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# Veterinary medicine protecting and promoting the public's health and well-being

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## Abstract

Dr. Calvin Schwabe's vision of "One Medicine" has long inspired many in the public health community to strive toward bringing human and veterinary medicine together to improve the public's health and well-being around the world. In an increasingly human-dominated world, as Dr. Schwabe suggested many years ago, human health provides the most-logical unifying or apical cause in veterinary medicine's hierarchy of values. Veterinarians in all aspects of the profession—have opportunity and responsibility to protect the health and well-being of people in all that they do, including protecting food security and safety; addressing threats to antibiotic sensitivity; preventing and controlling zoonotic emerging infectious diseases; protecting environments and ecosystems; participating in bio- and agro-terrorism preparedness and response; using their skills to confront non-zoonotic diseases (such as malaria, HIV/AIDS, vaccine preventable diseases, chronic diseases and injuries); strengthening the public-health infrastructure; and advancing medical science through research. This article provides an overview of contributions made by veterinarians in each of these areas, and discusses the challenges to be overcome and the need for strategic thinking and action to achieve the vision of "one medicine".

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## 1. Introduction

I am pleased to honor Dr. Calvin Schwabe for his lifetime achievements in and contributions to veterinary medicine, public health, and the history of medicine. In particular, I honor him for his longstanding vision of "One Medicine" which has inspired so many of us to strive toward bringing human and veterinary medicine together to improve the public's health and well-being around the world.

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Admittedly, I was a bit intimidated at the thought of speaking on this topic in Dr. Schwabe's presence. After all, his book *Veterinary Medicine and Human Health* (Schwabe, 1984—first published almost 40 years ago) describes much of what I am going to share with you this afternoon—even with all of the changes that have occurred in our world since that time. I consult the book often, and find it as relevant today as I did the first time I read it.

## 2. Global public health

What are some of the driving world forces that are influencing global public health? At the top of the list, of course, is the ever-increasing human population, and accompanying urbanization. Humans more and more are sharing wildlife and livestock habitats, as well as developing close relationships with companion animals. Globalization of trade and food, increased international movement and travel of people and animals, changes in climate, and increased access to information all make the world we live in a small place. What impacts human health in one place impacts all. Protecting the public health where one lives means improving global health overall. Finally, the terrorist events of September and October 2001 have underscored the shared global responsibility to prevent acts of bio- and agro-terrorism and to be prepared to respond to global health-security threats.

Veterinary medicine is a human-health activity. No matter what aspect of the profession veterinarians work in, there is opportunity and responsibility to protect human health and well-being with every decision and action taken. Veterinarians in their work—in all aspects of the profession—are obliged to and must actively, conscientiously, and routinely (as a standard of care and practice) step up to the plate to protect the health and well-being of people.

Graduating veterinarians swear that among other obligations, they will use their scientific knowledge and skills for the benefit of society through the promotion of public health (American Veterinary Medical Association, 2003). Some have commented on the natural tension which seems to exist in the oath where “protecting animal health” and “conservation of animal resources” are perceived to conflict in some circumstances with the “promotion of public health”. But—in an increasingly human-dominated world—the health and well-being of humans will take precedence. Thus, as Dr. Schwabe suggested so many years ago, human health indeed provides the most-logical unifying or apical cause in veterinary medicine's hierarchy of values (Schwabe, 1984) and provides an important pathway for veterinary medicine to evolve successfully in the future.

The Institute of Medicine (1988) defined “public health” as what we, as a society, do collectively to assure the conditions in which people can be healthy. This means:

- protecting food security and safety;
- addressing threats to antibiotic sensitivity;
- preventing and controlling emerging infectious diseases (many of which are zoonotic in nature);
- protecting environments and ecosystems; engaging in bio- and agro-terrorism preparedness and response;

- using our skills to confront non-zoonotic diseases (such as malaria, HIV/AIDS, vaccine preventable diseases, chronic diseases and injuries);
- strengthening the public-health infrastructure; and
- advancing medical science through research.

The World is calling us. Are we ready to meet the call?

The link between human and animal health has been understood conceptually for many years by those of us here today (thanks to the teachings of Dr. Schwabe and others). There now is the public's growing awareness and focus on food safety, the epidemics of bovine spongiform encephalopathy and foot-and-mouth disease in the UK, the introduction and movement of West Nile virus in the US, issues related to protecting the environment and biodiversity, and worries over the possibility of additional bioterrorism attacks. This awareness produces an unprecedented opportunity at this time to make the concept of linking human and animal health a reality.

