# 'One World – One Health' and the global challenge of epidemic diseases of viral aetiology

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**Summary**

'One World – One Health' is an exciting movement to encourage wildlife, domestic animal and human health professionals to work collectively to address the world's most challenging health concerns. It is broad in scope and truly multidisciplinary. This particular commentary on 'One World – One Health' is focused on ways in which individuals are forging closer collaboration and action to meet the global threat of emerging diseases caused by viruses, with particular attention being paid to those diseases that are zoonotic.

**Keywords**

Emerging disease, Global health, Health, One Health, One Medicine, One World, Zoonosis.

## "Un solo mondo – Una sola salute" e la sfida globale delle malattie epidemiche a eziologia virale

**Riassunto**

*"Un solo mondo – Una sola salute", è un movimento coinvolgente, con un vasto ambito di intervento e a carattere realmente multidisciplinare. Il movimento è nato per promuovere la collaborazione tra i professionisti della salute dell'uomo e degli animali al fine di affrontare le sfide più difficili che interessano la salute globale. Questa esposizione su "Un solo mondo – Una sola salute" affronta nello specifico la nascita di forme di collaborazione più strette e la realizzazione di interventi idonei a contrastare la minaccia globale di malattie emergenti causate da virus, in particolare le zoonosi.*

**Parole chiave**

Malattia emergente, Salute, Salute globale, Una sola medicina, Un solo mondo, Una sola salute, Zoonosi.

## Introduction

This 'One World – One Health' commentary is divided into two parts, as follows:

- the first part reviews the provenance of the initiative and why it is needed
- the second part outlines how the initiative relates to the increasingly important challenge of emerging diseases and then proceeds to examine two epidemics to illustrate how the control of emerging viral diseases is best pursued by the precepts of 'One World – One Health' and the commitment of individuals to the initiative.

## Part 1
## Definition and recent history of 'One World – One Health'

'One World – One Health' should not be viewed as a new direction. The term 'One World – One Health' has been used throughout this paper in recognition that the need is global. Others have used the terms 'One Medicine', as originally coined by Calvin

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Schwabe (1927-2006), the shorter form of 'One Health' and the longer form of 'One World, One Health, One Medicine' as used by the World Veterinary Congress. All of these terms are considered synonymous.

As has been noted in other commentaries, the interconnected nature of animal, human and environmental health has been recognised since ancient times (12, 16). Instead 'One World – One Health' is a renewed focus on the common roots of the health professions and the advantages that can accrue by working closely together to meet the challenges of the 21st century. The success of the 'One World – One Health' movement relies on the commitment of all health professionals, since we each contribute valuable skills and perspectives that will ultimately advance the cause.

The term 'One World – One Health' as it applies to the well-being of people, domestic animals and wildlife was initiated at an inaugural workshop hosted by the Wildlife Conservation Society (WCS) and the Rockefeller University in New York City in September 2004. Since 2004, the WCS has organised additional conferences that have focused on the issue (20). Earlier, the Society for Tropical Veterinary Medicine, in a series of themed conferences starting in 1999 under the banner of 'Working together to promote global health', identified the need for a multidisciplinary approach to meet the challenges of the 21st century and influenced the WCS (17).

'One World – One Health' has now become a rallying call in response to both the decline in public health services throughout the world in the latter part of the 20th century and a lack of collaboration between the health professions (particularly medicine and veterinary medicine) in the 20th century. The latter has been attributed by Kahn, Kaplan and Steele (12) to the focus on individualised clinical care and the explosion of biomedical research. In the United States, the American Veterinary Medical Association and the American Medical Association have endorsed 'One World – One Health'. The initiative has also been 'high on the agenda' at recent meetings of the general assembly of the Federation of Veterinarians of Europe. Other national organisations, such as the British Medical Association and the British Veterinary Association, and international organisations, such as the World Health Organization (WHO) and the World Organisation for Animal Health (formerly known as the *Office International des Épizooties* or OIE) recognise that the challenges of the 21st century, particularly as they relate to emerging diseases, demand closer collaboration between all health professionals, especially veterinarians and physicians.

