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Capacity building for wildlife health professionals: the Wildlife Health Bridge

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Abstract

The Wildlife Health Bridge was established in 2009 with the aim of improving the expertise and knowledge base of wildlife health professionals in biodiverse low- and middle-income countries. The Wildlife Health Bridge centres around partnerships among educational institutions: the Zoological Society of London, the Royal Veterinary College, the University of Edinburgh's Royal (Dick) School of Veterinary Studies, the Wildlife Institute of India, and the University of Melbourne Veterinary School. The Wildlife Health Bridge provides quality education in wildlife health, ecosystem health, and wildlife biology, facilitates the interchange of students between collaborating countries for research studies and provides a global graduate network of wildlife health professionals. In addition to established Masters' level wildlife health training programmes run by the partner organisations, the Wildlife Health Bridge has developed a collaborative field-based course, Interventions in Wild Animal Health, provided annually in India since 2016, which has trained 138 veterinarians to date, enhancing local and international capacity in managing emerging wildlife health issues and building global professional linkages. The Wildlife Health Bridge's Wild Animal Alumni network facilitates networking and exchange between Wildlife Health Bridge institutions and

graduates, with over 701 members from 67 countries, half of which are biodiverse low- and middle-income countries. Collaboration between educational institutions has enabled new ideas and ongoing developments in the delivery of materials and learning outcomes. The Wildlife Health Bridge is building global capacity in trained wildlife health professionals, through educational programmes and a synergised network, with the aim of impacting conservation practice to benefit human, domestic animal and wildlife health.

Keywords: Capacity, conservation, interventions, partnership, professional, training, veterinarian, wildlife health

INTRODUCTION

There is increasing recognition that effective wildlife conservation programmes must incorporate and address wildlife health issues; wildlife health professionals with specialist knowledge have an essential role.

The health of wildlife is dependent on many interacting biological, sociological, and environmental determinants and drivers[1]; it is defined here as the physical, physiological, behavioural and social well-being of free-ranging animals measured at an individual, population and wider ecosystem level, and their resilience to change. Both infectious and non-infectious diseases affect wildlife and reflect the health of an ecosystem. Wild animals can be both the source and target of disease agents, and may act as sentinels of ecosystem health, by indicating the impacts of climate change and pollution, for example. Wildlife health problems are not limited to wildlife diseases but include methodological challenges, such as how to conduct health surveillance more effectively and efficiently, socio-political problems, human-animal conflict, disease emergence and spill-over. Because these problems are complex and cannot be solved by experts in any one discipline, highly trained wildlife health professionals, and specifically wildlife veterinarians, are only part of the required interdisciplinary team adopting a One Health approach required to solve animal, human and environmental health challenges[2-4]. This approach integrates skills and enables people to work together to address the full spectrum of conservation issues and derive holistic solutions that promote healthy wildlife populations and sustainable ways of life[5,6].

The contributions of wildlife veterinarians to diverse interdisciplinary teams can improve conservation success rates[5-8]. In addition to the clinical role of veterinarians in species conservation, through participation in *in situ* and *ex situ* captive management and health care programs for endangered species, they also contribute to the planning and implementation of such programmes[9-11]. Roles for veterinarians include wildlife capture and immobilisation, health assessment and monitoring of wildlife and sympatric domestic animal populations, studies of zoonoses and interspecies transmission of diseases, identification and investigation of emerging diseases, emergency outbreak response and disease risk analyses, including disease prevention through implementing biosecurity practices. Veterinarians may also provide training for non-professionals working with wildlife (e.g., park rangers and hunters). Veterinarians can also participate in the development of diagnostic capabilities for wildlife pathogens, welfare, regulation, welfare, and health aspects of wildlife utilisation programmes, planning of animal exports and imports, data collection and management, research and policy development, and capacity building in wildlife health[9,10,12-14].

Veterinarians who participate in wildlife conservation should receive specialised training to develop expertise that will enable them to contribute to conservation efforts. This training should include the disciplines of conservation biology and ecology, so that they can readily incorporate the role of veterinary medicine in the broader context of wildlife, animal, and human health[2,6,15,16]. Similarly, it is important for ecologists and wildlife biologists to have a good understanding of the impacts of wildlife health and disease[9,17], and what intervention options are possible. Veterinary professional tertiary education training

and qualification curricula vary around the globe, with most in high-income nations regulated by regional and international accreditation schemes, and aim to equip veterinarians with core skills and knowledge in animal health and disease, scientific methodology, and the clinical practice of veterinary medicine and surgery. However, the focus remains principally on livestock and companion animals, with wildlife forming either no, or a relatively minor, part of basic veterinary training. Biodiverse, low- and middle-income countries (LMICs) where there are urgent conservation needs may have a number of veterinarians employed in wildlife health roles, but they often lack wildlife health specialist training.

