

CONSERVATION MEDICINE / ONE HEALTH PROGRAMS

August 25, 2017

Conservation medicine addresses the growing disease challenges that threaten the survival of wild animal species and that negatively affect human public health. The field of conservation medicine emphasizes a multidisciplinary approach to studying the interrelated nature of diseases in animals and humans, in the context of environmental change. In recent years, the term One Health has evolved and has similar objectives to conservation medicine, in that it aims to merge animal and human health to benefit both. Human-related environmental changes have escalated in recent years, threatening animal and human health as well as all ecosystems on Earth. On a global scale, the human population growth to seven billion, with the associated habitat fragmentation and degradation, increased travel and trade, and climate change, has an impact on the health of all species.

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ZOOS

Chicago Zoological Society / Brookfield Zoo – Chicago, IL

<https://www.czs.org/Brookfield-ZOO/Home>

<https://www.czs.org/Centers-of-Excellence/Home>

The Brookfield Zoo partners with the University of Illinois in One Health programs as described under the University of Illinois program, and the zoo does not have a separate conservation medicine or One Health department.

Centers of excellence at the Chicago Zoological Society include the Center for Science for Animal Care and Welfare and the Center for Conservation Leadership. The Center for Animal Science conducts research and includes projects related to Endocrinology (to improve the well-being and reproductive success of species, both in zoos and in the wild) and Population Genetics (to promote species health and survival and ensure genetic diversity). The Center for Conservation Leadership involves conservation projects around the world in collaboration with various partners.

Cleveland Metroparks Zoo - Cleveland, OH

<https://clevelandmetroparks.com/zoo>

<http://www.aazv.org/page/733/Residency-Available-at-Cleveland-Metroparks-Zoo.htm>

While the Cleveland Metroparks Zoo (CMZ) website does not list programs related to One Health or Conservation Medicine, there was a posting for a Conservation Medicine Resident at the Cleveland Metroparks Zoo in 2011. This residency was for three years, approved by the ACZM and provided training in ecology, epidemiology, and wildlife population health. The description stated the resident will learn how to “assess the health disease and environment of captive and free-ranging wildlife population” and their research will “focus on methods to improve and monitor the health and well-being of these populations.” Based on this program description, CMZ has (or had) a conservation medicine program in the past.

The CMZ Conservation & Science department has a number of projects, and the Ruaha Carnivore Project specifically focuses on helping humans and large carnivores coexist.

Columbus Zoo and Aquarium – Columbus, OH

<https://www.columbuszoo.org/>

The Columbus Zoo partners with Ohio State University College of Veterinary Medicine in their Conservation Medicine program. This program is described in more detail under Ohio State University.

Maryland Zoo – Baltimore, MD

<http://www.marylandzoo.org/>

The Maryland Zoo has a new Department of Conservation and Research led by Dr. Ellen Bronson. The goal of this newly formed department is to develop projects that involve multiple departments and all levels of stakeholders. The department is undertaking a strategic planning process, which includes collection managers, veterinary staff, education, marketing, public relations, and grant writing managers, and a conservation liaison to the Board. Keepers and other hourly staff provide input to the process and receive mentoring through a Conservation and Research Advisory Group. The zoo's conservation projects are centered along the zoo's five signature animal programs - Panamanian golden frogs, African penguins, African elephants, polar bears, and chimpanzees, and future programs will add native species and other select species of interest. The zoo is currently heavily involved in the conservation of Panamanian golden frogs and African penguins in their native ranges, as well as multiple species native to Maryland in collaboration with the Maryland Department of Natural Resources such as black bears, pelicans, snowy owls, and bog turtles. The goal is for these existing programs and all new projects to include ecological, health, and educational components along with conservation initiatives. Multiple original research projects are ongoing at the Zoo and intersect frequently with the areas of conservation focus, especially involving Panamanian golden frogs and African penguins. Since sustainable solutions involve multiple stakeholders and all levels of personnel, the Zoo's Sustainability Committee is also an important part of the Department of Conservation and Research and continues to expand the green initiatives in the zoo and the surrounding park.

National Aquarium

<https://aqua.org/>

The National Aquarium has a Conservation Medicine program within the Animal Science and Welfare Department with Dr. Leigh Clayton as the Director. Dr. Kat Hadfield, a senior veterinarian, oversees the clinics, and the preventive medical care of animals in the Aquarium and Animal Rescue program, and "conducts clinical and conservation medicine research in aquatic animal health". Dr. Hatfield also serves as the primary manager of all veterinary training and mentoring programs.

New England Aquarium – Boston, MA

<http://www.neaq.org/>

<http://www.andersoncabotcenterforoceanlife.org/>

The New England Aquarium recently restructured its research and conservation department into the Anderson-Cabot Center for Ocean Life, the mission of which is:

"Transforming science into action by applying innovative, science-based solutions to combat the unprecedented threats to our oceans represented by climate change and other human activities."