In the United States, two physicians, Laura Kahn and Tom Monath, and a veterinarian, Bruce Kaplan, have been major architects of the various resolutions in support of 'One World – One Health' adopted by veterinary and medical organisations. The formal definition of 'One Health' by Kahn, Monath and Kaplan is given in Figure 1.

## Recent actions in support of 'One World – One Health'

A 'tipping point' defines the point at which a gradual change becomes irreversible and then proceeds with gathering momentum. It is derived from the metaphor of a rigid solid object being tilted to a point where it begins to topple. One hopes that the recent attention to 'One World – One Health' by the leaders of the veterinary profession, with the support of key individuals in the medical profession, has brought us to the tipping point whereby rhetoric will translate into renewed multidisciplinary focus and action necessary to achieve its goals.

Certainly there are several promising indicators that we may be approaching the tipping point, for example:

- in recognising that the organisations responsible for animal and public health became separated in the 20th century, by both organisation and culture, the Centers for Disease Control and Prevention (CDC) in the United States recently reorganised and created the National Center for Zoonotic, Vector-Borne and Enteric Diseases (NCZAD). The appointment of a veterinarian, Lonnie J. King, to be the director of the Center can be seen to support

the thesis that veterinarians are eminently qualified to lead the 'One World – One Health' initiative (14)

- many medical schools and veterinary medical schools in the United States now provide opportunities for their students to pursue joint degrees and certificates in public health
- in 2007, the Association of American Veterinary Medical Colleges (AAVMC) and the Association of Schools of Public Health (ASPH) held a joint symposium devoted to 'Partnerships for preparedness: future directions for schools of public health and colleges of veterinary medicine' (3)

Vision statement: One Health is dedicated to improving the lives of all species—human and animal—through the integration of human medicine and veterinary medicine.

Mission Statement: Recognizing that human and animal health and mental health (via the human-animal bond phenomenon) are inextricably linked, One Health seeks to promote, improve, and defend the health and well-being of all species by enhancing cooperation and collaboration between physicians, veterinarians, and other scientific health professionals by promoting strengths in leadership and management to achieve these goals.

'One Health' shall be achieved through:

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

Figure 1
Formal definition of 'One Health' by Kahn, Monath and Kaplan

- several joint degree and certificate programmes were highlighted at the symposium, along with collaborative research efforts. Special veterinary public health editions of the *Journal of Veterinary Medical Education* (Summer 2008) and *Public Health Reports* (May/June 2008) were published highlighting many of these efforts (2, 4)
- several conferences in the United States have recently focused on the 'One World – One Health' initiative. The 2008 Convention of the American Veterinary Medical Association devoted two consecutive days to the subject, with speakers addressing different aspects of the initiative
- in Europe, the University of Edinburgh has developed a distance learning programme that leads to a master's degree in international animal health. The concept of 'One World – One Health' underpins the content of the course (18)
- the Florida Department of Health and the University of Florida have collaborated to produce a One Health newsletter (8). This newsletter seeks contributions from the veterinary, medical and allied health professions
- the American Veterinary Medical Association recently published the One Health Initiative Task Force Report (1) (Fig. 2).

## Part 2
## The value of 'One World – One Health' in meeting the challenge of emerging diseases

The last 25 years has seen a spate of epidemics affecting human and animal populations on a global scale. In the 1990s in a prescient document, the United States Institute of Medicine focused attention on the changing character of infectious diseases and coined the term 'emerging diseases' to draw attention to the area (10). Since that time, many publications and reports have discussed the socio-economic, environmental and ecological factors ('drivers') that promote the emergence

of diseases, among them the following can be cited:

- extensive global trading and tourism patterns of the late 20th century (pathogens as hitchhikers)
- speed of mass transportation (less than the incubation time of disease, hence infected people can travel undetected)
- exposure to new pathogens through ecosystem disruption (human population pressures, exposure to wildlife)
- intensification and monoculture farming (viral amplification)
- technical sophistication in food processing masking true origins (individuals cannot exercise innate protective responses)
- evolutionary pressures through over-population and change in tropism (intensive agriculture).

