*A One Health Perspective

Exclusive to One Health Initiative team website, January 9, 2021 (may be reprinted *ad libitum*)

By Peng Gao, PhD

There is an urgent need for multidisciplinary research to solve today's complex environmental and human health challenges. Fortunately, research on One Health can ensure a comprehensive and holistic risk assessment of human, animal, and environmental health problems. The integration of humans, animals, and the environment has created a new continuum, and each group's health is inseparable. Although the concept of One Health looks promising, it involves multiple factors and is challenging to implement, and each factor may play a different but essential role. For example, the microbiota is a crucial part of environment health to provide energy and biodegrade pollutants, but some of them are biological stressors of the host, directly affecting the health of humans and animals. Fortunately, the technologies used in the exposome may provide the key to solving this problem by combining the identification and quantification of the stressors and the risk assessments.

People are increasingly aware of the human-animal, human-environment, and animal-environment health challenges that require an interdisciplinary approach, leading to the concept of One Health. Initially, due to the pandemic of zoonotic diseases, the idea was more focused on veterinary medicine. These diseases show that the health of humans, animals, and the environment are interconnected, and early responses to emerging zoonotic pathogens require an interdisciplinary and unified approach.

Due to the rapid development of globalization, emerging diseases pose a severe threat to both humans and animals, requiring coordinated response measures on a local, regional, and global scale. Furthermore, One Health is being extended to other areas, including broad health concepts for humans, animals, and ecosystems, such as understanding antimicrobial resistance, the role of phytotoxins and mycotoxins, ecotoxicology, and human health in urban environments. From the molecular level to the individual level, from the community to the planet within the interactions among the atmosphere, the lithosphere, the hydrosphere, the biosphere, and the anthroposphere, as well as each health field, including the environment, animals, and humans, can be regarded as an increasingly complex system. Therefore, the complexity of One Health far exceeds what we know, and no one can separate themselves from this interconnected world (Figure 1).

Based on the concept of One Health, an ideal risk assessment should be combined with conventional ecological and human health risk assessments as well as soil, water, and air monitoring levels to conduct a more comprehensive risk assessment of the entire environment. Therefore, health

risk assessment in One Health should aim to assess the impact of humans, animals, and the environment when they expose to pollutants, pathogens, land changes, invasive species, climate change, and other potential stressors. As a result, the concept of multiple stressors in the exposome and various receptors in One Health may be an ideal complement to each other for obtaining a more comprehensive overall risk assessment, rather than traditionally assessing human health risks and ecological risks separately. A comprehensive framework for One Health risk assessment based on this framework has been proposed by merging the traditional ecological and human health risk assessments (Figure 2).

In addition, Geographic Information System (GIS) provides information to track the collection, editing, analysis, storage, and visualization of geographic data. It allows mapping various data such as environment, terrain, and health-related data to understand pollution or pandemic trends and patterns. A conceptual framework that can discover the riskiest stressors in the One Health systems and display those stressors spatially by GIS for risk assessment purposes is proposed here (Figure 3).

Finally, the ideal method of integrating One Heath and the exposome should be targeted in time and space with the given target environment includes samples, stressors, pathways, and their interactions as much as possible, and assesses the risks of meeting a holistic health goal. To achieve this goal, a conceptual framework was proposed to study the overall relationships between multiple stressors and multiple species (Figure 4).

