

EDITORIAL

STUDIES ON WILDLIFE WITH A SPECIAL REFERENCE TO PREVENTING EMERGING INFECTIOUS DISEASES (EIDs) IN THE 21st CENTURY

ESTUDIOS EN FAUNA SILVESTRE PARA PREVENIR ENFERMEDADES INFECCIOSAS EMERGENTES EN EL SIGLO XXI

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ABSTRACT

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Emerging Infectious Diseases (EIDs) represent a serious threat for the health of humans, wildlife and livestock. These diseases are caused by pathogens that have evolved multi-resistance against medications, or have increased their host and / or geographical range. As a result, millions of people have died in the last decades because emerging and re-emerging diseases such as malaria, tuberculosis and Ebola haemorrhagic fever. Socio-economic factors (e.g. urbanization, demographic factors) and environmental drivers, e.g., deforestation, invasive species and anthropogenic land use change, have facilitated the spread of EIDs. Many studies have focused on these diseases in the last half-century. Our understanding of epidemiology of EIDs and how to control their spread remains limited. Because wildlife is an essential component in the epidemiology of many EIDs, the study of pathogens in wildlife will be essential to identify underlying causes and to successfully develop policies and strategies to mitigate these threats.

Keywords: deforestation - invasive species - malaria - parasites- emerging infectious diseases.

RESUMEN

Las Enfermedades Infecciosas Emergentes (EIDs) son una grave amenaza para la salud de humanos, animales domésticos y fauna silvestre. Estas enfermedades son causadas por patógenos que han desarrollado multi-resistencia frente a medicamentos, o han incrementado su rango geográfico o de hospederos. Como resultado, millones de personas han muerto en las últimas décadas debido a enfermedades emergentes y re-emergentes como la malaria, la tuberculosis o las fiebres hemorrágicas del Ébola. Factores socio-económicos (e.g. urbanización, crecimiento demográfico) y ambientales (deforestación, especies invasoras y cambios en el uso del suelo producidos por el hombre) han facilitado la dispersión de las EIDs. A pesar de que muchos estudios se han centrado en estas enfermedades en el último medio siglo, nuestro conocimiento sobre la epidemiología de las EIDs y cómo controlar su dispersión es aún limitado. Debido a que la fauna silvestre es un componente esencial en la epidemiología de muchas EIDs, el estudio de patógenos en animales silvestres será esencial para identificar las causas y desarrollar políticas y estrategias para mitigar estas amenazas.

Palabras clave: deforestación, especies invasoras, malaria, parasites.

The 20th century has seen an advance in human health without precedent in history. Coupled with other improvements in food intake and sanitation, the development of vaccines and antibiotics contributed to the steady enhancement in demography and economic growth in many parts of the world (WHO, 1999). Therefore, it became possible to imagine a world without the burden of pathogens and infectious diseases to humans. However, this optimism was premature, and drove to an erroneous policy by reducing investment in infectious diseases research (Berkelman *et al.*, 1994). As a result, since 1940s millions of people have died because more than 300 events of emerging and re-emerging infectious diseases (EIDs) (Jones *et al.*, 2008). These EIDs are caused by pathogens that have evolved resistance (multi-drug resistance tuberculosis and chloroquine-resistant malaria), pathogens from animals that now infect humans (HIV-1), or pathogens that have been probably presented in humans for centuries but which have recently increased in incidence and geographic range (for example, Lyme disease). Ironically, the economic and health successes of the last century also contributed to the increase of these pathogenic diseases, as “hidden costs” of this wellness. For example, economic and demographic growth led to urbanization, where millions of people live in crowded conditions, thereby facilitating the spread of infections (Neiderud, 2015). Moreover, with the aim to meet the demands of the growing population, the indiscriminate deforestation for logging and farming in tropical rainforests have provoked changes in the ecology and epidemiology of vector-borne diseases (e.g. malaria, leishmania and Chagas Disease), thus putting vulnerable populations at risk for infection (Sehgal, 2010). Furthermore, the current speed and reach of travel of transport in our globalized world promoted the fast spread of Severe Acute Respiratory Syndrome (SARS) from a single case, infecting over 8.000 people in 26 countries across 5 continents in two

weeks (Peiris *et al.*, 2004). Thus, it is clear that EIDs represent a formidable threat to global health.

