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ZOONOSES FROM PETS HORSES, DONKEYS AND MULES: WITH SPECIAL REFERENCES TO EGYPT

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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. Pets 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 animal acting as a vehicle and source of tick or flea exposure. Although pets have been implicated in transmission of zoonoses to their owners, risk of transmission from contact with pets is low and may be further reduced by simple precautions.

Key words: Zoonoses, Pets Horses, Donkeys and Mules.

Introduction

Pets serve valuable social roles in society (Parslow and Jorm, 2003). Pets may lower blood pressure, reduce cholesterol and triglyceride levels, and improve feelings of loneliness, while increasing opportunities for exercise, outdoor activities, and socialization, the pet-therapy programs are desirable components of the multidisciplinary treatment for frail elderly patients in long-term care (Stasi *et al*, 2004).

Despite these benefits, pets present zoonotic risks, especially for the immunocompromised hosts (Pickering *et al*, 2008). In addition, to infection from pets, there have been multiple outbreaks of enteric disease associated with animal exposure in public settings, such as county fairs, farms, and petting zoos (Sabry *et al*, 2012). In a review of 55 such outbreaks, most were due to Escherichia coli O157; 58% and Salmonella species; 22% (Steinmuller *et al*, 2006). The epidemiology of zoonoses from pet dogs and cats tops all-pet animals worldwide (Sabry *et al*, 2012, 2013).

Definition: 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. Incidence: The American Veterinary Medical Association's 2005 to 2006 survey of United States pet owners found that 63% of all United States households have at least one pet (www.avma.org). The most common route of infection related to pet contact, is through bites, especially in children (Myers *et al*, 2012). To the present authors knowledge, in Egypt, and other Arab countries non surveyed pet owners and consequently their zoonoses.

Risk Factors: Clinicians should ask about pets when taking a medical history and formu-lating 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. Adult pets are generally safer than younger animals, since they are less likely to be involved in playful activities that include

scratching and biting (Juckett, 1997). Children are at highest risk for infection because they are more likely to have close contact with pets.

Transmission: Transmission of an extensive array of bacterial, viral, and parasitic zoonotic pathogens can occur from pets. Many different routes of transmission can cause infections related to pets including: Infectious saliva that contaminate bite wounds, skin abrasions, or mucous membranes Hand-to-mouth transfer of microorganisms, cysts, or oocysts (eggs) from feces of an infected animal Insect bites when these vectors are carried into the home by pets or when bites transmit disease from a pet, acting as a disease reservoir, to humans Aerosol from body fluids (e.g., respiratory secretions, placenta) Scratches Contamination of water or the environment with pathogen containing animal urine Contamination of an object that is subsequently put into the mouth as pacifier (Weese *et al*, 2007).

Fecal transmission: Common zoonotic pathogens causing equine gastroenteritis include *Salmonella, Campylobacter,* Vibrio, *Cryptosporidium* and *Giardia*. Although the horses are not the usual source for human gastrointestinal infection, these pathogens should be considered in a patient who presents with compatible symptoms who has had contact with a horse with diarrhea (Roug *et al*, 2013).

Salmonella: An outbreak of salmonellosis in a population of hospitalized horses resulted in the closure of a veterinary teaching hospital for a period of 10 weeks (Ward *et al*, 2005). Fecal samples were collected from suspected cases and cultured for Salmonella. Thirty-three cases of infection by a multidrug-resistant strain of *S. typhimurium* were detected. S. typhimurium might have been introduced into the hospital environment by a foal presenting with diarrhea. Nyberg *et al*. (2011) reported that *Salmonella typhimurium* and *Enterococcus faecalis* were successfully treated by application of hydrated lime (Ca(OH)(2)). *Salmonella* spp. infections transmitted to humans usually result in a mild, self-limited gastroenteritis. However, severe invasive illness, such as septicemia or meningitis, can occur especially in infants and immunocompromised persons (Delaloye *et al*, 2004). In Egypt, Ahmed and Shimamoto (2014) stated that foodborne pathogens are a major threat to food safety, especially in developing countries where hygiene and sanitation facilities are often poor. *Salmonella enterica, Escherichia coli* O157:H7 and *Shigella* spp. were among the major causes of outbreaks of foodborne diseases

Campylobacter: *Campylobacter enteritis* in humans presents after an incubation period of one to seven days as a syndrome most commonly characterized by prominent abdominal pain and profuse diarrhea that is often bloody (Brzank and Wollenhaupt, 2013). Said *et al.* (2010) in Egypt stated that *Campylobacter* spp. are the major cause of enteritis in humans and more than 90% of reported infections are caused by *C. jejuni*. The main mechanism for resistance to fluoroquinolones is an alteration in the gyrA QRDR. MAMA PCR provides an economical and rapid means for screening fluoroquinolone resistance. Besides, Badawy *et al*. (2012) found that *Campylobacter* spp. was usually associated with *Giardia* spp.

