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Amol Rokde

School of Wildlife forensic &
Health, NDVSU, Jabalpur,
Madhya Pradesh, India

Devendra Podhade

School of Wildlife forensic &
Health, NDVSU, Jabalpur,
Madhya Pradesh, India

Diksha Lade

School of Wildlife forensic &
Health, NDVSU, Jabalpur,
Madhya Pradesh, India

Shiwane Pradhan

School of Wildlife forensic &
Health, NDVSU, Jabalpur,
Madhya Pradesh, India

Corresponding Author:

Amol Rokde

School of Wildlife forensic &
Health, NDVSU, Jabalpur,
Madhya Pradesh, India

Human-wildlife interactions, emerging pathogens, and the future of conservation

Amol Rokde, Devendra Podhade, Diksha Lade and Shiwane Pradhan

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Abstract

Emerging Infectious Diseases (EIDs) such as HIV/AIDS, SARS, pandemic influenza, and COVID-19 demonstrate how vulnerable humans are to pathogens originating from wildlife. These outbreaks have produced extensive health, economic, and societal consequences worldwide. However, public perception often treats wildlife as the primary source of zoonotic danger, overlooking human-driven factors like habitat loss, environmental disruption, and stress on wildlife populations that increase disease emergence. Such misunderstandings can reduce public support for conservation. The passage promotes a One Health approach that integrates human, animal, and environmental health to address wildlife-associated EIDs more effectively. It stresses that wild animals also suffer from pathogens originating from humans or livestock, as well as from various anthropogenic pressures. Enhancing science communication, correcting public misconceptions, and integrating disease ecology into conservation efforts are essential for reducing EID risks and supporting long-term biodiversity conservation.

Keywords: Emerging infectious diseases (EIDs), One Health, wildlife, zoonosis

1. Introduction

Most pandemics, for example HIV/AIDS, Severe Acute Respiratory Syndrome (SARS), and pandemic influenza originate in animals, are caused by viruses, and are triggered by ecological, behavioral, or socioeconomic changes. Despite their major impacts on global public health and increasing knowledge about how they emerge, no pandemic has ever been accurately predicted before it began infecting humans (Morse *et al.*, 2012)^[1]. Pathogen persistence within wildlife populations and subsequent spillover to livestock are well-recognized precursors to disease emergence in humans (Morse *et al.*, 2012^[1] and Jones *et al.*, 2008^[2]). Wildlife conservation faces numerous challenges. These include direct threats such as habitat destruction, overexploitation, and increasingly, the impacts of wildlife diseases on population viability (Daszak *et al.*, 2000)^[3]. In addition to these direct threats, negative interactions between humans and wildlife, including wildlife diseases, are becoming more frequent. When these interactions receive media attention and are perceived as socially risky, they can indirectly threaten wildlife conservation by reducing public acceptance of living alongside wildlife (Decker *et al.*, 2010)^[4]. The One Health movement aims to improve the health of humans, animals, and the environment. If applied effectively to wildlife, it has the potential to become a strong and positive force for conservation (Buttke *et al.*, 2015)^[5]. The health and welfare of wild animals are an increasing concern, yet large-scale analyses on how wildlife morbidity and mortality vary across time, space, and species remain limited (King *et al.*, 2023)^[6]. As of January 22, 2021, more than 95 million COVID-19 cases had been reported worldwide, and over 3 million people had died within the first year of the pandemic (WHO, 2021)^[7].

While this model has evolved over the past 35 years through adaptations and elaborations by various scholars (e.g., Decker *et al.*, 2012a)^[8], its core principle remains largely unchanged. The emergence of diseases like HIV/AIDS, SARS, and pandemic influenza shows how vulnerable humans are to new diseases that come from animals.

