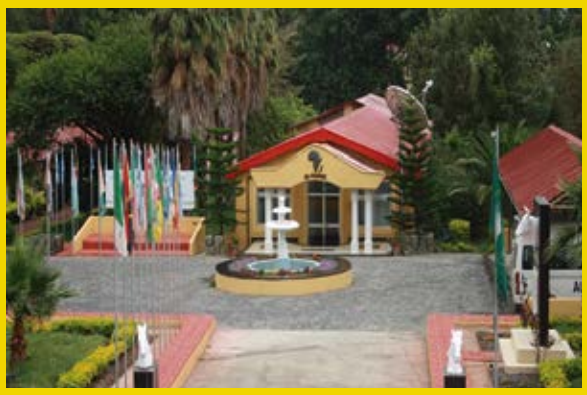

© OIE/P. Bastiaensen

© OIE/P. Bastiaensen

Veterinary Services in Africa and the accidental or intentional release of biological agents: time for a wake-up call?

P. Bastiaensen [1], J. Lasley [2], R. Prenat [3] & T. Brand [2]*

(1) Regional Sub-Representation for Eastern Africa, World Organisation for Animal Health (OIE), P.O. Box 19687, 00202 Nairobi, Kenya

(2) Programmes Department, World Organisation for Animal Health (OIE), 12 rue de Prony, 75017 Paris, France

(3) United Nations Security Council Resolution 1540, Group of Experts, 300 East 42nd Street, Suite 300, New York, NY 10017, USA

* Corresponding author: t.brand@oie.int

Keywords

Africa – biological – biosafety – laboratory – OIE – terrorism – threat – UNSCR 1540.

Summary

Although most animal disease outbreaks and food contamination incidents occur naturally, there is the possibility that disease may be spread following deliberate or accidental release of an infectious agent or toxin. Although the likelihood of such an event is low, the impact may be considerable and cross national boundaries. This paper looks at the vulnerability of African Veterinary Services, and in particular their national veterinary laboratories, to such occurrences. Some terrorist organisations seek to possess stocks of pathogens such as those of bubonic plague and anthrax. This, combined with weak public health and animal health systems in many parts of Africa (as illustrated by the recent outbreaks of Ebola), is cause for concern. According to the OIE's Performance of Veterinary Services (PVS) evaluation system, the most severely affected countries in West Africa possessed veterinary laboratories that were, at the time of the Ebola outbreaks, regarded as non- or under-performing. In Africa, 25% of national Veterinary Services almost always conduct diagnosis by clinical means only, without use of or access to a laboratory. Many veterinary laboratories store, handle and produce live vaccines under circumstances which are dangerous for both the laboratory personnel and the environment, with few or no biosafety and biosecurity measures.

Except for a few plant-derived toxins and strictly human pathogens, most of the known biological agents are of animal origin, and many are listed by the OIE. The OIE has entered into partnerships to bolster support from the security sector for programmes such as laboratory twinning, rinderpest post-eradication activities, the renovation of the World Animal Health Information System (WAHIS), the PVS Pathway and training for national laboratory focal points: the first training session was held in Zimbabwe in December 2016. The OIE is also working closely with the United Nations Office of Disarmament Affairs and with the Committee that supports the implementation of the UN Security Council Resolution 1540 (2004). As far as Africa is concerned, it is the African Union Commission that oversees the implementation of UNSCR 1540.

The OIE, in line with the UNSCR 1540 Resolution, and with its partner organisations at international and continental level, is ready to assist veterinary laboratory managers throughout Africa in assessing where they stand in terms of protecting the biological materials that they may stock, including vaccines, from being inadvertently or deliberately released into the environment.