Cryptosporidium: *Cryptosporidium* is an intracellular protozoan parasite that is associated with gastrointestinal diseases in all classes of vertebrates including horses. The cryptosporidial oocyst shedding is primarily found in immunocompromised or immature horses and rarely from healthy mature horses (McKenzie and Diffay, 2000). *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 (Aho, 1983). In immunocompromised hosts, the illness was more frequently protracted and severe, and can lead to significant malabsorption and weight loss. *Cryptosporidium parvum* and *C. homi-*

nis are the usual pathogens in humans; immunocom-promised hosts can also be infected by other *Cryptosporidium* spp. (Abdou *et al*, 2013). In Egypt, so many authors dealt with zoonotic cryptosporidiosis (Youssef *et al*, 2008). Mousa *et al*. (2010) stated Cryptosporidiosis, a parasitic zoonosis, while typically a short-term infection, has a global distribution and can cause severe illness in children and other vulnerable populations and they found that artificial breast feeding was not evaluated as only 3 infants had *C. parvum* compared to non-parasitic cause in 1 on the breast feeding.

Giardia lamblia: *G. 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. There is evidence supporting the zoonotic transmission of *Giardia*; horses may constitute a potential source for human infection of *Giardia* either directly or via contamination of watersheds (Traub *et al*, 2005).

The spectrum of clinical disease in humans includes asymptomatic infection, self-limited acute giardiasis, and chronic infection. *G. lamblia* causes both epidemic and sporadic disease and is an important etiology of water-borne and food-borne diarrhea, day-care center outbreaks, and diarrhea in international travelers and adoptees (Cacciò and Pozio, 2001). There are different strains of *G. lamblia* and antigenic variations within single isolates, but the significance of this heterogeneity for pathogenicity and the development of immunity is unclear (Musher and Musher, 2004). The pathogenesis of the diarrhea and malabsorption that can occur in giardiasis is incompletely understood since *Giardia* is not invasive organisms. The major structural and functional abnormalities associated with giardiasis are found in the small intestine. Human infection may be associated with a spectrum of light microscopic changes that range from no abnormalities, to mild or moderate partial villous atrophy, to subtotal villous atrophy in severe cases. An increase in crypt depth may also be seen. Even in the absence of changes in villous and crypt architecture, shortening and disruption of microvilli may occur. In addition, deficiencies in epithelial brush border enzymes (e.g., lactase) can develop. These alterations in epithelial structure and function probably play a role in pathogenesis (Dizdar *et al*, 2010). Moreover, Olson *et al.* (1997) reported double infection with giardiasis and cryptosporidiosis in Canadian farm animals

In Egypt many authors reported giardiasis in man and animals, Risk *et al*. (2004) studied the Genotyping of human giardiasis in relation to anti-*Giardia* secretory IgA and mucosal histo-pathology. Shatla *et al*. (2004) in Cairo detected *G. lamblia* antibodies in saliva of hospitalized children. Mahmoud *et al*. (2004) reported that giardiasis was one of the etiologic agent of skin dermatitis. Abou Holw *et al.* (2009) reported that giardiasis is one of the most common enteroprotozoal diseases; its association with *Helicobacter pylori* is a common clinical finding and that endoscopic and histopathologic examination showed significant gastric lesions in this group of patients as compared to those suffering only *G. lamblia*. El-Mohammady *et al*. (2012) stated that acute diarrhea continues to be a major cause of morbidity and mortality in children from developing countries and that Adenovirus, astrovirus, norovirus and *G. lamblia* were detected as the sole pathogen in 2% (n=34), 3% (n=56), 9% (n=191) and 7% (n=146) of the cases, respectively. They concluded that the incorporation of immunoassays yielded useful data in identifying pathogens in previously pathogen-negative diarrhea cases.

Clostridium difficile: *C. difficile* infection occurs in foals and horses following treatment with antibiotics and outbreaks might occur in veterinary hospitals (Madewell *et al*, 1995). *Clostridium difficile* is the most frequent cause of nosocomial diarrhea, and a significant cause of morbidity and mortality among hospitalized patients (McDonald, 2005). The vaccination with a partially puri-

fied preparation of inactivated toxins A and B may be a viable strategy for active immunization (Kotloff *et al*, 2001). Both the incidence and severity of *C. difficile*-associated diarrhea (CDAD) are increasing and that inpatient health care facilities are the primary site of *C. difficile* transmission. There are substantial short- and long-term attributable costs associated with *C. difficile* (Dubberke *et al*, 2008). The prevention and control of C. difficile requires a variety of interventions (Muto *et al*, 2007). To prevent spread to household contacts, patients with *C. difficile* should wash hands frequently with soap and water, especially after using the bathroom and before food preparation. Patients with diarrhea should avoid using the same toilet as other family members (Warny *et al*, 1994). In the hospital environmental cleaning is a must because the spores of *C. difficile* can survive on dry surfaces for up to several months, environmental cleaning in the setting of patient care for CDAD requires special attention (CDC, 2007).

In Egypt, Ibrahim (2014) gave an illustrative review on the prevention and control of CDAD in healthcare settings requires careful attention to hand hygiene, contact precautions, and environmental cleaning. Antibiotic restriction can reduce the *C. difficile* rates; strategies for antibiotic use should be tailored to health care delivery in particular institutions. There is insufficient data for routine use of probiotics, treatment of asymptomatic carriers, or vaccination

Aerosol transmission: Many microorganisms are aerosol zoonoses from the equines.

Rhodococcus equi: *R. equi* is a gram-positive pleomorphic organism that appears coccoid on solid media but forms long rods or short filaments in liquid media. The organisms can be acid fast with the Ziehl-Neelsen stain (Giguère *et al*, 2011).

