

# Prioritization of Disease Emergence Risk Factors for the Republic of Korea using a Nationwide Survey of Subject Matter Experts: A Model for Other Countries or Regions

Jusun Hwang<sup>1</sup>, Kyunglee Lee<sup>2</sup>, Daniel Walsh<sup>3</sup>, SangWha Kim<sup>1</sup>, Jonathan M. Sleeman<sup>1,3</sup>, and Hang Lee<sup>1</sup>

<sup>1</sup>Conservation Genome Resource Bank for Korean Wildlife, College of Veterinary Medicine and Research Institute for Veterinary Science, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Republic of Korea

<sup>2</sup>Cetacean Research Institute, National Institute of Fisheries Science, Nam-gu, Ulsan, 680-050, Republic of Korea

<sup>3</sup>USGS National Wildlife Health Center, 6006 Schroeder Road, Madison, Wisconsin, USA

## Introduction

Emerging diseases are driven by multiple factors including, but not limited to, climate and land use change, human population growth, global travel and trade, and increasing agricultural intensification. Since the relative importance of these drivers may vary among geographic regions, and simultaneously managing multiple risk factors for pathogen exposure, and disease emergence and amplification may be prohibitively expensive, prioritization of these risk factors is needed. Furthermore, effective management of emerging diseases requires agreement among the public health, agriculture, and environmental sectors on these priorities to enable the necessary multi-sectoral collaboration. The Republic of Korea (ROK) has been impacted by several emerging diseases. Consequently, we conducted a risk assessment to identify risk factors for pathogen exposure, and disease emergence and amplification to help determine priorities for the control and prevention of diseases of mutual concern for all sectors.



## Methods

We used an online questionnaire survey of subject matter experts to elicit opinions on emerging disease risk factors for wildlife-associated pathogens. Experts were asked to rank the relative importance of risk factors for pathogen exposure and introduction, and for disease emergence and amplification. To examine the experts' perceived risk we used a Bayesian, multivariate normal order-statistics model. We also examined the influence of field of study or sector (public health, agriculture, or environmental) on the perceived risk to investigate the degree of concurrence among the sectors.

## Results

Experts identified international human movement, illegal importation of wildlife, and migration of wildlife as the three primary routes posing the greatest risk of pathogen introduction into ROK (Table 1). Proximity of humans, livestock and wildlife was the most significant risk factor for promoting the spread of wildlife-associated diseases and pathogens, followed by high density of livestock populations, habitat loss and environmental degradation, and climate change. There was also general agreement among the three sectors of expertise (public health, agriculture, and environmental) regarding the relative importance of these external and internal risk factors.

**Table 1. Perceived risk of potential routes of introduction and spread of wildlife-associated diseases and pathogens.**

Rank	Risk Score	Exposure Pathway	Rank	Risk Score	Disease Emergence and Amplification Risk Factor
1	3.70	International human movement/migration	1	3.68	Proximity of humans, livestock, and wildlife
2	3.76	Illegal importation of wildlife and wildlife parts	2	4.64	High density of livestock populations
3	3.85	Migration or natural movement of wildlife	3	4.84	Habitat loss and environmental degradation
4	4.18	Accidental introduction of disease vector	4	5.10	Climate change
5	4.35	Smuggling of livestock products	5	5.96	Geographic proximity to neighboring countries
6	5.59	Legal importation of wildlife and wildlife parts	6	6.05	Overpopulation of species (wild boar, water deer)
7	6.14	Legal importation of livestock and products	7	6.39	Geological factors and geographic location of Korea
8	7.63	Importation of biological materials and pathogens	8	7.04	High density of human population
9	7.72	Importation of vegetables and plant material	9	7.24	Environmental pollution
10	8.08	Bioterrorism or the deliberate release of pathogens	10	7.39	Agriculture and farming systems
			11	7.67	Loss of biodiversity in Korea

## Conclusions

Control and prevention of emerging diseases requires a multi-sectoral, or One Health, approach, and these results provide evidence of positive progress towards this in ROK. Concurrence across sectors regarding priorities for emerging disease risk factors provides an important basis for developing mutually agreed-upon intervention strategies, including policy formulation, laboratory capacity, risk-based targeted surveillance, and disease response plans. Intervention strategies based on disease emergence risk factors are also cost-effective points of control that will mitigate against multiple diseases. We outline a rapid, cost-effective method of assessment of disease emergence risk factors for which the published literature is sparse, which also enables examination for concurrence among the three sectors. Ultimately, this study allows decision makers to use evidence-based priority setting when allocating resources to address disease risks, and may be useful for other countries or regions that wish to conduct similar risk assessments.

