



Abstract

One medicine is not a new idea. In the 19th Century, Robert Virchow, the German physician and pathologist, stated, 'Between animal and human medicine there is no dividing line, nor should there be. The interdependence of humans, animals, and their environment has never been more important than now. The most prominent issues putting pressure on global health today include the dramatic emergence and spread of zoonotic diseases, contamination of food, water and soil, bioterrorist events, and degradation of resources and habitats. Current global health challenges have prompted a call for more holistic, collaborative, action-oriented approaches toward the goal of logical and practical solutions. Veterinarians have pivotal obligations, opportunities, and contributions to make in enhancing public health, recognizing and responding to zoonotic diseases transmission, maintaining food and water quality, and promoting wildlife and ecosystem health.

Keywords: Global health – One health – One medicine

One health

One health is "the collaborative effort of multidiscipline working locally, nationally and globally– to attain optimal health for people, animals, plants and our environment" (AVMA, 2008). One Health is not a new concept, but it has become more important in recent years because many factors have changed the interactions among humans, animals, and the environment. These changes have caused the emergence and reemergence of many diseases.

The benefits of a One Health approach include:

Improving animal and human health globally through collaboration among all the health sciences, especially between the veterinary and human medical professions to address critical needs for meeting the new global challenges head-on through collaboration among multiple professions—veterinary medicine, human
Kahun Papyrus' (1900 B.C.)

medicine, environmental, wildlife and public health. Developing centers of excellence for education and training in specific areas through enhanced collaboration among colleges and schools of veterinary medicine, human medicine, and public health, and for increasing professional opportunities for veterinarians as well as adding scientific knowledge to create innovative programs to improve health.

History of One Health

The history of healing dates back to the ancient healers– 'the priests in olden times, such 'priest doctors' cared both the humans and animals. The Egyptian literature 'Kahun Papyrus' (1900 B.C.) described the chimeric animals and man in their mythology. The Papyri also dealt with the importance of vector borne diseases which was proved to be controlled by the use of mosquito nets.



Babylonian king Adadapla-iddina (1068-1047 B.C.) constructed a temple for goddess Gula who was worshipped as healer and protector from rabies and was represented by the figure of dog.



In 11-13th century, Chinese Zhou dynasty stressed the importance of integrated public health system in the society; principles of Yin-Yang were practiced through the acupuncture therapy in humans and animals.

The Chinese physician Xu Dachun, wrote in his book 'On the origin and development of medicine' that "The foundations of veterinary medicine are as comprehensive and subtle as those of human medicine and it is not possible to place one above the other"

Medical science reached its climax towards the end of first millennium under the influence of Arabs with Specific textbooks like *Kitab-al Baytara* (Ahmad ibn al-Husyn ibn Ahnaf).

Greek scholars Aristotle (384-322 B.C.) and Hippocrates (460-367 B.C.) corroborated the idea of integrated medicine. Hippocrates in his book 'On Airs, Waters and Places' proposed the need of a clean environment for healthy living which was extended to Roman civilization by the contribution from Galen (130-200 A.D.).

Hippocratic-Galenic concepts flourished to the renaissance through Europe and the future developments were carried out by Leonardo da Vinci (1452-1519) with his comparative anatomy thoughts and drawings.

In (1654-1720) Pope Clement XI appointed an Italian veterinarian Giovanni Maria Lancisi (for controlling Rinderpest). He was also successful in controlling Malaria by propounding the use of mosquito nets.

In (1728-1793) John Hunter, the famous experimental pathologist also backed the concept of comparative medicine.

In (1749-1823) Edward Jenner recollected the science of immunology trailblazing the small pox vaccination to James Phipps.

The first veterinary school at Lyon in France was founded on January 1761 by Claude Bourgelat (1712-1779) with an intention to eradicate rinderpest. Claude Bourgelat expressed his idea on integrated medicine as, "Either medicine (human medicine and veterinary medicine) will mutually enlighten and perfect the other when we discard the derisory, harmful prejudice"

Rudolf Virchow (1821-1902): In the 19th Century Rudolf Virchow, MD, was one of the most prominent physicians of the 19th century. Dr. Virchow was a German pathologist who became interested in the linkages between human and veterinary medicine while studying a roundworm, *Trichinella spiralis*, in swine. Rudolph Virchow regarded to be the father of comparative medicine and cellular pathology. He coined the term "zoonoses" to note those diseases spread between animals and humans. He stated 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."