© OIE/P. Bastiaensen

© OIE/Emilio Lçon

Introduction

Infectious disease agents and toxins found in animal populations and animal products are a considerable and on-going threat to animal health, agricultural economies, food security (both crops and livestock), food safety and public health. Most disease outbreaks and food contamination incidents occur naturally. However, there is also a real risk that disease may be introduced into susceptible human or animal populations following deliberate or accidental release of an infectious agent or toxin. These 'unnatural' biological threats carry special risks because pathogens may be engineered or released in such a way as to make them more harmful. Although the probability of a deliberate or accidental release may be relatively low, the impact may be catastrophic, from a national to a global level [13]. This paper looks at the vulnerability of African Veterinary Services, and in particular their national veterinary laboratory systems, to such deliberate or accidental release of pathogens, in a context of decreasing investments in Veterinary Services and the simultaneous emergence of terrorism cells in some countries of the continent.

Biological threats in the African perspective

As per the OIE Strategy on Biological Threat Reduction [10], a biological threat or 'bio-threat' refers to the accidental or deliberate release of a pathogen or toxin into a susceptible population.

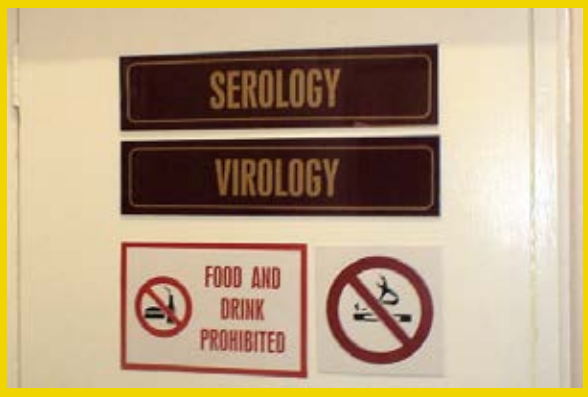
At first glance, a focus on biological threats in Africa may seem out of place. However, if we consider the threat of terrorism and the risk of the intentional release of pathogens and toxins in susceptible populations, such a focus should not seem inappropriate. Furthermore, no fewer than 59 biological agents in the Australia Group's 'List of Human and Animal Pathogens and Toxins for Export Control' [3] can be found in Africa (23 viruses, 21 bacteria and 15 toxins). There is reason to believe that, for example, ISIL is eager to obtain stocks of bacilla of bubonic plague and anthrax, as evidenced by recent criminal investigations conducted in Tunisia [5] and Kenya [2], respectively.

Africa is also regarded as a hub for many trafficking routes that could facilitate the transfer of pathogens. Smuggling routes provide terrorist groups and other criminal entities with the possibility of clandestinely transferring biological agents for use inside and outside the continent. In particular, the Sahelo-Saharan region is regarded as a critical zone in this respect.

The recent wave of outbreaks of Ebola virus disease (2014–2016) demonstrated the weakness of the public health systems in many of the affected countries in West Africa. However, little has been said about the capacity of veterinary laboratories, in particular in terms of biosafety and biosecurity, to handle biological samples of animal origin, some of which are suspected to be potential (dead-end, reservoir or maintenance) hosts for the Ebola virus, i.e. bats (Chiropterae) and (non-human) primates. According to the OIE's Performance of Veterinary Services (PVS) evaluation system, the countries in West Africa (Guinea, Liberia and Sierra Leone) that were most seriously affected by Ebola possess veterinary laboratories that are regarded as non- or under-performing, based on evaluations conducted in 2012, 2013 and 2010, respectively.

A broader, preliminary, Africa-wide review of data from the OIE PVS reports, produced by independent OIE assessors over the past ten years [14], reveals that weaknesses, in terms of diagnostic capacity to detect animal pathogens of zoonotic or major economic potential, are widespread in Africa. Out of 44 countries for which such reports are available,

© OIE/P. Bastiaensen



© OIE/P. Bastiaensen

11 conduct diagnosis 'almost always by clinical means only, with no access to/use of a laboratory to obtain a correct diagnosis', and another 20 have 'access to and use a laboratory to obtain a correct diagnosis', but for 'major zoonoses and diseases of national economic importance' only. Fifty-seven percent of countries do not have formal laboratory quality-assurance systems in place [P. Bastiaensen, personal communication, training of laboratory focal points, Harare, 2016]. There are many national veterinary laboratories storing, handling and producing live vaccines under circumstances which are dangerous for both the laboratory personnel and the environment in general, with little or no (appropriate) biosafety and biosecurity measures in place, and no capacity to prevent ill-intentioned individuals from stealing such pathological agents.