Dr. Charles Innis, Director of Animal Health at the New England Aquarium, participates with the Center on specific projects and the Center staff includes Dr. Rosalind Rolland, Director of Ocean

Health, and other experts in animal physiology, animal behavior and ecology. The Center has a cutting edge endocrinology laboratory specializing in reproductive and stress physiology of marine mammals, including analysis of unique tissue types such as feces, respiratory vapor and baleen. A long-term program on endangered North Atlantic Right Whales includes population surveys and monitoring, whale photo-identification and curation of the Right Whale Catalog, health assessments and reducing the impacts of human activities (fishing gear entanglement, underwater noise, vessel strikes). Other Center initiatives include a focus on reducing fisheries bycatch globally, sustainable fisheries and aquaculture, and a program empowering emerging global conservation leaders.

Separately from the Center, the New England Aquarium has a rescue and rehabilitation program for stranded sea turtles and marine mammals, many of which are endangered species. This work is primarily conducted in the northeast area although Dr. Innis and his colleagues have been called to other parts of the world to assist in critical incidents.

Palm Beach Zoo – West Palm Beach, FL

<http://www.palmbeachzoo.org/>

The Palm Beach Zoo has a Center for Conservation Medicine located in the Animal Care Complex. The Center is described as “the hub for all Palm Beach Zoo conservation initiatives here at the Zoo and around the world.”

A key project at the Center for Conservation Medicine, described under On Site Programs, is helping to establish databases on nutritional values for a variety of species and assessing the impact of diet on health. A conservation medicine related article under Conservation, “*Avian Influenza Testing & Surveillance*” references avian influenza as an important emerging disease due to the ability of these viruses to be transmitted among animals as well as humans.

Saint Louis Zoo – St. Louis, MO

<https://www.stlzoo.org/conservation/institute-for-conservation-medicine/>

Saint Louis Zoo established the Institute for Conservation Medicine (ICM) in 2011. The ICM takes a holistic approach to research on wildlife, public health and sustainable ecosystems to ensure healthy animals and healthy people.

Veterinarians, ecologists and human medical professionals are recognizing the role of infectious disease as an increasing threat to the health of animals, humans and ecosystems. A number of these pathogens, including rabies and Ebola viruses, directly affect the health of wildlife and human populations. Animals housed at zoos may serve as sentinels for emerging diseases of humans and animals in surrounding areas.

The Saint Louis Zoo's conservation medicine research focuses on diseases that affect the conservation of threatened and endangered wildlife species. Scientists study the origin, movement and risk factors associated with diseases so they can better understand the impact on the conservation of wildlife populations; the links between the health of zoo animals and free-living wildlife populations; and the movement of diseases between wildlife, domestic animals and humans.

The ICM is involved in several projects which span the globe including a study of box turtles in Missouri focused on environmental factors that may affect their health and have implications for humans; health assessments of dromedary camels used for milk in Kenya since the lack of pasteurization results in humans being exposed to zoonotic pathogens in camel milk; and how exposure to endocrine disrupting compounds (EDCs) in water and can affect human and animal health. The ICM is also working with the Galápagos National Park (GNP) to conserve giant Galápagos tortoises by conducting applied science to study their health and movements and develop strategies to reduce threats to the tortoises.

Smithsonian National Zoological Park - Washington D.C.

<https://nationalzoo.si.edu/SCBI/GlobalHealth/>

<https://nationalzoo.si.edu/smithsonian-global-health-program>

The Smithsonian National Zoo Conservation Biology Institute (SCBI) has a Global Health program that leverages multidisciplinary expertise in wildlife medicine, conservation pathology, training of international professionals, and investigation of emerging infectious disease to combat threats to conservation and public health worldwide.

Smithsonian's Global Health Program (SGHP) works with international partners to combat threats to wildlife, human, and ecosystem health and survival by addressing these challenges at their source: the human-wildlife interface. SGHP is based upon the One Health platform, which recognizes that the health of all species is intertwined and closely dependent upon each other. As such, SGHP scientists utilize a broad range of expertise to address wildlife health concerns, investigate disease at the human/wildlife interface, and conduct training in an effort to build intervention and response capacity worldwide.

As stated on the SGHP website:

The fate of human communities, wildlife, and ecosystems become more and more tightly interwoven as people continue to expand and the world becomes increasingly interconnected through the ease of travel. Animal trafficking and land-use change are constantly bringing humans and wildlife into close contact and providing opportunities for the spread of diseases into new locations and new species. Worldwide, an estimated 75 percent of diseases affecting human health are caused by pathogens originating in animals (zoonotic). These include HIV/AIDS, Ebola, SARS, influenza, and MERS coronavirus, just to name a few.

More detailed information on SGHP specific programs is on the website including sections on Public Health & Pathogen Detection, Global Health Exchange Program and Wildlife Outbreak Research & Response.

Wildlife Conservation Society (WCS) – New York City, NY (HQ)

WCS is affiliated with the New York City area zoos: Bronx Zoo, Central Park Zoo, Prospect Park Zoo, Queens Zoo and the New York Aquarium.