Kate Jones and colleagues (11) have reviewed the literature relating to 'emergence' and have analysed the 'drivers' of several hundred 'emerging disease events' from 1940 to 2004 to determine, at the global level, if trends exist in the temporal and spatial patterns of disease. They concluded that emerging disease events have risen significantly over the period of time that they studied (even allowing for temporal reporting bias) and that zoonoses dominate. Cases of wildlife-associated human diseases showed an upward trend from 1940 to 2004

The benefits of a one health approach

- Improving animal and human health globally through collaboration among all the health sciences, especially between the veterinary and human medical professions to address critical needs
- Meeting new global challenges head-on through collaboration among multiple professions – veterinary medicine, human medicine, environmental, wildlife and public health
- Developing centres of excellence for education and training in specific areas through enhanced collaboration among colleges and schools of veterinary medicine, human medicine, and public health
- Increasing professional opportunities for veterinarians
- Adding to our scientific knowledge to create innovative programs to improve health

One Health Initiative Task Force recommendations

'While the AVMA and the AMA plan to take a leadership role in this effort, the success of these recommendations will depend heavily on the collaboration of various health science professions, academic institutions, governmental agencies, and private industries'.

1) Create and fund a One Health Joint Steering Committee to begin the execution of the other recommendations and associated actions
2) Complete a One Health Proposal for Donors as well as a Business Plan and continue the process of engaging potential donors and sponsors
3) Create and implement initial components of a One Health Communication Effort
4) Engage an all-inclusive communications firm to develop and implement a communications plan and coordinate on-going media relations, public relations, publicity, marketing and advertising
5) Plan a study on One Health to be conducted by the National Academy of Sciences (NAS) and secure the necessary funding to underwrite this effort
6) Develop, charter and form a National One Health Commission (to replace the Steering Committee) and recruit full-time staff in key positions to support the goals and mission of the Commission and complete the recommendations within this report
7) Appoint a national/global One Health Advisory Team to help support the National One Health Commission, and give it direction, counsel and wisdom
8) Plan and hold a One Health National Summit
9) Convene several panels and a national meeting to establish a national research agenda for One Health
10) Work toward the inclusion of key One Health outcomes for listing in the strategies for Healthy People 2020 and Healthy Animals 2010
11) Inform, engage, and solicit the support of medical, veterinary medical and public health students and their respective organisations
12) Create a guiding coalition of liaisons, champions and key supporters to promote the One Health concept

Figure 2
Highlights from the One Health Initiative Task Force report published by the American Veterinary Medical Association (1)

and currently represent the most significant, growing threat to global health of all emerging diseases. Controlling for spatial reporting bias, they found that the emergence of zoonotic diseases from non-wildlife sources can be predicted by both the density and growth of the human population, as well as latitude. However they found that the richness of the wildlife fauna is the significant predictor for the emergence of zoonotic diseases originating from wildlife reservoirs, while human population and latitude did not appear to be related. Jones and her colleagues were able to identify certain 'hot spots' around the world where emerging diseases were most likely to originate. The analysis showed, not surprisingly, that there was a high spatial reporting bias for emerging diseases reflecting greater surveillance and research in the developed countries of Europe, North America, Australia and parts of Asia. This contrasts with the predicted disease 'hot spots' leading the authors to conclude that the global effort for surveillance of emerging diseases is poorly allocated with the majority of resources being focused on places from where the next important emerging pathogen is least likely to originate. The authors recommend that resources be directed to improve health monitoring of people at risk in developing countries to more quickly identify emerging diseases before their large-scale dispersal to other parts of the world. The developing countries of tropical Africa, Latin America and Asia should be the primary focus.

In a study of collaboration between the different sectors of medicine, Zinsstag and others (22) provided several convincing examples where veterinarians and physicians working together create synergism that can result in greatly improved health care in developing countries. Their examples, one of which is given here, are mostly drawn from the developing countries of West Africa, an area where the authors have extensive experience of practising 'One World – One Health' in the context of nomadic populations. In Chad, a study of the health status of nomadic pastoralists and their animals found no fully immunised nomadic child or woman, but cattle were largely vaccinated because of compulsory vaccination campaigns. It was realised that veterinary teams were organised to reach mobile populations, whereas vaccination of humans was restricted to static health centres, failing to account for nomads. Subsequently, joint vaccination campaigns have been developed which have shown both feasibility and cost reduction.

