

Students Engagement in One Health Initiatives in Africa: Recommendations to a Way Forward

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Abstract

Background: One Health is a multisectoral, collaborative, and interdisciplinary strategy that involves humans, animals, and environmental health.

Objectives: This study aims to examine the current involvement of medical and veterinary students in One Health initiatives and provide recommendations on challenges students face when participating in One Health programs.

Methods: We utilized our personal experience as medical and veterinary students and data from online scientific databases such as PubMed, Google Scholar, and African Journals Online (AJOL).

Results: One Health issues, such as COVID-19, Monkeypox, Ebola, Avian influenza, antimicrobial resistance, etc., continue to threaten the public health of Africans, which makes the involvement of students pertinent to contribute to the maximum enhancement of One Health awareness in the continent. In Africa, a limited number of medical and veterinary students are involved in the One Health initiatives and practices because of their limited knowledge about One Health. Also, many students face personal, social, and governmental challenges while participating in the program.

Conclusion: To increase the awareness of medical and veterinary students about One Health in Africa, the importance of One Health should be drawn from all the interdisciplinary courses offered by medical and veterinary students. The government should support One Health initiative programs among students, and interprofessional activities should be created among medical and veterinary students. This will inform the students of their role in eradicating One Health issues in Africa.

Keywords: One Health, Interdisciplinary Communication, Student Engagement, Africa

Background

One Health approach is a synergistic strategy that recognizes the health interdependency between people, animals, and their shared environment (1). This approach recognizes the strong relationship between these elements and their need to address health issues through interrelated perspectives (1).

Due to many anthropogenic drivers and changing disease patterns, there has been a sporadic increase in emerging pandemics globally. Adaptation and changes in microbes, climate and weather, human demography and behavior, poverty, and other factors are some causes of this increase, particularly in Africa (2). African

nations have experienced many disease outbreaks, including Severe Acute Respiratory Syndrome, Usutu virus disease, Anthrax, Polio disease, West Nile virus disease, Ebola, Monkeypox, etc., which have demonstrated that not only do we need essential education in improving epidemic preparedness but also a One Health approach that leverages the expertise of interdisciplinary set of professionals to potentiate responses to global health issues (3-11).

Despite an urgent need for a change in health approach to a more interdisciplinary One Health fashion, healthcare professionals require more awareness to facilitate such a transition (12). There is no

doubt that medical and veterinary students are prospective healthcare professionals who will carry on the mandate of collaboratively addressing global health concerns. However, there has been limited knowledge about the One Health approach among African students, especially medical students (13). This makes the implementation of the One Health approach challenging to some practitioners during practice.

Objectives

This study aims to examine the current involvement of medical and veterinary students in One Health initiatives and provide recommendations on the challenges students face when participating in One Health programs.

Methods

We utilized our personal experience as medical and veterinary students, supported by literature from scientific databases such as PubMed, Google Scholar, and African Journals Online (AJOL) in writing this paper. The databases were searched using the keywords: “Medical”, “Medicine”, “Veterinary”, “Veterinary Medicine”, “University”, “College”, “Students”, “One Health”, “One Health Initiatives”, “One Health Programs”, “One Health issues”, and “Africa”. Only articles published in English were included in the study. Articles published in other languages were excluded. Our focus was Africa; articles published outside Africa were excluded from the study.

Medical and Veterinary Students in Africa

Human and veterinary medicine are mainstream

programs that provide solutions to public health issues in Africa. This has resulted in a higher number of medical and veterinary schools in Africa. The International Association of Universities, the World Higher Education, and the American Veterinary Medical Association database 2022 list about 447 medical schools and 54 veterinary medicine schools in Africa (Figure 1). These are distributed across the northern, eastern, southern, central, and western regions of Africa. East Africa has the highest number of medical schools, with approximately 171, representing 38.3% of the total number of medical schools in Africa. West Africa followed closely with 119 medical schools, representing 26.6% of the total medical schools; North, Central, and Southern Africa after that had 71, 64, and 22 medical schools, representing 15.9%, 14.3%, and 2.9% of African medical schools, respectively. It is also worth mentioning that the country with the highest number of medical schools is Nigeria, a country in the western region of Africa. Leading their respective regions are Sudan, Egypt, the Democratic Republic of Congo, and South Africa, with 47, 30, 38, and 17 medical schools, respectively (Table 1) (14).

