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ZOONOTIC DISEASES FROM LIVESTOCK (SHEEP, GOATS, CATTLE, RABBITS) OR PETS (GUINEA PIGS, SOME BIRDS, FISH): A REVIEW

By

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Abstract

Generally, the wildlife health assessments help in identifying populations at risk of starvation, vector-borne infectious diseases, declining from anthropogenic impacts on natural habitats. Pets have the power to change the owners' lives. Pets make families, communities and even humans' health and happier. Studies showed those pets' owners, or even having contact with animals, benefit their physical, social and mental health. Nevertheless, many zoonotic diseases and arthropod-vector are risky to their owners, particularly children. This article reviewed several concepts that have taken shape in recent decades and discuss how these apply to common patient concerns with sheep, goats, cattle, and rabbits, as well as Guinea pigs, some birds, and fish.

Key words: Domestic animal, Pets, Benefits, Zoonosis, Prevention, Treatment.

Introduction

Pets serve valuable social roles in the society (Anderson *et al,* 1992). They may lower blood pressure, reduce cholesterol and triglyceride levels, and improve feelings of loneliness, by increasing opportunities for exercise, outdoor activities, and socialization (Parslow and Jorm, 2003). Pet ownership, mainly dog ownership, may be associated with decreased risk cardio-vascular disease (Levine *et al,* 2013). Despite these benefits, there have been multiple outbreaks of enteric disease associated with pets' exposure in public settings, such as county fairs, farms, and petting zoos (CDC, 2007). In 55 outbreaks, *Escherichia coli* O157 were 58% and *Salmonella* spp. were 22% (Steinmuller *et al,* 2006). In immunocompromised hosts mainly, pets cause zoonotic risks (Pickering *et al,* 2008). Home pets in Canada caused risky amounts of *Campylobacter* exposure than any other (Pintar *et al,* 2016).

Zoonosis from dog (Sabry *et al,* 2012), and cat (Sabry *et al,* 2013) as well as horses, donkeys and mules (Morsy *et al,* 2014) given. Nevertheless, Taha *et al.* (2024) in Egypt declared that the interest of keeping and rearing pets, mainly among youth and children, who consider pets as family members, increased in the last three decades.

Review, Discussion and Conclusion

A zoonosis is an animal disease transmissible to humans. Humans are usually an accidental host that acquires disease through close contact with an infected animal that may or may not be symptomatic. Many zoonotic diseases exposures occur at home through direct or indirect contact with the pets, agricultural animals, or feeder animals (Allen *et al,* 2001). People may acquire pet-associated zoonotic infections through bites, scratches or other direct contact of the skin or mucous membranes with animals, contact with their saliva, urine and other body fluids or secretions, ingestion of animal fecal material, inhalation of infectious aerosols or droplets and by bite of arthropods and other invertebrate vectors **(**Mani and Naguire, 2009).

Risk factors: The clinicians must ask about pets when taking a medical history and formulating a differential diagnosis (ACLAM, 2016). Abroad, the most common types of pets include dogs, cats, birds, small mammals, fish, reptiles and others (CDC, 2020).

Protection of most of these risks posed by pet ownership are good hygiene after handling pets, careful pet selection, proper pet care and vaccination (Hodgson *et al,* 2015). The new pets can pose more of a health risk, adult pets are generally safer than younger ones, since they are less likely to be involved in playful activities including scratching and biting, and children are at highest risk for infection, they are more likely to close contact with pets (Schmiedel *et al,* 2014).

Transmission of an extensive array of bacterial, viral, and parasitic zoonotic pathogens, including drug resistant organisms, pets occur by many routes (Meyer *et al,* 2012): 1- Infectious saliva that contaminate bite wounds, skin abrasions, or mucous membranes. 2- Hand-to-mouth transfer of microbes, and cysts, or oocysts (eggs) from an infected animal's feces. 3- Insect bites if vectors are indoors on pets, or if bites transmit disease from a pet, acting as a disease reservoir host, to humans. 4- Pets' fluids aerosol as respiratory secretions, and/or placenta. 5- Skin scratches. 6- Contaminated water or environment with pathogens in pets' urine. 7- Contaminated of any object put into pets' mouth e.g., pacifier (Weese *et al,* 2007).