In addition to the significance for conservation, greater veterinary training in wildlife diseases is recognised by the World Organisation for Animal Health (OIE) as an integral part of improved surveillance for emerging infectious diseases, many of which are zoonoses with a wildlife origin or reservoir[18-20]. Wildlife disease surveillance and the need for a One Health approach to disease surveillance, monitoring, prevention and control programmes, as well as to conservation efforts, and capacity building that improves zoonotic and other pathogen surveillance in wildlife at local and global scales is widely promoted, including by the OIE[20-23]. Equally, in conservation practice, including emergency conservation responses, the risk of introducing or amplifying infectious disease to a threatened species is real, and effective mitigation strategies are required[24]. Veterinary institutions are among a variety of universities, research institutions, government and non-government agencies working together towards capacity building in One Health, with a recognition that the focus in training should shift from merely managing zoonotic and infectious diseases, to include other issues such as antimicrobial resistance, climate change, environmental degradation, and biodiversity conservation[25].

The need for training of wildlife health professionals has led to the availability of a variety of face-to-face and online courses and postgraduate degree programmes in conservation medicine and wildlife health, for veterinarians and wildlife biologists. Wildlife health professional capacity-building and education in conservation can also be provided through conferences, training workshops and international networks that can facilitate communication with colleagues across the globe. Several organisations such as the European Association of Zoo and Wildlife Veterinarians, American Association of Zoo Veterinarians, the Wildlife Disease Association, and others that provide such opportunities are vital to enhance and share understanding and skills to improve the ability to respond quickly to emerging and emergency situations. This technical note describes the development of an international multi-institutional initiative focused on biodiverse LMICs where conservation and wildlife health issues are often great, but training opportunities are limited; the Wildlife Health Bridge is an example of capacity building of wildlife health professionals that has been successful and resulted in demonstrable impact.

Development of the Wildlife Health Bridge

In response to a recognised difficulty of access to training opportunities for wildlife professionals in LMICs, the Wildlife Health Bridge initiative commenced in 2009. The vision of the Wildlife Health Bridge is to increase the global capacity of highly trained wildlife health professionals within a synergised network. The objective of this initiative is to improve the expertise and knowledge of wildlife health professionals in biodiverse, LMICs by working collaboratively through an integrative approach to education which uses the strengths and knowledge networks of the different partners, and specifically has three aims, to:

(1) Provide high-quality education in wildlife health, ecosystem health, and wildlife biology to students from biodiverse countries that is locally relevant to the practice of wildlife health in low resource settings.

(2) Facilitate interchange of students between collaborating countries for research studies in wildlife health.

(3) Provide a global graduate network of wildlife health professional alumni for the purpose of (i) enabling networking by wildlife health professionals and (ii) facilitating contact and information exchange between the Wildlife Health Bridge education institutions and graduates.

The Wildlife Health Bridge grew out of existing relationships between a number of organisations, beginning in 2009 through discussions between the Zoological Society of London, the Royal Veterinary College and the Wildlife Institute of India, and later joined by the University of Edinburgh in 2014 and the University of Melbourne in 2018. The Wildlife Health Bridge collaboratively runs five educational courses in wild animal health: Master of Science (MSc) in Wild Animal Health, MSc in Wild Animal Biology, MSci in Wild Animal Biology (an undergraduate integrated master's degree), Master of Veterinary Science (MVetSci) in Conservation Medicine and a field course in the Interventions of Wild Animal Health [Table 1 and Figure 1].

The Zoological Society of London, Royal Veterinary College and University of Edinburgh have strong historical and current links with countries in South Asia and East and southern Africa through a number of ongoing conservation initiatives. Each institution within the Wildlife Health Bridge brings a wealth of experience in wildlife health research and education [Figure 2] and collaboratively deliver educational courses to achieve the first aim of the Wildlife Health Bridge, addressing the mutually acknowledged gaps in knowledge amongst wildlife veterinarians in field biology, ecology, and population survey, and lack of training and application of modern best practice in wildlife capture, restraint and anaesthesia, animal welfare and disease outbreak investigation.