Most border inspection agencies, including the Veterinary Services, are ill-equipped to detect the clandestine import or export of animal pathogens, which, most experts recognise, is much more challenging than the detection of chemical or radio-nuclear products and devices. The overall level of biosecurity in Africa is equally worrisome. According to data from the comprehensive review of the United Nations Security Council Resolution 1540 (2004), 44 African countries have neither a biosecurity legal framework nor national implementation measures. In addition, around 20 African countries have no national framework for controlling exportation of biological agents that can be used for terrorist purposes. This concerns the Committee of UNSCR 1540, with regard to the risk of theft and misuse of pathogens in Africa [R. Prenat, personal communication, African Union assistance and review conference on the implementation of resolution 1540 (2004) in Africa, Addis Ababa, 2016].

The OIE List of diseases and pathogens, with regard to the pathogenic agents that can represent a biological threat

The OIE currently lists 116 infections, infestations and diseases affecting (mostly food-producing) animals, including 28 diseases of aquatic species (fish, molluscs, crustaceans and amphibians). The decision to include a disease or pathogen in this list is based on an algorithm (see Chapter 1.2. of the OIE *Terrestrial Animal Health Code*: 'Criteria for the inclusion of diseases, infections and infestations in the OIE list' [11]). This considers factors such as the potential of the disease to spread internationally (via live animals or their products, vectors or fomites), whether natural transmission to humans has been proven, and whether human infection is associated with severe consequences, but without specifically referring to the concept of biological threat.

Where diseases are listed by the OIE, corresponding international standards provide guidance on how the Veterinary Authorities of importing and exporting countries can best provide for early detection, reporting and control of these agents [11]. In the corresponding *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* chapter [12], standards are provided that allow accurate diagnosis (i.e. detection, where applicable) of such pathogens, based on internationally agreed diagnostic laboratory methods.

Except for a few plant-derived toxins, for example ricin, abrin and several aflatoxins, as well as strictly human pathogens such as cholera (toxin), most of the 100 biological agents affecting humans and/or animals, as listed in the Australia Group's 'List of Human and Animal Pathogens and Toxins for Export Control' [3] as part of their 'Common Control List', are of animal origin. Sometimes, the animal interface

Table I

List of human and animal pathogens and toxins for export control (Australia Group, 2016) and OIE status (currently OIE listed, formerly OIE listed)

Disease: virus	OIE-listed
1. African horse sickness virus	✔
2. African swine fever virus	✔
3. Andes virus	
4. Avian influenza virus	✔
5. Bluetongue virus	✔
6. Chapare virus	
7. Chikungunya virus	
8. Choclo virus	
9. Classical swine fever virus	✔
10. Crimean–Congo haemorrhagic fever virus	✔
11. Dobrava–Belgrade virus	
12. Eastern equine encephalitis virus	✔
13. Ebola virus: all members	
14. Foot and mouth disease virus	✔
15. Goatpox virus	✔
16. Guanarito virus	
17. Hantaan virus (Hanta)	
18. Hendra virus (equine morbillivirus)	✖
19. Japanese encephalitis virus	✔
20. Junin virus	
21. Kyasanur Forest disease virus	
22. Laguna Negra virus	
23. Lassa virus	
24. Louping ill virus	
25. Lujo virus	
26. Lumpy skin disease virus	✔
27. Lymphocytic choriomeningitis virus	
28. Machupo virus	
29. Marburgvirus: all members	
30. Monkeypox virus	
31. Murray Valley encephalitis virus	
32. Newcastle disease virus	✔
33. Nipah virus	✔
34. Omsk haemorrhagic fever virus	
35. Oropouche virus	
36. Peste des petits ruminants virus	✔
37. Porcine Teschovirus	✖
38. Powassan virus	
39. Rabies virus and other Lyssavirus members	✔
40. Reconstructed 1918 influenza virus	
41. Rift Valley fever virus	✔
42. Rinderpest virus	✔
43. Rocio virus	
44. Sabia virus	
45. Seoul virus	
46. Severe acute respiratory syndrome (SARS)	
47. Sheeppox virus	✔
48. Sin Nombre virus	
49. St. Louis encephalitis virus	
50. Suid herpesvirus 1 (Aujeszky's disease)	✔
51. Swine vesicular disease virus	✖
52. Tick-borne encephalitis virus (Far Eastern)	
53. Variola virus	
54. Venezuelan equine encephalitis virus	✔
55. Vesicular stomatitis virus	✖
56. Western equine encephalitis virus	✔
57. Yellow fever virus	

