

# Emerging diseases and implications for Millennium Development Goals in Africa by 2015 – an overview

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## Summary

Emerging zoonotic diseases have assumed increasing fundamental importance in both public and animal health, as the last few years have seen a steady increase of new cases, each emerging from an unsuspected geographic area and causing serious problems, often leading to mortalities among animals and humans. The reasons for disease emergence or re-emergence are multiple and include certain major factors, such as expansion of the human population, climate change and globalisation of trade. Further contributing issues, such as the increased movement of animal species, microbial evolution, ecological disruption, changes in human behaviour, all imply that emerging diseases will not only continue to occur, but the rate of their emergence will also increase. These will constitute constraints for the attainment of the Millennium Development Goals by African Governments by 2015. There is no doubt that the current trend calls for more and stronger partnerships between national and international organisations, veterinary and medical communities, environmentalists, academics and policy-makers of various governments on the continent within the context of the global 'One Health' movement. This article attempts to analyse the impact of emerging diseases and the implications for the achievement of the Millennium Development Goals in Africa by the year 2015.

## Keywords

Africa, Disease, Emerging disease, Goal, Millennium, Medicine, One Health, Policy, Public health, Veterinary, Zoonoses.

## Rassegna delle malattie emergenti e loro implicazioni sugli obiettivi di sviluppo del Millennio in Africa stabiliti per il 2015

### Riassunto

*Le zoonosi emergenti hanno acquisito rilevanza crescente per la salute sia umana che animale poichè, negli ultimi anni, si è registrato un aumento costante del numero di nuovi casi emergenti da aree geografiche non sospette. Le cause di questa emergenza o riemergenza di malattie sono molteplici e includono alcuni fattori di importanza primaria, come crescita della popolazione umana, cambiamenti climatici e globalizzazione commerciale. Altri fattori concorrenti, quali maggiore mobilità delle specie animali, evoluzione degli agenti microbici, alterazione degli ecosistemi, cambiamenti del comportamento umano, lasciano presupporre che questa tendenza aumenterà di entità ostacolando la realizzazione degli obiettivi di sviluppo del Millennio stabiliti dai governi africani per il 2015. È indubbio che le attuali crisi richiedano nuove e più forti partnership: istituzioni nazionali e internazionali, comunità mediche e veterinarie, organizzazioni ambientaliste, esponenti del mondo accademico e politico dei governi del continente africano, nell'ambito del movimento globale "One Health". Questo*

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*contributo si propone di analizzare l'impatto delle malattie emergenti e delle loro implicazioni sulla realizzazione degli obiettivi di sviluppo in Africa stabiliti per il 2015.*

### **Parole chiave**

Africa, Malattia emergente, Medico, Millennio, One Health, Salute pubblica, Veterinario, Zoonosi.

## **Introduction**

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Emerging diseases can occur anywhere in the world and the consequences can be severe. Based on experience to date, it is difficult to predict the origin or the nature of future emerging diseases. Recently, new emerging diseases have in some instances demonstrated that they originate primarily where there are high concentrations of different animal species, often in close contact with people (2). As human lifestyles change due to advancing technologies, increasing populations and changing social behaviour, new diseases emerge, while those that have been controlled in the past sometimes tend to re-emerge.

Emerging diseases can be defined as infections that are new occurrences in a susceptible population or are rapidly increasing in incidence or geographic range (16). About 75% of the emerging diseases that have affected humans in the past 10 years are caused by pathogens originating from animals and/or their products (29). Approximately 60% of these diseases are zoonoses, including recent examples, such as H1N1 (commonly referred to as 'swine flu'), avian influenza, severe acute respiratory syndrome (SARS), Ebola haemorrhagic fever and probably human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS).

Some of the most important factors that have contributed to an increase in emerging diseases are as follows:

- expansion of the human population
- climate change
- globalisation of trade
- increasing movement of animal species, civil unrest/wars, microbial evolution and ecological disruption (16).

These and other current issues suggest that emerging diseases may not only continue to occur, but have the potential of increasing the rate of their emergence. These observations call for closer integration of veterinary, medical and environmental communities, along with relentless education of the general public and policy-makers on the African continent.

## **Complexity of factors underlying infectious disease emergence**

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### **Microbial evolution**

The emergence of some disease is due to the natural evolution of micro-organisms. For example, a new serotype of *Vibrio cholerae*, designated 0139, appears to be nearly identical to the strain that most commonly causes cholera epidemics, *Vibrio cholerae* 01, except that it has gained the ability to produce a capsule (8). The consequence of the new serotype is that even people who have immunity against the earlier strain are susceptible to the new one. Resistance to the effects of antimicrobial drugs is contributing to the re-emergence of many diseases, including malaria.