<https://www.wcs.org>

Wildlife Conservation Society (WCS) recognizes that health and welfare of people and communities across the globe are inextricably connected to their mission of protecting wildlife and wild places, and is working with nations to achieve these goals. (Strategy 2020).

The website states WCS “initiated and remains a leader in the One World – One Health™ interdisciplinary approach.”

In the last few decades, it has become increasingly evident that conservation, human health, and the health of wild and domestic animals are all inextricably linked. A single pathogen can wipe out the last populations of an endangered species and, in turn, threaten the stability of local human populations. Thus, there is an urgent need to simultaneously address the health of people and animals, recognizing that disease poses challenges to both conservation of the planet's biodiversity and efforts to improve the quality of human life.

WCS employs three primary strategies:

- Build local capacity to care for and protect the health of wildlife worldwide.
- Gather and applying critically needed information to protect the health of wildlife, people, and domestic animals, all as underpinned by environmental stewardship.
- Promote policies, guidelines, and best practices to ensure a healthy planet.

WCS develops and implements solutions that achieve long-term conservation success and create a healthier world. By engaging partners across conservation, public health, agriculture, and beyond, WCS provides critical information that influences policy and action.

See also the link to the “2015 WCS Health Program Update”

Zoo New England / Franklin Park Zoo – Boston, MA

<http://www.zoonewengland.org/>

The Conservation Medicine program at Zoo New England (ZNE) is led by Dr. Eric Baitchman, the Director of Animal Health and Conservation Medicine. The program has a One Health approach and involves three tenets: Genomics, One Health Research and Education, and Preservation of Biodiversity.

The goal of the Genomics focus area is to apply genomic technologies and translational medicine to zoo and wildlife species. Four pilot projects in 2017 will serve as proof of the concept that such studies will benefit both animal and human health. ZNE hopes to hold a workshop in 2018 to present the results of these pilot projects and discuss a future center for genomic medicine for zoological species to would serve the AZA and other institutions.

As part of the One Health focus area, ZNE and Harvard University Medical School have established a clinical elective for 4th year Harvard Medical School MD and MD/PhD students in

their senior year, which involves a one month rotation to illustrate that transdisciplinary collaboration and communication between human and veterinary medical professionals can benefit healthcare for both humans and animals. Believed to be the only formal collaboration of its kind in the country, the One Health Clinical Elective was officially listed in the Harvard Medical School course catalog in early 2017.

Conservation Medicine holds that the Preservation of Biodiversity enhances ecological health and in turn, the health of animals and humans. ZNE has had a leadership role in the Panama Amphibian Rescue and Conservation Project for 10 years, working to conserve critically endangered species of amphibians in Panama. On a local level, ZNE initiated the Franklin Park Biodiversity Project with a survey of plants and animals in Franklin Park and future plans include collaboration with local ecologists and biologists, and community outreach using iNaturalist.

Auckland Zoo – Auckland, New Zealand

<http://www.aucklandzoo.co.nz/sites/conservation/in-the-zoo/research>

The Auckland Zoo includes the New Zealand Centre for Conservation Medicine. The zoo website describes conservation medicine as focusing on the connections between human, animal and environmental health, which often involves collaborating with many different experts to help solve disease-related problems. The Centre includes “a veterinary team who take a conservation medicine approach to everything that they do.” The Centre’s senior veterinarian, Dr. Richard Jakob-Hoff is currently working with conservation partners to establish ecosystem health maps of sanctuary islands Tiritiri Matangi and Hauturu (Little Barrier). The Centre also works with breeding programs for critically endangered animals in the wild.

Perth Zoo - Perth, Australia

<https://perthzoo.wa.gov.au/veterinary-services>

The zoo website notes “Conservation Medicine is a growing scientific discipline which aims to understand the role of health and disease in wild animals (as ecosystems rather than individuals) and how it relates to their conservation.” Veterinarians at the Perth Zoo published a paper (International Zoo Yearbook, 2010) stating key aspects of conservation medicine include the potential impact of wildlife disease on biodiversity and the importance of wildlife health within the continuum of human and ecosystem health. Challenges for future growth are examined, and the paper states that successful zoo-based conservation medicine activities rely on strong relationships and broad acceptance across the entire zoo of the importance of conservation medicine outcomes.

Zoological Society of London’s (ZSL) Institute of Zoology (IoZ) – London, UK

<https://www.zsl.org/science/about-the-institute-of-zoology>

The Institute of Zoology (IoZ) is the scientific research division of the Zoological Society of London (ZSL) and works on conservation biology and scientific issues relevant to preserving animal species and their habitats. Fundamental and applied research is performed in five thematic areas.

The Wildlife Epidemiology area of research, led by Andrew Cunningham, involves the identification and investigation of wildlife diseases (both infectious and non-infectious); ranging from basic studies to the assessment of their likely impacts on human health and biodiversity conservation. I of Z uses inter-disciplinary approaches to understand how diseases influence their host populations and the mechanisms underlying disease emergence in wildlife, domestic animals and humans.