Sheep, goats, and cattle: Parapoxvirus infected humans transmitted from these farm animals may present with an erythematous maculopapular lesion after an incubation of three to seven days (Leavell *et al,* 1968). The lesions usually occur at the inoculation site (fingers or hands) and evolve slowly over a course of four to eight weeks from a papule to a vesicle and then to an ulcer with subsequent crusting, affecting mainly people who come in direct or indirect contact with infected pets (as farmers, veterinarians). The disease is usually benign and self-limiting, although in many cases, especially in young animals, and can be persistent to fatality (Spyrou and Valiakos, 2015).

Parapoxvirus specific type varies by host; for example, of virus infection occurs in sheep and goats while bovine papular stomatitis virus occurs in cattle: 1-Parapoxvirus infection diagnosed in two deer hunters in the Eastern United States who were field-dressed white-tailed deer. One patient had resolution of a papulonodular cutaneous lesion on his finger without medical intervention; second was antibiotics treated (Roess *et al,* 2010). 2- Four cases in the United States were associated with goats and lambs slaughtering for religious observances and all incurred puncture caused cutaneous lesions (CDC, 2012a). Lesions characterized by epidermal hyperplasia with occasional cytoplasmic inclusions, prominent vascular proliferation, and mixed inflammatory-cell infiltrates (Groves *et al,* 1991). 3- *Coxiella burnetii,* the etiology of Q fever agent, is a worldwide zoonosis with goats, sheep and cattle, common animal reservoirs shed in urine, feces, milk, and/or birth products (Marrie, 2003). Saliva transmits, and contaminates bite wounds, skin scratch, or mucous membranes (Elliot *et al,* 1985). In humans, exposure results from contaminated aerosols inhalation from parturient fluids of infected mammals, on newborn animals' coats, or from the placenta.

Q fever patients may be asymptomatic or presented with one of three clinical pictures: 1- A self-limited flu-like illness, 2- Pneumonia, 3- Hepatitis (Honarmand, 2012) and 4- Fever endocarditis is the most commonest picture of chronic infection, usually among patients with valvular heart disease on background of tetralogy of Fallot surgical repair (Al Suqri and Al Brashdi, 2024).

Rabbits: Pet rabbits' zoonosis is rare (Chomel, 1992). Although they can contract and potentially transmit a variety of zoonotic pathogens with any one of them is unusual. Pet rabbits zoonotic pathogens are 1-Gastrointestinal: *Salmonella* spp., *Yersinia pseudotuberculosis*, and *Cryptosporidium* spp. transmitted by contaminated rabbit feces (Shiibashi *et al,* 2006). The HEV reported a significant proportion among rabbits, the source for human disease (Lhomme *et al,* 2013). 2- Respiratory: *Pasteurella multocida* colonizes and causes a respiratory disease (snuffles) or eye infections in rabbits (Rougier *et al,* 2006).

Although, *P. multocida* occurs in the animal breeders' oropharynx, and antibodies detected in their sera, but occupational disease was not reported (Donnio *et al,* 1994). 3- *Bordetella bronchiseptica* was isolated four times in 2.5 years from a 79-year old bronchopneumonia farmer patient contacted with rabbits (Gueirard *et al,* 1995). Studies reported that rabbits had clinical symptoms consistent with *B. bronchiseptica* respiratory infection and one symptomatic rabbit sacrificed led to organism isolation from the lower respiratory tract. 4- Neurologic: Rabies virus detected in pet rabbits contracted infection from wild animal (Kerr and Donnelly, 2013). 5- Cutaneous dermatophytes as *Trichophyton* (ringworm) are prevalent in rabbits on farms and skin infection transmitted to humans through direct contact with the rabbits' skin lesions (Skorepová *et al,* 2002). 6- Cheyletiellosis (by rabbit fur mite) caused a papular, pruritic eruption in man, although human infection was inability by mite to cause human skin disease (Parish and Schwartzman, 1993).

