

MEDICAL SCHOOL HOTLINE

One Health in Medical Education: A Proposed Framework

Sameer Kejriwal BS; ZoeAnn A. Kon MPH; Erin T. Annick BA; Carley C. Kida BA;
Joshua K. Kepler BS; Jonathan R. Carino MSc; Jourdan P. McMillan PhD;
Sandra P. Chang PhD

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In 1993, the Medical School Hotline was founded by Satoru Izutsu PhD (former vice-dean UH JABSOM), it is a monthly column from the University of Hawai'i John A. Burns School of Medicine and is edited by Kathleen Kihmm Connolly PhD; HJH&SW Contributing Editor.

Abstract

The One Health concept focuses on the interconnections between human health, animal health, and the environment, stressing the need for interdisciplinary collaborations to address complex issues such as the health challenges posed by climate change and global pandemics. One Health is a central part of the curriculum of veterinary schools, however, it is rarely incorporated into medical school education. Nationally, there are limited examples of formal One Health education and training for medical students. To incorporate One Health into its curriculum, John A. Burns School of Medicine developed a Dean's Certificate of Distinction in One Health that consists of a One Health foundational course, a clinical One Health elective course, participation in the One Health Interest Group, engagement in One Health educational and outreach activities, and a One Health research or curriculum development project. To the authors' knowledge, this is the first One Health certificate program developed and implemented in any Association of American Medical Colleges accredited medical school. Although introducing similar programs into medical curricula will continue to be challenging, we hope it will serve as a framework for other academic institutions.

Keywords

One Health; Dean's Certificate of Distinction; medical education; multidisciplinary

Abbreviations and Acronyms

AAMC = Association of American Medical Colleges
CDC = Centers for Disease Control and Prevention
COD = Dean's Certificate of Distinction in One Health
JABSOM = John A. Burns School of Medicine
NOAA = National Oceanic and Atmospheric Administration
UCD = University of California, Davis
USDA = United States Department of Agriculture

Introduction

One Health is a multidisciplinary and emerging concept that recognizes the interconnections between human, animal, and

environmental health, a concept that is an integral component of veterinary education¹ but is not universally incorporated into medical school curricula. It emphasizes collaboration between professional fields and has gained greater significance due to the interdisciplinary approaches required to address current health challenges due to the COVID-19 pandemic and climate change.²

The recognition of the interrelationship between animal and human health dates back to the 1800s³ and has increased in prominence in recent years, now including the concept of ecosystem health. In 2004, an international symposium of worldwide health experts established the Manhattan Principles to provide a more holistic approach to preventing epidemic/epizootic disease and maintaining ecosystem integrity.⁴ The US Centers for Disease Control and Prevention (CDC) established the CDC One Health Office in 2009,³ and in 2022 a comprehensive One Health Joint Plan of Action was endorsed by the Quadripartite organization consisting of 4 agencies: the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Program (UNEP), the World Health Organization (WHO), and the World Organization for Animal Health (WOAH).⁵ These developments provided corroboration that a One Health approach is needed to solve problems threatening humans, animals, and the environment.

The One Health concept was introduced into veterinary medical education in the 1960s⁶ and in 2011 the Association of American Veterinary Colleges recommended that all veterinary students achieve competency in 3 areas: clinical, professional, and One Health.⁷ The University of California, Davis, (UCD) School of Veterinary Medicine created the One Health Institute, which allows students to participate in medical, public health, and conservation projects.⁸ Nevertheless, this concept is not uniformly included in US medical education, leaving a massive, untapped opportunity for interdisciplinary collaboration and global health advancement.⁹ For the few US medical schools with One Health

as part of their curricula, student participation remains limited and opportunities vary.⁹ A survey of 133 American medical schools in 2020 found that only 56% included One Health in some form, ranging from minor references in Microbiology to elective courses focused on One Health.⁹ One example is Washington University School of Medicine that partnered with the Saint Louis Zoo and the University of Missouri's College of Veterinary Medicine to provide One Health exposure consisting of veterinary hospital tours, a One Health fair and conference, and health care professional presentations.¹⁰ Another example is Georgetown University School of Medicine which offers an introductory lecture-based elective course exploring various One Health topics.⁹ Harvard Medical School offers one of the most interactive One Health elective courses, where students shadow the daily clinical practice of veterinarians at the Franklin Park Zoo.⁹ Though these offerings hold promise, there is considerable potential for expansion and commitment to provide opportunities to familiarize medical students with this approach.