The People, Wildlife and Ecosystems area of research focuses on the key areas of understanding processes that promote and impede human-wildlife coexistence, evaluating the contribution of ecosystem services to sustainable livelihoods, economies and society, and understanding and predicting the impacts of policy and management interventions on conservation outcomes.

OTHER ORGANIZATIONS

Centers for Disease Control and Prevention – Atlanta, GA

<https://www.cdc.gov/onehealth/>

The One Health concept recognizes that the health of people is connected to the health of animals and the environment. CDC uses a One Health approach by working with physicians, ecologists, and veterinarians to monitor and control public health threats and learning how diseases spread among people, animals, and the environment. Diseases that can be shared between animals and people are called [zoonotic diseases](#). Animals also share our susceptibility to some diseases and environmental hazards and therefore they can serve as early warning signs of potential human illness. For example, birds often die of West Nile virus before people get sick with West Nile virus fever.

The Zoonoses Education Coalition (ZEC) has developed a set of evidence-based, plain language recommendations, which can be used by everyone involved in promoting healthy pets and healthy people. CDC, the United States Department of Agriculture (USDA), and the 4-H Public Health Youth Education Program have an ongoing partnership to educate youth on the transmission and prevention of zoonoses.

CDC scientists study how diseases in animals become threats to human health in the United States and around the world. They also look at how changes in the environment affect the health of animals and humans. Such research helps us understand:

- How viruses, bacteria, and parasites spread between animals and humans.
- How a person's behavior can increase the risk that they will get sick from an animal.
- How quickly these diseases can spread.

Diseases can spread around the world very quickly, so it is important for CDC to work closely with other countries to build strong partnerships with human and animal health organizations.

Conservation Medicine Center of Chicago - Chicago, IL

<http://www.luhs.org/depts/cmcc/index.htm>

The Conservation Medicine Center of Chicago (CMCC) brings together the Chicago Brookfield Zoo, the University of Illinois, College of Veterinary Medicine and the Loyola University Chicago School of Medicine. The CMCC brings together a unique team of physicians, veterinarians, researchers and clinicians in many disciplines. The goal of the CMCC is to study the relationship among animals, people and the environment: how animals and people each affect the ecosystem and how changes in the ecosystem affect the health of all species. CMCC strives to attain that goal through both research and education.

As stated on the CMCC website:

It is now common knowledge that people and animals can suffer from some of the same diseases. Infectious diseases transmitted between animals and humans are known as zoonoses and the CMCC has set up a core laboratory to investigate potential zoonotic diseases.

Factors responsible for the emergence of infectious diseases are often the same that threaten the environment and wildlife populations. Diseases that have been held in check by natural mechanisms or isolated from potential new hosts may emerge when human influence changes the ecology of the historic host of the disease. For example:

- Lyme disease emerged as the populations of host species such as deer exploded and animals that kept the deer population in check were eliminated by human development.
- HIV, the virus that causes AIDS, emerged in central Africa, probably as a mutation of a Simian virus. The emergence was apparently related to contact with primates and most likely a result of the increasing slaughter of primates for commercial trade in bush-meat.

Projects (current and planned) specifically related to animal and human interactions include studying deer mice to help better understand if they play a role in Lyme disease transmission, and studying the effects of environmental toxins on the dolphin populations in Florida. Other projects include immunology studies on frogs to understand the global decline in amphibian populations, and tracking the rabies epidemic in raccoon populations in the eastern US.

National Oceanic and Atmospheric Association – Silver Spring, MD (HQ)

<http://cpo.noaa.gov/AboutCPO/SocietalChallenges/NOAAOneHealth.aspx>

NOAA is a federal scientific agency that is part of the US Department of Commerce. NOAA is highly focused on data, modeling, and other “tools” to assess environmental conditions. NOAA’s original focus areas were weather, marine charts for coastal areas and fisheries however, they have expanded into numerous other areas including One Health. The NOAA website states, “the One Health concept recognizes that the health of humans is inextricably linked with the health of animals and the environment.” NOAA One Health is an agency-wide group that aims to advance NOAA’s science and services to inform health decisions through improved understanding of the linkages between environmental conditions and health outcomes, and the delivery of useful products, data and tools.

Veterinary Initiative for Endangered Wildlife (VIEW) – Bozeman, MT

<http://www.viewwildlife.org/>

The Veterinary Initiative for Endangered Wildlife (VIEW) is a conservation organization that focuses on the need to address health threats as part of a comprehensive strategy for protecting endangered wildlife.

The VIEW website state that:

...the serious nature of infectious diseases transmitted across species is increasing. Numerous conservation efforts with endangered species have demonstrated the potential impact of disease to limit recovery of wildlife. For example, epidemics of canine distemper have been reported in wild African lions and captive tigers. Infectious and transmissible disease, when not identified, treated, and prevented, can do untold, yet preventable, harm to wildlife populations, domestic animals, and humans.