R. equi is a soil organism carried in the gut of many herbivores and widespread in their environment. On horse farms, progressive environmental contamination with R. equi has been related to the length of time that animals were present. The highest numbers of organisms have been found in the surface soil on horse farms with endemic disease. Exposure to soil contaminated with herbivore manure is likely the major route of acquisition for both animal and human infection (Rosen and Jablon, 2003). Most human infections have been associated with immune system dysfunction (e.g., HIV, solid organ transplant recipients). Pulmonary infections are the most common form of human disease (Mulè *et al*, 2012). Besides, Nath *et al.* (2013) reported of *R. equi* granulomatous mastitis immunocompetent woman. Bildik *et al*. (2013) reported two cases of *Rhodococcus equi* bacteremia as a cause of sepsis in premature infants who had increasing respiratory distress with multiple episodes of apnea

In Egypt: Mohamed *et al*. (2009) reported suspected lesions in 110/745 (14.8%) of the slaughtered pigs' carcasses, from which only 67 specimens produced suspected mycobacterial colonies. Sequence analysis of IGS resolved the identities of 10 of the 11 conventionally unidentified isolates as being 4 different non-tuberculous *Mycobacterium* species. The last isolate was proposed as a non-*Mycobacterium* species and was confirmed by its identification as *Rhodococcus equi* based on the 16S ribosomal DNA sequence analysis.

Brucella: *Brucella* spp. infection in horses appears to have a worldwide distribution, but human infections transmitted by horses are uncommon. The Brucella spp that are frequently associated with horses are *B. suis* and *B. abortus* (Cvetnic *et al*, 2005). Humans may become infected when they are exposed to body fluids from a *B. suis* or *B. abortus* infected horse. Most cases of human transmission from horses are in developing countries.

In Egypt, regarding human brucellosis, Hussein *et al.* (2005) examined 7154 patients at Assiut Fever Hospital examined for *Brucella* antibodies by slide agglutination test and ELISA-IgM and IgG. They found

that brucellosis infection was higher in patients from the rural areas (1.3+/-0.005% and 1.25+/-0.009%) than from urban ones (1.23+/-0.001% and 1.12+/-0.01%) as diagnosed by both agglutination test and ELISA, respectively, and that the prevalence varied significantly between different occupational and age groups. Afifi *et al.* (2005) showed that the distribution of brucellosis was similar in both rural and urban settings in all parts of Egypt. Fadeel *et al.* (2006) in the NAMRU-3 examined sera from patients with AFI at 13 fever hospitals across Egypt between 1999 and 2003. They found that the sensitivity and specificity of ELISA for total specific antibodies were >96% versus 87% for TA as compared to the current gold standard method for *Brucella* microbial culture. Assessment of *Brucella* antibody classes by ELISA in random subsets of the 5 groups showed significantly high (p>0.001) levels of anti *Brucella* IgG (>81%) and IgM (>90%) in groups I and II only. They concluded that ELISA was more suitable for AFI surveillance and clinical settings than blood culture and TA, as being cost-effective, easier to use, faster, and the coated plates can be stocked for at least 8 months, providing a potential for field use and automation.

Meky *et al*. (2007) in Alexandria found that working with animals, breeding goats and eating ice cream bought from street vendors were significantly associated (P< 0.05) with brucellosis by univariate and multivariate analysis. Contact with infected animals and their products was the most important means of transmission. Jennings *et al*. (2007) in Al Fayoum Governorate conducted population-based surveillance for acute febrile illness (AFI)) among all hospitals and a representative sample of community healthcare providers. AFI patients without obvious etiology were tested for brucellosis by culture and serology. Of 4490 patients 321 (7%) met brucellosis case definition. The estimated annual incidence per 100000 populations was 64 and 70 in years 2002 and 2003, respectively. The median age of brucellosis patients was 26 years and 70% were male; 53% were initially diagnosed as typhoid fever. They added that close contact with animals and consumption of unpasteurized milk products were associated with brucellosis. El Sherbini *et al.* (2007) in Gharbia Governorate examined 616 inhabitants (aged 3-75 years) and 350 livestock of 97 households in two villages. Positive sera were 0.0 & 1.7% in man and 0.0 & 16% in livestock, respectively. The calculated sero-prevalence considered the clustering of brucellosis within households was 0.03 for man and 5.2 for livestock. The village variable (P=0.07) and keeping sheep indoors (P=0.01) were significant risk factors for human brucellosis, whereas only the village was significant for livestock (P<0.001). Sheep gave the highest brucellosis positivity among livestock, without detected association between human and livestock brucellosis.