Wild rabbits: Zoonotic diseases more likely to cause human disease, by contact are the following: 1- *Tularemia* caused by *Francisella tularensis* and handling infected rabbits is one of the most common modes of infection in the United States from 2001 to 2003, an outbreak of human tularemia in Wyoming was temporally associated with rabbits' outbreak (CDC, 2005). 2- Wild cottontail rabbits on Nantucket Island, Massachusetts harbored human babesiosis (Holman *et al,* 2005). 3- Cottontail rabbits on Nantucket Island also harbored *Anaplasma phagocytophilum* agent of human granulocytic anaplasmosis (HGA), but its impact on human disease is unknown (Goethert and Telford, 2003).

Generally, to keep companion small mammal pets has increased worldwide in popularity (Schuppli *et al,* 2014). Rodents, including hamsters, gerbils, guinea pigs, mice, rats (including Gambian rats), and prairie dogs are becoming more common pets in the United States (Hill and Brown, 2011), as well as UK and some European Countries (Fenton *et al,* 2025). Since, they are valuable sources in biomedical studies of biological processes, disease pathogenesis, therapeutic interventions, safety, toxicity, and carcinogenicity (Cooper *et al,* 2021). Pet rats can transmit germs that make humans sick, but risk is lower than with wild rats. Diseases spread via contact with a rat's urine, feces, saliva, or ocular secretions or by bites scratch are the following: 1- Rat-bite fever, known as streptobacillosis, spirillary fever, bogger, and epidemic arthritic erythema infection is by urine or mucosal secretions or even nasal, fecal, or ocular secretes (Morsy *et al,* 2022). The rat bite fever is transmitted by rats, mice, and squirrels, a fatal case in a pet shop employee occurred after a superficial finger injury contaminated rat cage (Shvartsblat *et al,* 2004). Rat bite fever should be differentiated from meningococcemia, disseminated gonorrhea, Lyme disease, brucellosis, herlichiosis, rickettsial infections (Woods, 2013), ants allergy (Sanad *et al,* 2002), and insect bites (Morsy, 2012). 2- Leptospirosis or Weil's disease, a blood infection caused by bacteria *Leptospira* spp. can infect humans, dogs, rodents, and many other wild and pet animals (Lane and Dore, 2016). The risk for pet-associated leptospirosis is highest among pet rat owners, as wild rats are the main reservoir for *Leptospira icterohaemorrhagiae*, especially *L.* serovar (Dupouey *et al,* 2014). 3- Hantavirus is a life-threatening zoonotic disease characterized by lung edema, hypoxia, and hypotension, starts as vague flu-like symptoms or can cause hemorrhagic fever and renal syndrome (Toledo *et al,* 2022), in Europe infection was associated with pet rats (Jameson *et al,* 2013). 4- Salmonellosis, the first human outbreak was from pet rodents association due to multidrug resistant *S. enterica typhimurium* in patients and ill pet hamsters purchased from a Minnesota pet market (Swanson *et al,* 2007). 5- Tularemia, a three-year-old boy with tularemia was associated with a pet hamster bite (CDC, 2005). Pet prairie dog transmits tularemia (Avashia *et al,* 2004). Egyptian tularemia tabanid-ve-