Current Experience of One Health in Medical Schools

One Health is not a commonly discussed topic in African medical schools. A study by Terrigbade and Babalobi found that 31.7% of medical students have a detailed knowledge of One Health, 23.3% of medical students were eager to learn more about One Health, and generally had an averagely good attitude towards the One Health concept (13).

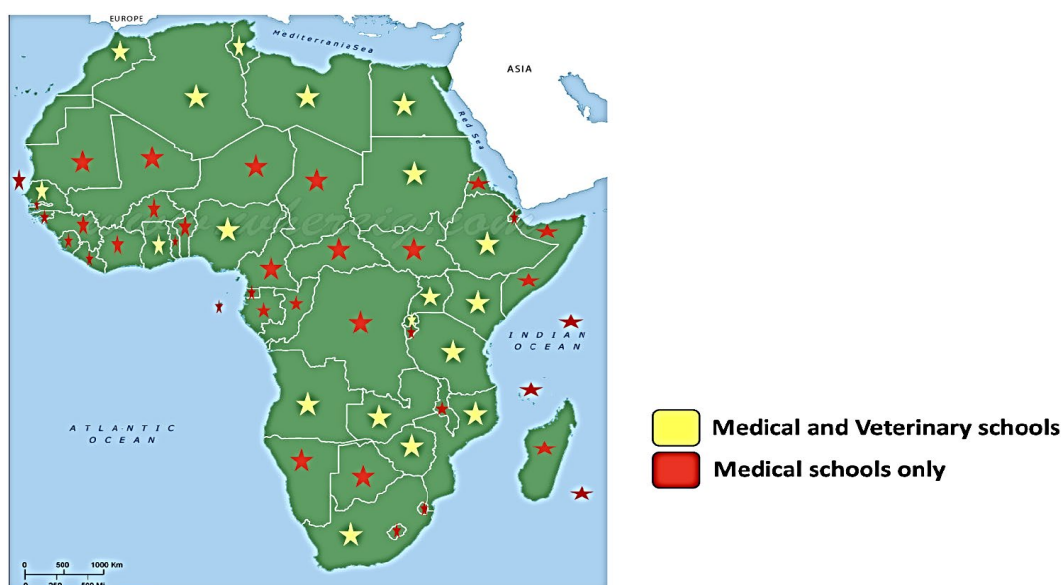


Figure 1. A map illustrating the distribution of veterinary schools in Africa

Table 1. List of medical and veterinary schools in Africa (14, 15).

Country	Region	Number of medical schools	Number of veterinary schools
Algeria	Northern Africa	17	6
Angola	Central Africa	10	1
Benin	Western Africa	2	Nil
Botswana	Southern Africa	2	Nil
Burkina Faso	Western Africa	6	Nil
Burundi	Eastern Africa	6	Nil
Cameroon	Central Africa	8	Nil
Cape Verde	Western Africa	2	Nil
Central African Republic	Central Africa	1	Nil
Chad	Central Africa	1	Nil
Comoros	Eastern Africa	1	Nil
Democratic Republic of the Congo	Central Africa	38	Nil
Djibouti	Eastern Africa	1	Nil
Egypt	Northern Africa	30	13
Equatorial Guinea	Central Africa	1	Nil
Eritrea	Eastern Africa	2	Nil
Eswatini	Southern Africa	1	Nil
Ethiopia	Eastern Africa	26	5
Gabon	Central Africa	3	Nil
Ghana	Western Africa	7	1
Guinea	Western Africa	8	Nil
Guinea-Bissau	Western Africa	2	Nil
Ivory Coast	Western Africa	5	Nil
Kenya	Eastern Africa	17	1
Lesotho	Southern Africa	1	Nil
Liberia	Western Africa	2	Nil
Libya	Northern Africa	9	2
Madagascar	Eastern Africa	6	Nil
Malawi	Eastern Africa	5	Nil
Mali	Western Africa	2	Nil
Mauritania	Western Africa	1	Nil
Mauritius	Eastern Africa	10	Nil
Morocco	Northern Africa	9	1
Mozambique	Eastern Africa	9	1
Namibia	Southern Africa	1	Nil
Niger	Western Africa	3	Nil
Nigeria	Western Africa	49	10
Republic of the Congo	Central Africa	1	Nil
Rwanda	Eastern Africa	2	1
Sao Tome and Principe	Central Africa	1	Nil
Senegal	Western Africa	7	1
Seychelles	Eastern Africa	1	Nil
Sierra Leone	Western Africa	21	Nil
Somalia	Eastern Africa	1	Nil
Somaliland	Eastern Africa	1	Nil
South Africa	Southern Africa	17	2
South Sudan	Eastern Africa	3	Nil
Sudan	Eastern Africa	47	3
Tanzania	Eastern Africa	9	1
The Gambia	Western Africa	1	Nil
Togo	Western Africa	1	Nil
Tunisia	Northern Africa	6	1
Uganda	Eastern Africa	11	1
Zambia	Eastern Africa	10	1
Zimbabwe	Eastern Africa	3	1

