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Artykuły przeglądowe

Parasitic zoonoses; public health and veterinary perspectives

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ABSTRACT. The importance of parasitic zoonoses continues to increase on both local and global scales as interactions between people and animals become more frequent through global travel, intensification of agriculture, habitat devastation, and changes in world trade patterns. A current and real threat is the potential for a deliberate introduction of a zoonotic disease through the prospect of bioterrorism. Parasitic zoonoses represent significant problems in public health, animal agriculture and conservation, and the meat industry. There is an urgent need for integration of medical and veterinary services, continuous disease surveillance in both humans and animals, the teaching of zoonoses to medical doctors, and intensified research on zoonotic agents and diseases. The convergence of both public health and veterinary services currently represents a real challenge for managing zoonotic diseases.

Key words: public health, zoonoses.

I. Factors responsible for local and global manifestations of parasitic zoonoses

Parasitic zoonoses are common and are increasingly being recognized as a significant public health threat in both local and worldwide scales [1]. The following factors enhance the transmission of zoonotic parasites and facilitate the re-emergence of old and emergence of new zoonotic parasitoses.

1. Advances in transportation technology have practically removed geographical barriers and allowed increased human contact with various species of animals in their natural habitats [2, 3].

2. Changes and ecological interventions into stable ecosystems have caused ecosystem disruption, habitat fragmentation and degradation, and ecological disintegrity [4, 5, 6, 7, 8].

3. Intensified contacts among animal species that did not interact spatially before and intensified association of humans with these animals through: (**A**) animal conservation and rehabilitation centers, national parks and wildlife reserves [9, 10, 11, 12, 13, 14, 15], (**B**) industrial animal production and concentrated animal feeding operations (CAFO) [15], and (**C**) increased urbanization, landscape fragmentation, free-ranging/farmed game species hunting, and bush-meat hunting [5, 8, 14, 17, 18, 19].

4. Locally and globally increased susceptibility of humans to various infectious agents resulting from: (**A**) the HIV/AIDS pandemics and its consequences [2, 8, 20], (**B**) advances in immunosuppressive therapy for cancer and organ transplant patients [3], (**C**) certain medical conditions, i.e., diabetes that increase susceptibility to infections, and (**D**) agricultural and industrial pollutants that impair the human immune system [3].

5. A significant shortage of donated human organs and medical advances in: (**A**) genetically engineered organs produced in animals, and (**B**) clinical xenotransplantation which significantly increa-

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ses potential for xenoses (= zoonoses acquired *via* xenotransplantation [21, 22], leading to generation of new pathogens [23].

6. The significant deficiency, i.e., proactive approach, in management of zoonotic diseases [24], (**A**) in the area of preventive medicine practices which is a result of poor understanding and recognition of the reservoir(s) of zoonotic parasites [3, 24, 25], and (**B**) lack of public knowledge on transmission of some parasitic agents [26].

7. A paucity of scientific data that make zoonoses poorly understood as a public health problem [27], and lack of integration between public health and veterinary services [2, 28, 29]. It is commonly assumed that veterinarians are responsible for animal and public health management with regards to zoonoses [13, 28, 30]. Consequently, symptomatic rather than etiologic diagnoses are made by clinicians, particularly in pediatric and geriatric populations, and this results in a considerably high number of non-diagnosed and misdiagnosed zoonotic diseases cases [31].

II. Factors responsible for increased public awareness of zoonoses

The public vigilance and awareness of health threats from zoonotic infections has significantly increased during recent years predominantly due to:

1. development of advanced molecular epidemiology techniques, i.e., PCR genotyping, DN fingererprinting, microarray chip technology, which are used for diagnosis and identification of parasitic agents, and for surveillance and epidemiologic investigations [2, 32];

2. enhancement of funding of research focused on infectious diseases as a direct effect of (**A**) bioterrorism threat, and (**B**) recognition of the importance of HIV pandemic [2, 8], and

3. advances in communication and dissemination of information on emerging and re-emerging diseases and universal electronic access to information and databases.