### **Changes in human behaviour**

Changes in societal norms and behaviour can inadvertently create opportunities for micro-organisms to spread and flourish. For example, day-care centres where diapered infants mingle, oblivious to sanitation and hygiene, are a relatively new component of Western society that has encroached into the African societies. For obvious reasons, these centres can be hotbeds of contagious diseases. Many young children have not yet acquired immunity to common communicable diseases. As a consequence, illnesses, such as common colds and diarrhoea, are readily transmitted among this susceptible population.

This is particularly true with intestinal pathogens, such as *Giardia lamblia* and *Shigella* species that have a low infectious dose, because infants often explore through taste

and touch and are thus likely to ingest faecal organisms (12).

### **Complacency and the breakdown of public health infrastructures**

As most infectious diseases are controlled today and therefore of lessening concern, complacency can develop, paving the way for the resurgence of a disease. For example, the preliminary success of the plan to eliminate tuberculosis in the United States by the year 2000 resulted in less public attention being paid to the disease (20). New reports, education and research money on tuberculosis were all diverted to more common diseases. Simultaneously, the HIV/AIDS crisis developed and funding for some social welfare programmes was curtailed, resulting in an increasing in the number of people at risk of developing active tuberculosis due to poor health and living conditions. Consequently, tuberculosis re-emerged as an increasing threat. Fortunately, increased public health measures, including direct observation of drug therapy compliance, brought the disease back under at least temporary control. In addition, decreased vigilance in ensuring childhood immunisation resulted in the resurgence of measles in the late 1980s (11) and even now in some parts of Nigeria.

### **Advances in technology**

Technology can make life easier but can inadvertently create new habitats for micro-organisms. The advent of contact lenses to correct vision gave micro-organisms the opportunity to grow in new locations, i.e. the lenses and storage solutions of users who did not employ proper disinfection methods. For example, contact lens-related microbial keratitis (CLRMK) remains an essential problem in Thailand (19). In turn, this resulted in new types of eye infections because of ignorance or behavioural patterns by users of contact lenses.

### **Population expansion**

The increase in the world population and the subsequent denser living conditions create situations in which diseases can be transmitted more easily. In areas where the population has

expanded, people are coming in contact with previously unknown reservoirs of disease, such as that of Ebola haemorrhagic virus. This may be partly due to an increase in population and competition for food. The reservoir of the Ebola virus, while unknown, shows increasing evidence suggesting a role of non-human primates (having a similar disease in humans) and/or bats in the chain of transmission to humans (25).

### **Infrastructural development**

Dams which provide an important source of power necessary for economic development can also constitute a hazard for the spread or re-emergence of certain diseases. For example, transmission of the disease schistosomiasis relies on the presence of an aquatic snail that serves as a host for the *Schistosoma* spp. parasite. Construction of dams, such as the Aswan Dam on the River Nile, has increased the favourable habitat for the snail, thereby extending the distribution of the disease (30).

### **Mass distribution and importation of food**

Foodborne illnesses have always existed, but the ease with which items can be transported through international trade worldwide can create new problems. Widespread distribution of foods contaminated with pathogens can result in a similarly huge outbreak of disease(s). For example, contaminated raspberries grown in Guatemala were linked to a 1996 multi-state outbreak of a diarrhoea disease in the United States, affecting more than 900 people, caused by the intestinal parasite *Cyclospora* (21).

### **War and/or civil unrest**

Wars and civil unrest can disrupt the infrastructure on which disease prevention relies. Refugee camps that crowd people into substandard living conditions, a lack of toilet facilities and safe drinking water, are hotbeds of infectious diseases. Epidemics of cholera, dysentery and other infectious diseases are common in these conditions. Unfortunately, war and/or civil unrest disrupt disease eradication efforts, e.g. Ebola haemorrhagic infection in the Democratic Republic of the Congo (10).

## Climate change

Changes in temperature and rainfall may affect the incidence of certain diseases. For example, warm temperatures favour the reproduction and survival of some arthropods, which incidentally survive as vectors of diseases, such as malaria, West Nile encephalitis (WN), Rift Valley fever (RVF), just to mention a few. The heavy rainfall and flooding that resulted in a surge of cholera cases in Africa may have been due to the effects of El Niño (27).