El Kholy *et al.* (2009) found that PCR positivity increased significantly with the increasing seropositivity titers by using the standard tube agglutination test and reported that 100% positivity were in the patients with positive blood cultures. They recommended the PCR as a best alternative to brucellosis culture. Mansour *et al.* (2009) reported the first case of Egyptian *Brucella* meningitis. Fadeel *et al*. (2011) in NAMRU-3 compared ability of four commer-cially available ELISA kits (Bioquant, IBL, Vircell, and Euroimmun) to diagnose brucellosis in patients from Egypt and the United States. The sensitivities for all kits tested, except Vircell, were greater than 90% while specificities were variable with the Bioquant assay having a specificity of less than 40%. Detection of IgG antibody was more sensitive than IgM antibody for diagnosing brucellosis cases but specificity was comparable. Overall, there was good agreement between all of the kits except Bioquant. They concluded that no diagnostic assay was 100% reliable for brucellosis; serology

should be considered in tandem with patient history, clinical signs, and other test results. El-Metwally *et al.* (2011) examined 329 attendances of the out-patients clinics of Al-Azhar and Ain Shams Universities Hospitals and Giza Governorate farmers for brucellosis. The patients were 213 (64.75%) working in dairy farm and/or consumed raw milk, 16 (14.85%) used home slaughtering of sheep, and 100 (30.4%) were working in Giza Government Slaughterhouse. Clinically and by ELISA-IgM 259 of 329 were proven brucellosis patients (77.8%). Others had schistosomiasis *mansoni* or toxoplasmosis, or fascioliasis. They reported that signs and symptoms of brucellosis patients were fever (91.5%), chills (84.1%), Myalgia (69.5%), headache (58.2%), fatigue (77.2%), anorexia (54.1%), tachycardia (38.6%), hepato- and/or splenomegaly (46.2%), lymphadenopathy (19.6%) lower back abdominal pain (8.8%) and/or constitutive symptoms (13.1%).

In Egypt, regarding non-human brucellosis, Salem and Mohsen (1997) experimentally considered fish as a susceptible species to brucellosis (*B. melitensis biovar*) and suggested the possibility of zoonotic transmission. Samaha *et al.* (2009) compared brucellosis sero-prevalence in cattle with respect to breed, age, and sex, and in humans with history of contact animals. The prevalence in more-than-1-year-old cattle was significantly higher than in less-than-1-year-old cattle. Total sero-prevalence in humans' brucellosis ranged from 5% to 8%, without seasonal significant differences. Hegazy *et al*. (2011) used a spatial scanning method to identify areas with significantly higher proportions of seropositive flocks and milk tanks. 12.2% of sheep and 11.3% of goats were positive against *Brucella* spp. and 12.2% and 12% of cattle and buffalo milk tanks had antibodies against *Brucella* spp. They stated that brucellosis was endemic at high levels in all ruminant species in Kafr El Sheikh Governorate. The high intensity of infection transmission among ruminants combined with high livestock and human density and widespread marketing of unpasteurized milk and dairy products may explain why Egypt has one of the highest rates of human brucellosis worldwide.

Coxiella burnetii: *C. burnetii,* the etiologic agent of Q fever, is a worldwide zoonosis. The most common animal reservoirs are goats, cattle, sheep, cats, and occasionally dogs or horses. 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 serosurvey of horses in Uruguay found a positive rate of 5.5% in 1979 and 21.7% in 1985 (Marrie, 2003). Q fever (Australian Q fever or Balkan influenza) caused by C. *burnetii*; is worldwide zoonotic disease in Australia, America, Asia, Africa and parts of Europe (Craig and Edward, 1998). It has been reported in Egypt (Wilson, 1991). *C. burnetii* is endemic in Mediterranean area and has a wide range of hosts; cattle, sheep, goats, pigs, horses, camels, buffaloes, dogs, cats, pigeons, ducks, geese, fowls and turkeys (Fenga and Pugliese, 2013). Street dogs and cats were considered as sentinel animals for monitoring of *C. burnetii* in surrounding house-hold environment, livestock and stray wildlife (Zborowsky and, Hellmich, 2011).

The clinical presentation of Q fever varies per host species. *C. burnetii* infection in animals is mainly asymptomatic except for pregnant ruminants in which abortions and stillbirth can occur. In humans, the disease is also mainly asymptomatic, but clinical presentations include acute and chronic Q fever and the post-Q fever fatigue syndrome. Knowledge of the pathogenesis of Q fever in animals and excretion of *C. burnetii* in infected animals is crucial in understanding the transmission routes and risks of human infection: A self-limited flu-like illness Pneumonia Hepatitis. Chronic infection

most commonly involves the heart as endocarditis (Roest *et al*, 2013).

In Egypt, Hoogstraal *et al*. (1967) reported *Rickettsia conori, R. prowazeki*, and *Coxiella burneti* infections in rodent hosts and their tick-vector. Mazyad and Hafez (2007) reported antibodies against *Coxiella burnetii* were estimated among sheep, goats and camels (190), their owners (150 patients with pyrexia of unknown origin) and 30 normal individuals in North Sinai over the 2006 by indirect immounofluorescence assay. Nested polymerase chain reaction was used to detect Com-1 gene (genetic target of *C. burnetii*) encoding a 27-kDa outer membrane protein in the samples. *C. burnetii* IFA antibodies (IgM & IgG) in patients were 8 (5.3%) and a healthy control (3.3%). The overall was 9 of 180 (5.0%). *C. burnetii* IgM were detected in 3/150 (2%) patients with positive genome, while IgG were detected in 5/150 patients, only the three who had IgM and IgG had positive genome suffered high fever. *C. burnetii* antibodies were detected in 20 (22.5%), 12 (16.8%) & 4 (13.3%) of sheep, goats, camels, which total 36/190 (18.9%).