The longest-standing courses of the Wildlife Health Bridge, the MSc Wild Animal Health and Biology Courses, are internationally recognised to produce graduates of the highest standing, recruited into high profile wild animal health posts around the world. The students receive training in conservation biology, the management of wild animals and the epidemiology, treatment and control of wildlife disease. Veterinarians participate in the Wild Animal Health MSc, whilst non-veterinarians (predominantly from a biology or ecology background) are trained through the Wild Animal Biology MSc.

The MVetSci Conservation Medicine course was established in 2012 and is targeted at veterinarians. The intermittent, part-time study structure provides flexibility enabling students to study whilst maintaining their professional careers. Compulsory topics include ecosystem health, epidemiology, wildlife disease management, intervention techniques (e.g., capture and restraint), and an introduction to research. Choice is also provided for students to pursue a wide range of elective courses to further develop their specific subject interests.

The Interventions in Wild Animal Health course was developed as a component of the MVetSci Conservation Medicine degree and was also offered to selected South Asian veterinarians via the Wildlife Institute of India and other external delegates. This field course runs annually in India and offers 'hands-on' practical training to veterinarians in undertaking interventions in the health, welfare and conservation of wild animals and their habitats, and investigating emerging diseases. The three-week intensive course compliments the online taught Masters' courses, focusing on the practical skills which are difficult to teach in an online environment, but also acts as a stand-alone training course available as continuing professional development. Practical training is delivered by staff from all five participating organisations, and delegates are provided with a comprehensive training manual (Interventions in Wild Animal Health: A manual for

Table 1. Masters-level programmes/courses in wild animal health run under the Wildlife Health Bridge Initiative

Programme/course	Duration	First graduating year	Collaborators
MSc Wild Animal Health (WAH)	1 year full-time	1995	Royal Veterinary College/Zoological Society of London
MSc Wild Animal Biology (WAB)	1 year full-time	2004	Royal Veterinary College/Zoological Society of London
MSci Wild Animal Biology (MSci)	1 year full-time	2019	Royal Veterinary College/Zoological Society of London
MVetSci Conservation Medicine (CM)	3-6 years (part-time, online)	2015	University of Edinburgh
Interventions in Wild Animal Health Field Course (IWAH), a component of the MVetSci Conservation Medicine	3 weeks (in person); 10 weeks online (2021/2022)	2016	Royal Veterinary College/University of Edinburgh/University of Melbourne/Wildlife Institute of India/Zoological Society of London

MVetSci: Master of Veterinary Science.