HIV/AIDS has caused high illness and death rates in many countries and has changed global public health. Building upon this wildlife management framework, wildlife conservation is the effort to prevent threats to wildlife populations, species, and habitats. Where necessary, conservation involves restoring wildlife populations, habitats, and the ecological processes essential for their sustainability. Additionally, wildlife conservation aims to influence individuals, communities, and institutions so that human activities do not degrade wildlife, habitats, or ecological processes. Instead, it promotes a philosophy, ethic, and practical approach to support conservation efforts. Beginning in early 2020, the rapid global spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) the causative agent of coronavirus disease 2019 (COVID-19) has led to profound disruptions across all sectors of society, including economic systems (He *et al.*, 2020^[9]; Zhu *et al.*, 2020^[10]). While most studies on wildlife conservation have traditionally focused on biological and ecological aspects, including the impact of wildlife diseases (Daszak *et al.*, 2000^[3]; Deem *et al.*, 2001^[11]). The perspective of importance of considering human dimensions and social sciences is crucial within the framework of One Health, which integrates human, animal, and environmental health, recognizing their interconnectedness. Wildlife conservation, in essence, is a philosophy that seeks to manage wildlife populations and their habitats without depleting species or their environments. Public support for conservation depends on people believing that wildlife provides more benefits than risks. If people start seeing wildlife mainly as a danger, support for conservation could decrease (Decker *et al.*, 2010)^[4]. Hence, maintaining societal backing for wildlife conservation hinges on ensuring positive net benefits for society from wildlife.

2. One health in wildlife conservation with wildlife-linked diseases

With the expansion of agriculture and livestock production into natural habitats, humans and domestic animals are increasingly coming into contact with wildlife. This heightened interaction promotes the transmission of infectious agents and parasites to new hosts and environments, creating novel host-parasite relationships and new ecological niches within disease transmission cycles (Sengar *et al.*, 2017)^[12]. Applying this reasoning to One Health, wildlife-associated diseases could potentially influence public perceptions of wildlife's benefits and risks. One Health emphasizes the interconnectedness of animal, environmental, and human health outcomes, both conceptually and practically. While it mobilizes multiple sectors to address health issues affecting various species efficiently, it must also address public understanding gaps, particularly regarding zoonotic diseases. Emerging infectious diseases (EIDs) linked to wildlife can exacerbate negative public perceptions and erode support for wildlife conservation due to fears of human health impacts (Decker *et al.*, 2011)^[13]. This poses a significant challenge that requires urgent attention to avoid detrimental outcomes for conservation efforts.

In recent years, the prominence of zoonotic infectious diseases has heavily influenced research priorities concerning wildlife pathogens. This focus has led to the neglect of studies addressing parasite diversity, ecological dynamics, and control strategies. Although attention has largely centered on humans and domestic animal health, a comprehensive understanding of how emerging pathogens function within complex wildlife communities is essential for effective

disease ecology and conservation planning (Thompson *et al.*, 2010)^[14]. Managing zoonotic diseases in wildlife adds complexity to the social aspects of wildlife conservation (Peterson *et al.*, 2006)^[15]. As these health risks affect a broader population, the balance between positive and negative impacts associated with wildlife may be shifting toward the negative in many areas (Butler *et al.*, 2003)^[16]. This shift could lead to reduced societal tolerance for wildlife, affecting conservation efforts. The specific contribution of wildlife-associated diseases to this emerging conservation threat is still uncertain, but evidence suggests it should be taken seriously by wildlife conservationists. Issues such as decreased community tolerance for wildlife due to disease concerns (Decker *et al.*, 2010)^[4] underscore the need for effective disease management and risk communication strategies. Wildlife-origin zoonotic pathogens, which have dominated major pandemics in the past century, emerge most often where human population density and wildlife biodiversity are both high (Keusch *et al.*, 2009)^[17].

Communicating the principles of One Health, emphasizing the interconnectedness of human and animal health in relation to diseases, can influence perceptions of wildlife and EIDs. However, these messages must be carefully crafted to ensure they reinforce positive perceptions and support for wildlife conservation efforts. In the latter half of the 20th century, concerns surrounding wildlife expanded beyond traditional worries about economic impacts on agriculture and forest regeneration. They now encompass issues such as motor-vehicle collisions involving larger animals and safety threats to humans from encounters with large carnivores. Over the past two decades, interest among wildlife professionals and the public has grown in understanding the economic, safety, and health impacts of interactions between humans and wildlife. This increased awareness stems from firsthand experiences of negative consequences associated with wildlife presence (Buttke *et al.*, 2015)^[5].

These consequences include property damage caused by habituated wildlife in human-dominated landscapes, threats to pets and livestock, and the transmission of wildlife-associated diseases (Conover, 2001)^[18]. While wildlife-associated diseases have long been a concern in many developing countries, aside from well-known diseases like rabies, their significance as major risks to human and wildlife health in other parts of the world was not widely recognized until recently.