In another survey carried out by Yanney, only 5.8% of students were found to have heard of One Health. A great majority indicated an interest in learning more about One Health topics and believed that understanding the topics would be helpful for their future careers (16). Furthermore, it was said that because of the college's innately collaborative and interdisciplinary atmosphere, undergraduate education is the perfect setting for introducing One Health to students (16).

The first exposure of medical students to 'One Health' at the College of Medicine, University of Ibadan, Nigeria, is in the fifth of the six years of the medical program. This curriculum might have contributed to the limited knowledge of medical students in Nigeria about One Health because they were not exposed to One Health principles earlier, and their participation in One Health Programs will be equally affected during their studies and after.

Pre-service capacity development efforts have been implemented at Makerere University in Uganda to foster One Health competencies among students who would become practitioners (10). Student One Health Innovation Clubs, undergraduate field experiences at demonstration sites, graduate fellowships, small grants to support research and innovations, and cross-college collaborative training approaches have helped integrate One Health into the fabric of university offerings and incorporate it into didactic education systems. Partnerships with government departments, the commercial sector, and foreign organizations were launched to benefit the students and pave the way for future experiential learning and in-service opportunities (17).

To promote One Health concepts in eight Eastern, Central, and West African countries, a network of human medicine, public health, and veterinary medicine institutions known as One Health Central and Eastern Africa (OHCEA) was established (18, 19). In Uganda, Interested medical students of different levels from Makerere University join the Makerere University Students One Health Initiative Club (MAKSOHIC), which proffers early exposure and enables participants to gain expertise and competency in One Health leadership, research, innovation, and scientific communication via creative intellectual discussion and participation around identified One Health concerns. Many international universities in the developed world have also adopted the idea of engaging medical students in the community medicine rotation in their fourth year of study (20, 21).

Even though the level of exposure varies amongst the different medical schools, just about little or none of them deemed it fit to pursue research interest in this One Health field. Public opinions and collaborations with fellow enablers of the One Health approach or any intervention were not found. The scarcity of literature on the awareness or impact of the One Health approach in medical schools supports our assertion. This revealed that African medical students are averagely aware of One Health. Amongst those aware, an almost insignificant percentage of them are not involved in research related to One Health.

Current Experience of One Health in Veterinary Medical Schools

Veterinarians are significant stakeholders in the stewardship of One Health, and they provide versatile training directly or indirectly applicable to the health of animals, humans, and wildlife. Therefore, proper education of veterinary students during their training on One Health will be a fundamental approach to promoting the One Health landscape in Africa. However, only a few countries in the continent have recognized veterinary medical schools (Table 1). Egypt, Nigeria, Sudan, and Algeria have the highest numbers, while others have fewer veterinary schools. This data suggests the need to establish more veterinary schools in the African region as this will increase the number of professionals with skills to tackle One Health issues in Africa.

Studies have been conducted to assess students' knowledge of One Health and related issues in some veterinary schools in Africa (11, 12). It has been shown that veterinary students need a better perception of knowledge on antimicrobial resistance and stewardship and that knowledge of One Health and related issues like antimicrobial resistance (AMR) is more prevalent among final-year veterinary students compared to pre-final year veterinary students (22).

