

***One Health* approach to wicked public health problems**

Laura K. Borkenhagen^a, Gregory C. Gray^{1b}

a) Duke Global Health Institute, Duke University, Durham, North Carolina, USA

b) Division of Infectious Diseases and Nicholas School of the Environment, Duke University, Durham, North Carolina, USA

Abstract

Food safety, antimicrobial resistance, and emerging diseases are public health problems found in every country of the world. Such problems often require the collaboration of public health, veterinary health, environmental health, and agricultural business professionals in their prevention and control. Increasingly, due to modern transportation and agricultural techniques, once local or regional public health problems are now becoming international in scope, affecting thousands of people and animals. We must find ways to work across disciplines and across geographical borders to prevent and control these problems. Many organizations have embraced the One Health approach as a way forward in developing the necessary multidiscipline and international collaborations.

Key words: *One Health, zoonotic diseases, food safety, antimicrobial resistance*

As the world human population approaches nine billion, international travel and transportation become more accessible, and global movements of goods increase, very complex public health problems are emerging.

One such challenge is the antimicrobial resistant bacteria, which now pose a serious threat to human health, causing a number of medications to be ineffective. The cause of this resistance has been linked not only to improper use of antibiotics in humans, but also to the common practice of using subtherapeutic doses of antibiotics in animal feed [1,2]. Further, emerging infectious diseases

now quite readily move with people, animals, or food products. The SARS outbreak of 2003, the H1N1 pandemic of 2009, and the *Ebola* outbreak of 2014, to name only a few, are emerging diseases of the 21st century that resulted in an estimated 774 [3], over 151,700 [4], and 11,310 deaths [5], respectively. Another large, complex, public health concern is food safety, with an estimated 600 million people suffering food-borne illnesses each year [6]. As such, investigation and development of systems to ensure consumer safety are required at all stages of production. Such complex problems require the involvement

¹ Correspondance author: Division of Infectious Diseases and Nicholas School of the Environment, Duke University, 312 Trent Ave, Durham, NC 27710 U.S.A., e-mail: Gregory.gray@duke.edu

of multiple disciplines and a range of methodologies to control. As more of these dynamic complex problems arise, developing innovative approaches to combat these challenges becomes a greater priority.