Such effective collaboration is not always the case. In an article titled *Emerging zoonotic epidemics in the interconnected global community*, Gibbs discussed recent epidemics caused by viruses and analysed how such events drew attention to the need for improved interdisciplinary action by government organisations in support of 'One World – One Health' (9). Tables I and II provide an update for several of the diseases discussed by Gibbs in 2005 and list additional diseases that emerged in 2007 and 2008.

The control and, where feasible, eradication of several of these diseases involves scientists from several different disciplines. In line with the precept, as outlined in the introduction to this paper, that 'One World – One Health' is broader than the cooperation between veterinarians and physicians, we have looked for examples of cooperation between health care professionals, scientists, sociologists, anthropologists and wildlife specialists in controlling and eradicating these diseases. We have found many examples in support of the 'One World – One Health' initiative, but have decided to profile the involvement of two veterinarians who are committed to supporting 'One World – One Health' through their work with avian influenza and the haemorrhagic fevers caused by Ebola and Marburg viruses. To place their efforts in context, we first provide an update on the current situation with both diseases.

## Highly pathogenic avian influenza H5N1

The threat that the Asian strain of highly pathogenic avian influenza (HPAI) H5N1 virus can create a pandemic of human influenza still exists, although the threat is perceived as diminished now that the popular

Table I
A time-line of epidemics in 2007

| Month | Event | Comment |
|---|---|---|
| January 2007 | Rift Valley fever (RVF) in Kenya, Somalia, Tanzania | Prediction as an El Niño event was successful<br>RVF is highly feared when compared with West Nile with which it is often compared |
| February | Highly pathogenic avian influenza (H5N1) in poultry in the United Kingdom | Complex marketing of poultry meat within Europe believed to be the origin |
| April | Bluetongue overwinters in northern Europe<br>Major epidemic develops during the summer<br>Spreads by September to the United Kingdom | Could climate change produce more clinical disease elsewhere? |
| April | African swine fever appears in the Republic of Georgia and spreads to Armenia | Extensive epidemic<br>Origin probably from south-east Africa |
| May | China reports epidemic of porcine reproductive and respiratory syndrome<br>Subsequently appears to have spread to Vietnam and Myanmar | A particularly virulent strain associated with approximately 25% mortality<br>In China, 280 000 pigs affected of which more than 70 000 died |
| May | Pet food crisis in United States<br>Melamine contamination that originates in China | A model for a bioterrorist? |
| July | Chikungunya in Italy | Demonstrates how quickly disease can spread in a susceptible population |
| August | Foot and mouth disease in the United Kingdom | Bioterrorism initially thought possible, but poor biosecurity identified as probable cause |
| August | Ebola re-emerges in the Democratic Republic of the Congo and Uganda | Over 100 die<br>Marburg virus also surfaces |
| August | Equine influenza in Australia | Demonstrates how quickly disease can spread in a susceptible population<br>Several thousand horses infected<br>Declared eradicated in Australia in March 2008 |

Table II
A time-line of epidemics in 2008

| Month | Event | Comment |
|---|---|---|
| January to August | African horse sickness type 2 | Recognised in Nigeria, in Senegal and then in Ethiopia where outbreak extensive |
| February to April | Rift Valley fever re-emerges in South Africa and Madagascar | Relatively small epidemic but involved Cape buffalo in South Africa |
| April to December | Peste des petits ruminants reported in Kenya, Tibet and Morocco | A disease that has spread widely (or been recognised) in last 30 years |
| June | Hendra cases re-emerge | Australian horses and human affected |
| July | Marburg in Uganda/Netherlands | Dutch tourist infected by visiting bat cave |
| | Bluetongue continues to cause major problems in northern Europe | Excellent example of rapid development and deployment of vaccine through collaboration between industry and government |
| December | Ebola Reston appears in pigs in Philippines | First recognition in domestic animals |
| All months | Human cases of highly pathogenic avian influenza H5N1 continue to occur in Asia | Media attention less, but threat remains |