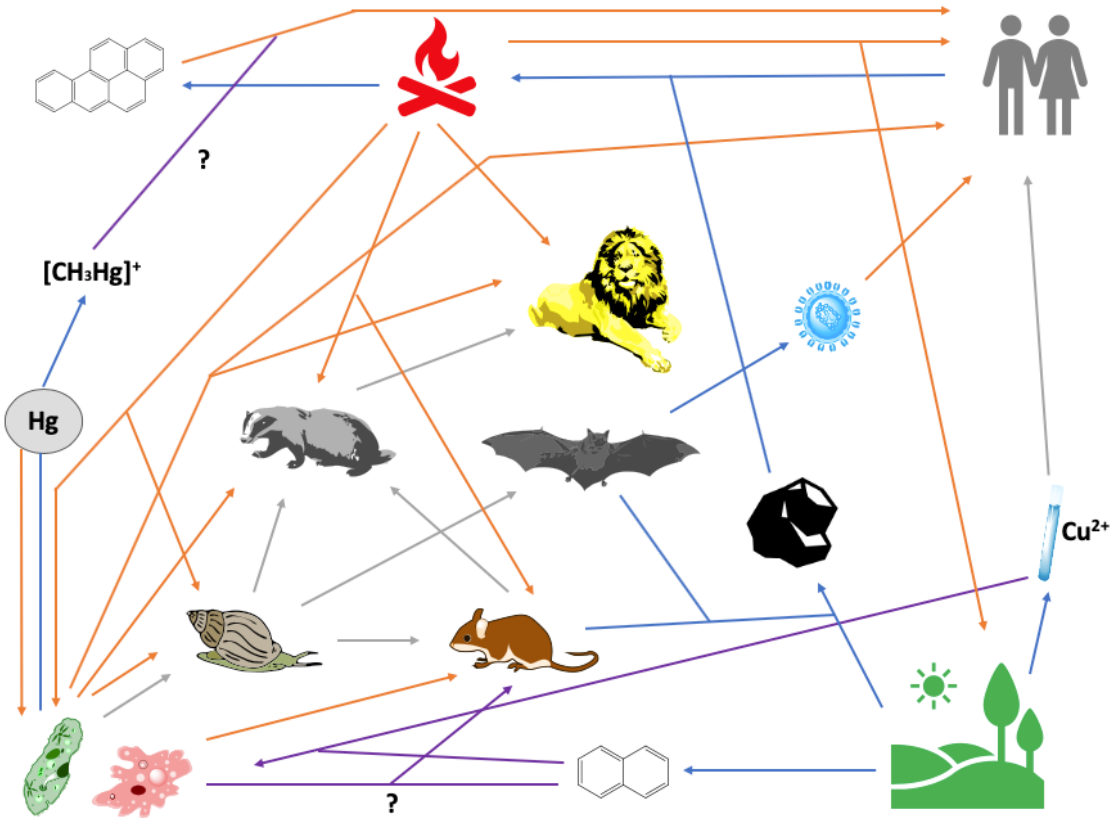

Figure 1. Biotic and abiotic interactions within One Health. Blue lines represent origin pathways. Orange lines represent stressors' impacts. Gray lines represent consumption relationships. Purple lines represent more-than-additive toxicity. Question marks represent uninvestigated cases. Not all relationships are presented. Organic, inorganic, biological, and physical stressors are represented by naphthalene and benzo[a]- pyrene, copper and mercury, microbes and coronavirus, and heat, respectively.