One Health Programs Available for Students in Africa

Efforts have been made to improve the training of potential One Health professionals in Africa, prominent among which is the One Health Central and Eastern Africa (OHCEA), now Africa One Health University Network (AFROHUN). The OHCEA is a network of 19 institutions across 10 countries in Africa aimed towards improving One Health capacity in region (23).

Some institutions within the OHCEA network have One Health field attachments consisting of a multidisciplinary group of students, including veterinary students, who live and work together in the community (18). Such initiative has enabled the

involved students to appreciate teamwork, community development, use of available resources through innovative means, and benefit communities (24). Also, many institutions within the OHCEA promote the formation of One Health clubs (24). One Health clubs provide students a medium to discuss and integrate One Health concepts practically (25). While these developments show promise in helping to drive forward One Health's involvement of medical veterinary students in Africa, upscaling the implementation of such initiatives across other regions and countries within the region will potentiate its benefits. Such implementation should also involve low- and high-level students to ensure their increasing knowledge and practical involvement in One Health programs through available platforms earlier.

Issues and Challenges

Lessons from the outbreak of zoonotic infectious diseases in Africa have further highlighted the importance of One Health in the region (26, 27). To this end, a collaboration of various fields of health involving an enlarged body has been working to improve the health situation in Africa (27). The exact concept of one health (18). However, these collaborations exist only at the top and professional levels. Little initiatives about One Health Research have been found among African medical and veterinary medical students, primarily due to the challenges that limit its fostering among these populations.

Limited One Health student clubs: One Health has been widely endorsed and encouraged in Africa, and several large One Health initiatives currently encompass an array of universities in Africa (28). However, only one of these initiatives (One Health Central and Eastern Africa (OHCEA)) is notably recognized for forming One Health Student clubs (18). The absence of One Health student clubs among students limits students' exposure and knowledge about One Health, reducing their chances of stimulating their interest in One Health programs.

Lack of inter-professional learning: Apart from the limited One Health student clubs challenge, medical and veterinary students are rarely given opportunities for inter-professional learning as part of their coursework and clinical training; in many African institutions, medical and veterinary medical schools are not in the exact location (28). This difference in the learning environment's locations and the few opportunities for inter-professional learning among medical and veterinary students stifle potential interactions between

these students, limiting their collaboration to foster One Health Initiatives.

Difficulties of long-distance collaboration: Notwithstanding the distance between medical and veterinary students, the practice of One Health is still possible under these conditions. The utilization of Internet and social network services allows for long-distance collaborations; however, the difficulty associated with this method in terms of the cost of purchasing data, power supply problems, scheduling convenient times for each other, and so on does not encourage students' interest in utilizing it. In addition to the convenience issues concerning organizing opportunities for collaboration between medical and veterinary medical students, the considerable academic workload and accompanying stress among these students do not help the situation. Several studies have reported high burnout among African medical and veterinary medical students (29, 30). Under these conditions, adding more commitments like engaging in collaborations for One Health will be difficult for these students. It may also explain the low involvement of African medical students in One Health programs.

Little interest of students in One Health Programs: Another barrier to students' participation in One Health initiatives is the medical research disadvantage in most African institutions. According to research conducted in Saudi Arabia, most students face issues such as a lack of funding and required skills, limited access to professional supervisors or mentors, limited or no access to database subscriptions, and inadequate laboratories and equipment (31, 32). These factors, combined with African institutions' little emphasis on research as part of their curriculum, have resulted in the current situation in which African medical students generally have little interest in research, which invariably significantly impacts their participation in One Health initiatives (33).

Limited knowledge of One Health concept: An ideological barrier exists because the structure of One Health can be unclear to many potential stakeholders. Many medical students are unaware of the scope of One Health because of the limited exposure to cases or classes during their training. A previous study done by Terrigbade and Babalobi showed that 31.7% of medical students at the University of Ibadan, Nigeria, have an idea of the One Health concept (13). Compared to veterinary students, which make up 65% of the population, medical students need more involvement in One Health initiatives.

Recommendations: We recommend several proposals to strengthen medical and veterinary students' involvement in One Health initiatives.