press throughout the world has grown weary of the story. The waning months of 2005 and the first six months of 2006 were characterised by the invasion of Europe through infected migratory wild birds. The molecular epidemiology indicated that the virus had arisen from northern China. Since that time, the HPAI H5N1 virus has been isolated from wild birds across a wide geographic area of Europe and there has been spill-over into domestic poultry. For example, the complex trading patterns in poultry in the European Union have led to poultry products being considered responsible for an outbreak in turkeys in England in January/February 2007. The virus has also spread from Asia to countries in the Middle East and Africa, but it is less clear whether the virus arrived in migrating birds or infected poultry/poultry products. The HPAI H5N1 virus is now believed to be endemic in poultry in some countries in Africa. While many countries in Asia are now recording fewer outbreaks in domestic poultry, the virus continues to be endemic in rural areas of South-East Asia despite concerted eradication efforts. The virus regularly 'jumps species' into small numbers of humans, particularly in Indonesia, and there is evidence in Sumatra that limited person-to-person transmission has occurred within families. While there have been major concerns that the virus could be introduced via migratory birds to the Western hemisphere, the generally North-South character of the bird migration patterns and the limited overlap of the flyways of the New and Old Worlds have thus far protected the Western hemisphere from infection by wild birds. The threat of mutation of the avian influenza (H5N1) virus, so that it can be successfully transmitted between humans, remains of great concern. On 18 February 2009, the WHO reported 408 confirmed cases of avian influenza virus infections in humans since December 2003 with 254 deaths (62% mortality rate) (21). No convincing evidence exists to suggest that mutation of the virus to allow human-to-human infection has occurred, but the ecology and current virus load in the poultry of South-East Asia significantly elevate the risk of this occurring. If the H5N1 virus were to mutate to permit efficient transmission between humans and if it were to retain the ability to cause a mortality rate similar to that of the current infections, the ensuing pandemic could be horrific. The Spanish influenza of 1918, which is believed to have killed approximately 50 million people, had an overall mortality rate of approximately 2% and, as previously noted, the current mortality rate of avian influenza virus in humans is significantly higher.

Virologists and epidemiologists have been following the deepening problem of H5N1 in Asia since 1997 and have repeatedly warned of the risk of a pandemic of human influenza. It is often overlooked that an estimated 300 million poultry have died of this disease. For some developing countries, this has affected food supplies. To their credit, many countries have invested heavily to control the disease in their poultry, but most are developing countries and lack the long-term resources. While improved management and attention to biosecurity on farms will limit the spread of HPAI, effective vaccines for both poultry and humans need to be developed. The correct selection of prototype viruses for vaccine development is critical for effective prevention and control. This selection depends upon molecular characterisation and comparison of viruses from multiple geographic locations. It is in this arena that Ilaria Capua has steadfastly promoted the importance of 'One World – One Health' through resolutely promoting open access to scientific data for epidemiological investigation and vaccine development.

Capua graduated as a veterinarian in 1989 (7). Her work with HPAI began in earnest in 1999 when, as director of the virology department at the *Istituto Zooprofilattico Sperimentale delle Venezie* in Legnaro, Italy, she was directly involved in managing several avian influenza epidemics. In 2000, she developed the DIVA (differentiating vaccinated from infected animals) strategy, based on heterologous vaccination, to combat avian influenza. This strategy, the first ever developed to combat avian influenza by vaccination while still enabling the trade of products, resulted in the eradication of avian influenza at that time in

Italy. With such a pedigree, it was natural that she would become involved with the epidemic of HPAI H5N1 as it spread from South-East Asia. In 2004, the Food and Agriculture Organization (FAO) invited her laboratory to become a global reference laboratory for avian influenza. As result, she became involved in the global epidemiology and control of H5N1, particularly as it affected poultry in countries in the Middle East and Africa.