Disease: bacterium	OIE-listed
1. *Bacillus anthracis* (anthrax)	✔
2. *Brucella abortus*	✔
3. *Brucella melitensis*	✔
4. *Brucella suis*	✔
5. *Burkholderia (Pseudomonas) mallei*	✔
6. *Burkholderia (Pseudomonas) pseudomallei*	
7. *Chlamydia psittaci (Chlamydophila psittaci)*	
8. *Clostridium argentinense* (formerly known as *C. botulinum* type G), botulinum neurotoxin producing strains	
9. *Clostridium baratii*, botulinum neurotoxin producing strains	
10. *Clostridium botulinum*	✔
11. *Clostridium butyricum*, botulinum neurotoxin producing strains	✔
12. *Clostridium perfringens*, epsilon toxin producing types	✔
13. *Coxiella burnetii*	
14. *Francisella tularensis*	
15. *Mycoplasma capricolum* sub-species *capripneumoniae* ('strain F38') (CCPP)	
16. *Mycoplasma mycoides* subspecies *mycoides SC* (CBPP)	
17. Rickettsia prowazekii (louse-borne typhus)	
18. Salmonella typhi (typhoid fever)	
19. Shiga toxin producing Escherichia coli	
20. Shigella dysenteriae	
21. Vibrio cholerae	
22. Yersinia pestis	

Disease: fungus	OIE-listed
1. *Coccidioides immitis*	
2. *Coccidioides posadasii*	

Toxins	OIE-listed
1. Abrin	
2. Aflatoxins	
3. Botulinum toxins	
4. Cholera toxin	
5. *Clostridium perfringens* toxins	
6. Conotoxins	
7. Diacetoxyscirpenol	
8. HT-2 toxin (Fusarium)	
9. Microcystins (cyanoginosins)	
10. Modeccin	
11. Ricin	
12. Saxitoxin	
13. Shiga toxins (verotoxins, verocytotoxins)	
14. *Staphylococcus aureus* enterotoxins, haemolysin alpha toxin and toxic shock syndrome toxin (formerly known as S. enterotoxin F)	
15. T-2 toxin (*Fusarium*)	
16. Tetrodotoxin	
17. Viscumin (*Viscum album* lectin 1)	
18. Volkensin	

✔ OIE-listed

✖ Previously listed by the OIE but recently delisted (in the past five years). Disease chapters (for diagnostic purposes) are still available in the *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* [12].

is an (invertebrate) vector; for example, lice may play a role in the transmission of (epidemic) typhus fever, or petechial fever, without necessarily requiring the involvement (as a host) of a mammal or bird. Table I lists these 100 viral, bacterial and fungal pathogens, and toxins, and indicates which of them has an OIE standard, i.e. a chapter in the *Terrestrial Code* [11]. Note that the OIE does not list toxins, only pathogens (diseases, infections and infestations).