Establishment of One Health student clubs: To increase the African medical and veterinary students' exposure to the One Health approach, the available regional One Health initiatives, such as the One Health Central and Eastern Africa (OHCEA), should set up more One Health student clubs. The One Health clubs would serve as student communities of One Health enthusiasts. It would also provide an enlightenment avenue and discussion platform to help incite students' interest and ultimately kindle up the one health research culture (17).

Revisiting the curriculum of medical students to include the One Health concept: The knowledge of medical students about One Health could be higher than veterinary students, which might be linked to limited courses on One Health. The curriculum of medical students should be revisited to include a significant amount of the One Health concept. This will help increase medical students' awareness about One Health and make them curious to be involved in One Health initiatives. The only course in which medical students are exposed to One Health is 'Community Medicine,' which is minimal compared to veterinary medicine courses that teach veterinary students about One Health. Every aspect of medical courses should be related to animals and environments (One Health). It will help the students to know the importance of One Health.

Increasing funds for One Health student clubs: Funding should be available to support the students involved in One Health initiatives. Students must engage in One Health align projects for the community to reduce the One Health emerging issues in Africa. To do this, they need limited funds to organize themselves in order Africa. We shout out to the World Health Organization, National Institute of Health, and other health organizations to support the ideas of the young students willing to contribute to One Health issues like COVID, Ebola, Lassa fever, etc., in Africa.

Increasing One Health mentorship programs for students: Mentorship is important in an organization that involves young people to guide them to success because they lack the required skills. One Health Practitioners should make it compulsory for them to guide student Organizations built to promote One Health. The issue of mentorship is something that is lacking in Africa and limits young students' ability to get involved in things to promote themselves.

Conclusion

One Health is a multisectoral, collaborative, and transdisciplinary strategy to obtain optimal health outputs while acknowledging the interdependence between humans, animals, plants, and their shared environment. Reinforcing the involvement of African medical and veterinary students in One Health initiatives is crucial. It will benefit the students and the health and research community in Africa. As One Health public challenges are increasing daily in Africa, students will develop the sense to tackle them from school and help promote One Health programs. Recommendations provided in this article include the establishment of One Health student clubs, revisiting the curriculum of medical students to include the One Health concept, increasing funds for One Health student clubs, and increasing One Health mentorship programs for students are essential in battling the challenges faced by students.

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References

1. World Health Organization (WHO). One Health. [cited 2022 Oct 4]. Available from: URL: <https://www.who.int/europe/initiatives/one-health#:~:text=One%20Health%20is%20an%20approach,achieve%20better%20public%20health%20outcomes>.
2. Fenollar F, Mediannikov O. Emerging infectious diseases in Africa in the 21st century. *New Microbes New Infect.* 2018 Sep 21;26:S10-S18. doi: [10.1016/j.nmni.2018.09.004](https://doi.org/10.1016/j.nmni.2018.09.004). [PMID: [30402238](https://pubmed.ncbi.nlm.nih.gov/30402238/)] [PMCID: [PMC6205565](https://pubmed.ncbi.nlm.nih.gov/PMC6205565/)]
3. Okello AL, Bardosh K, Smith J, Welburn SC. One health: past successes and future challenges in three African contexts. *PLoS Negl Trop Dis.* 2014 May 22;8(5):e2884. doi: [10.1371/journal.pntd.0002884](https://doi.org/10.1371/journal.pntd.0002884). [PMID: [24851901](https://pubmed.ncbi.nlm.nih.gov/24851901/)] [PMCID: [PMC4031173](https://pubmed.ncbi.nlm.nih.gov/PMC4031173/)]
4. Akinsulie OC, Adesola RO, Bakre A, Adebawale OO, Adeleke R, Ogunleye SC, et al. Usutu virus: An emerging flavivirus with potential threat to public health in Africa: Nigeria as a case study. *Front Vet Sci.* 2023 Feb 16;10:1115501. doi: [10.3389/fvets.2023.1115501](https://doi.org/10.3389/fvets.2023.1115501). [PMID: [36875996](https://pubmed.ncbi.nlm.nih.gov/36875996/)] [PMCID: [PMC9980716](https://pubmed.ncbi.nlm.nih.gov/PMC9980716/)]
5. Akinsulie OC, Adesola RO, Aliyu VA, Oladapo IP, Hamzat A. Epidemiology and Transmission Dynamics of Viral Encephalitis in West Africa. *Infect Dis Rep.* 2023 Sep 5;15(5):504-517. doi: [10.3390/idr15050050](https://doi.org/10.3390/idr15050050). [PMID: [37736997](https://pubmed.ncbi.nlm.nih.gov/37736997/)] [PMCID: [PMC10514837](https://pubmed.ncbi.nlm.nih.gov/PMC10514837/)]
6. Adesola RO, Okeke VC, Hamzat A, Onawola DA, Arthur JF. Unraveling the binational outbreak of anthrax in Ghana and Nigeria: an in-depth investigation of epidemiology, clinical presentations, diagnosis, and plausible recommendations toward its

