Emerging infectious diseases pose a significant burden on human and animal health and global economies. Conventional approaches to epidemic control have most often been reactive. However, explosive human population growth, dramatic changes in land use, and increased global trade and travel require a shift toward a proactive, predictive approach. The PREDICT project aims to prevent, detect, and rapidly respond to the spillover of novel infectious pathogens from wildlife to humans.

While the linkage of human, animal, and environmental health is at the heart of our One Health approach – an increasingly important and recognized lens through which governments, NGOs, and practitioners view public health – the global health community still has three critically important needs:

1) Broader and deeper knowledge of pathogens with the potential to emerge from animals;
2) Targeted surveillance to maximize available resources;
3) Tools to characterize organisms that could be pathogens of significance and to predict where and how they might spillover to susceptible hosts.

**Challenge:** Develop a strategic framework to identify pathogens of pandemic potential that have not yet emerged.

**Opportunity:** Current infrastructure improvements and technological advances have dramatically and rapidly improved our ability to identify high-risk interfaces for disease transmission and to detect novel pathogens before widespread spillover occurs. These advances include improvements in information technology, molecular diagnostics, and risk modeling.

PREDICT has built a broad coalition of partners to discover, detect, and monitor pathogens at the wildlife-human interface using a risk-based approach. Our efforts integrate digital sensing and on-the-ground surveillance at critical points for disease emergence. PREDICT is at the cutting-edge of recent technological advances allowing rapid detection and diagnosis of high-risk viral families, even in settings where resources are limited.
The goal of the PREDICT project in Indonesia was to build an early warning system for potential zoonotic disease through partnership within scientific and government institutions. PREDICT-Indonesia was a collaboration between Bogor Agricultural University Primate Research Center, EcoHealth Alliance, Eijkman Institute for Molecular Biology, Metabiota, Smithsonian Institution, and government and other scientific partners.

Background

The threat of emerging pandemic diseases is facilitated by the interaction of wildlife and humans at human-animal interfaces. In Indonesia, as in other countries, increasing contact between wildlife and humans leads to greater risk of human exposure to pathogens, both well-known and new. Habitat disturbance, such as forest clearing for agriculture or development purposes; transportation; handling of wildlife; and wildlife consumption, among other human-mediated practices, promotes direct opportunities for pathogens to move from wildlife to people. Development of early warning systems, including expanded surveillance and diagnostic capacity for potential disease threats to human beings, is urgently needed by government agencies, research, and academic institutions in order to better serve and protect the public.

Disease Surveillance

- PREDICT partners conducted wildlife surveillance for zoonotic pathogens among priority taxonomic groups.
- Since the beginning of the project in 2011, PREDICT partners have collected ~2000 specimens from bats, rodents, and non-human primates from lowland forest, urban, mountain forest, and marine areas that have active interaction with humans, including ecotourism areas.
- PREDICT also screened samples from people with high wildlife contact from West Java and Papua and hopes to expand testing to include East and Central Java, Bali, Borneo, North Sumatera, Sulawesi, and Sumba.
- Samples were collected from important interfaces between animals and people, including wildlife markets, free-ranging wildlife in contact with researchers, areas with contact between tourists and wildlife, hunted wildlife, peri-domestic settings in and around human dwellings (near villages and urban areas), and wildlife sanctuaries.

Top: The Celebes Crested Macaque (Macaca nigra) is endemic to Sulawesi. Ecotourism in limited parts of their range and breeding for research present risks for contact with humans.

Bottom: Wildlife being sold in market from Northeastern Sulawesi, an area for PREDICT animal sampling. Photos by W. B. Karesh.
Global Impact

**Strengthened the National Capacity for Zoonoses Surveillance:**

- PREDICT trained over 50 individuals including government employees, research scientists, veterinarians, biologists, laboratory technicians, personnel from safari parks, rangers, and other collaborators in proper field sampling techniques, laboratory testing methods, as well as biosafety practices.
- PREDICT strengthened collaborative networks between the wildlife and health communities and supported the coordination among government ministries and research and educational institutions to help develop early warning mechanism for prevention of and response to zoonotic diseases arising from wildlife.
- PREDICT developed and equipped the Emerging Virology laboratory at Eijkman Institute (EVRUE) with capabilities to test human samples for a broad range of families of viruses of emerging pandemic concern.

**Enhancing Disease Surveillance and Response:**

- PREDICT-Indonesia endorsed and contributed to a system for reporting pathogen surveillance in animals to the national authority responsible for animal disease management (i.e. the Directorate of Animal Health Services at the Ministry of Agriculture of the Republic of Indonesia). Such a mechanism was not previously in place, and will allow for more coordinated flow of surveillance information within the country and to meet international reporting obligations.
- PREDICT provided the protocols, training, and supplies needed for diagnostic techniques for 21 viral families at the Primate Research Center and Eijkman Institute laboratories, using synthetic DNA plasmid controls and broadly reactive consensus PCR assays to detect and classify zoonotic viruses.

**Partnerships**

- Primate Research Center at Bogor Agricultural University
- Eijkman Institute for Molecular Biology
- Ministry of Health
- Ministry of Agriculture
- Ministry of Forestry
- Indonesian Institute of Science
- Universitas Sam Ratulangi, Manado Sulawesi Utara
- Padjadjaran University, Bandung, Java
- U.S. Centers for Disease Control and Prevention

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