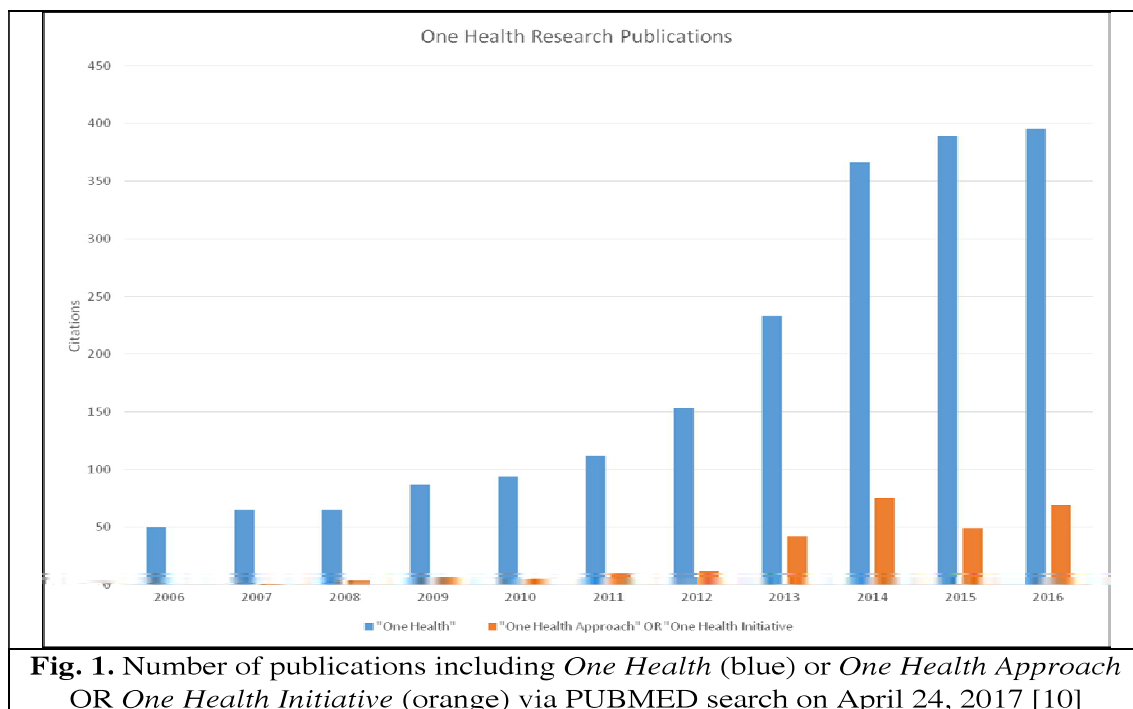
The One Health Approach

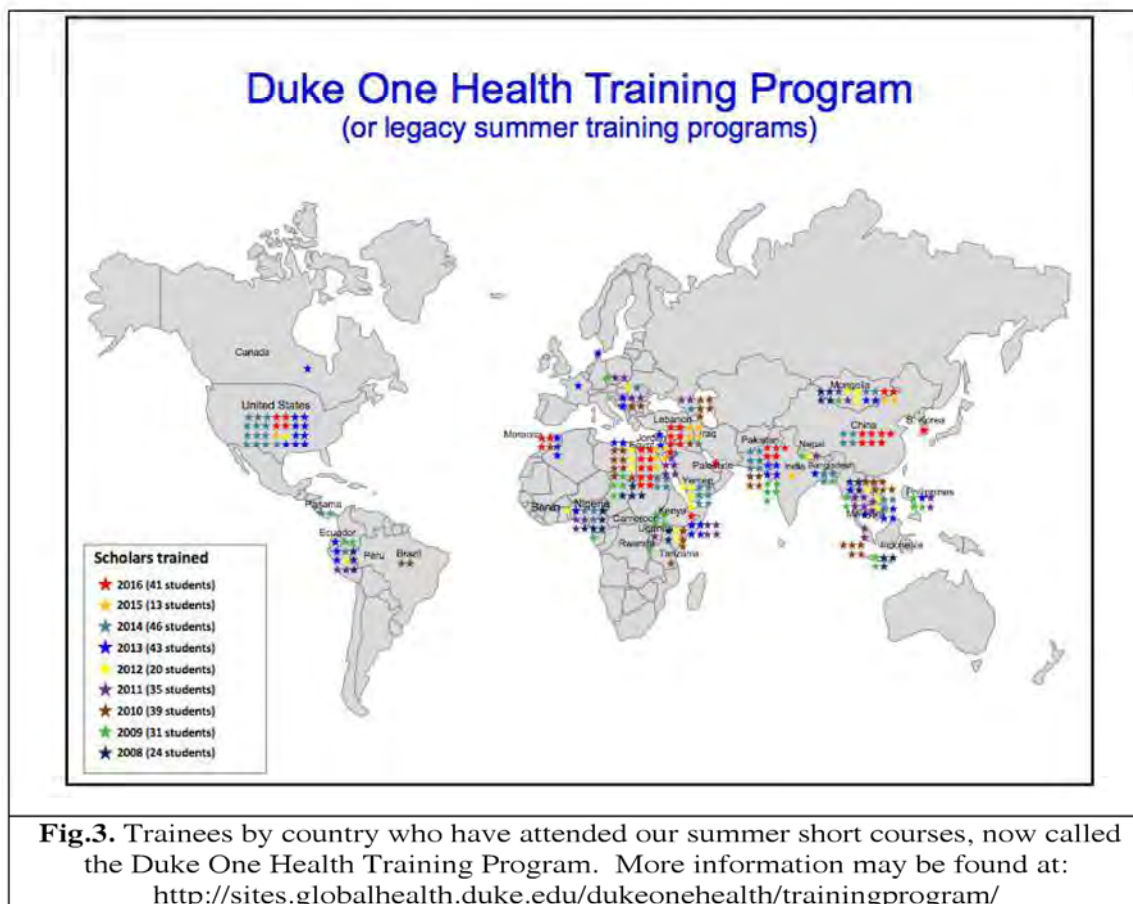
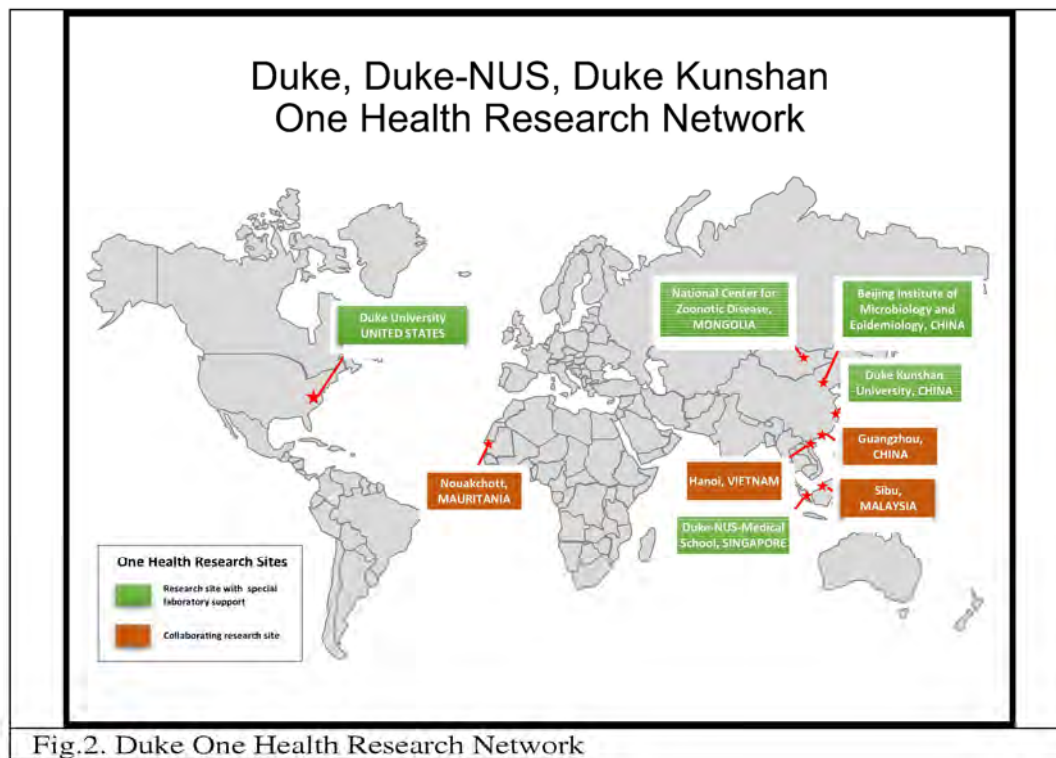
The *One Health* approach aims to tackle complex problems by coalescing the efforts of public health officials, veterinarians, physicians, environmental professionals, scientists, and so on. Broadly defined, *One Health* is, “the collaborative effort of multiple disciplines working locally, nationally, and globally, to attain optimal health for people, animals, and our environment” [7]. These multidisciplinary collaborations connect different perspectives, create new research strategies founded on academic breadth, and foster the kind of holistic and innovative problem solving necessary to manage these complex problems.