ctors was reported (Morsy and Habib, 2001). 6- Rabies (Family Rhabdoviridae) from rodents rarely reported but in New York State, rabies was detected pet guinea pig (Eidson *et al,* 2005). Rabies is a preventable disease transmitted by a rabid animal bite, mainly dogs with human fatal rabies up to 99% of all humans' rabies; rabies affects cats and farm wildlife animals, such as bats, skunks, raccoons, and foxes, but without effective treatment (El-Bahnasawy *et al,* 2024). 7- Lymphocytic choriomeningitis (LCMV) is acquired by direct contact or aerosol from wild house mice are the 5% main reservoir (CDC, 2005). Pet rodents, such as hamsters and guinea pigs acquired LCMV by contact with infected mice (Barton and Mets, 2001). The LCMV is an important cause of aseptic meningitis with high morbidity during congenital and organ-transplant transmission, and the house mouse, *Mus musculus*, is the reservoir and human acquired infection bt exposure to aerosolized virus from mouse excreta (Gass *et al,* 2025). A large human LCMV outbreak was associated with pet hamsters sold by a single distributor in 1974, when 181 human cases detected in 12 states, without deaths (Gregg, 1975). A LCMV infection in organ transplant recipients was due to asymptomatic infected donor who had a pet hamster and LCMV was isolated from it (Trevejo *et al,* 2005). 8- Human cowpox infection primarily reported in Europe, and a young boy was infected from a sick pet rat in UK (Hönlinger *et al,* 2005). 9- Ringworm, *Trichophyton* spp. is the most common humans' zoonosis acquired from the rodents (Pollock, 2003). 10- Parasites by rodents mostly transmitted to children are teniasis and cysticercosis (*Hymenolepis nana,* and *H. diminuta*) causing nausea, vomiting, and diarrhea, with rats and mice are the suitable reservoirs host of *H. diminuta* (Khan *et al,* 2021). 11- Sarcoptic mange mite (*Trixacarus caviae*) causes humans' pruritic skin lesions (Nath, 2016). Guinea pigs' *Trixacarus caviae* (usually asymptomatic), but infestation in immunosuppressed man and animal causes severe dermatological problems, as alopecia, intense pruritus, hyperkeratosis, and non-dermatological seizures (Deak *et al,* 2024). In Egypt, camphor oil treated human scabies (Morsy *et al,* 2003). 12- A pet rat digs a lot due to a natural, instinctive behavior to satisfy its needs for burrowing, foraging, and nesting (Ratuski and Weary, 2022).

Birds or backyard poultry (chickens, ducks, turkeys, and geese) have many kinds of external and internal causative agents, virus, bacteria, fungi, protozoa, helminths and arthropods (Bush and Clayton, 2018). The wild birds only, share in spreading of zoonotic West Nile virus, but Lyme disease is as dispersers of ticks borne *B. burgdorferi*, and enter pathogens, such as *Salmonella* and *Campylobacter* spp., by feeding on sewage and garbage, transmitting zoonotic agents to directly or by contaminated poultry operations (Reeds e*t al,* 2003). The most common pet-related avian bacterial zoonosis are *Chlamydia psittaci* (psittacosis or parrot fever), and *Mycobacterium avium* and *Salmonella* spp. in their gastrointestinal tracts, without zoonotic *M. avium or Salmonella* data (Thegerström *et al,* 2005). However, three salmonellosis outbreaks caused by contact with chicks and other baby poultry (ducklings, goslings, and baby turkeys) purchased at agricultural feed stores in the springtime (CDC, 2007). Birds may display clinical illness or may be persistent carriers, and human infection ranges from subclinical to severe with pneumonia (Hogerwerf *et al,* 2017). From 2004 to 2011, multistate outbreaks were more than 300 salmonellosis by *S. Montevideo* acquired from a mail-order hatchery of young poultry (Gaffga *et al,* 2012). Pet birds are susceptible to helminthes, protozoa, lice and mites (Mayer and Donnelly, 2012). Bayzid *et al.* (2022) in Bangladesh among 549 pet birds, helminthes were *Ascaridia, Capillaria* and *Heterakis* spp. and fewer *Choanotaenia* and *Raillietina* spp. The intestinal protozoa species were *Eimeria* followed by *Isospora* and *Caryospora* and blood protozoa species were *Haemoproteus, Plasmodium* follo-

wed by *Leucocytozoon.*

Nosanchuk *et al.* (2000) reported that fungus, *Cryptococcus neoformans* occurs globally in soil areas frequented by birds, especially as pigeons and chickens pass in excreta. Human cryptococcal disease (pneumonia or meningitis) associated with pet bird contact primarily in immunocompromised ones (Shrestha *et al,* 2004). CDC (2017) did not recommend screen healthy ones for *C. neoformans*. Zoonotic *Histoplasma capsulatum* is not by pet birds, as fungus growth was stimulated in bird droppings (Kayali *et al,* 2016).