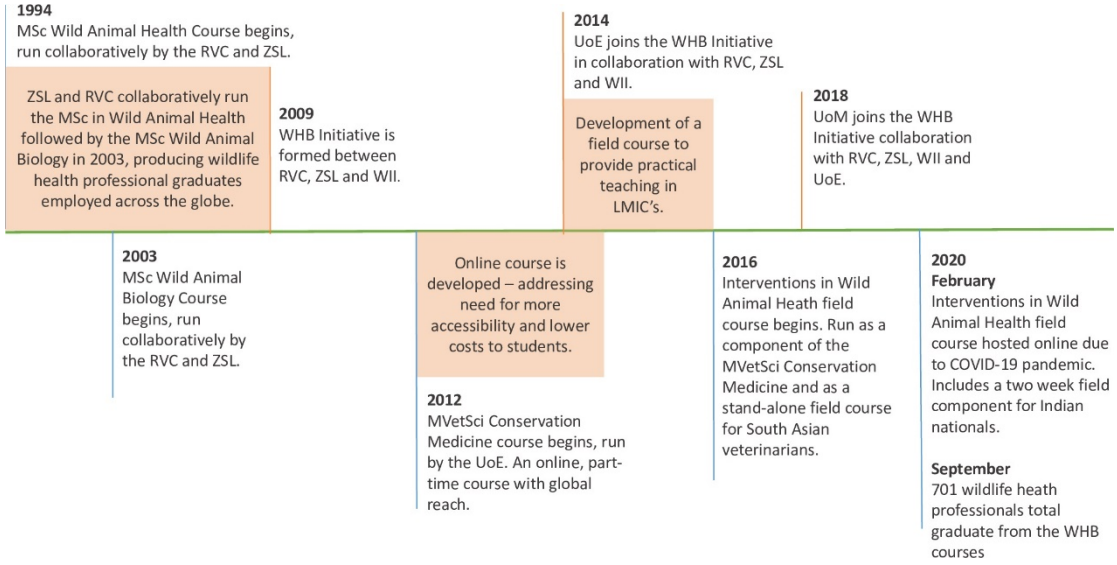

Figure 1. Timeline detailing the development of the WHB and the educational courses run by the collaboration. The areas shaded orange indicate the start of new courses which have been instrumental in developing capacity in wildlife health in LMICs. WHB: Wildlife Health Bridge; RVC: Royal Veterinary College; WII: Wildlife Institute of India; UoE: University of Edinburgh; UoM: University of Melbourne; ZSL: Zoological Society of London; LMICs: low- and middle-income countries.

field veterinarians working for the health and conservation of terrestrial species). The three principal components of training that are essential for effective capacity-building in wildlife health management are: (i) population monitoring, (ii) disease outbreak investigation and (iii) physical and chemical restraint of free-living wild animals. The focus for each of the components is practical planning and skills, through training in carrying out transects in the field, gathering information in the field when faced with mass mortality events, and anaesthetic monitoring following field capture. Essential background material is delivered in lectures, while other sessions use a problem-orientated approach with group work.

The Interventions in Wild Animal Health course enables a rich cultural exchange between participants and the development of lasting professional networks. Such networking complements the technical training; the ability to work across social and cultural divides is, in many regards, as important as the technical knowledge in the field of wildlife health. Many training programmes provide insufficient emphasis on the

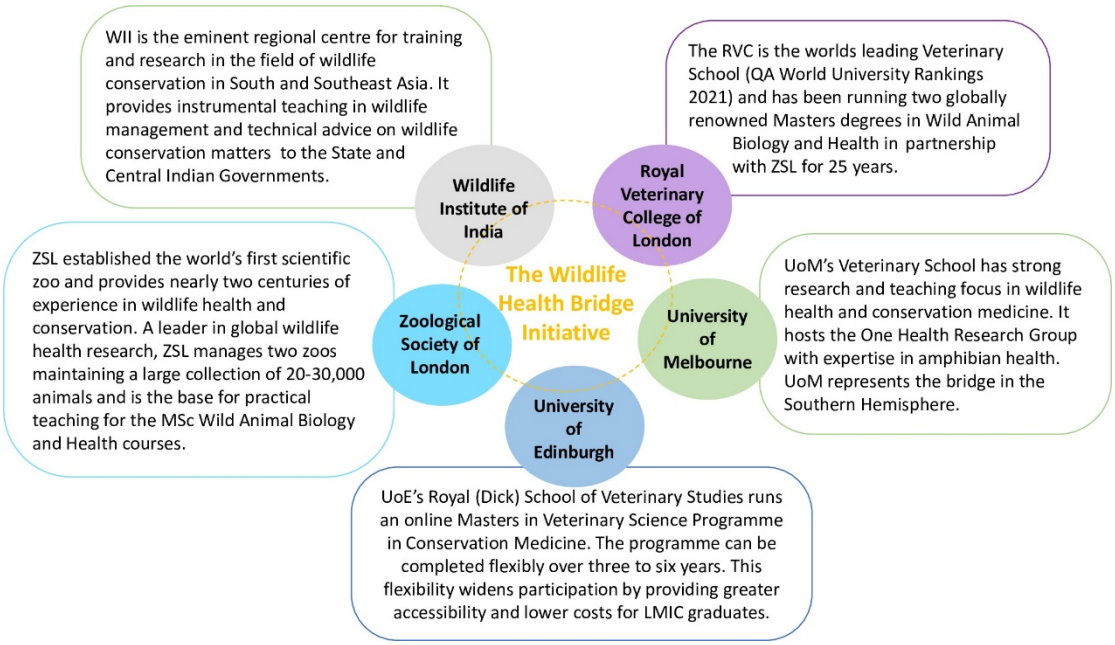

Figure 2. Diagram detailing background on the Wildlife Health Bridge collaborating institutions. RVC: Royal Veterinary College; WII: Wildlife Institute of India; UoE: University of Edinburgh; UoM: University of Melbourne; ZSL: Zoological Society of London.

importance of interpersonal relationships and teamwork, despite this being demonstrated to be critical in achieving positive conservation outcomes[26]. The interactions with tutors and fellow participants during the course have a demonstrable impact, with one graduate describing it as "life-changing" (Dr Wungak Yiltawe - personal communication).