William Osler, 1849-1919: Father of veterinary pathology in North America
The Canadian physician William Osler was the first to use the term 'One Medicine' in the English language literature. Dr. Osler had a deep interest in the linkages between human and veterinary medicine. He trained with many well-known physicians and veterinarians, including Dr. Virchow. One of his first publications was titled, "The Relation of Animals to Man."

While serving on the medical faculty of McGill University.

Daniel E. Salmon (1850 –1914):

The first graduate Doctor of Veterinary Medicine (DVM) qualified in the United States was Daniel E. Salmon (July 23, 1850 – August 30, 1914) Salmon confirming the role of animal vectors in the spread of the disease that are transmitted to humans from animals as tuberculosis from cattle. An epoch-making discovery was made by Salmon and Smith while studying hog cholera. Together they demonstrated that dead organisms killed by heat could immunise animals against living disease organisms. Salmon was honoured by his European colleagues when they named the common intestinal infectious bacteria **Salmonella after him**. He was also president of the American Public Health Association (APHA) and the AVMA.

James Law (1838-1921):

A veterinarian was educated at the Edinburgh Veterinary College and the medical school at Edinburgh University. He became the first professor of veterinary medicine in the United States, at Cornell University, and later the first dean of the New York State Veterinary College. Law became a leader in public health and was a scientist who believed in 'one medicine' where physicians and veterinarians should have close relations. His work on tuberculosis, foot and mouth disease and other epizootics had a profound effect on animal and human health in America.

James H. Steele (1947):

James H. Steele, in 1947, DVM, MPH, founded the Veterinary Public Health Division at CDC (Centers for disease control and prevention).

With this Division at CDC, the principles of veterinary public health were introduced to the United States and other countries. The Division (CDC) played an important role in the public health response to diseases such as rabies, brucellosis, salmonellosis, Q fever, bovine tuberculosis, and leptospirosis. Dr. Steele understood the important role of animals in the epidemiology of zoonotic diseases.

He recognized that good animal health is important for good public health. His idea was perfectly mirrored in the phrase 'One World, One Medicine, and One Health'

Calvin W. Schwabe DVM DSc (1927-2006):

"Father of Veterinary Epidemiology"

Calvin Schwabe, DVM, ScD, MPH, made many important contributions to veterinary epidemiology over his career. He began his career studying zoonotic parasitic diseases and directed the World Health Organization (WHO). He stressed the increasing interdependence of animals and their products with human health problems and encouraged both the medical and veterinary professions to take action to prevent these diseases from occurring. He asserted that "there is no difference of paradigm between human and veterinary medicine, and is the extension of notions of comparative medicine. Both sciences (human as well as veterinary medicine) share as general medicine, a common body of knowledge in anatomy, physiology and the origin of disease in all species" (Schwabe, 1984).

1967: Joint Food and Agriculture Organization (FAO)/WHO Expert Committee on Zoonoses more than 150 zoonoses were identified .

1975: The joint FAO/WHO technical report, VPH (Virtual physiological Human) was defined as 'the contributions to the physical, mental and social well-being of humans through an understanding and application of veterinary science'.

In 1999: The WHO conference on veterinary public health and control of zoonoses in developing countries invited experts from a total of 18 industrialized countries, countries in transition and developing countries. Held in Teramo, Italy, the conference was expanded to include FAO collaboration with the World Organization for Animal Health (OIE: Office International des Épizooties). 'The major purpose was to consider the contributions that VPH 'Virtual Physiological Human programmes could make to human health on a global basis,

with a particular future emphasis on developing countries'.

2000: More than 200 diseases were occurring in humans and animals that were known to be transmitted mutually; their aetiologies included viruses, bacteria (along with rickettsiae and chlamydiae), fungi, protozoa and helminths as well as arthropods and modes of transmission. This represents recognition of and/or emergence of a greater than 30% increase of zoonotic diseases in the last third of the 20th century. With newer diagnostic and research tools in an exponentially expanding age of biotechnology, what will this number be during the 21st century and beyond?