As reported in *Science* (5, 6) , it was because she was at the centre of this research that Capua became aware that many laboratories were failing to release their characterisation (i.e. sequence data) of new H5N1 isolates; information that was needed urgently for vaccine development. Her discomfort began in February 2006, when the WHO requested that she deposit the sequence of a sample from Nigeria, the first African country affected, in a database that was restricted to a select number of laboratories. If she shared her sequence she would have access to the rest of the restricted data. Capua refused and instead deposited her sequences in GenBank for the entire world to see. At the same time, in a message on ProMED, an email list for emerging infectious diseases, she asked her colleagues to follow suit and asked *Science* to investigate. Various reasons were advanced to justify the restricted access. The WHO defended the closed database on the grounds that affected countries often did not want information published on the identity of the strains in their country. In response, Giovanni Cattoli, the director of research and development in Capua's lab, was reported by *Science* to have said that it 'is simply not our experience,' noting that of the 15 countries the Capua team had dealt with, 14 said sharing data was 'fine'. Others pointed out that disclosure of the information restricted a laboratory's opportunity to publish scientific papers. In response to these concerns, Capua remarked: 'What is more important? Another paper for Ilaria Capua's team or addressing a major health threat? Let's get our priorities straight'. Capua received international recognition and a ground swell of support; hence the policy was changed. Her story is an important reflection of 'One World – One Health' in action.

## Haemorrhagic fevers caused by Marburg and Ebola viruses

The discovery of Ebola and similar viruses in the 1970s brought fame to Fred Murphy (a veterinarian), Karl Johnson and Pat Webb (both physicians). They were working for the CDC at the time and it is very appropriate that they were recognised for their discoveries. There are many individuals, physicians, veterinarians, wildlife specialists and health care workers who willingly place themselves at high risk when outbreaks of these haemorrhagic fevers occur. Most are from the developing countries of the world and remain unrecognised in the scientific literature. For many years they, with their counterparts from North America and Europe, have wrestled to understand the natural ecology of these viruses and ways to both prevent and control such outbreaks.

The most recent outbreaks of Marburg virus have occurred in Angola and Uganda. In the 2004-2005 outbreak in Angola, there were 252 cases, of which 227 (90%) were fatal. In Uganda in 2007, two mine workers were infected and one died. Also in Uganda, in July 2008, a Dutch tourist was presumed to have been exposed to the virus in a cave in the Maramagambo forest in Queen Elizabeth Park; she later died in Holland.

The most recent outbreaks of Ebola virus occurred in 2007 in the Democratic Republic of Congo, with 372 cases, of which 166 (45%) were fatal and in Uganda in 2007/2008, where there were 149 cases and 39 deaths (26% mortality rate). The outbreak in Uganda occurred in the western region in the district of Bundibugyo (15). There was a delay of several months in establishing the diagnosis. This has been attributed to the atypical nature of the cases which were reported to be less severe than those normally associated with Ebola.

Charles Noki, a Ugandan veterinarian who graduated in 1995, is typical of those people who volunteered to control the recent

outbreaks of Ebola and Marburg in Uganda by putting duty ahead of personal risk. Noki is currently studying for an MPH degree at Makerere University in Kampala and volunteered to work on the 2007/2008 Ebola epidemic in the Bundibugyo district of western Uganda with physicians and veterinarians from Doctors Without Borders, Afrinet, WHO, The Red Cross, the United Nations Children's Fund (UNICEF), CDC and public health colleagues from Uganda. It is highly improbable that Charles Noki will ever become as celebrated as Ilaria Capua; he will probably not even feature in any publication on the outbreak in Bundibugyo, but his actions bring to mind the earlier quote of Capua, 'What is more important? Another paper or addressing a major health threat? Let's get our priorities straight'. Most would agree that Noki, like so many who work in the developing countries on emerging diseases, has his priorities straight!

Thirty-one years have passed since the first case of Marburg was identified. Building on a succession of studies involving primates and the recent association of human exposure within caves, it is now emerging that bats are probably the reservoir of Marburg and Ebola viruses (13, 19). Understanding the epidemiology of the filoviruses has been difficult. The success of recent years is testimony to collaboration between physicians, veterinarians, wildlife ecologists, and health care workers; a true example of team work and the spirit of 'One World – One Health' in action.

## Conclusions

'One World – One Health' is a burgeoning movement, about which much has been written in the United States and abroad. It is the hope of the authors that this commentary provides an update on recent activities to advance the movement, within and beyond the veterinary profession. Although we have focused on a small number of individuals in this commentary, there are numerous, unsung 'One World – One Health' champions that have contributed greatly to these efforts.

We currently face a multitude of inseparable global challenges. All health professionals must embrace the 'One World – One Health' concept, which promotes mutual respect and coordination of each profession's unique skills, in order to successfully solve the health challenges of the 21st century.

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