While the idea of *One Health* is not new [8], the concept of *One Health* approaches has gained much momentum during the last 10 years. In 2006, the American Veterinary Medicine Association (AVMA) established a *One Health Initiative Task Force* with a goal of assessing the possibility of collaboration between academic institutes, government bodies, and health science

professionals in an effort to assess, treat, and prevent the problems that were too complex for one discipline to solve [7]. In an April 2016 search, there were at least 57 academic institutions worldwide with some sort of a *One Health* program; 13 percent having a *One Health* certificate, masters, or PhD program[9]. Additionally, in that same search, 68 non-academic organizations had some sort of a *One Health* program [9].

Articles citing “*One Health*” on PubMed have increased nearly 8 times from 2006 to 2016 (50 to 396) (fig.1) [10]. Additionally, dedicated *One Health* journals are beginning to emerge. *EcoHealth* (Chief editor in the USA), *Infection Ecology and Epidemiology* (Chief editor in Sweden), the journal *One Health* (Chief editors in Australia and Germany), *International Journal of One Health* (Chief editor in India), and the *One Health International Journal* (Chief editor in Romania) are each promoting the *One Health* approach. *One Health* research is also disseminated at dedicated conferences, such as the International Symposium on *One Health* Research, the *One Health EcoHealth* Conference, the *One Medicine* Symposium, and the *One Health* European Interregional Conference.