VIEW focuses on building local expertise and provides training and infrastructure to support locally sustainable wildlife disease investigation, prevention and treatment. VIEW also conducts research and promotes policies that ensure healthy environments for wildlife and the people and domestic animals that share their habitat.

World Wildlife Fund (WWF) – Gland, Switzerland (HQ)

<https://www.worldwildlife.org/initiatives>

The World Wildlife Fund's mission is not focused on One Health and/or Conservation Medicine in the sense that the organization does not do research or study the interrelationships between animal and human health issues.

The mission of the WWF has changed to include human populations however as described on the website:

WWF's work has evolved from saving species and landscapes to addressing the larger global threats and forces that impact them. Recognizing that the problems facing our planet are increasingly more complex and urgent, we have refined the way in which we work around an ambitious new strategy. Our new strategy puts people at the center and organizes our work around six key areas: forests, marine, freshwater, wildlife, food and climate. By linking these six areas in an integrated approach, we can better leverage our unique assets and direct all our resources to protecting vulnerable places, species and communities worldwide. People are at the center of our work because together we can change the trajectory of the threats to nature, and help ensure nature's ability to provide—for the sake of every living thing, including ourselves.

WWF works in 100 countries around the globe. The organization focuses on efforts to conserve specific species, particularly those whose protection influences and supports the survival of other species. WWF also works to protect specific places based on the wealth and variety of life they support, challenges faced and the WWF's ability to have a positive impact on them.

UNIVERSITIES

Cornell University – Ithaca, NY

<https://www2.vet.cornell.edu/>

The mission statement of Cornell’s College of Veterinary Medicine (CVM) specifically states:

”We promote researchto better inform the practice of medicine, public health and policy ... We seek to advance understanding of both animal and human health, foster open collaboration across disciplines ...”

The CVM is “dedicated to advancing animal and human health through discovery-based research, the delivery of excellent clinical care, and continued vigilance against the spread of diseases”. The traditional DVM program is offered as well as Master and PhD degrees, which include study in infectious disease epidemiology, biomedical and biological science and food systems for global health. The CVM also administers a Master of Public Health program, which takes a One Health approach to solving public health problems and recognizes an interdisciplinary approach is needed to focus on the interrelationships between animals, humans and the environment. The MPH program involves cross-campus initiatives related to sustainability and international issues.

A specific zoo partnership is not mentioned on the website.

Fontbonne University – St. Louis, MO

<https://www.fontbonne.edu/academics/departments/biological-and-physical-sciences-department/one-health-certificate/>

Fontbonne University’s Biological and Physical Sciences Department offers a One Health Certificate, which was developed in partnership with the St. Louis Zoo’s Institute of Conservation Medicine. Dr. Sharon Deem, Director of the ICM, states that the Fontbonne program “offers a trans-disciplinary, holistic approach necessary to solve the 21st century challenges that increasingly threaten wildlife species survival, ecosystem sustainability and public health.” The One Health program is described as:

One Health is a growing field combining human medicine, veterinary medicine and environmental conservation to study the interconnectedness of the world. As human and animal populations coexist in closer environments, the health and well-being of all become intertwined. Diseases like avian flu and epidemics like colony collapse in bee populations impact both animals and humans. One Health students will take a close look at the intersection of disease transmission, climate change, public health, animal health and more as they explore this increasingly critical field.

It is noteworthy that the program at Fontbonne is offered to undergraduates, while most other programs evaluated are offered as part of DVM and/or PMH degree programs.

Fontbonne University partners with the St. Louis Zoo Institute of Conservation Medicine

Michigan State University – East Lansing, MI

<https://reg.msu.edu/AcademicPrograms/ProgramDetail.aspx?Program=5256>

<https://natsci.msu.edu/news-events/news/2016-08-new-study-abroad-course-conservation-medicine-in-new-zealand/>

http://www.fw.msu.edu/uploads/files/Glassen_Conservation_Medicine_Call_2017.pdf

Michigan State University has two distinct programs focused on Conservation Medicine. A Graduate Specialization in Fish and Wildlife Disease Ecology and Conservation Medicine is administered by the Department of Fisheries and Wildlife and the College of Agriculture and Natural Resources. This is available as an elective to master and doctoral students in the College of Veterinary Medicine, College of Agriculture and Natural Resources, and College of Natural Science. This Specialization is described as:

The Specialization in Fish and Wildlife Disease Ecology and Conservation Medicine is designed to provide students with improved understanding of the likely consequences of increased contact between fish and wildlife, domestic animals and human populations for emergence and spread of infectious diseases. Students will gain a sound understanding of the basis of fish and wildlife disease, and an appreciation of the diagnostic and surveillance tools needed to move toward effective disease control among wild populations and ecosystems. Students will also obtain the skills that will enable them to work effectively within interdisciplinary and interagency teams to develop disease surveillance, control, and prevention plans.