Mosquito-borne disease: Among the mosquito-borne encephalitis viruses, the greatest public health threat in North America are posed by the West Nile, St. Louis encephalitis, and La Crosse encephalitis viruses (show table 1). Venezuelan equine encephalitis virus is of concern in Central and South America, while Japanese encephalitis virus affects persons living or traveling to parts of Asia. Dengue is a rare cause of encephalitis throughout the tropical world (Deresiewicz *et al*, 1997). Among the tick-borne viruses that cause encepha-litis, tick-borne encephalitis virus has the greatest public health impact worldwide and is of concern to residents of or visitors to northern parts of Eastern Europe and Asia. Powassan virus is a rare, tick-borne cause of encephalitis in the northeastern United States, eastern Canada, and Russia (Erwin *et al*, 2002). Horses can be infected by Eastern, Western, or Venezuelan equine encephalitis virus or West Nile virus (Burgueño *et al*, 2013). However, although both human and horses may develop encephalitis from each of these agents, infection with Eastern and Western equine encephalitis (EEE and WEE) and West Nile virus results in low or undetectable levels of viremia, thus these hosts do not serve as reservoirs for further spread of the virus. The horse, however, acts as a reservoir of disease for Venezuelan equine encephalitis (VEE) virus (Pisano *et al*, 2013). WNV, a member of the Japanese encephalitis virus antigenic complex, was first isolated in a blood sample in a patient from the West Nile province of Uganda in 1937. This RNA virus was initially considered of minor public health importance (Gubler, 2007).

In Egypt, Mohammed *et al*. (1970) examined acute blood samples from 120 children, attending the fever hospital in Alexandria and complaining of fever for the HAI and CF antibodies against arbovirus antigens; Sindbis, West Nile (WN), Yellow fever, Dengue 1, Sand-fly fever, Quaranfil, Chenuda and Nyamanini. Positive reactions were only detected against Sindbis (4.3%) and WN (4.3%) antigens. The convalescent sera obtained from 48 of these children showed a pronounced HAI titer against WN antigen in 14.6% of them. The same sera showed a lower titer against yellow fever antigen (Asibi strain) which is due to cross-reaction between the two viruses. None of the acute or the convalescent sera showed CF antibodies against Quaranfil, Chenuda or Nyamanini antigens.

Darwish *et al*. (1987) stated that fever and myalgia are non-specific clinical manifestations of illness which commonly occur in patients with arboviral disease. Such illness is often mis-diagnosed as "influenza". They examined sera samples of 55 patients with fever and myalgia, acute and convalescent in Imbaba Fever Hospital, Giza. Based on viral isolation, and clinically, 4 patients (7%) had acute arboviral infections. Hemagglutination inhibition and IFA tests showed that one had

WNV infection, 2 had sand-fly fever virus-Naples (SFN), and 1 had sand-fly fever virus-Sicilian (SFS) infection. SFN was isolated from the acute serum sample of 1 of the 2 patients with SFN infection.

Corwin *et al*. (1992) estimated arboviral, rickettsial, and Hantaan viral antibody in schoolchildren (8- 14 years) from 4 villages in Bilbeis district of the Nile Delta. The antibody prevalence was 9% for Sicilian sand-fly fever, 4% for RVF, 3% for WNV and 9% for Hantaan (HTN) virus. Antibody was found among 22% (93/418) of the same study subjects against *Coxiella burnetti*, 53% against *Rickettsia typhi*, and 37% against *R. conorii.* Corwin *et al*. (1993) also examined blood samples from a total 915 persons representing 190 study households. Enzyme immunoassay testing showed that the overall prevalence of IgG antibody was 4% to sand fly fever Sicilian (SFS), 2% to sand-fly fever Naples (SFN), 15% to RVF, 20% to the WN, and 4% to Hantaan (HTN) viruses. Antibody was found among 32% of the same study subjects to *C. burnetii*, 58% to *R. typhi*, and 32% to *R. conorii*. None was in population less than seven years of age and in only 3% of those 7-12 years old. But, 26% of the study population 13-19 years old, who were young children and infants at the time of the outbreak, Geometric mean titers (GMT) ranged from 139 for C. *burnetii* to 1,305 for RVF, and did not vary significantly by age, except for high titers for RVF in the 20-49-year-old age group.

Abbassy *et al*. (1993) reported WN virus was detected for three and four days after feeding in *A. persicus* and *A. hermanni*, respectively, and decreased to undetectable levels in both species. When dose was increased to 10 (6.2), virus was detected until days 6 and 8, respectively. In *A. arboreus*, virus titers in whole tick homogenates reached a peak of 10 (4.0) on the 4th day post-feeding and remained constant at 10(3.0) after day 6 throughout the 20- or 50-day observation periods. No evidence of transstadial transmission from nymph to adult was detected. Larvae from experimentally infected females successfully transmitted virus to clean chicks and virus was recovered from F1 larvae. Virus was present in coxal fluids secreted by infected females after infective meals. They concluded the demonstration of the WN virus infection in experimentally infected *A. arboreus* ticks and documents horizontal and vertical transmission.