April 7, 2003: The eminent veterinary virologist, Frederick Murphy and the physician, Karl M. Johnson integrated efforts to untangle the Ebola Hemorrhagic fever on April 7, 2003 in Africa and so 'One health' concept can be better perceived. William Karesh, DVM saying that **"Human or livestock or wildlife health can't be discussed in isolation anymore. There is just one health And the solutions require everyone working together on all the different levels"**.

"The following year, Karesh and colleagues Robert Cook, VMD and Steve Osofsky, DVM launched a series of conferences around the world with the theme of **One World - One Health**.

2004: The Wildlife Conservation Society publishes the 12 Manhattan Principles called for an international, interdisciplinary approach to prevent disease and formed the basis of the **"One Health, One World"** concept.

2007: The American Medical Association passes the **One Health resolution promoting partnership between human and veterinary medicine**

2007: **The One Health approach is recommended for pandemic preparedness**

2008: FAO, OIE, and WHO collaborate with UNICEF, UNSIC, and the World Bank to develop a joint strategic framework in response to the evolving risk of emerging and re-emerging infectious diseases. One Health becomes a

recommended approach and a political reality.

October 25-26, 2008, representatives from more than 120 countries and 26 international and regional organizations attended the International Ministerial Conference on Avian and Pandemic Influenza in Sharm el-Sheikh, Egypt. Participants endorsed a new strategy for fighting avian influenza and other infectious diseases, one that focuses infectious disease control in areas where animals are spread

2009: **The One Health Office is established at CDC** the role of the One Health Office has expanded to include supporting public health research that furthers the One Health concept, facilitating the exchange of data and information among researchers across disciplines and sectors. United States Agency for International Development (USAID) launched the Emerging Pandemic Threats (EPT) program. Program draws on expertise from across the animal and human health sectors to build regional, national, and local One Health capacities for early disease detection, laboratory-based disease diagnosis, rapid disease response and containment, and risk reduction. Key recommendations for One World, One Health are developed. Experts attended from 23 countries for further discuss the One World, One Health strategy and the objectives in the Strategic Framework, which was first released at the International Ministerial Conference on Avian and Pandemic Influenza in Sharm el-Sheikh. During the meeting, key recommendations emerged for actions that countries could take to advance the concepts of One Health.

2010: The Hanoi Declaration, which recommends broad implementation of One Health, is adopted unanimously participants confirmed the need to bring greater attention to **the links between human and animal health to address threats that happen when animals, humans, and the ecosystem interface.** The Tripartite Concept Note is published - Recognizing that managing and

responding to emerging infectious diseases is complex and requires multi-sectoral cooperation, the Food and Agriculture Organization of the United Nations (FAO), the World Organization for Animal Health (OIE), and the World Health Organization (WHO) joined together to publish the Tripartite Concept Note in April 2010.

Experts identify clear and concrete actions to move the concept of One Health from vision to implementation. May 4-6, 2010, CDC, in collaboration with the World Organization for Animal Health (OIE), Food and Agriculture Organization of the United Nations (FAO), World Health Organization (WHO). The meeting, which came to be known as the "Stone Mountain Meeting," was designed to define specific action steps to move the concept of One Health forward.

2010: The United Nations and the World Bank recommend adoption of One Health approaches. In July 2010, the World Bank and the United Nations released the "Fifth Global Progress Report on Animal and Pandemic Influenza" "emphasized the importance of adopting a One Health approach to sustain momentum in pandemic preparedness."

In the last 30 years the prevalence of infectious disease has increased such that 75% of the emerging infectious diseases in humans are of animal origin. World Bank (2010) estimated a direct loss of US \$2 billion and an indirect loss of \$20 billion on the zoonoses.

Veterinarians are considered to be the sanctified professional group likely to see both humans and animals and the ecology of agents with special reference to the vector potentiality. Recent drifts taking place in the globalised world include emerging infectious diseases (Avian influenza, Swine flu, zoonotic Enterohaemorrhagic E. coli, SARS) need to tighten the concept of 'One health' with a high degree of collaboration to tackle the issues smoothly.

Emerging critical global issues that demand veterinary attention
International trade and travel The movement of people, animals, and agricultural products can quickly spread disease pathogens around the world.

Global climate change: Vector-borne zoonotic diseases such as yellow fever and certain encephalitides may become more widespread as the geographic range of their mosquito vectors increases. Warming temperatures and shorter winters played a part in the establishment of the tropical diseases dengue and malaria in more temperate areas of the world during the 1980s and 1990s.