Overlying the OIE listed diseases with those of the Australia Group Common Control List illustrates that there are pathogens of particular concern not only to the veterinary and public health sectors but also to the 'security sector'. In particular, this sector is concerned with strengthening global security – in this case 'biological security' – through the prohibition of the development, production, stockpiling, or otherwise acquiring or retaining biological agents and toxins, or related biological weapons or equipment materials. Similar conclusions can be drawn from comparisons with the authoritative listing of 'Bioterrorism and High Consequence Pathogens' published by the Center for Food Security and Public Health (CFSPH) of Iowa State University [6].

Although the OIE is an organisation dedicated above all to the improvement of animal health and animal welfare, and to veterinary public health, worldwide, it has been working with the security sector on a number of topics to enhance global security in the broadest of contexts.

Implementing biological threat reduction

In support of the reduction of biological threats, the OIE has not radically changed its programmes currently available to Member Countries in terms of capacity building. However, it has expanded its partnerships to receive support from the security sector for programmes such as twinning, focal point training, rinderpest post-eradication activities, renovation of the *World Animal Health* Information System (WAHIS) and the Performance of Veterinary Services (PVS) Pathway, to name a few.

In addition, and in relation to biological threat reduction and global security, the OIE has a cooperation agreement with the United Nations Office of Disarmament Affairs which, by extension, has allowed for working relationships with the Biological and Toxin Weapons Convention and with the Committee that supports the implementation of UNSCR 1540 (2004). These two key international instruments effectively commit the international community to the non-proliferation of weapons of mass destruction, including biological weapons. In relation to the 1540 Committee, the OIE is considered to be a technical assistance provider and responds to requests received from the Committee on behalf of other countries. There are currently eight requests for assistance from African countries to the 1540 Committee. The OIE has responded favourably to several of them, in order to strengthen the capacity of certain veterinary laboratories dealing with potentially dangerous pathogens [7].

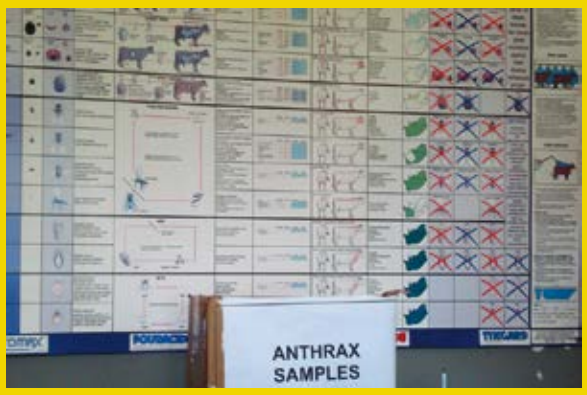
The African Union (AU) Commission, based in Addis Ababa, Ethiopia, oversees the implementation of UNSCR 1540 at African level and this task is entrusted to its Department of Peace and Security on the basis of Decision Assembly/AU/Dec.472(XX) of the 20th Ordinary Session of the Assembly of the AU, held from 27 to 28 January 2013 in Addis Ababa. It requests the AU Commission to take the necessary steps, in collaboration with the Committee established pursuant to UNSCR 1540 (1540 Committee) and all other stakeholders, to further promote and enhance the implementation of resolution 1540 (2004) in Africa [1].

Addressing the accidental or deliberate release of biological agents in veterinary laboratories in Africa

Following the first OIE Global Conference on Biological Threat Reduction, organised in June 2015 in Paris, France in close collaboration with the World Health Organization, the OIE Strategy on Biological Threat Reduction (BTR) was updated [10] to reflect the OIE's strategic vision for the mitigation of these threats. The strategy is centred on five key areas:

a) maintaining scientific expertise and setting standards, and guidelines


© OIE/Emilio Lçon



© OIE/J. Stratton

b) good governance, capacity-building and implementation of the 'One Health' concept
c) global disease intelligence and updates on the latest methods for disease prevention and control
d) international cooperation and solidarity between countries
e) advocacy and communication.

