



FORESIGHT

Infectious Diseases in Africa:
using science to fight the
evolving threat

OFFICE OF SCIENCE AND TECHNOLOGY

Cover picture: Ebola virus

Foresight Infectious Diseases in Africa: using science to fight the evolving threat

Office of Science and Technology

This paper is intended to inform the debate about infectious disease in Africa. It is supplemented by nine short articles, which appear as appendices under separate cover. The opinions expressed are those of the authors, and do not necessarily represent the views or policies of their organisations or Governments.

Foreword



This paper is a product of the Office of Science and Technology's Foresight project on the Detection and Identification of Infectious Diseases. It is intended to inform the deliberations of the Commission for Africa.

The paper considers infectious diseases in humans, animals and plants, and argues that whilst the threat to human health and economic development is already severe, the risks are set to change in the future. This is due to a wide range of factors such as climate change, new patterns of land use, conflict and urbanisation.

Understanding how the threat will evolve will be vital in devising strategies for disease control, but also in other policy areas such as economic development, defence, and social planning.

Science has the potential to play a key role in the fight. This paper therefore proposes a joint international study in 2005 to analyse future risks, and their possible impact on African societies. The study will also explore options for the control of diseases, particularly through new strategies for their detection and identification. The idea is to bring together experts, stakeholders and donor organisations at the end of the work to consider what needs to be done, and to catalyse action.

This paper has been written through the Foresight programme of the Office of Science and Technology. I am extremely grateful to the many eminent scientists who have contributed – these are from Denmark, Kenya, Senegal, Tanzania, Uganda, UK and USA.

A handwritten signature in black ink that reads "David King". The signature is written in a cursive, flowing style.

Sir David King KB ScD FRS

Chief Scientific Adviser to HM Government
and Head of the Office of Science and Technology



Infectious Diseases in Africa: using science to fight the evolving threat

Authors:

Tony Barnett	London School of Economics	UK
David Bradley	London School of Hygiene and Tropical Medicine	UK
Joe Brownlie	Royal Veterinary College	UK
Glyn Davies	formerly Kenya Veterinary Research Laboratory, Kabete	UK
Andrew Githeko	Medical Research Institute	Kenya
Ernie Gould	Centre for Ecology and Hydrology	UK
Rosie Hails	Centre for Ecology and Hydrology	UK
Mike Hulme	Tyndall Centre for Climate Change	UK
Brian Mahy	CDC	USA
Franziska Matthies	Tyndall Centre for Climate Change and Dept of International Health	UK Denmark
David Mwaniki	Medical Research Institute	Kenya
Joseph Okello-Onen	Uganda Livestock Research Institute	Uganda
G. William Otim-Nape	National Agricultural Research Organisation	Uganda
Mark Rweyemamu	Food and Agriculture Organization	Tanzania
Alpha Amadou Sall	Insitut Pasteur	Senegal
David Serwadda	Makerere University	Uganda
Nelson Sewankambo	Makerere University Medical College	Uganda
R. Soi	Kenya Agricultural Research Centre	Kenya
Mike Thresh	Gatsby Charitable Foundation (formerly NRI)	UK
Marion Wooldridge	Veterinary Laboratories Agency	UK

1. The scourge of disease in Africa

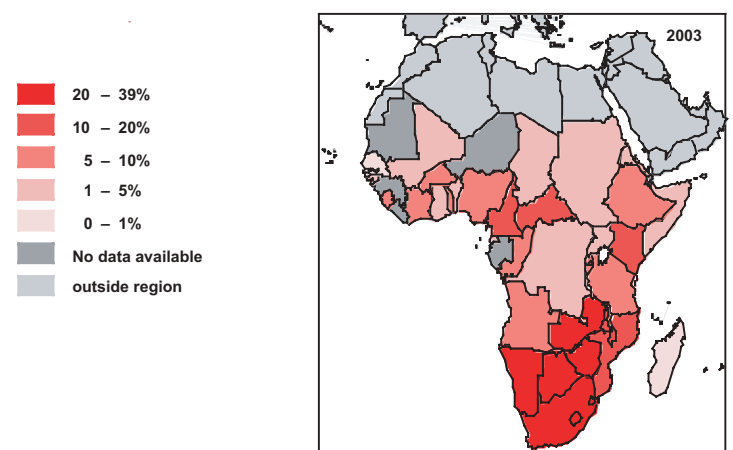
The importance of infectious diseases to Africa could not be greater. By attacking crops, livestock and people, they cause starvation, impair economic development, and at worst, can destabilise entire countries. By interacting with each other and with society in complex ways, they create a vicious spiral of decline.