Habitat destruction: Deforestation can force wildlife reservoirs of zoonotic diseases into closer proximity with humans. The sudden emergence of Nipah virus disease in pigs and humans in Southeast Asia in the late 1990s may have been caused by rapid deforestation to clear land for farming and timber production. The natural reservoir for Nipah virus appears to be fruit-eating flying foxes (bats in the genus *Pteropus*). As deforestation reduced their native food sources, flying fox populations were thrust into closer contact with commercial fruit orchards and fruit trees on pig farms, where the virus spread to pigs and then to humans.

Overpopulation: As human populations encroach upon wildlife habitat, people come into contact with more wild animals and the diseases they carry. Ebola and AIDS probably jumped from chimpanzees to humans as population pressures increased the consumption of bushmeat, exposing people to infected blood and tissues during butchering. Wildlife health is impacted, too, as native species are exposed for the first time to human and domestic animal diseases. In the 1990s an outbreak of canine distemper in domestic dogs caused high mortality in lions and other carnivores in Serengeti National Park in Tanzania.



Ecotourism: Ecotourism is championed as a vehicle for developing countries to benefit financially in exchange for habitat conservation, but tourism activities can introduce diseases to wildlife. A study based on data obtained from the Ugandan Health Ministry's Health Monitoring Information System indicated that serious diseases such as malaria, measles, and tuberculosis were among those most likely to be transmitted to gorillas by human visitors. **Veterinary and public health planning and oversight are essential for maintaining the health of animals affected by ecotourism.**

Food safety: A number of emerging infectious zoonotic diseases threaten the safety of our food supply and the control of these diseases requires the collaborative efforts of various health workers. Veterinarians, public health and human health professionals must be continually involved in the trace-back and control of food-borne illnesses such as bovine spongiform encephalopathy (BSE) and infections caused by *Escherichia coli*.

Bovine spongiform encephalopathy: A degenerative neurological disease of cattle similar to scrapie in sheep and Creutzfeldt-Jakob disease (CJD) in people, BSE was first diagnosed in the United Kingdom (UK) by veterinarians. The number of cases increased rapidly in the UK because of a change in the processing of feed rations containing protein and calcium derived from meat and bone meal. A few years after BSE was diagnosed in cattle,

an unusual form of CJD appeared in young and adults in the UK. The origin of infection for this variant CJD was traced back to cattle infected with the prions of BSE, the tissues of which had been consumed by the affected patients. Since 1996, BSE has resulted in more than 180,000 cattle deaths and more than 200 human fatalities. The disease has been most prevalent in the UK, but several thousand cases have also been reported in native cattle in 21 other countries. To bring this disease under control in animals and people, strict restrictions have been placed on the feeding of ruminant meat and bone meal to domestic animals and captive wildlife in many countries throughout the world. Veterinary clinicians and veterinary meat inspectors are on the alert for affected animals to prevent them from entering the feed or food supply chain and many countries have implemented surveillance systems to examine brains of cattle to ensure BSE is not in their herds.

***Escherichia coli* O157:H7** (contamination of leafy greens).

The recent outbreaks of *E. coli* O157:H7 in the USA associated with spinach and lettuce has presented a dilemma for regulatory and public health officials. Although cattle were originally thought to be the reservoir host for the outbreaks, the fields where the produce was grown had no direct link to cattle. Investigators looked at irrigation water, composted manure, and even birds as the potential

cause of the contamination. Recently, the role of feral pigs surfaced as a source of contamination. After mingling with cattle in the pastures more than a quarter of a mile away, the pigs moved onto the leafy green fields and defecated in the fields. In this particular outbreak, leafy greens were the principal vector enabling the E. coli O157:H7 to move from cattle, through feral pigs and on to the consumer introduction of food-borne diseases into new geographic areas.

Co-operation between the veterinary and medical professions must be strengthened to combat these and other emerging threats to the world food supply. It is of ever-increasing importance to provide safe and adequate food and water for the world's human population.

Intentional adulteration of food:

Intentional adulteration of food is the means by which terrorists can sicken large numbers of individuals with the intent of destabilising the country, overwhelming healthcare facilities, or causing economic losses to the food providers and suppliers. It can also come about when products are added to falsify ingredient results.