III. At the beginning

In 1967, the Joint FAO/WHO Experts Committee defined zoonoses as "*diseases and infections naturally transmitted between vertebrate animals and humans that present problems in a global scale and are no longer associated with rural or sylvatic environments"* [33]. The term anthropozoonoses is defined as infections transmitted from man to animals whereas the term zooanthroponoses has been applied to infections transmitted from animals to man [33]. Since then both terms have been used interchangeably in the literature which has generated a considerable confusion; and therefore, the term zoonoses is commonly preferred. Zoonoses are classified into parasitic zoonoses, i.e., protozooses, and

Table 1. Interactive World Wide Web (WWW) Sites on Zoonotic Infectious Diseases and Agents

Institution or *Journal*	WWW Site Address
Centers for Disease Control (CDC)	http://www.cdc.gov
Morbidity and Mortality Weekly Reports, CDC	http://www.cdc.gov/mmwr/mmwr.html
Emerging Infectious Diseases, CDC	http://www.cdc.gov/ncidod/eid/index.htm
Emerging/Reemerging Infections-EIIN Network	http://info.med.yale.edu/EIINet/infections/html
The World-Wide Web Virtual Library: Veterinary Medicine	http://netvet.wustl.edu/
National Foundation for Infectious Diseases	http://www.nfid.org/
Zoonosis References	http://medicine.bu.edu/dshapiro/zooref.htm
U.S. Department of Labor, Occupational Health and Safety Administration (OSHA)	http://www.osha.gov/SLTC/
Federation of American Scientists	http://www.fas.org/main/home.jsp
Pet Borne Zoonoses	http://www.fpnotebook.com/ID124.htm
Open Directory Project	http://dmoz.org/Health/Conditions_and_Diseases/Infectious_Diseases/Zoonoses/
Zoonoses Health Web Links	
Health and Medicine Website Directory	http://www.internet-health-directory.com/Conditions_and_Diseases_Infectious_Diseases_Zoonoses.html
Zoonoses	http://health.allfind.us/c/13bc3/
Clinical Web International Parasitic Diseases	http://medir.ohsu.edu/cliniweb/C3/C3.html
Ectoparasites and Endoparasites	http://www.soton.ac.uk/~ceb/EctoEndodirectory/parasiticzoonoses.htm
Parasitic Zoonoses Main Site: Academic Links	

metazooses (trematodoses, cestodoses, nematodoses, pentastomidoses, and arthropodoses); and microbial zoonoses, i.e., bacterioses, chlamydioses, rickettsioses and viroses; and fungal zoonoses, i.e., mycoses [33]. Obligate zoonoses include zoonoses transmitted from animals to humans and facultative zoonoses include zoonotic infections transmitted predominantly among people or among animals [32]. Epidemiologically, zoonoses are classified as: (**1**) directly transmitted, i.e., food-and-waterborne [33, 34], contamination-derived, transplacental-transmitted, and bloodborne; and (**2**) indirectly transmitted, i.e., vector-borne [4, 33].

Recent research in zoonoses is extremely dynamic. The amount of available information and the dynamics of new information on emerging and re-emerging zoonotic diseases make it difficult to present a comprehensive list, review, or an update. Therefore, it is suggested to consult electronically websites listed in Table 1 for recently updated information.

IV. Parasitic zoonoses as a threat in public health and veterinary medicine

It is important to emphasize that the last major human epidemics of infectious diseases have arisen from animals [35]. Human-parasite relationships are essential in the re-emergence and emergence of parasitic zoonoses [36]. Host-related factors include a variety types of immunodeficiencies that allow for the crossing of the species barrier by parasitic agents [36]. Also, the genetic predisposition of a host conditions infections in some individuals [36]. Parasite-related factors that promote zoonotic transmission include inter and intraspecific genetic variability that generates genotypes that are better adapted to infect humans [36, 37, 38].