Both pet and wild birds transmit avian influenza (Boseret *et al,* 2013). WHO (2016) in Egypt reported that 356 human avian influenza A (H_5N_1) cases from 9 March 2006 to 30 September 2016, with 121 deaths (case-fatality 34%). Egypt reported sporadic cases from the beginning of 2016; ten cases reported from 1 January 2016 to 30 September 2016, with four deaths (case-fatality 40%).

Pet fish are rarely associated with human infection, but fish-related human illness was from fish consumption, rather than pet owners (Adams *et al,* 1997)

Mycobacterium marinum: This causes fish tuberculosis and contaminates aquaria water housing infected fish. Humans develop *M. marinum*, or fish tank granuloma, when they sustain a minor skin injury while cleaning a fish tank (Decostere *et al,* 2024). Other atypical *Mycobacterium* species, mainly *M. fortuitum* and *M. chelonae,* cause a similar disease in fish and man (Kern *et al,* 1989). Zoonotic disseminated *M. marinum* infection in HIV/AIDS patients was infrequently reported (Streit *et al,* 2006).

Occupational exposure: Fish zoonoses are associated usually with fishermen exposure by spine puncture or open wounds include *Aeromonas hydrophila*, *Edwardsiella tarda*, and *Erysipelothrix rhusiopathiae* (Ziarati *et al,* 2022). A pet goldfish transmitted necrotizing fasciitis caused by *Erysipelothrix rhusiopathiae* was isolated from drainage (Simionescu *et al,* 2003).

Exotic pets: Zoonotic risks from exotic pets and wildlife used as pets are probably under-estimated, since they may be traded illegally (so, escaping standard surveillance systems), be fed exotic diets that may contain unusual pathogens, and harbor unknown pathogens. Public education on risks from exotic pet trades, bush-meat, and wildlife was necessary (Chomel *et al,* 2007).

Ferrets: The Egyptian weasel is a unique population of the least weasel endemic in northern Egypt, and listed as Least Concern on the IUCN Red List (McDonald and Hoffmann, 2016). They were associated with *Salmonella* and *Campylobacter*, and less commonly cryptosporidiosis (Rehg *et al,* 1988), as well as toxocariasis, tuberculosis, leptospirosis and listeriosis (Morris and Norman, 1950). *Mycobacterium microti* or vole tuberculosis was isolated from man's pet ferret (Cavanagh *et al,* 2002), and zoonotic giardiasis (Abe *et al,* 2005). Benign and zoonotic influenza were commonest by aerosols from infected ferrets, the influenza studies animal model (Langlois, 2005). Although not common, but ferrets vaccination against the two neurologic fatal viral diseases: canine distemper and rabies is necessary for the owners (Wade, 2018).

Hedgehogs: They have existed alongside ancient Egyptian people since the very earliest periods of sedentary settlement. Hedgehog bones were detected among human refuse at the earliest Neolithic sites of Merimde Beni-Salame in the Western Delta and Nabta Playa as well as Bir Kiseiba in Southern Egypt (Hamilton, 2022). In Egypt, genera *Hermiechinus* and *Paraechinus* with five species known as one so-called ‘long-eared hedgeh og’ and several desert species worldwide (Osborn and Ibrahim, 1980). Hedgehogs are small, nocturnal, spiny-coated insectivores become popular as the exotic pets (Hoefer, 1994). Hedgehogs pose risks for zoonotic and potential zoonotic viral, bacterial, protozoal, and mycotic diseases (Riley and Chomel, 2005). The Confirmed zoonotic diseases are 1- Bacteria: *Salmonella* spp. *Mycobacterium marinum* & *Yersinia pseudotubercu-*