Darwish *et al*. (1996) evaluated three serologic tests for WNV detection. ELISA showed 45% while HI and IFT indicated 37.6 and 26.4% positive sera among the tested 178 sera taken from the flooded village, respectively. The positive predictive values for the 3 tests were more than 80% while the negative predictive ones were different for these tests: 66.7% for ELISA, 44.1% and 37% for HI and IFT, respectively. They concluded that for screening of population in an endemic area, started with ELISA (the more sensitive) followed by HI and/or IFT.

El-Esnawy (2001) examined Egyptian workers at sewage treatment plants (STPs) work and lives in areas, which are highly infested with arthropods. Most of these diseases cause, febrile, influenza like illness, headache, backache, abdominal pain, and fatigue. To determine arboviral etiology in those workers, 264 serum samples were obtained from the workers in four STPs during January and October 1999. ELISA was performed for IgG & IgM, to detect the WN, Sindbis (SIN), Rift Valley fever (RVF), Sand-fly Naples (SFN) and Sand-fly Sicilian (SFS) viruses. The results showed that (WN) has highest prevalence (143/264, 54.14%), followed by (SFN) (58/264, 21.97%) then (RVF) (23/264, 7.95%), while, only one recent infection for each of RVF, SFS and SFN (1/264, 0.38%) and 3 persons for SIN viruses. Out of the four STPs Helwan workers' exhibited the highest infection rate for most of the studied arboviruses WN, SFN, SIN and SFS.

Turell *et al*. (2002) isolated 33 virus isolates from 36,024 mosquitoes. Viruses were initially identified by indirect fluorescent antibody testing and consisted of 30 flaviviruses (all members of the Japanese encephalitis complex, most probably WN virus and three alphaviruses (all members of western equine encephalitis complex, most probably Sindbis). The identity of selected viruses was confirmed by reverse transcriptase-PCR and sequencing. *Cx. antennatus* and *Cx. perexiguus* accounted for five (17%) and 23 (77%) of the WN virus isolations, respectively, RVF virus was not isolated from these mosquitoes.. They concluded, that one must remember, that even during a known arbovirus outbreak, other arboviruses might still be circulating and causing disease.

Soliman *et al,* (2010) found WNV actively circulatied in different areas in Egypt and causing febrile illness in a considerable proportion of individuals in the study sites. Kropman *et al*. (2012) in the Netherlands reported a 44-year-old female presented with fever and a flaccid paresis of the left leg, following a holiday in Egypt. Prevalence and distribution of huge species mosquito-vectors allover Egypt was reported (El-Bashier *et al*, 2006; Mikhail *et al*, 2009; Shoukry and Morsy, 2011; Morsy, 2012). El-Bahnasawy *et al*. (2013) gave an overview of the current understanding flaviviruses mainly WNFV. Primary care physician and senior nurse should be able to include the disaster diseases in differential diagnosis of various clinical conditions, and should take a thorough history to request specific dependable laboratory test(s) as soon as possible, and positive patient should be transferred to the fever hospital.

Equine encephalitis: Large outbreaks of Western equine encephalitis in humans and horses occurred in the western United States in the 1950s and 1960s. However, a declining horse population, equine vaccination, and improved vector control have reduced the incidence of the disease. Infection of avian species results in a viremia of sufficient magnitude and frequency to maintain a reservoir of infected mosquitoes. Infection of horses causes low level viremia and thus the horse is not a reservoir of WEE or EEE virus (Gibbs, 2005).

In contrast, horses serve as the primary amplification hosts for Venezuelan equine encephalitis (VEE) virus without which there would be little human disease (Perri *et al*, 2003). Effective prevention of both human and equine disease can be accomplished by immunizing equines. Mosquitoes are required as a vector for human transmission. VEE has a widespread geographic distribution from Florida to South America (Carrara *et al*, 2007).

The mosquito or tick becomes infected when feeding on the blood of the viremic animal. The virus then replicates in the mosquito or tick tissues, ultimately infecting the salivary glands. The mosquito or tick transmits the virus to a new host when it injects infective salivary fluid while taking a blood meal (Erwin *et al*, 2002). Human disease occurs after an incubation period of one to six days, and is heralded by a brief febrile illness of sudden onset, accompanied by malaise, nausea or vomiting, headache, and myalgia. Less than 0.5% of adults and less than 4 percent of children develop encephalitis, characterized by nuchal rigidity, seizures, coma, and paralysis. Long-term sequelae and fatalities are uncommon. In Egypt Badiali *et al*. (1966) gave a preliminary report on rabies in suspected equine encephalomyelitis cases. Abdel-Gawad *et al*. (2014) reported equine herpesvirus type 1 (EHV-1) was detected in an Indian rhinoceros (*Rhinoceros unicornis*), which was euthanized because of severe neurological disease.

Saliva transmission: Saliva can transmit and contaminate bite wounds, skin abrasions, or mucous membranes.

