.

Elsheikha, HM, Soltan, DM, el-Garhy, MF, 2009: Inference of molecular phylo-geny of *Sarcocystis felis* (Sarco-

cystidae) from cats based on nuclear-encoded ribosomal gene sequences. J. Egypt. Soc. Parasitol. 36, 2:441-53.

Fahmy, MM, el-Dien, NM, 2002: Control of *Ctenocephalides felis* on dogs and cats using the insect growth regulator (or chitin synthesis inhibitor) lufenuron Program, in Egypt. J. Egypt. Soc. Parasitol. 32, 1:99-108.

Falusi, O, French, AL, Seaberg, EC, *et al*, 2002: Prevalence and predictors of *Toxoplasma* seropositivity in women with and at risk for human immunodeficiency virus infection. Clin. Infect. Dis. 35:1414.

Friedman, CR, Torigian, C, Shillam, PJ, *et al*, 1998: An outbreak of salmonellosis among children attending a reptile exhibit at a zoo. J. Pediatr. 132: 802-8.

Glaser, CA, Angulo, FJ, Rooney, JA, 1994: Animal-associated opportunistic infections among persons infected with the human immunodeficiency virus. Clin. Infect. Dis. 18:14-9.

Godfrey, DR, Blundell, CJ, Essbauer, S, *et al*, 2004: Unusual presentations of cowpox infection in cats. J. Small Anim. Pract. 45:202-9.

Haenssle, HA, Kiessling, J, Kempf, VA, *et al*, 2006: Orthopoxvirus infection transmitted by a domestic cat. J. Am. Acad. Dermatol. 54:S1.

Hirsh, D, Farrell, K, Reilly, C, Dobson, S, 2004: *Pasteurella multocida* menin-gitis and cervical spine osteomyelitis in a neonate. Pediatr. Infect. Dis. J. 23:1063.

Hüe, T, Graille, M, Mortelecque, A, Desoutter, D, Delathière, J, *et al*, 2013: Diagnostic methods used to monitor an outbreak of babesiosis (*Babesia bovis*) in a herd of feral cattle in New Caledonia. Aust. Vet. J. 91, 6: 254-8.

Kaplan, JE, Masur, H, Holmes, KK, 2002: Guidelines for preventing opportunistic infections among HIV-infected persons: Recommendations of the U.S. Public Health Service and the Infectious Diseases Society of America. MMWR; Recomm. Rept. 51:1-14.

Khalafalla, RE, 2011: A survey study on gastrointestinal parasites of stray cats in northern region of Nile delta, Egypt. PLoS One 6, 7:e20283. doi: 10. 1371/ journal.pone.0020283.

Khalil. HM, Khaled, ML, Arafa, MS, Sadek, MS, 1976: Incidence of *Toxocara canis* and *Toxocara cati* infections among stray dogs and cats in Cairo and Giza Governorates, A.R.E. J. Egypt. Pub. Hlth. Assoc. 51, 1:45-9.

Koehler, JE, Glaser, CA, Tappero, JW, 1994: *Rochalimaea henselae* infection: a new zoonosis with the domestic cat as reservoir. JAMA 271: 531-8.

Kotton, CN, 2007: Zoonoses in solid-organ and hematopoetic stem cell transplant recipients. Clin. Infect. Dis. 44:857-66.

Krebs, JW, Mandel, EJ, Swerdlow, DL, Rupprecht, CE. J, 2005: Rabies. Am. Vet. Med. Assoc. 227:1912.

Kurushima, JD, Ikram, S, Knudsen, J, Bleiberg, E, Grahn, RA, *et al*, 2012: Cats of the Pharaohs: Genetic Comparison of Egyptian Cat Mummies to their Feline Contemporaries. J. Archaeol. Sci. 39, 10:3217-3223.

Ladiges, WC, DiGiacomo, RF, Yamaguchi, RA, 1982: Prevalence of *Toxoplasma gondii* antibodies and oocysts in pound-source cats. J. Am. Vet. Med. Assoc. 180:1334.

Lappin, MR, Breitschwerdt, EB, Jensen, WA, *et al*, 2004: Molecular and serologic evidence of *Anaplasma phagocytophilum* infection in cats in North America. J. Am. Vet. Med. Assoc. 225: 893-9.

Lawn, SD, Planche, T, Riley, P, *et al*, 2003: A black necrotic ulcer. Lancet 361:1518.

Lo Re, V 3rd, Brennan, PJ, Wadlin, J, *et al*, 2001: Infected bronchial cleft cyst due to *Bordetella bronchiseptica* in an immunocompetent patient. J. Clin. Microbiol. 39:4210-8.

Lopez, A, Dietz, VJ, Wilson, M, *et al*, 2000: Preventing congenital toxoplasmasis. MMWR; Recomm. Rep. 49:59.

Lowell, JL, Wagner, DM, Atshabar, B, *et al*, 2005: Identifying sources of human exposure to plague. J. Clin. Microbiol. 43:650-60.

Makhlouf, LM, Monib, ME, Abou-Zkam, AA, Romia, SA, el-Ganayni, GA, *et al,* 1989: A microfilaria in a stray cat from Assiut, Egypt. J. Egypt. Soc. Parasitol. 19, 1:247-9.

Marrie, TJ, 2003: *Coxiella burnetii* pneumonia. Euro Respir. J. 21:713.

McLean, CR, Hargrove, R, Behn, E, 2004: The first fatal case of *Capnocytophaga canimorsus* sepsis caused by a cat scratch. J. R. Nav. Med. Serv. 90: 13-20.