## How government policies implementation will help in mitigation of emerging diseases and attainment of Millennium Development Goals

Figure 1 below portrays the relationship between government policies, sustainable environment, veterinary and public health expert's direct impact on emerging diseases and Millennium Development Goals. Proper implementations of government policies will create a sustainable environment which is one of the Millennium Development Goals. Collaborative work between veterinary and public health experts within the context of

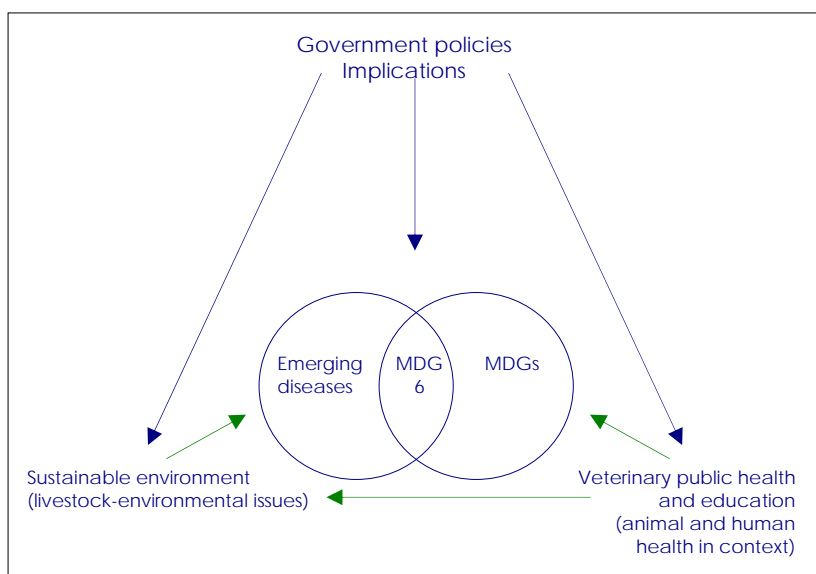
global 'One Health' will help in the mitigation of emerging diseases.

The Millennium Development Goals are eight goals to be achieved by 2015 that respond to the world's main developmental challenges (23). These goals ranging from goal numbers 1 to 8 include:

1. Eradication of extreme poverty and hunger
2. Achievement of universal primary education
3. Promotion of gender equality and empowerment
4. Reduction of child mortality
5. Improving maternal health
6. Combating HIV/AIDS, malaria, and other diseases
7. Ensuring environmental sustainability
8. Developing a global partnership for development.

The governments on the African continent can only achieve these goals on a continent that is free of war and/or civil conflicts, and free of emerging disease outbreaks to the extent possible and essentially supported by good governance.

The principal Millennium Development Goal that interfaces with emerging diseases is Millennium Development Goal No. 6, which is combating HIV/AIDS, malaria, and other



MDG Millennium Development Goal

Figure 1  
Government policies and emerging disease dynamics

diseases. These other diseases mentioned in the sixth goal of the Millennium Development Goals include emerging diseases. Ensuring environmental sustainability is another goal of the Millennium Development Goals that also interfaced with emerging diseases. This includes livestock and environmental issues, such as land, water, air, biodiversity and ecosystems. Therefore, the mitigation of emerging disease outbreaks in Africa could largely contribute to achieving the Millennium Development Goals in Africa by 2015. For, as the saying goes, 'a healthy population is a productive population'. When there is complete eradication of microbial infectious agents in Africa, other Millennium Development Goals such as the eradication of extreme poverty and hunger, the reduction of child mortality, achieving universal primary education etc., will be reached. However, good governance and rule of law on the continent of Africa must be a pre-requisite for the attainment of the Millennium Development Goals by 2015.

### **A new paradigm shift for productive partnership**

New and strategic areas for partnerships within the global 'One Health' movement should be scientifically explored in Africa. The lessons of the recent past have taught us to expect the reoccurrence of emerging infections at any time and/or any place. Therefore, there is an urgent need to strengthen research, investigation and disease control partnerships among animal health and public health experts.

Emerging infectious diseases do not have boundaries, that is, they occur and can spread to other continents of the world. It is therefore pertinent to adopt a global collaborative agenda that focuses on the surveillance, prevention and control of emerging and re-emerging infectious diseases of animal origin. This should include the following components:

- integrated research agenda
- interdisciplinary zoonotic disease research centres

- infrastructural development; work force development
- improved international coordination/cooperation and focus oriented.