The development of the Wild Animal Alumni network achieves the third aim of the Wildlife Health Bridge. This is an international knowledge exchange network of graduates from the Masters' courses and the Interventions in Wild Animal Health course and connects the primarily South Asian wildlife veterinarians that have undertaken this field course with veterinary colleagues from around the world. The administrative hub for the Wild Animal Alumni is at the Zoological Society of London, and the network of graduates has been growing since the first alumni qualified from the MSc in Wild Animal Health in 1995. The network and engagement are maintained via email lists and social media groups using a variety of communications, and include newsletters and bulletins containing articles, details of publications, job advertisements and conference announcements. A Facebook group is also facilitated for knowledge exchange.

Outcomes and impact of the Wildlife Health Bridge

To date, 701 participants have graduated from the five courses and become members of the Wild Animal Alumni network, with 293 (42%) being active members, defined as those who have opted in to receive email communications in the form of newsletters bulletin. The network (both active and non-active) is predominantly composed of Masters of Wild Animal Biology and Wild Animal Health graduates reflecting the greater length of time these courses have been running [Figure 3]. Across all courses, the alumni network has representation from 67 different countries, of which 33 (49%) are LMICs, as defined by the Organisation for Economic Co-operation and Development based on gross national income per capita as published by the World Bank (Available from: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups).

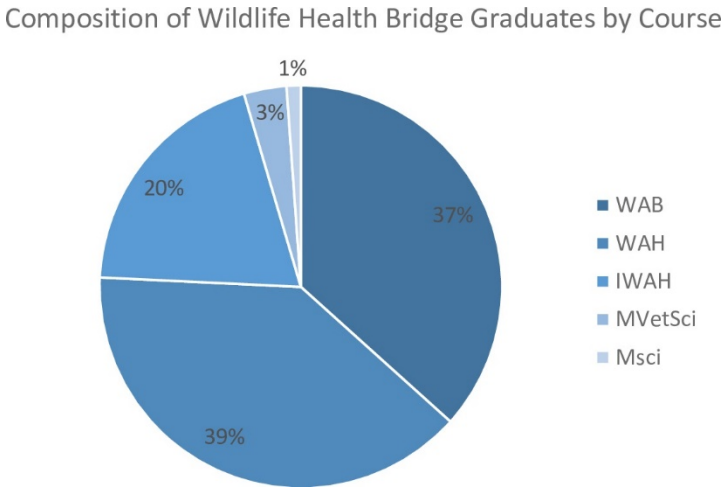

Figure 3. Composition of 701 Wildlife Health Bridge graduates by course. WAB: MSc Wild Animal Biology; WAH: MSc Wild Animal Health; IWAH: Interventions in Wild Animal Health; MVetSci: MVetSci Conservation Medicine; MSci: MSci Wild Animal Biology.

The WHB currently holds data on the careers of 367 graduates. Of these 367, 80% have established a career in the wildlife health field at some point after graduation [Figure 4]. This conversion rate of graduates to professionals indicates the Wildlife Health Bridge is achieving their first aim of providing high-quality education. These students are able to obtain roles where their acquired skills are not only desired but consistently place them above their peers in a competitive market and result in successful job acquisition. Clinical and research work are the dominant career paths taken by graduates. As discussed, the presence of wildlife veterinarians in conservation efforts leads to greater success rates. Therefore, it can be inferred that in a best-case scenario, the courses are proximally contributing to global conservation efforts through the output of clinicians specifically trained in wildlife health. The field of wild animal health is broad, and the careers of veterinary Wildlife Health Bridge graduates are similarly diverse, including working with both captive and free-living wildlife as clinicians, pathologists, researchers, consultants and teachers at institutions including zoos, universities, *in situ* conservation agencies, governments, and rehabilitation centres. Demonstrating the global impact of such capacity building, Wildlife Health Bridge graduates have filled senior posts around the world, including, since 2010: Director of the Chilean National Zoo; Senior consultancy role for Myanmar Zoos; Assistant Professor, Department of Public Health Sciences at Penn State University; Deputy Head of World Animal Health Information and Analysis Department, OIE; Professor of Wildlife Parasitology at the University of Rakuen, Japan; Deputy Director Wildlife Reserves, Singapore; Senior One Health Advisor at Wildlife Conservation Society.