Michael, SA, Morsy, TA, El-Seoud, S F, Saleh, MS, 1982: Leishmaniasis antibodies in stray cats in Ismailia Governorate, Egypt. J. Egypt. Soc. Parasitol. 12, 1:283-6.

Mohamadain, HS, Ammar KN, 2012: Re-description of *Physaloptera praeputialis* von Linstow, 1889 (Nematoda: Spirurida) infecting stray cats (*Felis catus* Linnaeus, 1758) in Qena, Egypt and overview of the genus taxonomy. J. Egypt. Soc. Parasitol. 42, 3: 675-90.

Morsy, TA, 2012: Insect bites and what is eating you? J. Egypt. Soc. Parasitol. 42, 2:291-308.

Morsy, TA, Abou el Seoud, SM, 1994: Natural infection in two pet cats in a house of a zoonotic cutaneous leishmaniasis patient in Imbaba area, Giza Governorate, Egypt. J. Egypt. Soc. Parasitol. 24, 1:199-204.

Morsy, TA, Sadek, MS, Abdel Hamid, MY, 1981: Intestinal parasites of stray cats in Cairo, Egypt. J. Egypt. Soc. Parasitol. 11, 2:331-45

Naqvi, SH, Becherer, P, Gudipati, S, 1993: Ketoconazole treatment of a family with zoonotic sporotrichosis. Scand. J. Infect. Dis. 25:543-9.

Nutter, FB, Dubey, JP, Levine, JF, *et al*, 2004: Seroprevalences of antibodies against *Bartonella henselae* and *Toxoplasma gondii* and fecal shedding of *Cryptosporidium* spp, *Giardia* spp, and *Toxocara cati* in feral and pet domestic cats. J. Am. Vet. Med. Assoc. 225: 1394-400.

Overgaauw, PA, van Duijkeren, E, Sprong, H, van Exel, JC, 2012: Flea and tick control in dogs and cats. Tijdschr. Diergeneeskd. 137, 5:316-20.

Parslow, RA, Jorm, AF, 2003: Pet ownership and risk factors for cardiovascular disease: another look. Med. J. Aust.179:466-76.

Pinsky, RL, Fishbein, DB, Greene, CR, Gensheimer, KF, 1991: An outbreak of cat-associated Q fever in the United States. J. Infect. Dis. 164:202.

Richards, FO Jr, Kovacs, JA, Luft, BJ, 1995: Preventing toxoplasmic encepha-litis in persons infected with human immunodeficiency virus. Clin. Infect. Dis. 21, 1:S49.

Rifaat, MA, Arafa, MS, Sadek, MS, Nasr, NT, Azab, ME, *et al*, 1976: *Toxoplasma* infection of stray cats in Egypt. J. Trop. Med. Hyg. 79, 3:67-70.

Rifaat, MA, Morsy, TA, Sadek, MS, Mahmoud, AM, 1981: The antibodies against some parasites in stray cats in Cairo. J. Egypt. Soc. Parasitol. 11, 2: 517-24.

Robinson, RA, Pugh, RN, 2002: Dogs, zoonoses and immunosuppression. J. R. Soc. Hlth. 122:95.

Saeed, AM, Harris, NV, DiGiacomo, RF, 1993: The role of exposure to animals in the etiology of *Campylobacter* jejuni/coli enteritis. Am. J. Epidemiol. 137:108-9.

Schubach, A, de Lima, Barros MB, Schubach, TM, *et al*, 2005: Primary conjunctival sporotrichosis: two cases from a zoonotic epidemic in Rio de Janeiro, Brazil. Cornea 24:491-8.

Silveira, IR, Santos. NC, Linhares. DR, 2011: Protocol of the animal assisted activity program at a university hospital. Rev. Esc. Enferm. USP. 45, 1: 283-8.

Stasi, MF, Amati, D, Costa, C, *et al*, 2004: Pet-therapy: a trial for institutiona-lized frail elderly patients. Arch. Gerontol. Geriatr. Suppl. 9:S407-12

Talan. DA, Citron, DM, Abrahamian, FM, Moran, GJ, Goldstein, EJC, 1999: Bacteriologic analysis of infected dog and cat bites. N. Engl. J. Med. 340:85.

Tenter, AM, Heckeroth, AR, Weiss, LM, 2000: *Toxoplasma gondii*: from animals to humans. Int. J. Parasitol. 30: 1217-22.

Thompson, RC, 2004: The zoonotic significance and molecular epidemiology of *Giardia* and giardiasis. Vet. Parasitol. 126:15-20.

Thompson, RC, Kapel, CM, Hobbs, RP, Deplazes, P, 2006: Comparative development of *Echinococcus multilocularis* in its definitive hosts. Parasitology 132:709-14.

Trevejo, RT, Barr, MC, Robinson, RA, 2005: Important emerging bacterial zoonotic infections affecting the immunocompromised. Vet. Res. 36: 493.

Wallace, MR, Rossetti, RJ, Olson, P E, 1993: Cats and toxoplasmosis risk in HIV-infected adults. JAMA 269:76-9.

Weitzman, I, Chin, NX, Kunjukunju, N, Della-Latta, P, 1998: A survey of dermatophytes isolated from human patients in the United States from 1993 to 1995. J. Am. Acad. Dermatol. 39: 255-62.

Woods, JP, Crystal, MA, Morton, RJ, Panciera, RJ, 1998: Tularemia in two cats. J. Am. Vet. Med. Assoc. 212: 81-6.