### 3. Food safety

Food-borne illness is a major problem around the world, causing serious mortality and morbidity. The global spread of food-borne disease has been enhanced by (Käferstein et al., 1997):

- globalization of the food supply;
- intensified food production industries in developing countries (trying to meet the needs of export markets);
- centralized processing of human and animal foods, followed by widespread distribution; and
- expanded markets in industrialized countries for “ethnic foods”.

New threats to food safety around the world have emerged. These threats include: the intensification of food-animal production in many countries; prion-caused transmissible spongiform encephalopathies; recognition that non-symptomatic food animals can harbor organisms pathogenic to humans; pathogens of importance becoming resistant to standard antibiotic therapies; infectious diseases visibly crossing borders; and ever-increasing opportunity for chemical contamination of foods.

Food-borne infections in people in the US were notoriously under-reported for years (as is still the case in developing countries)—making it difficult to know the magnitude and extent of illness. As Dr. Schwabe taught us, disease surveillance is the backbone of public health. In 1996, veterinarians and colleagues at the Centers for Disease Control and Prevention (CDC), US Department of Agriculture (USDA), the (US) Food and Drug Administration (FDA) and state health departments came together to develop FoodNet—an active sentinel surveillance system in the US. FoodNet helps to identify food-borne infections in people and the source of infection, so effective interventions can be undertaken. FoodNet collects data on 10 food-borne infections in nine US sites that account for 13% of the US population. FoodNet's first objective is to document the magnitude and trends of human food-borne infections in the US. This sentinel surveillance system has detected decreases over time

in the incidence of *Campylobacter*, *Salmonella*, *Shigella*, *Yersinia*, and *Listeria* during 1996–2001. These decreases were coincident with the implementation of hazards-analysis, critical control-point methods. FoodNet also serves as a platform for the conduct of more detailed investigations of risk factors for food-borne diseases and effective interventions to prevent them (Centers for Disease Control and Prevention, 2001a).

In the late 1970s and 1980s, questions surfaced regarding the potential for antibiotic use in food animals to affect the efficacy of antibiotics used for human infections. Antibiotics are used widely in human and agricultural settings, and we know now that there are multiple factors contributing to antibiotic resistance; these factors include overuse and misuse in both human and agricultural settings. Today, the emergence and spread of antimicrobial resistance is believed to be threatening the success of infectious-disease treatment and prevention around the world (World Health Organization, 2001a,b). There are active campaigns to mitigate the inappropriate use of antibiotics in human settings—but it is veterinary medicine's responsibility to protect human health by providing leadership in addressing the appropriate and judicious use of antibiotics in food animals.

Veterinarians and colleagues at the CDC, FDA, USDA and selected state health departments have established another key sentinel surveillance system called the "National Antimicrobial Resistance Monitoring System (NARMS) for Enteric Bacteria". NARMS monitors and reports on antimicrobial resistance of six pathogens (obtained from human infections) to 17 different antimicrobials in 27 sites (covering 158 million people in the US—56% of the US population). USDA and FDA coordinate testing for antimicrobial resistance of *Salmonella*, *Campylobacter*, and *E. coli* isolates from infections in a number of food and companion animals (Centers for Disease Control and Prevention, 2000c). NARMS informs medical and veterinary practitioners on the status of antibiotic resistance so that judicious decisions on the use of antibiotics can be made.

Recently, thanks to NARMS and other surveillance systems, a problem has come to light regarding *Salmonella Newport* infections (in the US) that are showing resistance to multiple antibiotics (i.e. ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, tetracycline, amoxicillin-clavulanic acid, and several cephalosporins) used as treatment for human *Salmonella* infections. These *Salmonella* are called "Newport MDR-AmpC"; several outbreaks in the US have been linked to dairy cattle. Findings from public-health surveillance have led to intensified follow-up of outbreaks in Massachusetts and Vermont (US). *S. Newport* MDR-Amp C has been detected in stools of both ill and well dairy cattle. Many dairy strains have had the same pulse-field gel-electrophoresis pattern as the human isolates. Dairy farms with Newport MDR-Amp C had illness and deaths in cows—and on one farm, ill persons and milking cows had the same strain. Risk factors for human illness include contact with cattle, consumption of bovine products such as ground beef and unpasteurized cheese (Centers for Disease Control and Prevention, 2002e). Much more needs to be done to understand the relationship between *S. Newport* infections in people, cattle, and the transfer of antibiotic-resistant strains. This is an evolving story where veterinary medicine should be leading efforts to understand the human–food animal link, and to identify and then implement effective control measures.