Duke One Health

Taking a closer look at our program dedicated to this collaborative approach, the Duke *One Health* team, a network of researchers and professionals from more than nine different countries (fig.2), aims to understand the emergence and transmission of zoonotic pathogens. Zoonotic diseases, diseases that are transmitted from animals to humans or vice versa, account for three out of five new human illnesses [11]. The aforementioned emergent virus H1N1, for instance, originated as a reassortment of human, swine, and avian influenza viruses [12].

The Duke *One Health* team conducts surveillance for various novel respiratory viruses at the human-animal interface in multiple countries across the world. One prime example is our *US National Institute of Health R01* study with partners in China which has the following aims:

- 1) to identify and characterize enzootic and emergent swine influenza viruses (SIVs);
- 2) to employ aerosol, fecal, environmental swabs, and water sampling to identify environmental areas with a high prevalence of SIVs;
- 3) to identify occupational risk factors for SIV infection, and
- 4) to identify serological and mucosal immunity biomarkers of protection against prevalent and emergent SIVs.

Similarly, the Duke *One Health* team is also conducting surveillance for novel human and animal viruses through US Department of Defense grants for work in Malaysia, Mauritania, Singapore, and Vietnam and soon we will train other partners to do the same in Egypt, Iraq, and Pakistan. We are also training US and Mongolian professionals to conduct *One Health* research in Mongolia under a US National Institute of Health grant. This program has engaged teams of scientists conducting important multidisciplinary work in tick-borne diseases, equine zoonoses, and zoonotic parasitic diseases. These efforts will help us understand the ecology of zoonotic pathogens and multidrug resistant bacteria which are often associated with modern agriculture.

Our network is also heavily engaged in training US and international scholars continuing the tradition of the *One Health* approach through the summer Duke *One Health* Training Program. This three-week program assembles professionals from multiple countries (fig.3) to learn about *One Health* problem solving, global disease surveillance, and interventions to reduce

infectious disease threats to public health. The four course offerings include:

- Introduction to the *One Health* Approach;
- Public Health Laboratory Techniques;
- An Introduction to Entomology, Zoonotic Diseases, and Food Safety; and
- An Introduction to Environmental Health.

This course work ultimately affords the scholars of *One Health* the opportunity to become well-versed in the global surveillance and public health threats while fostering multidisciplinary research skills.

CONCLUSIONS

In summary, as the human population grows, and agriculture and transportation follow suit, it is imperative that once local or regional public health, veterinary health, and environment health concerns become global concerns engaging the multiple disciplines involved. The multidisciplinary *One Health* approach is gaining traction as the key way forward in responding to these modern complex problems that affect human, animal, and environmental health. Antimicrobial resistant bacteria, emerging diseases, and complex problems surrounding food production are challenges that are not going away, but perhaps a more concerted effort, such as the *One Health* approach, can mitigate their devastating effects on the health of humans, animals, and the environment.

REFERENCES

1. Blaser MJ – *Missing microbes: how the overuse of antibiotics is fueling our modern plagues*, Macmillan, **2014**;
2. Ghosh S, LaPara TM – *The effects of subtherapeutic antibiotic use in farm animals on the proliferation and persistence of antibiotic resistance among soil bacteria*, ISME J, 2007, **1**(3),191-203;
3. *** *SARS Basic Fact Sheet*, Centers for Disease Control and Prevention, Atlanta: CDC. **2012**, Available at: <https://www.cdc.gov/sars/about/fs-sars.html> (Accessed 5 May 2017);
4. *** *First Global Estimates of 2009 H1N1 Pandemic Mortality Released by CDC-Led Collaboration*, Centers for Disease Control and Prevention. Atlanta: CDC, **2012**, Available at: <https://www.cdc.gov/flu/spotlights/pandemic-global-estimates.html> (Accessed 5 May 2017);