Rabies: Rabies is a preventable zoonotic disease. The etiologic agents are neurotropic RNA viruses belonging to the Family Rhabdoviridae, Genus Lyssavirus. In addi-

tion to the type species, rabies virus, at least 10 other rabies-related viruses can cause fatal encephalitis that is clinically indistinguishable from classical rabies, and formal inclusion of additional lyssavirus members is anticipated (WHO, 2005). Almost all cases of rabies are transmitted from rabid animals through a bite. In rare cases, rabies results from a non-bite exposure (e.g., aerosolized virus) or transplantation of tissue from a donor with unrecognized rabies (Davis *et al*, 2007). The clinical diagnosis of rabies is straightforward in developing countries when a nonimmunized patient presents after a bite by a known rabid animal. In developed countries, some patients may have an unrecognized exposure (e.g., to a bat) or are unaware of the risks of exposure and did not receive postexposure prophylaxis (Jackson, 2005). Laboratory diagnosis of rabies requires several specimens (e.g., saliva, skin, serum, CSF) and multiple testing modalities, since the sensitivity of any single test is limited. Serum antibody titers, for example, may not test positive until rather late in the course of illness, if at all. However, the sensitivity of the combination of tests approaches 100%, depending upon specimen quality, timing of collection, and diagnostic expertise. Virus shedding can be intermittent; as a result, serial samples should be obtained (Dacheux *et al*, 2008). Although rare, horses can become infected and die with rabies (Feder *et al*, 1988). Human rabies is rare in the United States, with only 47 cases reported between 1990 and 2005 (Potter *et al*, 2007). 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 (Rupprecht *et al*, 2002).

Aylan *et al*. (2011) stated that rabies is a threat in all parts of the world where animal reservoirs persists, including Eastern Europe and the Middle East. Rabies experts from seven Middle East and Eastern European countries (Croatia, Egypt, Georgia, Iran, Serbia, Turkey, and Ukraine) met for two days in Istanbul, Turkey (June 8-9, 2010), to exchange information on the epidemiological situation concerning human and animal rabies in their respective countries and to discuss strategies for rabies elimination and control. They added that in Egypt, animal rabies is present both in urban areas and rural settlements. Stray dogs are the main transmitters to other animals and humans. The situation has been stable for the last 10 years with an annual number of 80 human rabies cases.

On the other hand, equines act as animal hosts for many diseases endemic in Egypt.

Fascioliasis *F. gigantica* and *F. hepatica* tops all the zoonotic helminthes worldwide.

Haridy *et al.* (2002) carried out a preliminary coprologic examination of donkeys and horses in eight centers of Gharbia governorate. The overall rate in donkeys was 3.03%, in horses was 1.5%, and in mules 0.0%. Horses 2/74 (2.70%) and 1/26 (3.86%) were infected in Zefta and El Mahala El Kobra centers respectively. None of the horses was infected in other six centers. On the other hand, donkeys showed infection rates of 4.6%, 7.6% and 9.09% in the centers of Santa, Zefta and El Mahala El Kobra respectively. They concluded that according to population density of donkeys and horses in Gharbia governorate, donkeys represent the 4th rank in number. So, donkeys and to a very less extend, horses should be considered within the preventive and control measures of zoonotic fascioliasis. Morsy *et al.* (2005) in Tamyia Center, Al-Fayoum Governorate, examined some farm animals for natural infection with *Fasciola* species. The results showed 40% infection in sheep, 20% in buffalos, 6.7% in donkeys and zero% in horses. Haridy *et al*. (2007) postmortum examination of 88 donkeys used as gargantuan meal in the Zoo at Giza revealed

hepatic fascioliasis in 15 (17.05%). Anti-F*asciola* antibodies by ELISA showed positivity in 12/15 with crude worm antigen, and positivity in 14/15 with locally prepared *Fasciola* excretory-secretory (Fges) antigen.

Toxoplasmosis: *T. gondii* is one of the important zoonotic parasites of worldwide. El-Ghaysh (1998) Menoufia Province reported ELISA *T. gondii* antibodies in 121 adult donkeys. Shaapan and Ghazy (2007) inoculated Portions of heart, liver, skeletal and diaphragmatic muscles obtained from 150 slaughtered horses at Giza-Zoo abattoir to mice and cats. *T. gondii* tachyzoites were isolated successfully from the peritoneal exudates of mice 6-8 days post inoculation with pooled horse tissues. *T. gondii* tissue cysts containing bradyzoites were detected in the impression smears of mice brain about 45th days post infection. The oocysts were detected in feces of cats 3-6 days post feeding on horse tissues containing tissue cysts, which were sporulated within 3-5 days in 2.5% Potassium dichromate. A total of 79/150 horse meat samples were infected with an incidence rate of 52.6%. Ghazy *et al*. (2007) used crude antigen of *Toxoplasma gondii* tachyzoites from horse tissues (LA) to detect antibodies in horses, which showed good diagnostic efficiency (38.1%) by ELISA. To increase this efficiency, two fractions were obtained from LA by CNBr-Sepharose 4B affinity column chromatography named; unbound (LAunb) and bound (LAb). LAb showed the highest diagnostic potency (51.7%), while LAunb showed the lowest one (31.7%) using ELISA. The electrophoretic profile of LA (12 bands), LAb (6 bands) and LAunb (6 bands) showed molecular weights from 25.1 to 184.3kDa. The immunoreactive bands of each of the three antigen were identified with infected horse sera by immunoblot assay. Four immunogenic bands of 155.8, 115.1, 83.2 and 66.2kDa were identified in LAb and probably were responsible for the highest diagnostic potency. Examination of horse sera by IFAT at a dilution of 1: 64 and Modified Agglutination Test (MAT) at a dilution of 1: 25 revealed that 170 (40.5%) and 202 (48.1%) had antibodies against *T. gondii*, respectively. Haridy *et al*. (2009) examined draught horses (3-15 years) including 90 males and 10 females in the first half of the year 2009 *T. gondii*. The overall ELISA-antibodies were 25% in Greater Cairo, 50% (females) and 22.2% (males). Haridy *et al.* (2010) in greater Cairo examined 75 females & 25 males aged between 3-10 years working donkeys, ELISA antibodies of *T. gondii* found 45/100 (45%), also milk obtained from 7/15 (46.3%). females were positive.