Of the human diseases in Africa, HIV constitutes a 'time bomb'. The estimated 26 million people now infected are likely to develop AIDS over the next decade (Figure 1). The effects of other diseases such as malaria and tuberculosis, which are already severe, will be amplified by the large numbers of people with suppressed immune systems. Women will be disproportionately affected and life expectancy, already reduced to around 40 years in some countries with high HIV prevalence, will further decline. And just as greater demands are placed on healthcare and social welfare systems, the economic performance of countries will be compromised by an increasingly debilitated workforce.

➔ **Appendix 1**

Livestock agriculture is the most important industry across sub-Saharan Africa, and disease is its biggest constraint. Overall, the industry represents 25% of the gross domestic product of the region, and in certain countries, provides enough stock for export. The threat from many diseases remains huge, although the near elimination of Rinderpest has shown that success can be achieved.

Figure 1 **HIV prevalence in adults in sub-Saharan Africa, end 2003**



Source: *Global AIDS Report, July 2004, Geneva, UNAIDS*

➔ **Appendix 2**



Infectious Diseases in Africa

Crop diseases and pests are major threats to African food security. Resistant varieties are the only realistic control, and long delays in developing these makes detection and eradication of new diseases particularly important. However, cassava mosaic disease (CMD) is a recent success story (Figure 2). CMD attacks one of the most important subsistence crops in sub-Saharan Africa and a particularly severe form of the disease was identified in Uganda in 1988. Since then it has attacked large tracts of East and Central Africa, affecting millions of people who depend upon it for survival – particularly in times of drought. However, rapid mobilization of mosaic-resistant varieties, aided by biotechnology, and action at both local and international level has now helped to control the disease in many places.

Appendix 3

Appendix 4

Figure 2 **Woman farmer in Uganda with a variety of cassava which is resistant to cassava mosaic disease**



Arguably, the greatest threat in Africa does not stem from any single disease, but from the combined effect of the wide range of diseases in humans, crops and animals which interact with each other and with societies and the natural environment. These interactions are many and complex and can produce a spiral of social, economic and environmental decline. Understanding these interactions will be vital in developing cost effective strategies to break out of the trend.

2. An evolving threat

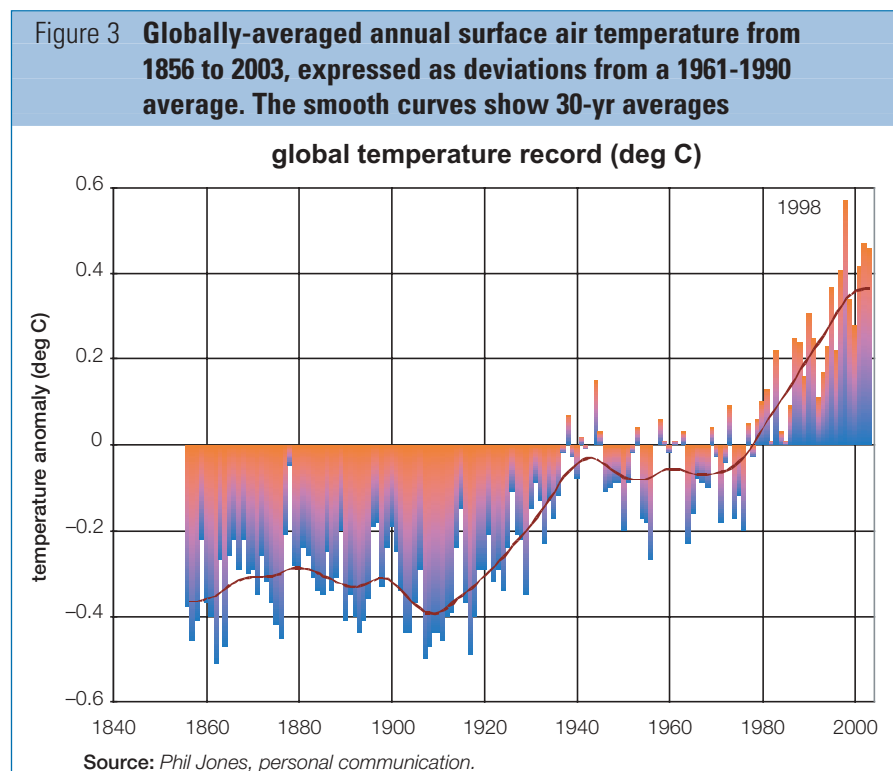
The risk of infectious diseases is changing. New patterns of urbanisation and land use, climate change, migration and conflict will all combine to alter the people, animals and plants at most risk. Entirely new diseases will also emerge – either imported from countries outside Africa, or generated within Africa itself, as pathogens mutate and cross species barriers.