Parasitic zoonoses represent significant problems in animal conservation and rehabilitation, animal agriculture, and the meat industry [28, 39, 40, 41, 42]. The competing conceptions of risk for zoonotic disease spread to people *via* food chain, a new approach proposed for animal agriculture, considers coping with risk and uncertainties related to transmission of zoonoses, microbial contamination of raw food products, and inactivation of zoonotic agents in waste management [26, 43]. The advantages of this approach rely on the recognition and characterization of these risks and subsequent development of proactive preventive practices [26]. In terms of managing zoonotic infections, animal conservation and rehabilitation are challenged with similar issues as the agricultural systems and the meat industry. However, vigilance against zoonotic disease in animal conservation and rehabilitation is maintained through industry and government-mandated sanitation standards, which are fortified by reporting duties to regional and federal health agencies [9, 13]. Therefore, animal conservation and rehabilitation will continue to be confronted, similarly as animal agriculture [26], with policy issues in the face of uncertainties related to zoonotic diseases and their prevention [9, 11, 13, 30].

Conservation of wild animals in their natural habitats represents a unique challenge for management of zoonoses [11, 14, 15, 44, 45]. Most zoonotic parasites, e.g., helminths, display three distinctive life-cycles, i.e., sylvatic, zoonotic, and anthroponotic [5, 7, 25, 46]. Thus, the pathogens eradicated from human and domestic animal populations, i.e., through anthelmintic programs, can survive in sylvatic habitats of national parks or wildlife refuges and then subsequently re-invade human and domestic animal reservoirs [5, 46, 47]. Most of the animal conservation operations are localized in underdeveloped and developing countries where public health policies and sanitation standards are not strongly executed and disease control activities are often inadequate or unavailable [31]. Therefore, many epidemiologic and public health aspects of zoonotic diseases in the areas of intensive and extensive animal conservation operations remain largely unknown [31, 45]. There are several modes of transmission of zoonotic parasites and pathogens specifically recognized in conservation and rehabilitation operations. These are as follows: (**1**) direct exposure and contact with animals through occupational and recreational contacts [15], (**2**) exposure to vectors, i.e., insects, ticks, transmitting zoonotic infectious agents, (**3**) consumption or exposure to animal products which include illegal access to meat and improper utilization of wildlife products [17], (**4**) environmental contamination, and insufficient or poor sanitation [14, 15, 16], and (**5**) unconventional transmission [41, 48].

Identification of the potential risk of zoonotic infections in animal conservation operations needs to be proactive in order for the development of successful and self-sustainable prevention programs [9]. Proactive identification of the zoonotic risk and the resultant development of the best preventive management practices should consider: (**1**) zoogeography of different climatic conditions [5], (**2**) socioeconomy [5, 49], (**3**) spatial and temporal characteristics

of infectious diseases and their vectors present at the particular area [5, 50, 51], and (**4**) feasibility and environmental safety of preventive measures [5, 52]. At the level of national park management there are specific issues related to wildlife conservation and ecosystem health, and the zoonotic potential of many diseases [44]. Fortunately for animal conservation operations, some of the zoonotic disease preventive practices developed for livestock and wildlife in animal agriculture, can be adopted (with or without modification). These include: (**1**) permanent surveillance of the disease and infectious agents [6, 29], (**2**) continuous education and special teaching focused on high risk groups [24], (**3**) large-scale baited vaccines and oral immunization of wildlife and feral animals against zoonotic agens [52, 53], (**4**) mass-treatment, i.e., immunization and anthelmintic actions, of livestock in areas adjacent to national parks and wildlife refuges [28], (**5**) appropriate husbandry practices, prophylaxis, therapy, vaccines, and quarantine that prevent rather than promote zoonotic diseases [30, 53], (**6**) anti-fertility or contraceptive vaccines for wildlife that reduce wildlife abundance and risk for zoonotic transmission [52], and (**7**) prompt execution of public health policies, disease control activities, and sanitation standards [24]. The future of conservation medicine in national parks will include the development of protocols for wildlife health monitoring and surveillance as well as evaluation of disease ecology issues related to zoonotic infections [44].

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