Recently, a series of incidents resulted in global food-related health concerns for both animals and people. Testing for protein routinely involves measuring elemental nitrogen without consideration of true protein. Melamine, along with cyanuric acid, contains relatively large quantities of nitrogen in its chemical structure, so it is sometimes illegally added to food to increase the perceived protein content.

In 2004, a large number of pets in Asia developed renal disease which was initially attributed to fungal toxins but later associated with the presence of melamine (Melamine combines with cyanuric acid and related compounds to form melamine cyanurate and related crystal structures, which have been implicated as contaminants or biomarkers in Chinese protein adulterations) in pet food.

In 2006, a similar acute renal condition occurred in dogs and cats in the USA. The

United States Food and Drug Administration oversaw the outbreak and, through the efforts of the State Diagnostic Laboratories in New York and California, crystalline structures of melamine and cyanuric acid in the kidneys were identified as the cause. The outbreak was resolved through the recall and removal of the contaminated pet foods from stores.

In 2008, a severe renal condition occurred in China involving hundreds of thousands of young children consuming infant formula (milk substitute). Melamine was again detected in the formula.

The role of veterinarians was critical in identifying the presence of the adulterant in pet foods, which in turn notified the world to the use of melamine as a cause of acute renal disease.

Bio-defence: Some zoonotic diseases are unfamiliar to the general medical community and exist as potential agents of bioterrorism against human populations because of their virulence, lack of treatment options, and ease of production, transmission, and infection. **Bioterrorism** is terrorism involving the intentional release or dissemination of biological agents. These agents are bacteria, viruses, or toxins, and may be in a naturally occurring or a human-modified form.

Zoonotic bioterrorism agents can also target agriculture, causing economic disruptions and undermining consumer confidence in food supplies. Outbreaks of livestock diseases can result in mass culling of animals, import and export restrictions on livestock, and fears of human contagion and pandemics.

Both veterinary and medical expertise is critical in formulating prevention and response plans for possible acts of bioterrorism involving zoonotic diseases.

Zoonotic Diseases

A zoonotic disease is a disease which can be caused by viruses, bacteria, parasites, and fungi and can be passed between animals and humans. Scientists estimate that more than 7 out of every 10 infectious diseases in humans are spread from animals.

Many people interact with animals in their daily lives. Animals raised for food and keep them in our homes as pets. Humans might come into close contact with animals at a county fair or petting zoo or encounter wildlife when they clear wooded land for new construction. What are the ways through which people can get zoonotic diseases?

1-Coming into contact with the saliva, blood, urine, or feces of an infected animal

2-Being bitten by a tick or mosquito (often called a "vector").

3-Eating or drinking something unsafe (such as unpasteurized milk, undercooked meat, or unwashed fruits and vegetables that are contaminated with feces from an infected animal).

Luckily, there are many ways you can protect yourself and your family from zoonotic diseases.

You can: Always wash hands and follow proper hygiene, handle food safely, prevent bites from mosquitoes and ticks, know the simple things you can do to stay safe around your pets, be aware of zoonotic diseases both at home and when you travel.

The increasing occurrence of emerging infectious diseases indicates that bridging animal, human and environmental health through the One Health concept is becoming even more critical. Veterinarians can ideally provide this bridge with their in-depth understanding of biological systems, knowledge of disease processes and epidemiology, experiences with diagnosing and managing diseases in large populations of animals, and success in eliminating and preventing infectious diseases.

Veterinarians can be, and often are, the first line of defense for zoonotic diseases as well as for various toxicants that occur naturally or by intentional terrorist attack.

Veterinarians are in contact with a wide variety of domestic and free-ranging animals, effective and efficient diagnostic systems, and local and national regulatory systems for animal health, food safety, and public health must be taken in consideration. One Health represents a

unique and significant opportunity for veterinary medicine to collaborate with human medicine and public, wildlife and environmental health for the greater good. An integrated approach is the key to promoting One Health, and this approach is best developed by ensuring that veterinarians are extensively involved in collaborative teams, particularly in leadership roles.

The facts

Majority of emerging diseases are diseases or animals transmissible to humans animal health critical to protein supply and food safety. Genomics and pathogenesis of disease shared by animals and humans. Prevention, diagnosis, and treatment of human and animal diseases utilize similar technologies biodefense: Shared animal and human threat agenda. Companion animals play an increasing role in human welfare.

