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Evolution of a transdisciplinary "One Medicine–One Health" approach to global health education at the University of California, Davis

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ABSTRACT

In today's world health events in one nation or geographic area often have repercussions for the health and well-being of populations beyond that region; sometimes even globally. In recent years many factors, most notably concern about emerging infectious diseases, have contributed to an increasing appreciation of the interdependency of human, animal and ecosystem health worldwide. Integrated global approaches to improve the health of humans, animals and their shared environments are proving to be in the best interest of many countries. A special symposium and award were established in memoriam to the internationally renowned epidemiologist, Dr. Calvin W. Schwabe, who (while at the University of California, Davis) was a significant advocate of the "One Medicine" approach to public health, calling upon all health professionals, including veterinarians, to work collaboratively and comparatively to improve human health. This paper discusses the evolution of the "One Medicine" concept into a global "One Health" approach to research, training capacity and service infrastructure, focused not only on disease, but also on health at the individual, population, and ecosystem levels. Projects involving UCD faculty which attempt to integrate a One Health approach include the Health for Animals and Livelihood Improvement (HALI) Project in Tanzania, Envirovet Summer Institute, Avian Flu School and Newcastle Immunization Program in Africa, a web-based virtual global health training program, and the Calvin Schwabe One Health Project.

1. Why focus on global health education?

The world has become a global community, made up of villages as small as a group of bandas in rural Tanzania and as large as the 13 million people in Mumbai, India. The smoke from one village blows over the hills, pastures, and oceans only to be inhaled in distant villages. Health issues are no different. What happens in one nation or geographic area has repercussions for the health and well being of that region and potentially the whole global community. In veterinary medicine this concept is of critical importance in addressing transboundary diseases such as brucellosis, tuberculosis and foot-and-mouth disease. Infections with pandemic potential zoonotic diseases (SARS—severe acute respiratory syndrome, avian influenza, West Nile encephalitis, Lyme disease, echinococosis, anthrax), water toxicity due to pathogens, pesticides and chemicals, and more insidious infections such as human immunodeficiency viruses (HIV) and multi-drug resistant tuberculosis are examples of how health issues quickly become worldwide concerns.

The developed and the developing world share concerns about factors, including malnutrition, migration, access to health care, environmental illness, urbanization,

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and infectious diseases, that affect human health. Developing nations continue to struggle with problems related to rapid population growth, sanitation, adequate safe water, lack of sustainable agriculture and livestock, as well as access to quality health care. At the same time, the health problems in developed nations have shifted to chronic degenerative illnesses, escalating health care costs, and the use and misuse of technology.

Global environmental changes, population growth and increasing international trade, have resulted in expansive, often rapid movement of people, pathogens, animal (livestock and wildlife) products and produce worldwide (Slingenbergh et al., 2004; Bender et al., 2006; Chomel, 2008). Such movement creates enormous challenges for tracking and controlling pathogens (foot-and-mouth disease and avian influenza viruses) and toxins (melamine and ethylene glycol) that threaten both human and animal health. Most countries, including the USA, are inadequately equipped to deal with diseases involving the human–animal interface and environmental change. The impact of these health problems on the world's poorest communities is even more profound, and many have just begun to be recognized.

A global perspective and approach to improve the health of humans, animals and the ecosystems in which they live is in the best interest of all countries. Health is an imperative for economic strength and prosperity. Improved health increases productivity, reduces the need for foreign aid, and creates greater demand for goods and services, thereby stimulating the global economy. By improving health and reducing human suffering we also contribute to political stability, making the world more secure.

Now more than ever, transdisciplinary approaches are needed to solve these complex health problems at the human–animal–environmental interface. Facilitating the involvement of our global community, including universities, industry, governments, non-governmental organizations (NGOs) and citizens, is the only approach that holds promise to improve global health. As a first step, universities need to provide relevant training to prepare students and faculty for successful participation in the sensible resolution of pressing global health problems.

2. The "One Medicine" concept

The connection between human and animal health is not a new observation. In the 19th century Robert Virchow, the German physician and pathologist acknowledged that "between animal and human medicine there is no dividing line, nor should there be. The object is different, but the experience obtained constitutes the basis of all medicine" (Kahn et al., 2007). Early in his medical career, Virchow's experimental studies on *Trichinella spiralis*, a helminth parasite of pigs, as well as bovine cysticercosis and tuberculosis lead him to coin the term "zoonosis" to describe pathogens such as these which are transmitted from animals to humans (Saunders, 2000). In 1873 a young Canadian physician – Sir William Osler – went to study with Virchow in Germany and upon his return he was the first to establish the field of veterinary pathology as an academic discipline in a North American school of veterinary medicine. Osler was also the first to use the term "One Medicine" in the English language literature (Cardiff et al., 2008; Saunders, 1987).

There are several notable examples of successful collaborations involving veterinary and medical scientists over the past 150 years that resulted in significant discoveries benefiting both human and animal health. In 1893, Theobald Smith and F.L. Kilbourne were the first to discover that arthropods could serve as vectors for pathogen transmission. They showed that *Boophilus* ticks transmitted the intra-erythrocytic protozoal parasite *Babesia bigemina*, which caused the severe, often fatal cattle disease known as redwater. Subsequently, their work lead to the discovery by Walter Reed that mosquitoes vector the virus responsible for yellow fever in humans (Wilkinson, 1992). Another example of zoonotic disease discovery is Edward Jenner's famous observations on the exposure of milk maids to cowpox and their resistance to smallpox resulting in the first human smallpox vaccine (Baxby, 1996). Similarly, Jenner's use of the first inactivated vaccine for hog cholera in pigs laid the foundation for the production of human typhus and polio vaccines (Kahn, 2006). A more recent example of successful collaborative discovery is that of physician Rolf Zinkernagel and veterinarian Peter Doherty who were awarded the Nobel Prize in 1996 for their pioneering work showing how the immune system distinguishes normal cells from virus-infected cells (Zinkernagel and Doherty, 1974).

The Schwabe symposium at the Conference of Research Workers in Animal Disease, where this paper was presented in December 2008, was originally established in honor of another renowned scientist and advocate of comparative, collaborative medicine, Calvin W. Schwabe. Dr. Schwabe, the late veterinary epidemiologist and parasitologist organized and chaired the Department of Epidemiology and Preventive Medicine in the School of Veterinary Medicine at the University of California, Davis. During the second half of the 20th century Dr. Schwabe reintroduced the "One Medicine" concept in his book *Veterinary Medicine and Human Health* and is credited with renewing recognition that the "cumulative effect of all practitioners of medicine is aimed at quality of human life and survival" (Schwabe, 1984). Schwabe's presciently contended words that "the critical needs of man include the combating of diseases, ensuring enough food, adequate environmental quality, and a society in which humane values prevail" (Schwabe, 1984) are even more profound today. His vision that human and veterinary medical practitioners are obliged to work together in sharing information to ensure the physical, mental, social, economic and inner health for all life, have never been more important than it is now in our changing global environment.

3. A trandisciplinary "One Health" approach to combat emerging diseases

Many factors have contributed to an increasing appreciation of the interdependency of human, animal and ecosystem health. Arguably, the most notable is the