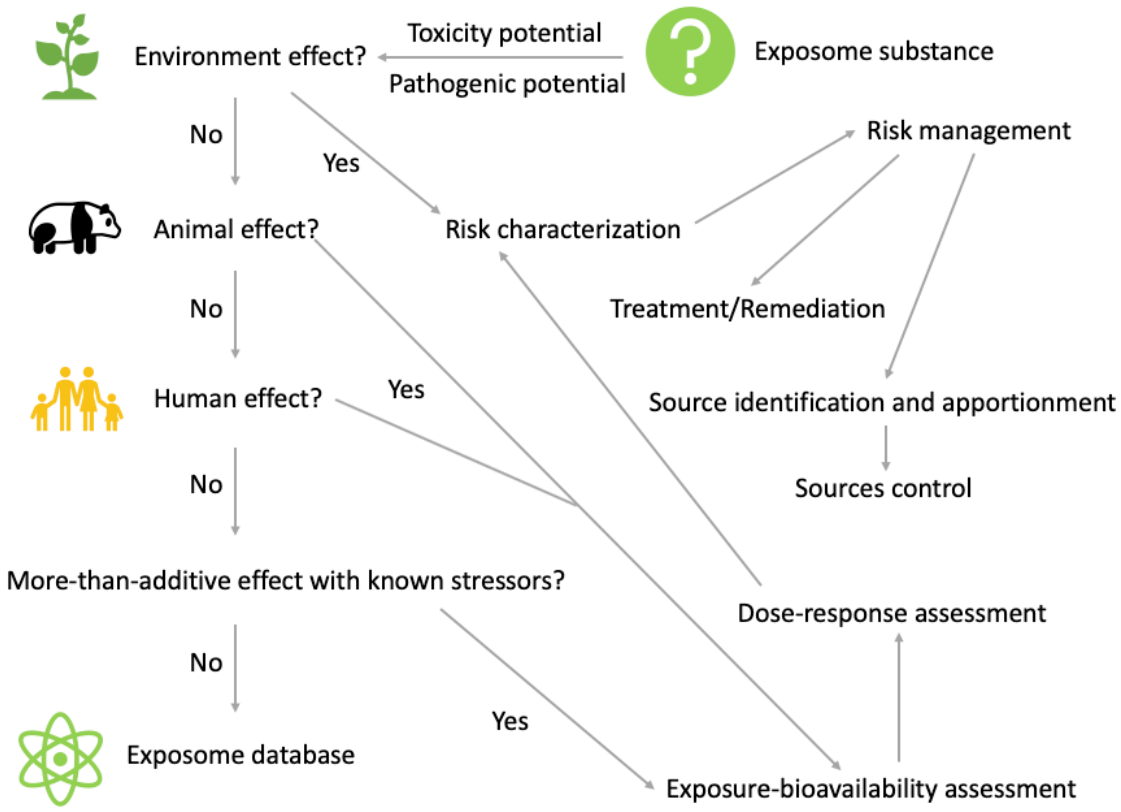

Figure 2. A conceptual framework to assess One Health risks of the exposome stressors.

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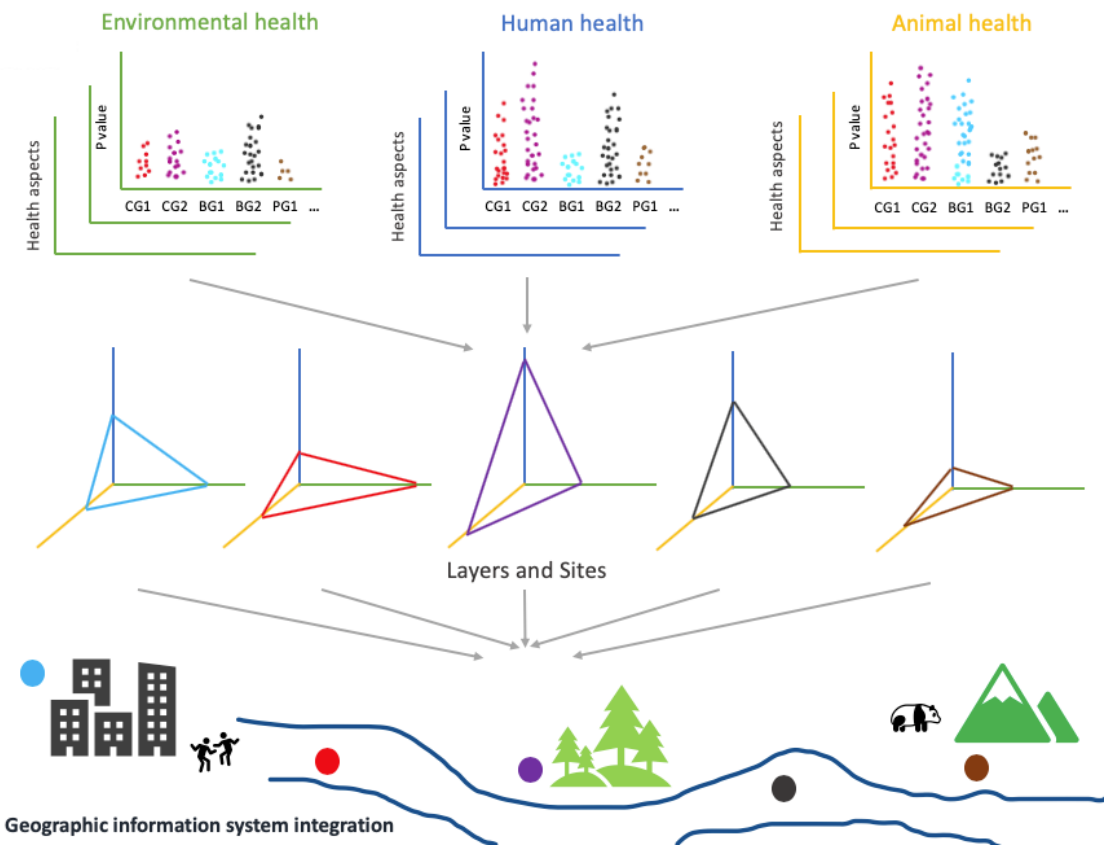