Non-veterinary Wildlife Health Bridge graduates have filled senior posts around the world. As examples showed, after completing both an MSc thesis and PhD on the species, a WAB graduate developed the Kenya Wildlife Trust Mara Cheetah Project, a cheetah conservation project in the Masai Mara, Kenya; another graduate became a Senior Scientific Officer in Exotics & Wildlife Trade at the Royal Society for the Prevention of Cruelty to Animals (RSPCA); whilst another completed a PhD at University College London and Zoological Society of London (ZSL), and joined the staff of Palacký University, Olomouc in the Czech Republic followed by Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Yunnan. From his related MSc thesis, a Wild Animal Biology (WAB) graduate completed a PhD at Imperial College London using large-scale camera trap and occupancy surveys to understand where tigers and other mammals survived in a human-dominated landscape and then became the Director of the Panthera Tiger Program.

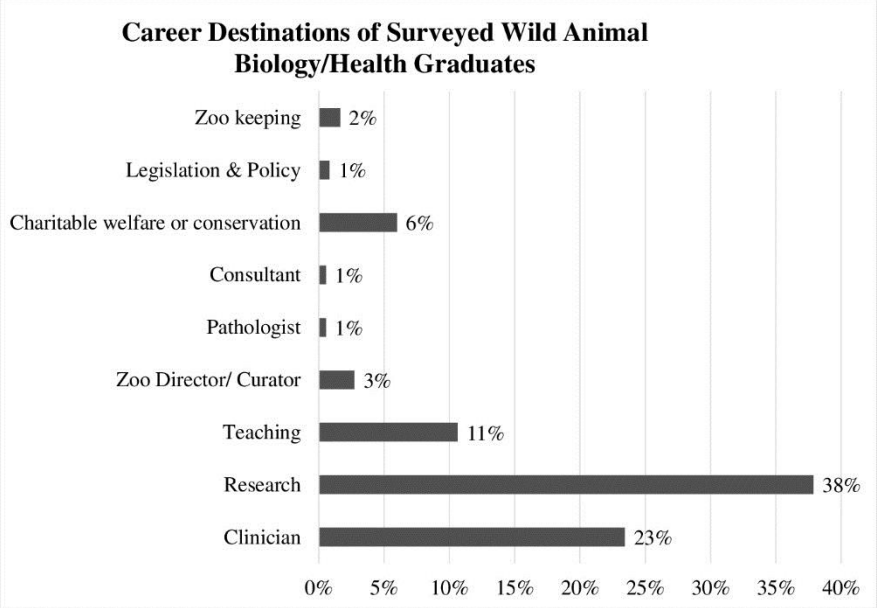

Figure 4. Career destinations of 367 surveyed Wild Animal Biology/Health Graduates.

Since the Interventions in Wild Animal Health course began in 2016, graduates have had a demonstrable impact in the field of conservation and wildlife health. One of the first cohorts of the MVetSci Conservation Medicine and IWAH courses applied knowledge and skills gained through his training to develop, with colleagues, the Rwanda Wildlife Conservation Association. A primary focus is the grey crowned crane (*Balearica regulorum*), an endangered species which has been heavily poached for the wildlife trade. Through the work conducted by the Rwanda Wildlife Conservation Association, the crane population has recovered from approximately 300 to an estimated population of 748 in 2019. This work has now been extended to include habitat restoration, bat conservation and research into wildlife disease. Rwanda is a resource-poor country which has made great strides in restoring its protected areas following the genocide in 1994, and well-trained and motivated individuals such as this graduate are essential to continue this positive trend.

Graduates from the field course are making a significant impact in LMICs and beyond, including the Head Veterinarian at Budongo Conservation Field Station in western Uganda, and the Deputy Director and Veterinary Advisor of the Corbett Foundation in India. For the South Asian attendees recruited through Wildlife Institute of India, the Interventions in Wild Animal Health program has been instrumental in developing and enhancing the capacities of veterinary professionals across these regions, with over 80 attending what is viewed as a highly prestigious course. The majority of these professionals are employed as veterinary officers in national parks and sanctuaries; some are working with non-governmental organisations and veterinary universities. These graduates are proactively contributing toward wildlife conservation through reintroduction programs, wildlife disease surveys, disease investigations, ecological research and managing wild animals in distress.