- eradication in Africa. Bulletin of the National Research Centre. 2024 Apr 26;48(1):45. doi: [10.1186/s42269-024-01203-4](https://doi.org/10.1186/s42269-024-01203-4).
7. Adesola RO, Idris I, Opuni E. Public health concerns surrounding the cDVPV2 outbreak in Africa: Strategies for prevention and control with a special focus on Nigeria. Health Sci Rep. 2023 May 12;6(5):e1269. doi: [10.1002/hsr2.1269](https://doi.org/10.1002/hsr2.1269). [PMID: [37187504](https://pubmed.ncbi.nlm.nih.gov/37187504/)] [PMCID: [PMC10176430](https://pubmed.ncbi.nlm.nih.gov/PMC10176430/)]
 8. Ogunleye SC, Akinsulie OC, Aborode AT, Olorunshola MM, Gbore D, Oladaye M, et al. The re-emergence and transmission of Monkeypox virus in Nigeria: the role of one health. Front Public Health. 2024 Jan 5;11:1334238. doi: [10.3389/fpubh.2023.1334238](https://doi.org/10.3389/fpubh.2023.1334238). [PMID: [38249416](https://pubmed.ncbi.nlm.nih.gov/38249416/)] [PMCID: [PMC10797020](https://pubmed.ncbi.nlm.nih.gov/PMC10797020/)]
 9. Boutayeb A. The Impact of Infectious Diseases on the Development of Africa. Handbook of Disease Burdens and Quality of Life Measures. 2010: 1171–88. doi: [10.1007/978-0-387-78665-0_66](https://doi.org/10.1007/978-0-387-78665-0_66). [PMCID: [PMC7120372](https://pubmed.ncbi.nlm.nih.gov/PMC7120372/)]
 10. Otu A, Effa E, Meseko C, Cadmus S, Ochu C, Athingo R, et al. Africa needs to prioritize One Health approaches that focus on the environment, animal health, and human health. Nat Med. 2021 Jun;27(6):943–946. doi: [10.1038/s41591-021-01375-w](https://doi.org/10.1038/s41591-021-01375-w). [PMID: [34017135](https://pubmed.ncbi.nlm.nih.gov/34017135/)]
 11. Machalaba C, Raufman J, Anyamba A, Berrian AM, Berthe FC, Gray GC, et al. Applying a One Health Approach in Global Health and Medicine: Enhancing Involvement of Medical Schools and Global Health Centers. Ann Glob Health. 2021 Mar 26;87(1):30. doi: [10.5334/aogh.2647](https://doi.org/10.5334/aogh.2647). [PMID: [33816135](https://pubmed.ncbi.nlm.nih.gov/33816135/)] [PMCID: [PMC7996453](https://pubmed.ncbi.nlm.nih.gov/PMC7996453/)]
 12. Wilkes MS, Conrad PA, Winer JN. One health-one education: medical and veterinary inter-professional training. J Vet Med Educ. 2019 Spring;46(1):14–20. doi: [10.3138/jvme.1116-171r](https://doi.org/10.3138/jvme.1116-171r). [PMID: [30418808](https://pubmed.ncbi.nlm.nih.gov/30418808/)]
 13. Terrigbade I, Babalobi O. Awareness of one health by veterinary medicine and human medicine clinical undergraduate students, University of Ibadan, Nigeria. International Journal of Infectious Diseases. 2020; 101: 401. doi: [10.1016/j.ijid.2020.09.1064](https://doi.org/10.1016/j.ijid.2020.09.1064).
 14. International Association of Universities World Higher Education Database October 2022 (IAU WHED). The world of higher education is at your fingertips. [cited 2022 Oct 9]. Available from: URL: <https://whed.net/home.php>
 15. American Veterinary Medical Association (AVMA). Directory of AVMA ECFVG®-listed veterinary colleges of the world. [cited 2022 Oct 18]. Available from: URL: <https://www.avma.org/education/ecfvg/directory-avma-listed-veterinary-colleges-world>.