### **Improved international coordination and focus**

Interactions between international scientists and local, state and federal scientists, officials and agencies in Africa represent another area for improved collaboration. Coordination can occur both horizontally and vertically. Horizontal collaboration could be accomplished through improved links between the World Organisation for Animal Health (*Office International des Épizooties*: OIE), the World Health Organization (WHO), the Food and Agriculture Organization (FAO) and other international animal and human health organisations and through the development of partnerships between national veterinary services and their public health counterparts. Vertical linkages of organisational hierarchies and divisions, that is, field organisations and administrative units can enhance the ability to share information and act collaboratively within the same agency. The result will be new alliances with a firm focus on combating emerging infectious diseases. For example, the Secretariat of the Pacific Community (SPC) is working in collaboration with the OIE and FAO. This will enable Pacific Island representatives to highlight key animal health issues for consideration under the FAO/OIE global framework for progressive control of trans-boundary animal diseases (GF-TADS) (22).

### **Workforce development**

A trained and skilled workforce forms a key component of the public and animal health infrastructure. Veterinary personnel have a crucial role to play in responding to emerging infections. On account of the current trends in biological threats, there is an even greater need to employ and train public health veterinarians and animal health practitioners with expertise beyond clinical practice and, most especially in the areas of wildlife biology, ecology, virology, food safety, food and animal production, insecurity, preventive medicine and veterinary research (24).



Training programmes in applied epidemiology are critical to the development of a workforce that is ready to confront emerging microbial threats. Current programmes include the Centers for Disease Control and Prevention (CDC) Epidemic Intelligence Service (EIS) programme, which was established to train physicians, veterinarians, other allied health professionals and doctoral graduates for careers in public health. Since the programme began in 1951, nearly 200 veterinarians have received EIS training and subsequently distinguished themselves in public health careers in domestic and interventional public health agencies, academic institutions and non-governmental organisations (17). Presently, the CDC are training veterinarians, physicians and other paramedical professionals in the field of epidemiology; this will contribute to the attainment of the Millennium Development Goals.

Veterinary training can also be enhanced by an understanding of trade issues, political and regulatory structures, international regulations for both animal and human health, risk management, and population-based approaches for solving global health problems (17). The intricacies and changed epidemiological patterns of emerging and re-emerging zoonoses mean that veterinary and public health personnel in Africa must continue to expand their horizons of scientific and personal skills if they are to be successful. Knowledge of informatics, genomics, and recombinant DNA biotechnology, along with cultural competence, good team building and risk communication will also be important (15). All of the modalities encompassed in the 'One Health' concept should be employed (14).

### **Infrastructural development**

Resource constraints have weakened both the public health and animal health infrastructures on the continent of Africa over the past decades because of massive corruption in past and present governments. Coincidentally, with an unprecedented era of emerging and re-emerging infectious diseases, most countries lack financial resources to maintain current public health and animal health infrastructures

and lack funds for construction, modernisation, enhancement and recruitment. In most African countries, research facilities, laboratories and human resources in critical scientific areas have not kept pace with the evolving challenges. A typical example is the 2006 highly pathogenic avian influenza (HPAI) outbreaks in Nigeria where samples had to be sent to the FAO reference laboratory in Padua, Italy, for definite diagnosis (1) due to the non-existence of an international reference laboratory for that disease in Africa. A massive and sustainable investment is required to strengthen the many discrete and highly specialised components of the public health infrastructures in Africa that are needed for rapid response to infectious disease emergence. Furthermore, the prevention and control strategies for animal-borne diseases call for strategies that differ from those that spread only by human contact; this adds a level of complexity to the already limited public health infrastructures.

### **Animal and human health response teams**

The surveillance of animal hosts and investigation and containment of animal-borne-diseases are essential components of disease prevention and control. However, all of these are being complicated by the ecological complexity of zoonotic infections. Therefore, multidisciplinary teams with representatives from animal health and human health disciplines, such as field epidemiologists, veterinarians, ecologists, ornithologists and entomologists, will be required for successful disease investigation and containment (5, 14).

The effectiveness of a multidisciplinary team approach ('One Health') was shown during the 2003-2004 avian influenza outbreaks which generated unprecedented international cooperation between public health experts from CDC and animal health representatives from organisations in Vietnam, namely the National Institute of Hygiene and Epidemiology and the National Centre for Veterinary Diagnosis. To bridge the gap between human and avian influenza, the agencies shared their training and expertise, as

well as viral isolates and serological specimens from humans and birds (3). A similar situation was witnessed in the 2006 avian influenza outbreak in Nigeria, where samples were taken to the FAO laboratory in Italy for laboratory diagnosis (1). This exchange and co-ordination of information proved critical for successful influenza surveillance, reporting and containment efforts.