KEY LESSONS LEARNED AND FUTURE PLANS FOR THE WILDLIFE HEALTH BRIDGE

Over time the aims of the Wildlife Health Bridge have been reviewed, and the current focus on international networking and interchange of students have emerged as critically important. These lessons have been learned through feedback from our students and through staff observations at regular reviews of the

delivery methods. The Bridge has benefitted from the repeated contribution of the same core individuals in a manner that would not be possible with one-off courses. This enables continuity of knowledge and experience, and enhances the ongoing development and improvement of teaching materials, their delivery, and implementation of received feedback, as well as strengthening essential relationships and networks and continually building on historical and local knowledge relevant to each course. As an annual course, the Interventions in Wild Animal Health course has been important in bringing together contributors from around the world on a regular basis, fostering these key relationships. The backing of the partner institutions is critical in allowing this to happen.

The taught courses work towards the first aim (providing high-quality education) and the Wild Animal Alumni network addresses the third aim; we want to use the base that they provide to offer more opportunities for collaborative research (Aim 2). Our network is largely facilitated through social media pages and quarterly newsletters containing information about our alumni's current careers and ongoing research. We have learned the importance of capturing the contact details of our students whilst they study, to build on our network year upon year. Maintaining this contact with our graduates is vital for tracking the impact of our taught courses on their careers and conservation research. Additionally, alumni are canvassed for research project ideas for students on the Masters' courses, and further including them as contributors to Wildlife Health Bridge courses in the future will strengthen the network and provide a richer experience for students. Thus, we intend to foster a transition from an initial learning experience for students to long-term collaboration among our alumni colleagues.

Future plans

Having established the model for training wildlife veterinarians in South Asia through the Interventions in Wild Animal Health course, the Wildlife Health Bridge plans to extend this initiative to other low-income nations, where there is a lack of resources, and provide training in wildlife health for wildlife biologists. In choosing priority geographical locations for future courses, the Wildlife Health Bridge recognises the value of collaboration with established wildlife conservation institutions and governments in those countries where the Wildlife Health Bridge partners have established links. East Africa and South-East Asia have been identified as priority locations, and provisional plans for a course in East Africa have begun. At the same time, we have recognised the fragility of the prospects for face to face teaching given the COVID-19 pandemic and, consequently, have brought our existing knowledge and expertise in online learning, accrued through running the online MVetSci Conservation Medicine, to the fore through administering a remotely-taught Interventions in Wild Animal Health course in 2021 and 2022. An online course cannot substitute for practical hands-on experience, but the planning, travel, and close contact in the field required to administer a practical course are currently precluded by the COVID-19 pandemic.

SUMMARY

Wildlife health is an emerging global issue relevant to biodiversity conservation and human and domestic animal health[27]. There is an urgent need for effective solutions to wildlife health challenges that can be translated directly to practice, by bringing together broad multidisciplinary and interdisciplinary expertise, including veterinary expertise, and a One Health approach[28]. Capacity building is an essential principle of global health advancement that is as applicable to wildlife health as it is to human health[21,29]. The growing recognition of the interplay between domestic animal, human and wildlife health emphasises the growing need for wildlife health expertise in the interdisciplinary teams that can contribute to conservation practice and address complex global health issues such as pandemics of wildlife origin. By providing bespoke training for veterinarians and wildlife biologists in the principles and practice of wildlife health, and through a global graduate knowledge exchange network, the Wildlife Health Bridge is building global capacity in

trained wildlife health professionals. The Wildlife Health Bridge provides a successful example of a growing multi-institutional international collaboration and network that delivers a proven impact on conservation practice; we hope it inspires others to join or develop similar initiatives to fill other identified capacity gaps in wildlife health.

DECLARATIONS

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Authors' contributions

Data analysis and writing the article: Meredith A, Anderson N, Malik P, Nigam P, Thomas A, Masters N, Guthrie A, Davidson H, Patterson S, Amin R, Skerratt L, Kock R, Sainsbury A

Availability of data and materials

Not applicable.

Financial support and sponsorship

None.

Conflicts of interest

Professor Lee Skerratt is on the Editorial Board of One Health and Implementation Research.

Ethical approval and consent to participate

This research complies with the journal's ethical standards, and contains no research involving human subjects, experimentation with animals and/or collection of specimens. All descriptive information is obtained from databases held legitimately by the institutions involved in the Wildlife Health Bridge.

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