The John A. Burns School of Medicine (JABSOM) at the University of Hawai'i at Mānoa recently implemented a Dean's Certificate of Distinction (COD) in One Health in May 2022. COD students are provided opportunities to view medicine through the One Health lens throughout the 4 years of medical school,

ranging from course electives to school-wide symposiums to clinical rotations at the Honolulu Zoo. The COD also outlines various avenues for students to pursue their One Health-related interests, including research opportunities, in collaboration with local One Health stakeholders.

Certificate Program Development

The JABSOM COD in One Health was established to provide opportunities for medical students to engage in education and research centered on One Health. At the outset, JABSOM One Health program leaders reached out to stakeholders across different organizations, collaborated with medical education faculty, and gauged student interest. Then created a logic model detailing the necessary inputs, activities, outputs, and outcomes to be achieved through the COD program (**Figure 1**). Required inputs included resources provided by stakeholders, students, faculty, and guidance from the JABSOM Office of Medical Education. These resources led to the creation of a range of activities throughout the 4-year medical curriculum that included One Health courses, symposia, community outreach events, interdisciplinary lectures and workshops, the creation of a One Health interest group, and the development of a clinical practicum in One Health. The JABSOM One Health COD curriculum spans over all 4 years of medical school (**Figure 2**).

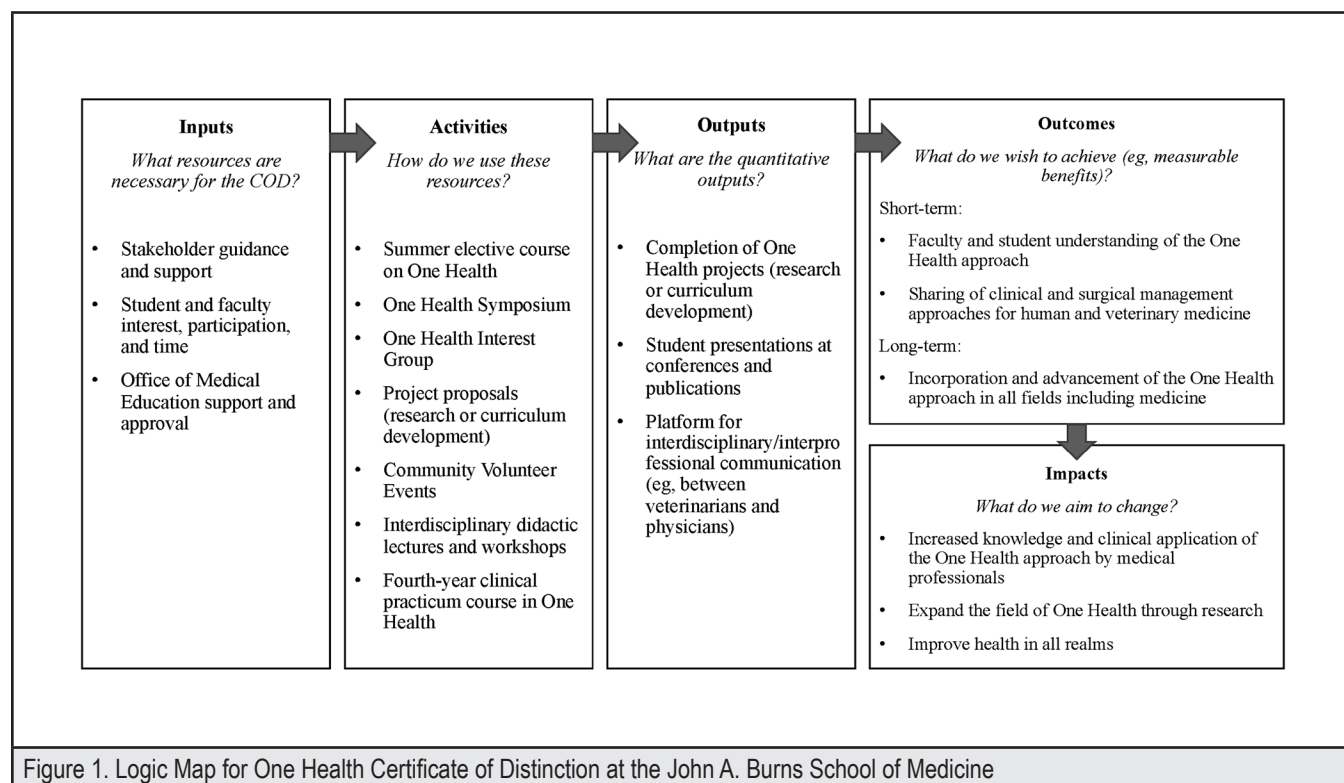


Figure 1. Logic Map for One Health Certificate of Distinction at the John A. Burns School of Medicine