Students pursuing a graduate study in Conservation Medicine may also compete for the annual Hal and Jean Glassen Conservation Medicine Fellowship given to a student pursuing graduate-level research related to the goals of this specialization.

The Department of Integrative Biology also offers a study abroad course in conservation medicine in New Zealand. This course considers the relationships between animal health, ecosystem/environmental health and human health. "Human health depends on healthy ecosystems," said Jeanette McGuire, integrative biology assistant professor. "More than 75 percent of new and emerging diseases are zoonotic—they move between animals and humans. One in five diseases results from preventable environmental exposures. To solve complex problems such as health issues, researchers and medical professionals will need the skills, tools and background provided by an integrative approach to global health...."

Ohio State University – Columbus, OH

<https://vet.osu.edu/cvm/new-collaboration-zoo-and-wilds-spur-research-through-new-residency>

The Ohio State College of Veterinary Medicine has a residency program (started in 2014) in Ecosystem Health and Conservation Medicine led by Barbara Wolfe, DVM, Ph.D., Dipl. ACZM. The program is created in partnership with the Wilds and the Columbus Zoo and Aquarium and "explores the intersections of animal health, environmental health and human health".

Dr. Wolfe describes conservation medicine as being a broad field and notes:

Seventy-five percent of emerging diseases in humans are coming from animals.... Most of those new diseases are coming from wildlife. The diseases, which have long existed among animals, are emerging in humans, because human encroachment on wildlife habitat is creating more intersection between humans and wildlife. There are growing needs for conservation medicine practitioners.

The resident will get the opportunity to work at the Wilds, a 10,000 acre plot of reclaimed mine land that is now a conservation center. The residency program requires completion of a DVM degree and leads to a Master's degree as well as eligibility to take the ACZM board exam.

The College of Veterinary Medicine also partners with the College of Public Health to offer a Veterinary Public Health specialization towards the Master of Public Health degree. The MPH-VPH degree was developed to prepare public health professionals to better protect the communities they serve. The program is open to veterinarians, as well as other professionals, including students with science backgrounds interested in public health. In addition to specialized instruction in the epidemiology of zoonotic diseases, students in the program receive training in food safety, biosecurity, and environmental health.

Ross University School of Veterinary Medicine – St. Kitts, West Indies

<http://veterinary.rossu.edu/>

Ross University School of Veterinary Medicine takes a One Health approach to understanding and sustainably reducing zoonoses. Zoonoses and other diseases affecting livestock production and health can have serious impacts on the economic growth, health and food security and alleviation of poverty in tropical and resource constrained countries.

Ross offers a Master of Science in One Health (MSc One Health) degree program to equip veterinarians, animal scientists, medical and biological scientists with an in-depth understanding of the principles of, and issues associated with, One Health. The program has 1-year, 2-year and 3-year options and is open to students with professional veterinary degrees as well as those with professional medical qualifications and bachelor degrees in biological, biomedical, environmental or ecological sciences.

The program provides graduates the background and experience to assess, investigate and manage animal health and zoonotic disease risks, to design and execute targeted research in animal health, and to manage veterinary intervention in the control and prevention of animal disease. Within the program, the student will have had the opportunity to focus on an area of interest, such as area disease control, vector borne diseases, zoonotic infections or conservation medicine. The taught portion of the degree is through distance learning and the research project is completed in St. Kitts and Nevis or other locations as appropriate, under the supervision of a RUSVM faculty member.

Tufts University – Medford, MA

<http://vet.tufts.edu/center-for-conservation-medicine/>

Tufts University Cummings School of Veterinary Medicine has a Center for Conservation Medicine (CCM). The mission of the Center is “to advance the health of animals, people and the environment through professional training, research and service to communities around the globe, utilizing a conservation medicine approach.”

The CCM has an interdisciplinary approach, which states:

Conservation medicine focuses on health relationships occurring at the interfaces of humans, animals, and the environment; it seeks to develop and apply health management practices, policies, and programs that sustain biodiversity and protect the ecosystems essential to animal and human health. Through the practice of conservation medicine, Tufts CCM brings together veterinarians, physicians, ecologists, and conservation professionals to support and develop educational programs and research activities that explore the relationships among animal, human, and environmental health.

Tufts offers a Master in Conservation Medicine (MCM)

A specific zoo partnership is not mentioned on the website.

University of Calgary – Calgary, Canada

<http://vet.ucalgary.ca/home/mission>

The University of Calgary’s Veterinary program includes public and ecosystem health, wildlife and conservation medicine, professional and communication skills, research skills and comparative medicine. Four areas of emphasis are available: production animal health, ecosystem and public health, investigative medicine, and equine health.

The Department of Ecosystem & Public Health examines current and emerging issues at the interface of human health, animal health, and the environment. While the terms Conservation Medicine and/or One Health are not in the title of the department, the disciplines represented in the department include ecosystem health, public health, epidemiology & disease surveillance, toxicology and pathology, population health, wildlife diseases & zoonoses, conservation medicine, microbiology and parasitology, risk assessment and animal health policy. Graduate programs include research relevant to animal health, disease, and welfare, and its relation to human health. All of these focus areas fit within the conservation medicine and/or One Health approach. Furthermore, the conservation medicine approach is expanding with additional faculty with expertise in conservation medicine to be added in the near future.