Serious efforts to mitigate inappropriate use of antibiotics in these human settings are underway in community and health care settings. Several groups have published important guidance on the judicious use of antibiotics in food animals (American Veterinary Medical

Association, 2001a; World Health Organization, 2001b)—but much more work is needed to get stakeholders to follow the guidelines. Veterinary medicine should be providing the leadership for putting the guidelines into practice.

As mentioned previously, there is ongoing intensification and consolidation of the food-animal industry. The world's growing population requires more animal protein—but we want more protein while not jeopardizing human health. Agro-business is growing, with fewer farms producing more animals. In 1997, there were approximately 450,000 concentrated animal-feeding operations (CAFOs) in the US. These operations produced some 132 million metric tonnes of waste which were applied—untreated—directly to fields and crops as fertilizer or soil amendment, or discharged or leaked from storage lagoons (Environmental Protection Agency, 2001). This practice has serious implications for pollution of waterways in the US—and for disease outbreaks caused by contaminated drinking water, recreational water, and food. Although yet to be documented, this practice may lead to adverse health outcomes caused by chronic exposure to chemicals and agents via contaminated groundwater (Campagnolo et al., 2002).

Veterinary practitioners, both clinical and corporate, should:

- provide guidance to food operations on how to prevent infections in food animals;
- participate in the conduct of disease surveillance in both humans and food animals;
- lead efforts to identify effective infection-control interventions in slaughter and processing plants;
- develop effective on-the-farm (including CAFOs) interventions to reduce the prevalence of pathogens in food animals; and
- provide leadership to minimize antibiotic resistance stemming from antimicrobial use in food animals.

#### **4. Environmental health**

Beyond CAFOs, veterinarians are natural leaders in finding solutions to many environmental-health problems, including investigations of harmful algal blooms, exposures to pesticides and toxins, responding to human-made and natural disasters, and exposures to excessive noise, heat, and cold, and cancer clusters (Centers for Disease Control and Prevention, 2003f).

#### **5. Emerging infectious diseases**

There is a strong link between emerging infectious zoonotic diseases and increasingly greater interaction among humans, livestock, and wildlife (Daszak et al., 2000). Infectious diseases globally cause over 13 million deaths per year, affecting all people regardless of age, gender, lifestyle, ethnicity, economic status, and causing suffering, poverty, and challenges to development in poor countries (World Health Organization, 1999). Approximately 75% of emerging diseases are zoonotic (Taylor et al., 2001); again, the link between human and animal health, and veterinary medicine's responsibility to engage

actively in identifying risk factors in preventing and controlling these diseases, is clear.

The World Health Organization (WHO) has tracked many zoonotic infectious disease outbreaks between 1996 to present, including Ebola virus outbreaks in Central Africa, Nipah Virus in Malaysia and Singapore, avian influenza in Hong Kong, and Hantavirus and West Nile virus (WNV) in the US. Each outbreak has helped the human medical and public-health communities recognize that the links between human and animal disease are real. Moreover, it is becoming better understood among public-health officials that preventing and controlling diseases in animals can be an important component of preventing and controlling disease in humans. Many veterinarians have understood this for a long time—but as never before, this point is now being underscored among public-health authorities ([Institute of Medicine, 2003](#); [King and Khabbaz, 2003](#)).

An outbreak highlighting this important link in the US is WNV. WNV was not believed to have been in the US before 1999. How this epidemic has unfolded (with the huge increases in human and animal cases observed in 2002) has maintained its high visibility in the US and continues to reinforce for the public-health community the connection between birds, mosquitoes, people, and other mammals. On 12 August 1999, an elderly patient ill from serious neurologic symptoms (including an unusual pattern of muscle weakness) was admitted to Flushing Hospital, Queens, NY, USA. At that same time, the Queens Branch of the Wildlife Conservation Society was reporting dead wild birds to the Bronx Zoo Branch, and the Bronx Zoo Branch forwarded dead bird samples to a wildlife pathologist at the NYS Department of Environmental Conservation. Over the next month, investigations of the epidemics in people and birds unfolded in an unlinked fashion. Because the human epidemic was identified (incorrectly) as being caused by St. Louis encephalitis (SLE) on 3 September—and SLE does not affect birds—human-health authorities assumed that they were different epidemics. It was not until 9 September that a veterinary pathologist at the Bronx Zoo moved on her suspicions that the epidemics were linked. She called the CDC—but the CDC, believing that the epidemics were not linked, referred her to the USDA. It was not until 23 September—5.5 weeks after the first human case—that WNV was identified as the cause of the outbreaks ([General Accounting Office, 2000](#)).