COD= certificate of distinction

Year 1	Year 2	Year 3	Year 4
<ul style="list-style-type: none"> Enroll in One Health COD program Introduction to One Health Course (summer) One Health interest group meetings Participate in One Health activities: <ul style="list-style-type: none"> Seminar or workshop presentations JABSOM sustainability or One Health event Interdisciplinary workshop on One Health Community volunteer activity related to One Health Complete entry survey Prepare COD individual development plan (IDP) 	<ul style="list-style-type: none"> One Health interest group meetings Participate in One Health activities: <ul style="list-style-type: none"> Seminar or workshop presentations JABSOM sustainability or One Health event Interdisciplinary workshop on One Health Community volunteer activity related to One Health Develop and present a One Health project proposal (research or curriculum development) Annual reflection and discussion of progress on COD with One Health advisor 	<ul style="list-style-type: none"> One Health interest group meetings Work on the One Health project proposed in Year 2 Organize one of the following leadership or mentoring activities: <ul style="list-style-type: none"> Guest speaker for One Health JABSOM sustainability or One Health event Interdisciplinary workshop on One Health One Health education for pre-health/pre-law students Annual reflection and discussion of progress on COD with One Health advisor 	<ul style="list-style-type: none"> One Health interest group meetings Practicum experience in One Health <ul style="list-style-type: none"> Clinical One Health elective, or Interdisciplinary One Health experience with community organization Complete and present the One Health project to a public audience (medical school symposium or other approved meeting) Complete exit survey Discuss COD IDP accomplishments and provide feedback on COD experience with One Health advisor

Figure 2. One Health Certificate of Distinction Curriculum at the John A. Burns School of Medicine

COD= certificate of distinction; IDP=Individual Development Plan

The quantitative outputs of the program include the completion of a One Health research or curriculum development project, dissemination of the project outcomes in a conference presentation or publication, and One Health events engaging veterinarians, physicians, and environmental scientists.

Short-term outcomes of the program are increased understanding of the One Health approach by faculty and students and sharing of clinical approaches used in human and veterinary medicine. Long-term outcomes are the broad integration of One Health in all fields, including human medicine. The projected impacts of the program are to assimilate the One Health approach into standard medical practice, to expand One Health knowledge, and to enhance health in all realms: human, animal, and environmental.

The authors investigated the format of the other JABSOM certificate programs to create a similar, standardized curriculum. They partnered with stakeholders from different disciplines including the Honolulu Zoo veterinarian, community veterinarians, scientists from the National Oceanic and Atmospheric Administration (NOAA), and faculty from the JABSOM Department of Tropical Medicine, Medical Microbiology & Pharmacology, the College of Tropical Agriculture and Human Resources, Department of Human Nutrition, Food and Animal Sciences, and the Thompson School of Social Work & Public Health, Office of Public Health Studies.

First- and second-year medical students are eligible to enroll in the COD program. The application process for students interested in participating in the COD program includes completing an online form and meeting with the One Health Advisor to discuss program requirements. The certificate program requires satisfactory completion of the One Health COD curriculum requirements by April 1st of the graduating year. Participants who complete the curricular elements are awarded the COD by the JABSOM Dean at graduation. The current cohort of participants for the One Health COD includes 1 fourth-year, 5 third-year, 1 second-year, and 3 first-year medical students.