3. Research needs in one health and wildlife conservation

Diseases shared between species can place significant pressure on entire ecosystems, affecting biodiversity, altering the behavior and structure of animal populations, and in some cases pushing species toward the brink of extinction (Williams *et al.*, 2002^[19] and Daszak *et al.*, 2000^[3]). Awareness of wildlife-associated diseases has surged due to evidence showing that 75% of all Emerging Infectious Diseases (EIDs) are zoonotic, originating mostly from wildlife, and their incidence has been increasing since 1940 (Jones *et al.*, 2008)^[2]. Diseases like Lyme disease, West Nile virus encephalitis, chronic wasting disease, and the potential for zoonotic avian influenzas have heightened public awareness and altered attitudes and perceptions of wildlife disease risks among health professionals and wildlife managers. Wildlife-associated diseases are now a growing public health concern affecting communities and individuals more widely than ever before, although the general public may still lack awareness or concern about these issues

(Hanisch-Kirkbride *et al.*, 2013) ^[20]. This lack of awareness could provide a window of opportunity for proactive research and development of effective risk communication strategies. The human dimensions of wildlife disease beyond impacts on human and wildlife health have received little research attention until recently (Decker *et al.*, 2010) ^[4]. The emergence of zoonotic diseases linked to domestic and wild animals has highlighted the health risks at human animal interfaces. Such pathogens transmit between species through spillover events occurring at wildlife human or domestic animal human boundaries (Bengis, *et al.*, 2004) ^[21]. The potential impacts of wildlife diseases are concerning for several reasons, particularly their potential to erode support for wildlife conservation efforts. Conservation is largely driven by grassroots movements supported by local communities. Opposition to wildlife presence, often manifesting as controversies over species like wolves and brown bears, can exert significant community-level influence. As human populations grow and natural habitats diminish, human-wildlife interactions and consequently negative encounters will likely increase (Madden, 2004) ^[22]. All types of natural hazards have the potential to dampen enthusiasm for outdoor activities, especially where risk perceptions are heightened. In the context of wildlife, risk refers to the possibility that interactions with wildlife lead to negative outcomes for people or things they value (Slovic, 1987 ^[23]; Klinke and Renn, 2002 ^[24]), such as pets or particular wildlife species. Wildlife-associated diseases possess characteristics of hazards where perceptions of risk can be exaggerated beyond actual risk levels and amplified in public discourse (Heberlein and Stedman, 2009 ^[25]). Traits like novelty, potential for severe outcomes (such as illness or death), lack of control over threats, and media reporting contribute to these perceptions. While concerns about wildlife-associated EIDs might have been less significant in another era, we currently live in a risk-averse society (Beck, 1992) ^[26] characterized by uncertainty regarding habitat and climate change effects (Shaw *et al.*, 2012) ^[27]. Thus, it is imperative for the wildlife conservation community to actively sustain support for wildlife conservation in situations where perceptions of risks associated with coexistence with wildlife may increase. Human and non-human animal health is closely interconnected, and the material as well as intangible relationships between them has profoundly influenced the development of human societies. As urban, suburban, and exurban populations increasingly encounter wildlife within their neighborhoods, it has become evident that urban wildlife plays an important role in shaping ecological dynamics, human-wildlife interactions, and broader public health considerations (Kretser *et al.*, 2008) ^[28]. These populations often lack experience with wildlife and may overestimate risks due to unfamiliarity, situational novelty, or concerns about threats to children and pets. This lack of prior experience with wildlife can translate into limited initial support for wildlife conservation, with negative interactions or perceived disease risks becoming the basis for forming opinions. Moreover, unlike negative human-wildlife interactions reported in remote or wild areas, wildlife-associated diseases bring perceived hazards to the doorsteps of millions of citizens and communities. Unfortunately, the benefits of biodiversity and natural habitats in reducing zoonotic disease risks are less widely understood or publicized beyond scientific circles (Schmidt and Ostfeld, 2001 ^[29]; Myers *et al.*, 2013 ^[30]). While diseases like Lyme disease and West Nile virus have reached many Americans

through local news, awareness of biodiversity's protective health benefits remains limited and lacks the personal relevance that local illnesses bring.