### **Integrated research agenda**

Despite the importance of the interface between human and animal microbes, the factors that influence the ability of infectious agents to cross the species barrier and infect new cells and populations are poorly understood. To ensure an effective prevention and response strategy for these agents, we need to understand the dynamics of their emergence, re-emergence or spread. For many pathogens, detailed information on molecular biology and pathogenesis is lacking, for others, even basic information about transmission route and host range is lacking (26, 28). Little is known about the organisms harboured by wild animals, the potential role of wildlife as a reservoir and vector, or the relative advantages of different control strategies. Interactions between wild and domestic animals require further research. To achieve this integrated research agenda, there is an urgent need for a new commitment and partnership between human and animal health clinicians, researchers, policy-makers and national and international organisations. Herein lies another expression of 'One Health' in action (14).

### **Surveillance in domestic animals, wildlife and humans**

As indicated by current trends, the identification and control of future epidemics will depend on the ability to rapidly detect, monitor and control disease caused by novel zoonotic agents (5). The 2003 SARS epidemic and the still-expanding epidemic of avian influenza in Asia and Africa exemplify not only the epidemiological convergence of animal and human health, but also the importance of connecting, if not integrating, surveillance systems for emerging infectious

diseases of humans, domestic animals and wildlife (17).

Detection at an early stage is very important for emerging zoonoses. In many cases, identification of a new disease threat occurs only after recognition of detectable disease in humans, even though clinical manifestations may have occurred first in animal populations (6). Therefore, it is important to identify health problems in animals that could be associated with human diseases and to investigate health problems in animals and humans (6).

ArboNET, for example, is an active arbovirus surveillance database and system; it is unique in its ability to collate and report surveillance data from humans, mosquitoes, birds, animals and sentinel chicken flocks, marking one of the first times that such data have been integrated into a single reporting system (4). Unfortunately, ArboNET does not connect to other tracking systems and many other zoonoses still remain unmonitored. Among the human and animal emerging disease surveillance systems that are operating globally, few freely share data and most lack standardised protocols and connectivity. In addition, local, state, regional, national and international authorities responsible for data collection often remain disconnected and the information fragmented. Surveillance of emerging infections in wildlife is especially problematic. Few human and animal diseases are notifiable and measures for the detection of human and livestock infections are inadequate for the identification of similar diseases in wildlife (7). The World Animal Health Information System (WAHIS) and Emergency Centre for Transboundary Animal Diseases (ECTAD) have held a series of training workshops on biosecurity for poultry farmers and live birds markets in West Africa (9).

### **Interdisciplinary zoonotic disease research centres**

The formation of research centres in Africa with the mandate of studying the dynamics of zoonotic diseases could provide an important stimulus to encourage interdisciplinary research. This will go a long way in addressing the highly complex nature of infectious disease

emergence on the continent and will promote the establishment of interdisciplinary research, education and training centres with different areas of specialty, including zoonoses (13).

Interdisciplinary research centres, housed within academic establishments in collaboration with federal agencies, could serve as loci for the integration of public health and animal health activities related to the prevention of emerging infectious diseases. They would provide a venue for interaction, data sharing, training and collaborative research among scientists, researchers, and practitioners in disciplines such as public health, clinical medicine, veterinary medicine, the social science and environmental sciences, economics, engineering and communications. Crucial expertise might include vector-borne disease, food safety, wildlife management, epidemiology, environmental microbiology, diagnostics and informatics.

## Conclusions

The responses of OIE member countries to a questionnaire on emerging zoonoses overwhelmingly acknowledged the impact of emerging zoonoses and their likely continued resurgence (18). A large number of member countries reported that they had experienced incidents of emerging and re-emerging diseases, along with the emergence of antimicrobial-resistant pathogens, and noted the importance of strengthening and improving surveillance, research and training to ensure or to build the capacity to address these persistent threats.

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The mitigation of emerging diseases on the continent of Africa will help to attain the Millennium Development Goals but the entrenchment of good democracy and rule of law must be a 'sine qua non' of the various governments of African countries. Another key point is the need for stronger partnerships with national and international animal and public health organisations, academic institutions, private practitioners in animal and public health and non-governmental organisations to meet the ensuing challenges. The OIE and the FAO must continue to be involved in their response to the needs of member countries and the changing demands and opportunities associated with emerging infections. Of paramount importance to this transformation will be the formation and strengthening of partnerships, mobilisation of resources and the development of a global intersectoral approach in tackling zoonotic threats.

Finally, the complexity of human-animal interactions calls for a new inter-dependence among animal and public health workers and a new strategic global cooperative paradigm shift in order to forge true and expedited progress in the surveillance, prevention and control of zoonotic diseases in Africa and the world in general. 'One Health' meets all of these needs and is a prescription for success in the 21st Century (14).



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