University of California, Davis – Davis, CA

<http://www.vetmed.ucdavis.edu/onehealth/about/project.cfm>

The University of California Veterinary School has a One Health Project, the goal of which is to “prepare a new generation of veterinary practitioners ... in a broad arena that includes not only traditional animal medicine, but also public health and ecosystem conservation.”

The One Health Project is described in more detail in the Project Profiles.

The need for veterinarians in public practice, comparative research, and food and production medicine continues unabated. By virtue of their education in comparative medicine, preventive research, and zoonotic training, veterinarians already work at the interface of human, animal and environmental health. The incoming generation of veterinary students should be supported and encouraged to become practitioners of the future by expanding their training to include the One Health approach. The unique challenges facing the world today mean that practitioners of the future need to be prepared to think and strategize with their science colleagues, create team solutions, and problem-solve as a global unit on behalf of the changing planet. Food, water, and soil safety have become paramount, as have zoonotic disease challenges and environmental shifts. Without the strong basis of a healthy. Without the strong basis of a healthy environment, there is no hope of maintaining the health of living beings.

A specific zoo partnership is not mentioned on the website.

University of Florida – Gainesville, FL

<http://research.vetmed.ufl.edu/one-health-2/uf-rising-global-health-initiative/>

<https://wildlife.forensics.med.ufl.edu/programs/courses/conservation-medicine/>

The University of Florida has multiple programs related to Conservation Medicine/One Health.

The College of Veterinary Medicine has established a One Health initiative, which includes:

- The science of emerging and re-emerging infectious and zoonotic diseases, such as HIV, SARS, West Nile virus, dengue, Rift Valley fever, influenza, and others
- Animal health assessment as a sentinel for environmental quality and early detection of emerging zoonotic threats,
- Animal research models for human disease.

“One Health” also facilitates monitoring agents of bioterrorism important for homeland security, including prevention and early detection of non-native diseases. Climate change is now associated with species movement resulting in the emergence of infectious diseases into humans and animals living in areas formerly unaffected.

The College of Veterinary Medicine, in partnership with the UF College of Public Health and Health Professions and the Institute of Food and Agricultural Sciences (IFAS), is expanding the One Health initiative and hiring new faculty members to further academic research excellence in this area. A dual DVM-MPH degree can also be earned.

The College of Public Health offers both a Master of Health Science & PhD in One Health and the Masters of Health Sciences in One Health has the option of a fully online program.

The MHS One Health concentration emphasizes working across public health, veterinary health, and environmental health disciplines to tackle difficult health problems. The program offers particular depth in how infectious diseases are transmitted at the human-animal interface; how the environment affects such disease transmission; and how we can predict and mitigate new and current disease threats. The PhD in Public Health, One Health concentration is a research-oriented health degree that has the same transdisciplinary focus as the Master program.

The College of Medicine also offers a Graduate Certificate in Wildlife Forensic Sciences and Conservation, which will “examine the links between climate, habitat and land use, emergence and re-emergence of infectious disease, parasites, and environmental contaminants, and the maintenance of biodiversity as an indicator of the ecohealth of a community. Forensics, as it relates to issues of wildlife crime, the illegal wildlife trade, and the consumption and trade of bushmeat; ecotoxicology as it relates to forensics and the use of plants to harm humans, livestock, or wildlife; applied techniques in conservation as it relates to the forensic sciences will all be discussed.” This certificate course is online, and available to students with a bachelor’s degree in a natural science subject or a DVM degree.

A specific zoo partnership is not mentioned on the website.

University of Illinois – Champaign, IL

<http://vetmed.illinois.edu/college-organization/center-for-one-health-illinois/>

The University of Illinois College of Veterinary Medicine includes The Center for One Health Illinois, which focuses on fostering human, animal, and ecosystem health through the three broadly defined areas of education, research, and public outreach. The website describes these areas as

- *Education:* To educate of a new cadre of health professionals who understand the determinants and contributing factors affecting human, animal, and ecosystem health (One Health), how public health policy is developed and affects the health of all three
- *Research:* To understand disease processes that occur at the interface of human and animal activities and their effects on the environment
- *Outreach:* To improve our society’s preparedness and response to natural and intentional exposures of biological, chemical, and physical agents

A dual DVM/MPH degree is offered in conjunction with the U of I School of Public Health.