The effect of climate on disease risk is illustrated by the 1997/98 El Niño – the higher temperatures in parts of Africa contributed to a cholera epidemic in Kampala. 6000 people were affected, mostly in the city’s slums. However, the effects of climate change may be far more widespread and longer lasting (Figure 3):

➔ **Appendix 5**

- Higher water temperatures may mean increased cholera bacilli in lakes, causing epidemics, and disrupting local fishing economies.
- Additional areas such as highlands and desert fringes may become vulnerable to malaria.
- The range of other vector-borne diseases and parasites may change, affecting crops and livestock, local economies and food exports.

Besides these direct effects, climate change will also affect the spread of diseases indirectly through hunger, conflicts over water supplies, and the displacement and migration of populations.



Infectious Diseases in Africa

Figure 4 **An *Aedes* ssp mosquito feeding on a human**



Changing land use will also have a profound effect on disease risk in Africa. For example, many of the viruses affecting plants and mammals result from the feeding of arthropods such as mosquitoes, sandflies or ticks (Figure 4) – so anything which affects the breeding of these vectors will affect the risks of disease. Important changes will include altered farming practices, deforestation, re-afforestation, urbanization, changes in transportation and water resource developments (Figure 5).

Appendix 6

Figure 5 **Complex effects of environmental changes: a new dam built in West Africa initiates a chain of events that leads to an epidemic of schistosomiasis**



The changes in the movement of people, animals and plants will spread diseases into new areas, and cause exposure to new pathogens (Figures 6 and 7). The drivers of change will be diverse and will include: conflict, migration, tourism, and trade – regional and international, legal and illegal. These increased risks will affect important export commodity economies as well as food security.

➔ **Appendix 7**

Figure 6 **Settlement of nomadic pastoralists in East Africa changes the pattern of both human and livestock diseases and the strategies for prevention and control**





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Figure 7 **Forced migration of refugees, temporarily settled in unoccupied land near the Nile, led to an outbreak of huge skin ulcers. This was due to an organism related to the leprosy bacillus, new to that area, and blocked half the surgical beds of the one nearby hospital**



Around 30 disease epidemics have emerged world-wide over the past 20 years in humans, most of which originated in animals and crossed to humans – so called ‘zoonotic’ diseases. Rift Valley Fever is an example, and new threats are already on the horizon, such as Avian flu from Asia. Entirely new zoonotic diseases therefore pose a substantial threat, although the situation is very uncertain – we do not know which diseases will cross species barriers, and when and where this is likely to happen. However, certain factors will amplify the risks for Africa – for example, increased livestock populations around growing cities, and the continent’s rich wildlife reservoir.

➡ Appendix 8

3. The need for better understanding: a joint study

Understanding how the risks of diseases will change is vital to develop effective strategies for control. It is also needed if countries are to plan for the future in diverse areas such as the economy, land use, and social policies. The Office of Science and Technology therefore proposes to mount a joint study by leading experts from Africa, the UK and other countries. It will use cutting-edge science to produce a vision of the future of infectious diseases in sub-Saharan Africa, and to consider options for meeting the future challenges. The intention is to inform policy development and to catalyse action where appropriate.

Here are some of the key questions that the study will address:

- What will be the most important disease risks in different parts of Africa in the future, and how will they be different from today?
- What are the most important factors that will drive changes in risk?
- What do these changes in risk mean for strategies to control diseases – in particular, their detection, surveillance and identification?

Systems for the detection, identification and surveillance (DI&S) of diseases could play an important role in managing future threats, since scientific developments could transform their capability. The study will therefore assess the potential of new DI&S systems, paying special attention to important issues such as their applicability to local conditions, long-term sustainability, and potential barriers to their implementation.

Appendix 9

The findings of the study will be available around November 2005 and will be made available to stakeholders in Africa, relevant international bodies, and donor organisations. The Office of Science and Technology also proposes to mount an international conference around that time, to present the findings, and to stimulate a debate on what further action could usefully be taken.

This paper has been produced through the international Foresight project on the Detection and Identification of Infectious Diseases (www.foresight.gov.uk). Foresight is run by the Office of Science and Technology under the direction of the Chief Scientific Adviser to HM Government. Foresight creates challenging visions of the future to ensure effective strategies now.



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