Echinoccocus granulosus causes hydatid cysts in man and animals. Haridy *et al*. (2008) macroscopically and microscopically reported hepatic hydatidosis in 17 out of 160 slaughtered donkeys**.** Aboelhadid *et al*. (2013) on post-mortem inspection at the zoo of Beni-Suef examined 145 donkeys for hydatid cysts. Ten had hydatid cysts; mainly in their livers. Molecular identification they were *Echinococcus equinus* (G4 genotype). An alignment of ND1 and CO1 partial nucleotide sequences with G4 partial nucleotide sequences revealed replacement of G at position 105 with A and replacement of A at position 276 with G respectively. It can be concluded that the donkeys involved in this study were harboring *E. equinus*.

Other reported cases: Morsy *et al.* (2001) in Aswan District reported *Tabanus taeniola* and *Haematopota minuscula* were trapped on camels and equines at daytime during summer of 2000, they added that many species of *Tabanus* and few species of *Haematopota* were reported before in Egypt. Of zoonotic interest was the detection of *T. evansi* in a worker caring for camels as indicated by *T. evansi* ELISA-antibodies and the presence of *T. evansi* in stained blood smears, the human case was successfully treated as indicated clinically, parasitologically and serologically (Haridy *et al*, 2011). Abo-Shehada *et al*. (1999) in Jordan reported that *T. evansi*-infected camels and horses showed all the clinical signs known for Sur-

ra and that all infected camels stared at the sun. Berlin *et al*. (2010) reported an outbreak of trypanosomoasis caused by *T. evansi* involving horses, camels and donkeys occurred in a farm in Israel. Most of the camels on the farm (8/10; 80%) were diagnosed with *T. evansi* infection whereas infection was less prevalent in the horses (3/7; 43%) and donkeys (6/13; 46%). Recurrence of infection was documented in one camel 4 months post treatment. Berlin *et al*. (2012) reported that seroprevalence of *T. evansi* in the Arava and Dead Sea region was 6.5% (9/139) in the first sampling compared with 4.1% (5/122) in the second, whereas the prevalence of RDB-positivity was 18.7% (26/139) in the first sampling and only 0.8% (1/122) in the second. All horses were asymptomatic except for one horse from the Arava and Dead Sea region that demonstrated clinical signs of surra combined with positive serology and RDB. They concluded that surra should be considered an important differential diagnosis in horses and other domestic animals in Israel with chronic weight loss, edema or neurological signs.

Farah *et al*. (2003) used twenty-three blood samples; five from five naturally infected horses with *Babesia equi*, and eighteen from asymptomatic horses with equine babesiasis from different localities in Egypt. All samples were subjected to microscopic examination, IFA and PCR. The carrier animals were microscopically detected in 7 out of 18 samples (38.8%) and in 9 of 18 by using IFA (50%), whereas PCR revealed that 14 samples were positive (78%). Two synthetic oligonucleotide primers, based on the *B. equi* merozoite antigen gene (EMA-1) were used. A 819 bps DNA fragment is specifically amplified from the gene encoding EMA-1 of *B. equi.*

Marzok and Desouky (2008) in seven donkeys reported a unilateral eye showing motile white worms in the aqueous humor, which were surgically removed from the eye anterior chamber of the in five of them.

Morsy (2008) by ultrastructure illustration reported some pathological pictures of *Gastrodicus aegyptiacus* in Egyptian horses

El-Seify *et al.* (2010) in postmortem examination of 54 adult donkeys slaughtered for the carnivore animals in Kafr El-Sheikh Zoological Garden, reported *Dictyocaulus arnfieldi* in their lungs.

Conclusion

Human communities often are an inadvertent source of food, water, and other resources to native species of animals and birds. Many people worldwide particularly in the developing countries utterly dependent on horses, donkeys and mules, there is nothing more important than caring for these group of animals that allow human welfare to work, families to carry on their life

Undoubtedly, the interrelationships among people in gregarious species can have profound effects on the animals' behavior, physiology, health and role as reservoir of zoonotic diseases. Captive housing should address the social needs of such species because failure to do so can result in the development and expression of abnormal behavior. Extensive work concerning the zoonosis from birds and animals other than dogs, cats and equines is in ongoing and will be published in due time elsewhere.

There are no general rules applicable to all social species, however. Determining the social conditions needed for members of any animal species requires an ethological approach that evaluates the sensory, cognitive, and ecological characteristics of animal and considers those characteristics in the design of captive housing, research and control. One must remember what God Said “And (He made) horses and mules and asses that you might ride upon them and as an ornament; and He creates what you do not know (Hallowing Quran 16:8)”

Additionally, all over the world people of humane societies should consider well treating of domestic animals through following

them up and treating infected ones with any sort of parasites or different pathogenic diseases. Protect your life by protecting domestic animal life.

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