Outreach & Collaborative Activities

To date, outreach activities have included a beach clean-up in partnership with NOAA in November 2023 and activities in January 2024 during the internationally proclaimed One Health Awareness Month. The beach clean-up included a presentation by Dr. Diana Kramer, the Regional Stranding Coordinator for NOAA Fisheries, on the application of the One Health approach for the preservation, recovery, and stewardship of marine protected species and the ocean ecosystem in Hawai'i. A collaborative activity in February 2022 was a journal club meeting of medical students from JABSOM and veterinary students from the UCD School of Veterinary Medicine. The meeting topic was the potential of sequential antibiotic therapy as a means for controlling the emergence of antimicrobial resistance.^{11, 12}

Other interdisciplinary One Health Month activities made available to the entire medical school included seminars presented by Dr. Neil Vezeau, a United States Department of Agriculture (USDA) Food Safety Veterinarian, on the One Health approach to the Maui wildfires, and from JABSOM faculty Dr. Elizabeth Kiefer on the effects of climate change on health. The month's activities also included a community display to increase public awareness of One Health and a JABSOM Walks for Aloha community event featuring a One Health talk by Dr. Sandra Chang.

Curriculum Development

A JABSOM One Health Symposium for first- and second-year medical students was held in September 2022. The symposium was organized by One Health Interest Group members and JABSOM One Health faculty. This symposium included presentations by Dr. Bonnie Buntain, a national One Health expert; Dr. Jill Yoshicedo, the Honolulu Zoo chief veterinarian; and Dr. Michelle Barbieri from NOAA. JABSOM Tropical Medicine faculty and graduate students assisted in leading case study breakout sessions. The symposium was attended by 163 individuals representing the entire first- and second-year medical student classes. In addition to the symposium, work is in progress to introduce One Health concepts into problem-based learning case modules.

Scientific Research

Medical students enrolled in the COD are working on research projects with the Honolulu Zoo veterinarian, Dr. Jill Yoshicedo, to address clinical problems and compose case reports relating to animal health. During the summer of 2022, 3 medical students studied the causes of morbidity and mortality of zoo animals over the past 10 years to identify potential common risk factors for infectious and non-infectious diseases in zoo animals and to compare these risk factors to those associated with human disease.

Presentations

Students developed posters for a One Health symposium held at UCD in October 2022. One COD student presented his experiences as a participant in the One Health COD program at the 21st Federation of Asian Veterinary Associations Congress in Fukuoka Japan in November 2022. In February 2023, a group of medical, graduate, and undergraduate students participated in an invited poster presentation on UH One Health initiatives at the UH Mānoa Research Day at the Hawai'i State Capitol Building. Finally, an overview of the COD program was presented by a One Health interest group representative at the April 2024 Biomedical Sciences Symposium to increase awareness of One Health opportunities at JABSOM.

Discussion

The JABSOM COD in One Health allows interested medical students to further their study of One Health by developing a deep knowledge base on this topic, applying this knowledge to address clinical problems, and sharing and communicating this knowledge to their peers and the general public. To the authors' knowledge, this is the first certificate curriculum in One Health developed at an AAMC-accredited medical school. Other medical schools cite various reasons for One Health's minimal inclusion in medical school curricula, including limited time for additional content in the medical school curriculum, geographic paucity of veterinary partners, and lack of health care professionals sufficiently well-versed in One Health to serve as faculty.⁹ The fact that JABSOM is a community-based medical school positions it well to provide collaborative, interdisciplinary training, leveraging existing relationships with local community organizations, state government agencies, and affiliated healthcare professionals as One Health resources.

Although the direct impact of a One Health approach on physician success has yet to be determined, the recent breakthroughs in medical research obtained using One Health perspectives are encouraging. For example, comparative oncology has brought together veterinarians, physicians, and researchers to discover novel therapeutic solutions for cancers including lymphomas, osteosarcoma, and melanomas.¹³ The recent development of *One Health Advances*, a journal dedicated to advancing One Health-related topics such as antimicrobial resistance, zoonotic diseases, and food safety showcases the need for medical professionals to understand the interdependence of animal, human, and environmental health.¹⁴ Following the graduation of One Health COD cohorts, the outcomes of this curriculum will be evaluated and quantitative and qualitative data on student experiences and program outcomes will be documented.

In conclusion, the One Health COD is a novel multidisciplinary approach to educating medical students about a concept relevant to a wide range of clinical settings. The hope is to create One Health practitioners capable of breaking down silos and creating interdisciplinary collaborations to improve health outcomes across human, animal, and plant ecosystems.¹⁵ Integrating the concept of One Health into medical curricula will continue to be challenging, but the hope is that this will serve as a framework for other academic settings. Through the COD, medical students will gain One Health competencies enabling them to provide improved patient care and promote health for all species.

Conflict of Interest

None of the authors identify a conflict of interest.

