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Barbara A. Han, Disease Ecologist

Research mission:

- Predict and understand pathogen spillover
- Reform global disease management from reactive to preemptive
- Push the frontiers of ecological prediction with AI and machine learning

Summary:

Barbara Han's research is at the intersection of ecology, computing, and global health. Han uses machine learning and artificial intelligence tools to understand when and where new zoonotic diseases are likely to emerge, and why.

Han employs complex algorithms to analyze patterns and processes in nature that could result in the next Ebola, Zika, or SARS-CoV-2. Some of these models compare traits of known animal disease carriers – size, diet, reproductive habits, biogeography – with thousands of species not yet known to carry disease, in order to predict which animals might become disease carriers in the future, and where these emergence events are most likely to occur globally. Underlying these research topics is the creative application of AI and the co-development of new AI approaches that enhance prediction and infectious disease intelligence for stakeholders across disciplines.

This research is actively contributing to a shift toward preemptive management for infectious disease spillover. This technology could impact surveillance programs, global health preparedness efforts, and land management decisions, as it becomes obvious that diseases are more likely to emerge from certain habitats or in response to certain types of human behaviors.

Han is an interdisciplinary connector, and routinely partners with diverse collaborators including scientists from IBM, NASA, and numerous national and international universities to advance research on global disease prediction. Combining tools, data, and concepts across multiple domains lends a synthetic approach to addressing the complexity that underpins the phenomenon of disease emergence and spread. She contributes to efforts led by WHO, CEPI, the Wellcome Trust, and multiple agencies within the US government to apply this research to disease preemption.

Select publications:

Han BA*, Varshney KR*, LaDeau S, Subramaniam A, Weathers KC, Zwart J. 2023. **A synergistic future for AI and ecology.** *Proceedings of the National Academy of Sciences.*

Fischhoff I.R., A.A. Castellanos, J.P.G.L.M. Rodrigues, A. Varsani, and B.A. Han. 2021. **Predicting the zoonotic capacity of mammals to transmit SARS-CoV-2**. *Proceedings of the Royal Society B: Biological Sciences.*

Han B.A., S.M. O'Regan, L.P. Schmidt, and J.M. Drake. 2020. **Integrating data mining and transmission theory in the ecology of infectious diseases**. *Ecology Letters.*

Han B.A., A.M. Kramer, and J.M. Drake. 2016. **Global patterns of zoonotic disease in mammals**. *Trends in Parasitology.*

Han B.A., J.M. Drake. 2016. **Future directions in analytics for infectious disease intelligence: Toward an integrated warning system for emerging pathogens**. *EMBO Reports.*

Han B.A., J.P. Schmidt, L.W. Alexander, S.E. Bowden, et al. 2016. **Undiscovered bat hosts of filoviruses**. *PLOS Neglected Tropical Diseases.*

Han B.A., J.P. Schmidt, S.E. Bowden, and J.M. Drake. 2015. **Rodent reservoirs of future zoonotic diseases**. *Proceedings of the National Academy of Sciences.*

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