losis. 2- Virus*:* Rabies, Herpesvirus, include human herpes simplex, 3- Mycotic: *Trychophyton mentagrophytes* var. *erinacei, Microsporum* spp. The potential zoonotic ones are 1- Bacteria: *Chlamydia psittaci, Coxiella burnetii, Yersinia pestis, Y. pseudotuberculosis, M. marinum.* 2- Virus: Arboviruses Tick-borne encephalitis, Crimean-Congo hemorrhagic fever, Tahyna virus, Bhanja virus, Paramyxovirus. 3- Mycotic: *Candida albicans.* 4- Protozoa (confirmed and potential zoonosis are *Cryptosporidium* spp. and *Toxoplasma gondii*. Hedgehog zoonotic transmit *Trichophyton mentagrophytes* (dermatophytes) causes a resolved spontaneously pruritic eruption within 2 to 3 weeks (Gregory and Engl ish, 1975). Humans' ringworm cases were associated with hedgehogs handling, within 1 to 2 minutes in a pet store (Rosen, 2000). El Bahnasawy *et al.* (2012) detected three human Crimean-Congo hemorrhagic fever cases, one in Almaza Fever Hospital and two in Gharbia Governorate.

Flying squirrels: Flying squirrels (*alsanajib altaayira*). They have several adaptations for gliding, including a furry membrane (patagium) that stretches between their wrists and ankles, a flattened tail that acts as a rudder and stabilizer, and a good sense of balance with flights recorded to 90 meters (Asari *et al,* 2007). They are in coniferous and mixed coniferous forests across much of Canada, from Alaska to Nova Scotia, and south to North Carolina Mountains & west to Utah in United States (Lu, 2012). Meyer and Rush (2024) in USA reported that they are the only vertebrate other than man and according to species, diets can includes seeds, fruits, leaves, flower buds, nuts, fungi, lichens, pollen, ferns, tree sap, insects, spiders, others, small birds, eggs, snakes and small mammals. McAllister *et al.* (2020) in USA reported that flying squirrels transmit leptospirosis, tularemia, Lyme disease, salmonellosis and Hantavirus and rare rabies by direct contact, contaminated urine or feces and/or ecto-parasites as lice, fleas, mites and ticks**.** There were many reports of human typhus by contact with wild flying squirrels or their nests, but none reported from pet flying squirrels (Reynolds *et al,* 2003). They also, harbor Staphylococci, *Rickettsia prowazekii* and *Toxo plasma gondii* (Duplantier *et al,* 2005).

Prevention or precautions: Preventive measures against acquisition of infection from animals generally include good hand-washing practices (Gammon and Hunt, 2019). Although petting zoos are common at public events, allowing the public to animals interact, there was minimal evaluation of practices at the petting zoos (McMillian *et al,* 2007). WHO (2009) has developed hand hygiene (HH) guidelines that outline the 'five moments' when HH is essential for protecting the healthcare worker (HCW) and patients. Pets transmit zoonosis to owners, but risk contact is low, and reduced by simple precautions (Stull *et al,* 2015): 1- Pets must regularly examined by a veterinarian to treat promptly for diarrhea and dermatoses, rabies vaccination is necessary. 2- Pets must feed high quality commercial food and neither eat raw meat nor eggs, or garbage, or feces, or hunt (Stasi *et al,* 2004). They must not be allowed to drink non-potable water, 3- Young pets cause a greater disease risk than older ones, as they are more likely to engage in playful nipping and biting, behavior in transmitting zoonotic pathogens, and 4- Owners must wash their hands after contact with pets and/ or cleaning cages. Miro *et al.* (2020) in Spain reported that health education recommendations provided by veterinarians, physicians, and nurses, to pet owners is the key to zoonosis control and reducing current parasitic prevalence in companion animals. Once more, apart from the pets' zoonosis, Mohamed *et al.* (2025) in Egypt reported that allergies or asthma caused by pet's fur, saliva, feathers or skin flakes (dandruff) zoonotic infectious diseases are usually from the poo, food, water or litter trays.