There is one point in the EIDs that should be highlighted, because sometimes is neglected: the essential information provided by studies on wildlife. Why are they so important? On one side, more than 60% of these diseases in humans are caused by pathogens spread from animals. For example, pandemic strains of influenza can emerge from avian and swine reservoirs. Furthermore, 71.8% of these zoonotic diseases events are provoked by pathogens with a wildlife origin (Jones *et al.*, 2008). For instance, many experts believe that HIV, the virus causing AIDS, evolved from a virus carried by a nonhuman primate in West Africa. Because wildlife is an essential component in the epidemiology of many EIDs, the study of pathogens in wildlife will be essential to successfully develop policies and strategies to mitigate these threats. On the other side, another point highlighting wildlife studies on EIDs relies on their trustworthy conclusions on the ecological drivers of the epidemiology. In this sense, confounding factors may cause an incorrect analysis of results and erroneous conclusions in the study of EIDs. In humans, socio-cultural and economic drivers (e.g. population density, economic growth), as well as ecological and environmental conditions (wildlife species richness, rainfall) may be major determinants of surge and spread of diseases. The formers are restricted to human populations, but the latter are shared with other animal species in the human-wildlife ecosystem interface. Therefore, the investigations of pathogen diseases in wildlife allow us to eliminate socioeconomics and cultural confounding variables from the study, and hence to achieve firm conclusions. Consequently, I call for an increasing number of studies on parasitology in wildlife as an important tool for identification of potentially zoonotic pathogens and hence reducing the likelihood

of future zoonotic disease emergence.

Because their rapid increase, infections with vector-borne pathogens have become one of the main EIDs in the last decades. Mosquitoes, bugs, ticks and many other arthropods are responsible for transmission of viruses (dengue, Chikungunya, West Nile virus), protozoans (malaria, Chagas) and bacteria (Lyme disease) infecting billions of people every year. Anthropogenic global changes (deforestation and land use change) have been proposed to cause the expansion of mosquito vector and the reemergence of malaria and dengue in South America (Daszak *et al.*, 2000). But this issue requires further studies removing potential confounding variables. As has been mentioned before, the factors favouring malaria outbreaks go beyond the basic biological elements and include ecological as well as socio-economic factors (Wilson, 2001). But these confounding effects are irrelevant in the context of parasites that infect wild animals. Studies on malaria parasites of birds have contributed significantly to the knowledge on biology and ecology of malaria parasites of other vertebrates, including human malaria (Marzal, 2012). Nowadays, research on avian malaria will be essential to fence these new health and environmental challenges.

Additionally, the introduction of domestic animals and wildlife alien species can also provoke emerging diseases with tremendous costs in terms of loss of biodiversity, mortality and economic expenses. We have many examples in which a foreign species can act as a “Trojan horse” because they can bring exotic parasites and pathogens inside them, and thus allowing its dissemination in the new areas. For example, Europeans introduced smallpox and measles to the Americas with fatal consequences for indigenous people. Also, a highly pathogenic morbillivirus disease (The *African rinderpest panzootic*) destroyed populations of many species of both domestic

and wildlife ungulate species in seven years, and contributed to the famine and death of many livestock-dependent African tribes (Spinage, 2003). In addition, avian malaria *Plasmodium relictum* Grassi & Feletti, 1891 is a widely pathogenic species, being responsible for mass mortality, population declines and even extinctions of many bird species worldwide after its introduction outside its native range (Valkiūnas, 2005). Recently this invasive malaria has been found infecting birds from Peru (Marzal *et al.*, 2015), representing a potential threat to over one-third of all bird species in the world. Therefore, introduced species may bring new diseases affecting biodiversity, ecosystem function and global health.

Finally, I would like to emphasize one very important issue. Most of surveillances and infectious diseases researches have been done in Europe, North America and Australia, which is in sharp contrast with the predicted areas of higher risk of zoonotic EIDs from wildlife in tropical Africa, Latin America and Asia (Jones *et al.*, 2008). These dissimilarities seem not to be very practical in the challenge of new EIDs, with the majority of scientific resources invested on areas where the next emerging pathogen or the new disease outbreak is highly unlikely to occur. I hence encourage for an urgent need for surveillance and monitoring studies on wildlife parasites as a potential threat for EIDs in these high-risk places. I also recommend promoting the creation of international networks on the study of emerging diseases as a valuable strategy for preventing EIDs on the 21st century. Scientists and experts from emerging disease hotspot areas should play a key role in these networks. It would enhance the collaboration, communication and education among its members, and provide a fast assistance during outbreak investigations.

In conclusion, we all (humans, wildlife and domestic animals) live in the same world,

sharing many pathogens and diseases. Deforestation, the introduction of pathogens through invasive species and anthropogenic land use change have increased the pathogen transmission at the human-livestock-wildlife interface, which have facilitated the spread of new and re-emerging infectious diseases. Despite significant attention given to these diseases in the last half-century, our understanding of EIDs epidemiology and how to manage them remains limited. Studies on parasites on wildlife would provide valuable information to identify underlying causes and to control their spread. In the fight against these infections, the creation of international networks with a multidisciplinary perspective involving scientists, educators, policy makers and practitioners would be desirable.

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