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Authors' Affiliations:

- Medical Student, One Health Interest Group, John A. Burns School of Medicine, University of Hawai'i, Honolulu, HI (SK, ZAK, ETA, CCK, JKK, JRC)
- Instructor, Department of Tropical Medicine, Medical Microbiology and Pharmacology, University of Hawai'i, Honolulu, HI (JPM)
- Professor and Graduate Chair, Department of Tropical Medicine, Medical Microbiology and Pharmacology, University of Hawai'i, Honolulu, HI (SPC)

Corresponding Author:

Sandra P. Chang PhD; Email: sandrac@hawaii.edu

References

1. Rabinowitz PM, Natterson-Horowitz BJ, Kahn LH, Kock R, Pappaioanou M. Incorporating one health into medical education. *BMC Med Educ.* 2017;17(1):45. <https://doi.org/10.1186/s12909-017-0883-6>
2. Dykstra MP, Baitchman EJ. A call for one health in medical education: how the COVID-19 pandemic underscores the need to integrate human, animal, and environmental health. *Acad Med.* 2021;96(7):951-953. <https://doi.org/10.1097/ACM.0000000000004072>
3. One health basics. Centers of Disease Control and Prevention. Updated June 6, 2022. Accessed March 22, 2023. <https://www.cdc.gov/onehealth/basics/history/index.html>
4. Cook AR. One world, one health: building interdisciplinary bridges to health in a globalized world. *One World, One Health.* September 29th, 2004. Accessed March 22, 2024. https://www.oneworldonehealth.org/sept2004/owoh_sept04.html
5. FAO, UNEP, WHO and WOA. 2022. One health joint plan of action (2022–2026). Working together for the health of humans, animals, plants and the environment. Rome. Accessed April 16, 2024. <https://iris.who.int/bitstream/handle/10665/363518/9789240059139-eng.pdf?sequence=1>
6. Schwabe CN. *Veterinary Medicine and Human Health.* Williams & Wilkins. 1984.
7. Andrews, K. Roadmap for veterinary medical education in the 21st century: responsive, collaborative, flexible. *AAVMC.* September 1, 2020. Accessed February 10, 2024. <https://www.aavmc.org/resources/roadmap-for-veterinary-medical-education-in-the-21st-century-responsive-collaborative-flexible/>
8. Conrad PA, Mazet JA, Clifford D, Scott C, Wilkes M. Evolution of a transdisciplinary "One Medicine-One Health" approach to global health education at the University of California, Davis. *Prev Vet Med.* 2009;92(4):268-274. <https://doi.org/10.1016/j.prevetmed.2009.09.002>
9. Docherty L, Foley PL. Survey of one health programs in U.S. medical schools and development of a novel one health elective for medical students. *One Health.* 2021;12:100231. <https://doi.org/10.1016/j.onehlt.2021.100231>
10. Sauerwein K. Washington University helping to advance one health movement in region. Washington University School of Medicine in St. Louis. March 8, 2016. Accessed February 17, 2024. <https://medicine.wustl.edu/news/washington-university-helping-advance-one-health-movement-region/>
11. Batra A, Roemhild R, Rousseau E, Franzenburg S, Niemann S, Schulenburg H. High potency of sequential therapy with only β -lactam antibiotics. *Elife.* 2021;10:e68876. <https://doi.org/10.7554/eLife.68876>
12. Roemhild R, Schulenburg H. Evolutionary ecology meets the antibiotic crisis: Can we control pathogen adaptation through sequential therapy? *Evol Med Public Health.* 2019;2019(1):37-45. <https://doi.org/10.1093/emph/eoz008>
13. LeBlanc AK, Mazcko CN. Improving human cancer therapy through the evaluation of pet dogs. *Nat Rev Cancer.* 2020;20(12):727-742. <https://doi.org/10.1038/s41568-020-0297-3>
14. Shen J, Schwarz S. Introducing One Health Advances: a new journal connecting the dots for global health. *One Health Adv.* 2023;1(1):1. <https://doi.org/10.1186/s44280-023-00011-1>
15. One Health High-Level Expert Panel (OHHLEP), Adisasmito WB, Almuhairi S, et al. One Health: A new definition for a sustainable and healthy future. *PLoS Pathog.* 2022;18(6):e1010537. <https://doi.org/10.1371/journal.ppat.1010537>