When taking a closer look at the African situation, and in particular the situation of African veterinary laboratories, 'maintaining scientific expertise and setting standards, and guidelines' remains a challenge for most under-resourced laboratories. However, efforts by, for example, the African Union, through the Interafrican Bureau for Animal Resources (AU-IBAR), to coordinate the active (submission of new texts) and passive (responsive) participation of African countries in OIE standard-setting, has borne fruit, especially when dealing with issues or diseases that are of high relevance for Africa, such as Rift Valley fever (RVF).

Whereas many African medical and veterinary services have embraced the 'One Health' concept, advocating a closer integration to 'better understand and address the contemporary health issues created by the convergence of human, animal, and environmental domains' [4], such integration is far from evident in veterinary and public health laboratories and more needs to be done to 'operationalise' One Health in laboratories in Africa. Paradoxically, the fight against antimicrobial resistance is paving the way for such collaborative approaches, where other initiatives in the past have failed, including those involved in combating Ebola.

The aforementioned PVS evaluation programme has been a resounding success in Africa, with nearly all countries (51 out of 54) having benefited from at least one, if not several, consecutive steps in the PVS Pathway, at their own request, providing for a degree of transparency and acceptance of external review that is unprecedented. The PVS Pathway includes specific programmes to address observed shortcomings in the performance of veterinary services, such as the OIE Veterinary Laboratory Support Programme, linked to Chapter 1.1.1. of the *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals*, on 'Management of veterinary diagnostic laboratories' [12], and which has to date benefited six African countries: Côte d'Ivoire, Libya, Sudan, Tanzania, Tunisia and Uganda.

In addition, the OIE Laboratory Twinning programme targets national reference laboratories (primarily in low-resource countries), which link up with existing OIE (and often FAO) Reference Laboratories with the primary goal of building expertise in the diagnosis of animal diseases and zoonoses to improve global capacity for disease prevention, detection and control. In some cases, such laboratories eventually become OIE Reference Laboratories in their own right [15]. Overall, this programme has been very successful in Africa: more than 15 countries have engaged in the programme and 26 Twinning Agreements have been concluded or are ongoing, resulting in the addition of three OIE Reference Laboratories (and Collaborating Centres) in Africa over the past five years [16], an increase of 23%.

Much of the work involved in building the capacity of veterinary laboratories is conducted in partnership with the United Nations Food and Agriculture Organization (FAO), which has several programmes and tools (e.g. the Laboratory Mapping Tool, LMT) that target the material and institutional strengthening of veterinary laboratories in the developing world [8].

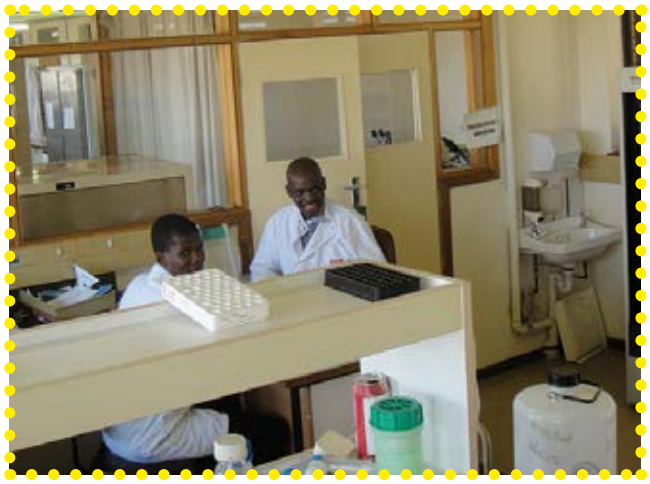
A good example, showing the role that may be played by laboratories in biological threat reduction, involves the recently recognised FAO/OIE rinderpest holding facilities for rinderpest virus-containing material (*Terrestrial Animal Health Code* Chapter 8.15, [11]). Materials such as rinderpest vaccines, biological samples and diagnostic materials should either be destroyed or be sequestered in a designated FAO/OIE rinderpest holding facility. The only FAO/OIE rinderpest holding facility for such material in Africa, following the eradication of rinderpest in 2011, is the BSL-3 facility of the Pan-African Veterinary Vaccines Centre of the African Union (AU-PANVAC), which is based on the premises of the National Veterinary Institute (NVI) in Debre-Zeit, Ethiopia [9].