What were the lessons learned with this event regarding how the cause of the outbreak was identified and how an effective response could be mounted? WNV has led to some important changes in how human-health officials are thinking about prevention and control of zoonotic emerging disease—providing a window of opportunity for veterinary medicine to participate more actively ([General Accounting Office, 2000](#)). First, partnerships were forged and strengthened in trying to monitor the spread of WNV across the country. Links have been strengthened between and among state and local health departments, state and local veterinarians, state and local wildlife veterinarians and biologists, mosquito control, the CDC, the USDA, the US Geological Survey, the Department of Defense, the Environmental Protection Agency (EPA), and others. Secondly, some important and innovative changes were made in developing surveillance systems for zoonotic diseases. Now—not only in food safety but also for an emerging infectious disease—there is real interest in linking surveillance in human and animal populations. Surveillance for WNV has involved birds, mosquitoes, and horses, as well as people. A National Zoological WNV Surveillance System

(supported in part by the CDC) collects and tests specimens from zoo animals—including birds, equids, other mammals, reptiles, and marsupials. Results are sent to participating zoos, local public-health departments and the CDC (Nolan, 2001; Knight, 2002). Without question, veterinary medicine has a real opportunity to make an impact on how prevention and control of these diseases are considered.

## 6. Bioterrorism preparedness and response

Another area that is driving the impetus to link human and animal health efforts is that of bio- and agro-terrorism. As in emerging diseases, the majority of potential agents in (CDC) categories A, B, and C are zoonoses (Centers for Disease Control and Prevention, 2003d). In the emergency response to the World Trade Center attacks in September 2001, the efforts of veterinary–medical assistance teams to provide medical care for working dogs were well publicized. Less publicized were the efforts of CDC veterinarians on staff as epidemiologists, who were at the front lines leading surveillance efforts for human disease in local hospitals. A veterinarian in EPA led environmental cleanup efforts on Capitol Hill in Washington, DC (Anonymous, 2002).

Many are aware of numerous foreign animal diseases that could be used in agro-terrorism. Not only would these diseases lead to complete devastation of our food animals and our economy—but, as was learned in the UK with FMD, if the principal response intervention is to slaughter all infected animals, public health could be threatened in several important ways. Depending on the method of carcasses disposal, concerns would be raised regarding pollution of air and water (if carcasses were burned), and safety of food and water (if carcasses were buried) (UK Department of Health, 2001). Mental-health issues would arise in connection with loss of livelihood and with complete stoppage of human and animal movement in a quarantine (Deaville and Jones, 2002). With veterinarians and other response officials in prolonged contact with disinfectants, questions regarding occupational health would arise. Again, veterinarians should be providing leadership in addressing these public-health questions.

## 7. Public-health infrastructure

Given the recent spotlight on bioterrorism preparedness, it is clear that veterinary medicine, in collaboration with other disciplines, must:

- participate in disease surveillance and response;
- upgrade our laboratories and join the laboratory response network;
- communicate risk;
- aid in decontamination and environmental cleanup; and
- carry out important applied research.

Such research would include diagnostics, testing interventions for prevention, treatment, and control, and identifying reservoir hosts and the epidemiology of disease transmission. Laboratory-animal veterinarians are vital in participating in study design and execution.

## 8. Companion-animal medicine

I am going to turn very briefly to an area where veterinarians need to do much more to protect human health in the resource-rich US: companion-animal medicine.

Given the large number of people owning pets and using the services of veterinarians in the US, there is a huge opportunity for and responsibility of veterinarians to counsel pet owners. Topics should include dog-bite prevention (an estimated 4.7 million dog bites per year, 800,000 requiring medical attention), and prevention of zoonotic infections from their pets, and the public-health benefits of reducing the number of stray dogs and cats through neutering ([American Veterinary Medical Association, 2001b](#)). Recently, the CDC established a website “Healthy Pets Healthy People” where veterinarians and the public can obtain accurate information on these issues ([Centers for Disease Control and Prevention, 2003b](#)).