 16. Yanney R. The Status of One Health Education among Undergraduate Pre-Health Students [dissertation]. Waco, Texas, US: Baylor University; 2021.
 17. Atusingwize E, Ndejjo R, Tumukunde G, Buregyeya E, Nsamba P, Tuhebwe D, et al. Application of one health approach in training at Makerere University: experiences from the one health workforce project in Uganda. One Health Outlook. 2020 Nov 30;2:23. doi: [10.1186/s42522-020-00030-7](https://doi.org/10.1186/s42522-020-00030-7). [PMID: [33829138](https://pubmed.ncbi.nlm.nih.gov/33829138/)] [PMCID: [PMC7993464](https://pubmed.ncbi.nlm.nih.gov/PMC7993464/)]
 18. Rwego IB, Babalobi OO, Musotsi P, Nzietchueng S, Tiambo CK, Kabasa JD, et al. One Health capacity building in sub-Saharan Africa. Infect Ecol Epidemiol. 2016 Nov 29;6:34032. doi: [10.3402/iee.v6.34032](https://doi.org/10.3402/iee.v6.34032). [PMID: [27906125](https://pubmed.ncbi.nlm.nih.gov/27906125/)] [PMCID: [PMC5131459](https://pubmed.ncbi.nlm.nih.gov/PMC5131459/)]
 19. OHCEA. One Health central and eastern Africa. Kampala, Uganda: Makerere University. [cited 2022 Oct 9]. Available from: URL: www.ohcea.org
 20. McIntosh S, Block RC, Kapsak G, Pearson TA. Training medical students in community health: a novel required fourth-year clerkship at the University of Rochester. Acad Med. 2008 Apr;83(4):357–64. doi: [10.1097/ACM.0b013e3181668410](https://doi.org/10.1097/ACM.0b013e3181668410). [PMID: [18367896](https://pubmed.ncbi.nlm.nih.gov/18367896/)] [PMCID: [PMC3332332](https://pubmed.ncbi.nlm.nih.gov/PMC3332332/)]
 21. Brill JR, Jackson TC, Stearns MA. Community medicine in action: an integrated, fourth-year urban continuity preceptorship. Acad Med. 2002 Jul;77(7):739. doi: [10.1097/00001888-200207000-00025](https://doi.org/10.1097/00001888-200207000-00025). [PMID: [12114157](https://pubmed.ncbi.nlm.nih.gov/12114157/)]
 22. Anyanwu MU, Okorie-Kanu OJ, Anyaoha CO, Kolade OA. Veterinary Medical Students' Perceptions, Attitude and Knowledge about Antibiotic Resistance and Stewardship: How Prepared Are Our Future Prescribers? Notulae Scientia Biologicae. 2018; 10(2): 156–74. doi: [10.15835/nsb10210258](https://doi.org/10.15835/nsb10210258).
 23. AFROHUN. Advancing One Health [cited 2022 Oct 10]. Available from: URL: <https://afrohun.org/>
 24. Buregyeya E, Atusingwize E, Nsamba P, Nalwadda C, Osuret J, Kalibala P, et al. Lessons from a community based interdisciplinary learning exposure: benefits for both students and communities in Uganda. BMC Med Educ. 2021 Jan 4;21(1):5. doi: [10.1186/s12909-020-02429-2](https://doi.org/10.1186/s12909-020-02429-2). [PMID: [33397353](https://pubmed.ncbi.nlm.nih.gov/33397353/)] [PMCID: [PMC7784318](https://pubmed.ncbi.nlm.nih.gov/PMC7784318/)]
 25. Nguyen HT, Tb TN, Pham PM, Tk TT, Pham PD. One Health Student Club – A Practical and Sustainable Way to Train One Health in Vietnam. International Journal of Infectious Diseases. 2022;116:S67. doi: [10.1016/j.ijid.2021.12.157](https://doi.org/10.1016/j.ijid.2021.12.157).