Much progress has also been seen in the field of disease intelligence and transparency, for example four cycles of training of national focal points for animal disease notification to the OIE via the World Animal Health Information System (WAHIS). This has seen an increase in regular (half-yearly) reporting to the OIE by African Member Countries over the past 12 years. The percentage of African Member Countries having submitted a six-monthly report in time to share information with other Members during the OIE General Session has increased from an average of 52% in 2006 to 89% in 2017, along with an increase in immediate notifications (mainly of outbreaks) from 6 in 2005 to 42 per annum currently [WAHIAD, OIE, personal communication, 2017]. However, many improvements could still be made in terms of the timeliness and accuracy of the reporting.

It is also necessary to stress the pivotal role that the national laboratory focal points can play in biological threat reduction, in terms of implementing appropriate biosafety and biosecurity measures and policies, not only to mitigate accidental releases of pathogens or toxins but also to guard against theft and potential misuse of biological material and equipment. The first (cycle) training of laboratory focal points was held in Harare, Zimbabwe, in December 2016 and was attended by focal points from 31 countries. Within the 16 hours of training content, a session of 3 hours (18%) was dedicated to biosafety and biosecurity, biological threat reduction and quality assurance.

The training of national focal points, along with most of the other activities and programmes of the OIE mentioned previously (PVS, twinning), including intensified communication and advocacy approaches, has been made possible by the international cooperation and solidarity among countries that has resulted from the adoption of the OIE's 3rd Strategic Plan (2001–2005). This has given rise to proactive initiatives to extend support to poorer and more vulnerable OIE Member Countries, and richer nations are expected to contribute in excess of their statutory contributions to the OIE, for the benefit of global animal health security. Many of these actions are channelled through the OIE's trust fund, the *World Animal Health* and Welfare Fund.


© C. Sabeta (OVI)


© OIE/P. Bastiaensen

Discussion and conclusion

The OIE's mandate has historically been the improvement of animal and welfare. The organisation thus contributes to food security and food safety for animal products worldwide. The protection of food animal production is, therefore, a major concern and the reason why the OIE has focused its standard setting on farm animals for almost a century.

Within the scope of its mandate the OIE has also developed a strategy on biological threat reduction, with a particular vision: **A world that is safe and secure from the accidental or deliberate release of animal pathogens, including zoonoses.**

The Member Countries of the OIE, and consequently the OIE itself, are increasingly faced with not only new societal demands (such as improved animal welfare and the concerns surrounding bioterrorism) but also biological (antimicrobial resistance) and environmental changes (climate change, invasive species, biodiversity and species conservation).

In Africa, these changes and their resulting impacts are magnified by the sheer number of infectious animal diseases that represent potential biological threats and often remain undetected and, even when detected, remain largely uncontrolled or untreated. They are also magnified by the lack of means to address biosafety and biosecurity in veterinary laboratories, leading to considerable risks for the bench worker, the people and the animals in the immediate vicinity of these laboratories and the wider environment, should the release of the biological agents find a suitably susceptible host population. Finally, they are magnified by the relative ease with which ill-intentioned individuals or groups may gain possession of some of the most infectious animal diseases known to humankind.