## 9. Non-zoonotic diseases

Veterinarians also are working to protect human health and well-being in disease prevention-and-control programs that do not involve animals per se. Such programs include evaluating and monitoring global vaccine-preventable disease programs, eradicating polio, evaluating the effectiveness of anti-malarial drugs for use in developing countries to reduce malaria-related morbidity and mortality, and controlling trachoma. Some may wonder (particularly with the narrow light in which our profession has come to see itself) if veterinarians working in these areas are still practicing veterinary medicine. I believe that they are, given that they are using their scientific knowledge and skills to promote public health as is stated in the veterinary oath. Consider the link between HIV/AIDS and the food famine that has been described in southern Africa ([UNAIDS/World Health Organization, 2002](#)). There, agricultural workers (including those raising livestock) infected with HIV/AIDS are dying—contributing to the shortage of food. Some women—desperate for food—are putting themselves at high risk of infection with HIV and sexually transmitted diseases by trading sex for food. Actively working for HIV prevention and control in that region protects food security and human health—both, areas of importance to veterinary medicine.

## 10. Advancing medical research

Finally, veterinary medicine should be at the forefront of medical research in the following areas:

- animal models;
- development of vaccines;
- treatment strategies for agents having bioterrorism potential;
- theriogenology;
- nutrition and chronic diseases;

- xenotransplantation; genomics; diagnostic tools;
- and more.

## 11. Achieving one medicine

In summary, many excellent veterinarians are protecting human health and well-being across the spectrum of public health. But, how are we doing in bringing human and veterinary medicine together—in pursuit of health for all? Certainly, awareness has been raised in the US after the highly visible zoonotic outbreaks I have mentioned. These outbreaks have led to nascent action in both the medical and veterinary communities. But to date, there has been mostly talk. For veterinary medicine to do what it can to lead to linked (maybe-even integrated) human and animal health, there are several challenges that must be overcome. These include:

- changing cultures of the two disciplines that have operated separately for decades;
- overcoming the organizational complexity of animal health at local, state, federal and international levels;
- expanding the limited and narrow view of what activities comprise veterinary medicine (and the consequent shortage of veterinarians going into public health, environmental health, and food safety);
- overcoming a tendency for veterinarians and physicians to communicate solely within their professions rather than to communicate across disciplines;
- hesitation to provide leadership on controversial issues; and
- understanding how to operate strategically and politically.

To operate strategically and politically, we must understand better how things work in Washington, DC with both the executive and legislative arms of the government. We must engage in policy analysis and dialogue, and partner with schools of medicine, public health, and other allied health professions. Veterinarians must apply for and be awarded funding through grants from the National Institutes of Health—giving veterinary scientists greater visibility as experts in the many areas I have spoken of today. It is essential that state veterinarians and state public-health veterinarians develop better communications and forge strong links. And finally, we must ensure that a broader view be maintained for our profession than that of companion animal medicine alone.

US veterinarians are protecting human health and well-being as private practitioners, and in positions with local, state, and federal agencies; schools of veterinary medicine, medicine, and public health; industry; and non-governmental and international organizations. At the CDC, approximately 70 of 75 veterinarians on staff are employed as epidemiologists working across the complete spectrum of public health. Veterinarians have served as Epidemic Intelligence Service (EIS) Officers since the inception of the program in 1951—195 graduating from the program to date (Pappaioanou et al., 2003). Many colleges of veterinary medicine are providing leadership by developing multiple-degree programs (i.e., DVM-MPVM, DVM-MPH, DVM-PhD) and by establishing centers of food safety, emerging diseases, healthy ecosystems, and international health.

## 12. Conclusion

In summary, veterinary medicine is a human-health activity. We have the responsibility to protect human health and well-being in all that we do. To act on this commitment unwaveringly, is critical to the future success of our profession in a human-dominated world. Veterinarians are working across the entire spectrum of public health around the globe—but more are needed. Bringing human and animal health together is important and feasible. Beyond the vision laid out by Dr. Calvin Schwabe, the task will require strategy, energy, and persistence. Great progress has already been made, but much work has yet to be done. The world is calling—now is our opportunity—we must act now.

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