 26. Rweyemamu M, Kambarage D, Karimuribo E, Wambura P, Matee M, Kayembe JM, et al. Development of a One Health National Capacity in Africa. Curr Top Microbiol Immunol. 2013;366:73–91. doi: [10.1007/82_2012_244](https://doi.org/10.1007/82_2012_244). [PMID: [22820706](https://pubmed.ncbi.nlm.nih.gov/22820706/)]
 27. Killewo J, Bazeyo W, Mdegela R. One Health Central and Eastern Africa: Historical and Future Perspectives. International Encyclopedia of Public Health. 2016 Oct 24:342–7. doi: [10.1016/B978-0-12-803678-5.00512-9](https://doi.org/10.1016/B978-0-12-803678-5.00512-9). [PMCID: [PMC7150016](https://pubmed.ncbi.nlm.nih.gov/PMC7150016/)]
 28. Courtenay M, Conrad P, Wilkes M, la Ragione R, Fitzpatrick N. Interprofessional initiatives between the human health professions and veterinary medical students: A scoping review. J Interprof Care. 2014 Jul; 28(4): 323–30. doi: [10.3109/13561820.2014.895979](https://doi.org/10.3109/13561820.2014.895979). [PMID: [24621114](https://pubmed.ncbi.nlm.nih.gov/24621114/)]
 29. Kajjimu J, Kaggwa MM, Bongomin F. Burnout and associated factors among medical students in a public university in Uganda: A cross-sectional study. Adv Med Educ Pract. 2021 Jan 25;12:63–75. doi: [10.2147/AMEP.S287928](https://doi.org/10.2147/AMEP.S287928). [PMID: [33531852](https://pubmed.ncbi.nlm.nih.gov/33531852/)] [PMCID: [PMC7846825](https://pubmed.ncbi.nlm.nih.gov/PMC7846825/)]
 30. Emikpe BO, Asare DA, Emikpe AO, Botchway LAN, Bonney RA. Prevalence and associated risk factors of burnout amongst veterinary students in Ghana. PLoS One. 2022 Jul 14;17(7):e0271434. doi: [10.1371/journal.pone.0271434](https://doi.org/10.1371/journal.pone.0271434). [PMID: [35834535](https://pubmed.ncbi.nlm.nih.gov/35834535/)] [PMCID: [PMC9282513](https://pubmed.ncbi.nlm.nih.gov/PMC9282513/)]
 31. Alsaleem SA, Alkhairi MAY, Alzahrani MAA, Alwadai MI, Alqahtani SSA, Alaseri YFY, et al. Challenges and Barriers Toward Medical Research Among Medical and Dental Students at King Khalid University, Abha, Kingdom of Saudi Arabia. Front Public Health. 2021 Aug 20;9:706778. doi: [10.3389/fpubh.2021.706778](https://doi.org/10.3389/fpubh.2021.706778). [PMID: [34490190](https://pubmed.ncbi.nlm.nih.gov/34490190/)] [PMCID: [PMC8417604](https://pubmed.ncbi.nlm.nih.gov/PMC8417604/)]
 32. AlGhamdi KM, Moussa NA, AlEsa DS, AlOthimeen N, Al-Saud AS. Perceptions, attitudes, and practices toward research among senior medical students. Saudi Pharm J. 2014 Apr;22(2):113–7. doi: [10.1016/j.jsps.2013.02.006](https://doi.org/10.1016/j.jsps.2013.02.006). [PMID: [24648822](https://pubmed.ncbi.nlm.nih.gov/24648822/)] [PMCID: [PMC3950504](https://pubmed.ncbi.nlm.nih.gov/PMC3950504/)]
 33. Ibrahim A, Asuku ME. Stimulating medical students' interest in research: A neglected craft in Africa. Pan Afr Med J. 2012;13:12. [PMID: [23308318](https://pubmed.ncbi.nlm.nih.gov/23308318/)] [PMCID: [PMC3527065](https://pubmed.ncbi.nlm.nih.gov/PMC3527065/)]