The Center for One Health partners with the Conservation Medicine Center of Chicago, the School of Public Health and the Zoology Pathology Program. The College of Veterinary Medicine partners with the Brookfield Zoo and the Shedd Aquarium

University of Minnesota – Minneapolis, MN

<https://www.vetmed.umn.edu/about>

The University of Minnesota College of Veterinary Medicine has a Global One Health Initiative which partners with other organizations to create “innovative solutions to tackle complex problems crossing human, animal and environmental health”. Students can obtain a dual DVM/MPH degree. As described on the College of Veterinary Medicine website:

The college embraces the “One Health” concept, which aims to transform new knowledge into better health for animals, people, and the environment. The college also plays an important role in the health of the community by assuring food safety, conducting biomedical research, preventing zoonotic diseases, and ... protection of Minnesota’s wildlife natural resource

The University of Minnesota leads a cooperative agreement with U.S. Agency for International Development (USAID) called the One Health Workforce project which focuses on creating a global workforce that is prepared to predict, detect, and respond to infectious disease outbreaks and creating a new kind of health professional with the practical skills and knowledge needed to address the multi- sectoral nature of emerging infectious disease threats. The One Health Systems Mapping and Analysis Resource Toolkit (OH-SMART) is an interactive mapping process fostering improved cross-agency interactions for comprehensive, systematic One Health approaches to infectious disease threats. The University of Minnesota, in collaboration with the U.S. Department of Agriculture (USDA) One Health Coordination Center, has piloted OH-SMART in the United States.

A specific zoo partnership is not mentioned on the website.

University of Missouri – Columbia, MO

<https://mizzouadvantage.missouri.edu/medicine/>

One Health/One Medicine is one of the Mizzou Advantage initiatives. Mizzou Advantage is a program that provides funding for specific projects that bring together multiple disciplines to address a specific issue. The One Health/One Medicine is described as the convergence of animal and human health. No specific projects were described.

The University of Missouri’s College of Veterinary Medicine does not have a conservation medicine program per se although two degree options are available that focus on animal and human health. A traditional dual MPH/DVM degree is available. A Master of Public Health degree (without the DVM) is also offered with a focus on Veterinary Public Health includes training in “zoonotic disease prevention, food safety and other emerging issues in animal and human health”. Dr. Loren Schultz is the director of the master of public health veterinary concentration area. Mizzou provides grant funding for MPH/DVM students to participate in internships with the St. Louis Zoo ICM program.

University of Washington – Seattle, WA

<http://deohs.washington.edu/cohr/>

The University of Washington has a Department of Global Health within the School of Public Health/School of Medicine. Undergraduates can obtain a Global Health minor. The University also offers a Master of Public Health, which provides interdisciplinary studies in global health.

The Department of Environmental and Occupational Health Sciences has a Center for One Health Research. The mission of the Center is to “investigate the health linkages between humans, animals, and their shared environments; including zoonoses, comparative clinical medicine, animals as sentinels, animal worker health, food safety, and develop innovative strategies for healthy coexistence between humans and animals in sustainable local and global ecosystems.”

Areas of research include:

- Zoonotic infectious diseases: Development of exposure and risk-based approaches to prevent transmission of infections between animals and humans (zoonotic diseases)
- Animals as "sentinels": Developing ways to better understand animal and human disease "sentinel" events to detect and control shared health threats from biological, chemical, and physical hazards in the environment.
- Surveillance of Emerging Diseases: The Center is part of USAID's PREDICT project to build a global early warning system for emerging zoonotic diseases.
- One Health Communication and Collaboration
- Human-Animal Medicine Textbook

This Center does not award separate degrees but works in partnership with the Department of Global Health to explore linkages between human, animal, and environmental health with a "One Health" perspective.

Washington University – St. Louis, MO

<https://onehealth.wustl.edu/>

<https://brownschool.wustl.edu/Academics/Master-of-Public-Health/Pages/Global-Health-Specialization.aspx>

Washington University does not have a veterinary school; however, the One Health concept is a growing focus area in the School of Medicine. One Health is an initiative to forge such collaborations and locally the School of Medicine is working with the Saint Louis Zoo's Institute for Conservation Medicine (ICM), Saint Louis University and the University of Missouri, Columbia veterinary school. In 2016, Washington University students formed One Health at WUSM, and numerous One Health events have taken place including a seminar titled "The Big Bet: How Linking Human and Veterinary Medicine Improves Health Across Species". There is a growing global effort among physicians, veterinarians and scientists to collaborate on research and education aimed at developing treatments and prevention strategies to improve the interconnected health of humans, animals and the environment, and the university is committed to join that effort.

Among other joint efforts, School of Medicine and zoo researchers are collaborating to study viruses in lemurs faced with habitat destruction and extinction. "The increase in interactions between humans and wildlife can lead to more infectious diseases in both," said Dr. Sharon Deem, Director of the St. Louis Zoo ICM "As importantly, animals may act as reservoirs or sentinels of diseases for humans. It requires physicians, veterinarians and scientists to work together to solve the global health challenges that we will face in our generation."

The Brown School of Social Work offers a Master of Public Health degree, which includes four areas of specialization, one of which is Global Health. The current description of the Global Health specialization is focused only on human health issues; however, there is growing interest in bringing the One Health concept into this program.