Measures to prevent disease in public settings: CDC (2011) recommended that organizers of public venues (e.g., state fairs, pet stores, circuses, child care facilities) should:

1- Prohibit food in animal areas, 2- Provide a transition between animal areas and non-animal ones, & 3- Share information about disease risk and prevention with attendees

Immunocompromised hosts and pets: Groups at high risk for serious infection from pets include persons with waning immunity (older adults); children less than 5 years old; and people who are pregnant, immunocompromised as HIV/acquired immunodeficiency syndrome without acting spleen, or on immunosuppressive therapy, or cognitively impaired (Glaser *et al,* 1994). To avoid zoonosis infection, people at higher risk should take particular precautions with any animal conact, thorough and frequent hand washing, the precautions might include avoidance contact with animals and their environment (as pens, bedding, and manure). Children, risk for exposure are reduced, if they are closely supervised by adults, carried by adults in animal areas, or animal contact only over a barrier. These measures discourage animals from jumping on or nuzzling children, minimize contact with feces, and soiled bedding.

Numerous reports exist of the transmission of zoonoses to humans during and after solid organ and hematopoietic stem cell transplantation (Kotton, 2007). Donor-derived infections from West Nile virus, Chagas disease, toxoplasmosis, rabies, lymphocytic choriomeningitis virus infection, and infection due to *Brucella* species reported. Most zoonoses present as a primary infection in post-transplant period; immunocompromised patients are more likely to suffer significant morbidity and mortality from these infections. Risks of zoonosis in transplant recipients are reduced by patient education.

The Panel on Opportunistic Infections in HIV-infected adults and adolescents has issued recommendations for HIV positive people who desire pet contact (Bisseru, 1967). The guidelines specify 1-When obtaining a new pet, HIV-infected persons should avoid animals aged <6 months or <1 year for cats (Robinson and Pugh, 2002), 2- HIV-infected persons must be cautious when obtaining a pet from pet-breeding facilities, pet stores, and animal shelters, because of highly variable hygienic and sanitary conditions, and avoiding stray animals. 3- HIV-infected persons should avoid contact with any diarrheic animal. HIV-infected pet owners must seek veterinary care for pets with diarrheal illness, and examined fecal samples for *Cryptosporidium*, *Salmonella*, & *Campylobacter*, 4- HIV-infected persons must wash their hands after handling pets, before eating, and avoid contact with pets' feces. 5- HIV-infected persons must avoid or limit contact with chicks and ducklings because of salmonellosis risk. 6- Gloves are necessary in cleaning aquarium to reduce the *M. marinum* infection risk. 7- Prevent contact with exotic pets of non-human primates.

Vaccination: Tetanus immune globulin and tetanus toxoid is necessary to all bite patients who have had two or fewer primary immunizations. Tetanus toxoid alone given to those who have completed a primary immunization series but who have not received a booster for >five years (CDC, 2012b).

Conclusion

Humans are usually an accidental host that acquires zoonotic disease via 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, parasitic, and viral zoonotic pathogens as well as prions can cause them. Acquiring diseases are by body fluids of an infected pet, by petting or touching, or bitten or scratched, or by touching areas where pets live and roam, or object or surface contaminated with the infective agents. Moreover, transmission is also by eating or drinking contaminated products.

Recommendations

Pets transmit zoonosis diseases to their owners, but risk transmission from pets is low, by regular veterinary supervises and reduced by simple precautions. A conceptual framework to improve design and to standa-

rdize wildlife health assessments are guidelines on experimental design, data acquisition and analysis, and species conservation planning and management implications.

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