Figure 3. A conceptual framework to characterize each stressor's risks at each site in the GIS for more comprehensive environmental treatment and risk assessment strategies in terms of One Health. Only the riskiest stressor is highlighted on each site as an illustration. Environment health aspects: plant, soil, sediment, air, freshwater, ocean, etc. Human health aspects: liver, kidney, lung, heart, brain, gastrointestinal tract, skin, etc. Animal health aspects: mammal, bird, arachnidan, amphibian, fish, etc. Examples of chemical, biological, and physical groups (CG, BG, and PG) would be PAHs, PCBs, and metals; bacteria, fungi, and algae; and heat, radiation, and noise, respectively.

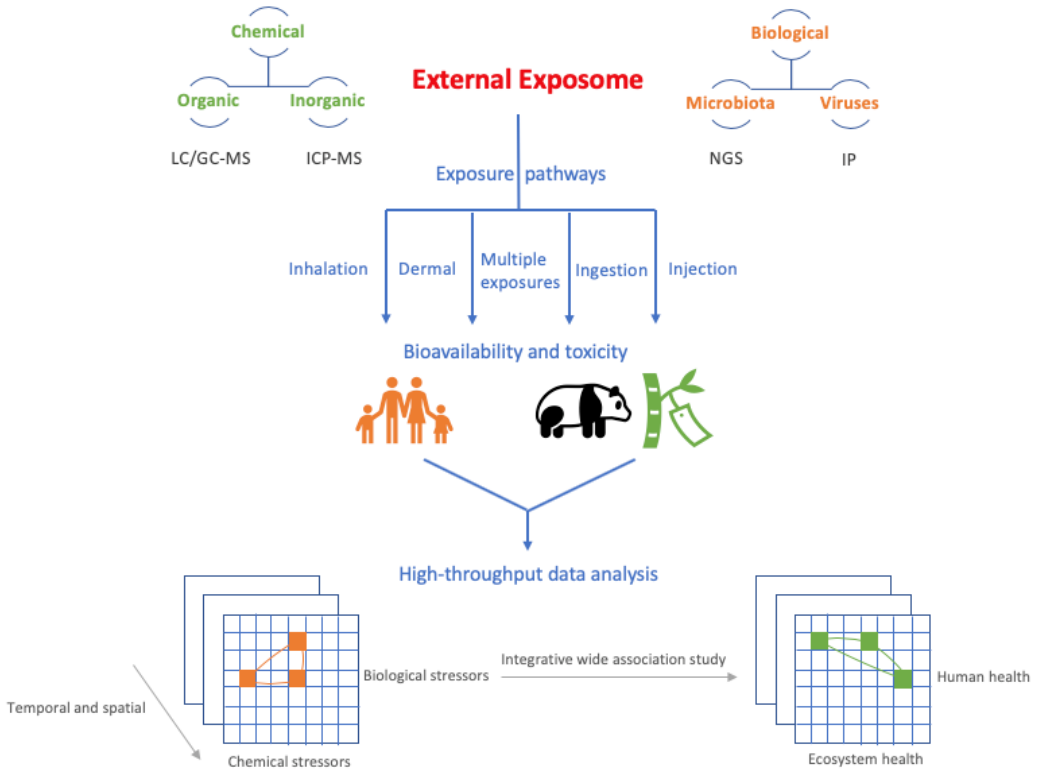

Figure 4. A conceptual framework to investigate the risks of chemical and biological stressors within One Health: from identification and quantification to big data analytics and machine learning algorithms.

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Biography

Dr. Gao is an analytical chemist trained in both environmental and biological sciences. He earned his Ph.D. degree from the University of Florida in August 2019, and currently

working on human exposome projects at Stanford University School of Medicine. His research focuses on multidisciplinary fields in environmental chemistry and toxicology, analytical chemistry, and environmental health sciences. Dr. Gao has published in various top environmental science journals, peer-reviewed hundreds of articles, and currently serving as an editorial board member of *Chemosphere*.

*See The Exposome in the Era of One Health, *Environ. Sci. Technol.* 2021, January 8, 2021, https://doi.org/10.1021/acs.est.0c07033,