4. Biodiversity and habitat loss

Furthermore, as biodiversity and habitat loss continue, so do increases in EIDs and threats to human health resulting from ecosystem degradation (Myers *et al.*, 2013) ^[30]. One Health represents a concept that places the natural world and wildlife at the forefront, aiming to garner positive attention for wildlife's well-being and the preservation of biodiversity, benefiting both human health and conservation efforts. By integrating various disciplines, One Health seeks to enhance the health of multiple species more efficiently and effectively. However, how wildlife is portrayed in One Health communications significantly influences public perception whether as a victim or a source of disease. Advocates of One Health must carefully consider the manner in which messages are conveyed (Decker *et al.*, 2011; 2012b) ^[13, 31].

Human pathogens across all major taxonomic groups include zoonotic species. Approximately 80% of viruses, 50% of bacteria, 40% of fungi, 70% of protozoa, and 95% of helminths that infect humans are of zoonotic origin (Taylor *et al.*, 2001) ^[32]. One Health is inherently complex, requiring deliberate public communications strategies. Strategically engaging veterinary and wildlife professions in One Health could help educate the risk-averse public about the origins and management of emerging zoonotic diseases, emphasizing the benefits of a healthy ecosystem and wildlife. In the competitive media landscape, an interdisciplinary One Health approach could amplify efforts across health professions, improving accurate and balanced media coverage. This approach addresses two critical factors influencing perceptions of wildlife-associated disease risks: self-efficacy and societal efficacy. Each health community human, companion animal, wildlife, and livestock can play a role in empowering individuals and enhancing societal trust as credible sources of health-related information.

Collaborative efforts to replace fear-based messaging with accurate and comprehensive information about diseases, the protective functions of biodiversity, and strategies to reduce wildlife-associated disease risks can help maintain or strengthen public support for wildlife conservation. Biodiversity, including diverse wildlife populations, provides numerous benefits to human health and well-being, in addition to its intrinsic ecological value (Millennium Ecosystem Assessment, 2005) ^[33]. Presenting the positive ecosystem contributions of wildlife alongside discussions of public health risks offers a more balanced and informed view of human wildlife interactions. (Jack, 2012) ^[34] advocates for enhanced communication across various professional communities that historically operated in isolation, including human health professionals, livestock and companion animal veterinarians, wildlife veterinarians, and environmental and wildlife scientists. In the absence of specific human dimensions research on wildlife-associated disease, all One Health professionals should adhere to general communication principles to establish credibility and trust when informing the public about wildlife-associated diseases. This is particularly challenging due to the scientific uncertainties often associated with wildlife diseases.

5. Public awareness

Public acceptance of wildlife is a critical factor, as conservation initiatives are less likely to succeed without

societal support. A central principle of wildlife management is the deliberate manipulation of wildlife populations, their habitats, human communities, and the interactions among these elements. Consistency in delivering balanced and informative messages about wildlife diseases, especially in the early stages after detection, is crucial for public understanding and trust. Coordination among communicators is essential to maintain effectiveness and coherence in messaging efforts. While some progress has been made in human dimensions research related to wildlife-associated diseases (e.g., Hanisch-Kirkbride *et al.*, 2013) [20], further studies are needed to better understand which groups are affected by wildlife diseases, the perceived risks, and the impacts experienced. Understanding the attitudes and beliefs of diverse public segments, particularly those encountering wildlife in urban and suburban settings, is paramount as human-wildlife interactions increase.

6. Conclusion

Past outbreaks like HIV/AIDS, SARS, and H1N1 influenza revealed human vulnerability to emerging zoonoses. The COVID-19 pandemic further highlighted these risks, resulting in massive health, economic, and social impacts worldwide. The One Health movement holds tremendous potential to enhance the health of multiple species and ecosystems. However, successful incorporation of wildlife into One Health initiatives requires careful handling to avoid unintended consequences that could undermine conservation efforts and public support for wildlife. The wildlife profession must develop, test, and evaluate wildlife-associated disease messages that enhance public knowledge, improve perceptions of self-efficacy and societal efficacy in disease mitigation, and safeguard wildlife support and value. Collaboration among wildlife, human, and domestic animal health professions is essential for designing and delivering balanced One Health messages that resonate effectively across diverse audiences. Taking proactive steps, such as preparing a position statement on One Health communication, is crucial to navigating potential challenges and maximizing the initiative's conservation benefits amidst ongoing habitat destruction and emerging infectious diseases.

Conflict of Interest

Not available

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Reference

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