One Health shall be achieved through:

1. Joint educational efforts between **human medical, veterinary medical schools, and schools of public health and the environment**
2. Joint communication efforts in journals, at conferences, and via allied health networks.
3. Joint efforts in clinical care through the assessment, treatment and prevention of cross-species disease transmission.
4. Joint cross-species disease surveillance and control efforts in public health.
5. Joint efforts in better understanding of cross-species disease transmission through comparative medicine and environmental research.
6. Joint efforts in the development and evaluation of new diagnostic methods, medicines and vaccines for the prevention and control of diseases across species.
7. Joint efforts to inform and educate political leaders and the public sector through accurate media publications.

Select examples to communicate One Health concepts to the public:

- 1- Explanations of the role of various professions in helping to quickly detect and control zoonotic and emerging diseases, such as Bovine Spongiform Encephalopathy, Highly Pathogenic Avian

Influenza, Lyme Disease (An acute inflammatory disease characterized by a rash with joint swelling and fever; caused by bacteria carried by the bite of a deer tick), West Nile Virus, Ebola, Monkey pox, and Severe Acute Respiratory Syndrome.

2-Health professions are more similar than they are different. Cancer is cancer, whether in people or animals. All substances known to cause cancer in people also cause cancer in animals.

3- One Health is the concept that spans disciplines. Many diseases affect different species so there should be a broad species perspective to meet today's challenges.

4-The diseases emerging are zoonotic, so they cannot be tackled by veterinary or human medical perspectives alone.

5- Because of the freedom to go anywhere in the world so quickly, coupled with the majority of emerging diseases being zoonotic, we need to have new approaches to new and old pathogens.

6-We need to understand the interrelatedness of human, animal, and environmental health, including the veterinarian's special perspective of understanding agricultural production systems, which is important as the demand for animal protein grows and as people encroach on rural areas.

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7-Damage to the environment, including climate change, is modifying disease vectors.

8-The message should exemplify a proactive, not a reactive, approach, and should be a part of a communications strategy.

"Collaboration Between Human and Veterinary Medicine"

- An initiative designed must be planned to promote collaboration between human and veterinary medicine.
 - Joint educational efforts between human medical and veterinary medical schools.
 - Encourage joint efforts in clinical care through the assessment, treatment, and prevention of cross-species disease transmission.
 - Support cross-species disease surveillance and control efforts in public health.
 - Support joint efforts in the development and evaluation of new diagnostic methods, medicines, and vaccines for the prevention and control of diseases across species.
- Veterinary Faculties must be engaged in a dialogue with the Egyptian Veterinary Medical Association to discuss strategies for enhancing collaboration between human and veterinary medical professions in medical education, clinical care, public health, and biomedical research**

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عصمت سيف النصر و محمد صالح
كلية الطب البيطرى - جامعة القاهرة

الطب الواحد ليست فكرة جديدة. ففي القرن ال19، قال العالم الالماني روبرت فيرشو والذي كان يعمل طبيباً عاماً وطبيباً لعلم الأمراض، (لا يوجد حداً فاصلاً بين طب الحيوان والطب البشري، ولا ينبغي أن يكون هناك أى حد فاصل). لم تكن أهمية الترابط بين البشر والحيوانات والبيئة بمثل ما هي عليه الآن. ومن أبرز المهام التي تشكل ضغطاً على الصحة العالمية اليوم هي الظهور والانتشار الدرامي للأمراض الحيوانية المنشأ، وتلوث الغذاء والماء والتربة، و أحداث الإرهاب البيولوجي، وتدهور الموارد والموائل. وقد دفعت تلك التحديات الراهنة المنظمات الصحية العالمية لنشر دعوة للتعاون، ووضع مناهج أكثر شمولية تهدف للوصول لحلول منطقية وعملية.

وللأطباء البيطريين أهمية خاصة لما يودونه من التزامات محورية في مجال اكتشاف ومقاومة ومنع انتشار الأمراض ذات الاصل الحيواني، واعطاء فرص للمساهمة في تعزيز الصحة العامة، كذلك دورهم الهام في الحفاظ على الموارد الغذائية ونوعية المياه، وتعزيز الحياة البرية وصحة النظام البيئي.