It is therefore time for a 'wake-up call', for veterinary laboratory managers everywhere in Africa to assess where they stand in terms of protecting the biological materials that they may stock, including those used for the production of live or inactivated vaccines, from being inadvertently or deliberately released into the environment. The OIE, in line with UNSCR 1540, and with its partner organisations at international and continental level, is ready to assist African nations in dealing with this menace today, before the threat becomes real.

http://dx.doi.org/10.20506/bull.2017.2.2647

References

1. African Union (2013). – Decisions and declarations. Assembly of the African Union Twentieth Ordinary Session (27–28 January 2013, Addis Ababa, Ethiopia). Available at: https://au.int/web/sites/default/files/decisions/9653-assembly_au_dec_450-473_xx_e.pdf (accessed on 17 May 2017).
2. Anon. (2016). – Kenya police 'foil anthrax attack' by 'IS-linked group'. BBC (UK). Available at: www.bbc.com/news/world-africa-36198561 (accessed on 17 May 2017).
3. Australia Group (2016). – List of human and animal pathogens and toxins for export control. Available at: www.australiagroup.net/en/human_animal_pathogens.html (accessed on 17 May 2017).
4. American Veterinary Medical Association (2008). – One Health: A New Professional Imperative. Available at: www.avma.org/KB/Resources/Reports/Documents/onehealth_final.pdf (accessed on 17 May 2017).
5. Griffin A. (2014). – Isis laptop reveals terror group 'wants to turn bubonic plague into a weapon of war'. The Independent (UK). Available at: www.independent.co.uk/news/world/middle-east/seized-isis-laptop-reveals-wmd-plans-9702030.html (accessed on 17 May 2017).
6. Iowa State University (2017). – Bioterrorism and High Consequence Pathogen Wallchart (Created by Glenda Dvorak). The Centre for Food Security and Public Health (CFSPH). Available at: www.cfsph.iastate.edu/Products/bioterrorism-and-high-consequence-pathogen-wallchart.php?lang=en (accessed on 17 May 2017).
7. United Nations (2017). – Security Council Committee established pursuant to resolution 1540 (2004). United Nations (UN). Available at: www.un.org/en/sc/1540/cooperation/general-information.shtml (accessed on 18 May 2017).
8. United Nations Food and Agriculture Organization (2016). – Sharing FAO tools for Veterinary Laboratory assessment. Available at: www.fao.org/ag/againfo/programmes/en/empres/news_231216b.html (accessed on 17 May 2017).
9. World Organisation for Animal Health (2015). – Resolution No. 25. Designation of Facilities as Approved for Holding Rinderpest Virus Containing Material. 83rd OIE General Session. Available at: www.oie.int/fileadmin/Home/eng/Media_Center/docs/pdf/A_RESO_2015_n25.pdf (accessed on 17 May 2017).
10. World Organisation for Animal Health (2016a). – Biological threat reduction. Available at: www.oie.int/fileadmin/Home/eng/Media_Center/docs/pdf/Fact_sheets/BIOTE_EN.pdf (accessed on 17 May 2017).
11. World Organisation for Animal Health (2016b). – Terrestrial Animal Health Code. Available at: www.oie.int/en/international-standard-setting/terrestrial-code/ (accessed on 17 May 2017).
12. World Organisation for Animal Health (2016c). – Manual of Diagnostic Tests and Vaccines for Terrestrial Animals. Available at: www.oie.int/en/international-standard-setting/terrestrial-manual/access-online/ (accessed on 17 May 2017).
13. World Organisation for Animal Health (2017a). – OIE Biological Threat Reduction Strategy, Strengthening Global Biological Security. Available at: www.oie.int/en/our-scientific-expertise/biological-threat-reduction/ (accessed on 17 May 2017).
14. World Organisation for Animal Health (2017b). – The OIE PVS Pathway. Available at: www.oie.int/en/support-to-oie-members/pvs-pathway/ (accessed on 17 May 2017).
15. World Organisation for Animal Health (2017c). – OIE Laboratory Twinning Programme. Projects completed to date and projects underway. Available at: www.oie.int/fileadmin/Home/eng/Support_to_OIE_Members/docs/pdf/projects_completed_underway.pdf (accessed on 17 May 2017).
16. World Organisation for Animal Health (2017d). – Africa-based OIE Reference laboratories. Available at: www.rr-africa.oie.int/en/REF/en_ref_laboratories.html (accessed on 17 May 2017).