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> CONTROL OF ENDEMIC TROPICAL DISEASES

Identifying certain animal diseases as "neglected"

François ROGER - Pascal BONNET

The "neglected" status given by the World Health Organization (WHO) to certain endemic tropical diseases, both human and zoonotic, affecting poor populations has resulted in the large-scale mobilisation of stakeholders and resources, thereby improving control of these diseases.

Hence the proposal to also recognise as "neglected" certain animal diseases with serious socio-economic impacts on marginalised populations in the least developed countries. This process nevertheless requires prior identification of economic and social impacts, as well as of the criteria and threshold from which this recognition should be applied.

Unlike emerging diseases (avian influenza, Ebola, etc.), some endemic tropical diseases fail to mobilise policy makers and public and private stakeholders. Research is unable to secure sufficient long-term financing; the public authorities and the private sector make little or no investment in the production of treatments and vaccines, or in control and surveillance, which receive only 0.6% of all global expenditure on health.

However, according to the World Health Organization (WHO), these diseases affect almost 1 billion people in low-income economies, mainly livestock farmers and family farmers, who have poor health and no access to preventive measures or treatments, should

these exist. Most of these people live in the least developed countries, where the tropical or sub-tropical climates are favourable to infectious and parasitic diseases and effective health systems are lacking. Consequently, socio-economic development is held back, even though a small amount of investment would often be enough to control or eradicate some of these diseases. When drugs and vaccines are available, rapid improvements can be made, provided there is an organised health system, whether public, private or mixed.

Noting the persistence of these communicable diseases that sustain poverty, and in order to mobilise the resources required to provide treatments and healthcare for the most vulnerable

> Tackling animal diseases that sustain poverty.

populations, WHO identified 17 tropical diseases as “neglected” (NTDs), including five zoonotic diseases (*T. solium* cysticercosis, echinococcosis, leishmaniasis, rabies, and human African trypanosomiasis, or sleeping sickness). It should be noted that three zoonoses (anthrax, bovine tuberculosis and brucellosis), whose status is unclear, are however considered by some authors as neglected.

However, no strictly animal (non-zoonotic) disease has been identified as “neglected” by the international organisations. Like NTDs, some nevertheless negatively impact on the poor, especially in remote areas far from the centres of power and services: livestock mortality and the decrease in production and product quality (meat, milk, leather) result in a loss of income, affecting food security, health and education. The risks incurred prevent livestock farmers from investing, meaning they remain in the poverty trap.

Official recognition of neglected disease status could therefore be beneficial in preventing certain risks, and controlling or even eradicating diseases with the highest social and economic impacts. It would enable the mobilisation of public and private resources for research (treatments, vaccines, risk factor identification, predictive modelling, socio-economic impact assessments, etc.) and the implementation of preventive measures (risk analysis, surveillance, farm biosecurity).

The benefits of identifying diseases as “neglected”

For the 17 NTDs, this recognition has resulted in substantial mobilisation: the Global Plan 2008-2015, then the 2012-2020 roadmap implemented by WHO; and the 2012 London Declaration, in which a coalition of pharmaceutical companies, public and private donors, national programmes and NGOs committed to eradicating 10 of the 17 NTDs by 2020.

Sleeping sickness, one of the 10 NTDs targeted by the London Declaration, is emblematic in this respect. In order to address the growing number of victims (300 000 people infected in the early 1990s) and of people exposed (60 million in Africa), human African trypanosomiasis became the subject of coordinated efforts, after being neglected for several

decades. WHO mobilised stakeholders: senior government officials; donors (Gates Foundation, DFID); research centres; and pharmaceutical companies, which committed to providing medicines free of charge to WHO in order for the organisation to distribute them. Stakeholders reorganised their operations. The result of this mobilisation is that the upward trend has been reversed: in 2012, fewer than 8 000 cases were reported. This success led WHO to include human African trypanosomiasis in its roadmap with the goal of eradicating it as a public health problem by 2020.

For other zoonoses, the “neglected” status has facilitated progress in research, financing and the mobilisation of the stakeholders concerned, and has helped to curb the collapse of expertise. One example, human rabies transmitted by dogs, is still present in tropical zones despite the existence of effective means of intervention. Epidemiological studies have been conducted in Africa. In particular, they have shown that contrary to belief, the vaccination of young dogs helps to increase immunisation coverage in the canine population. Pilot studies (Tanzania) have demonstrated the feasibility of eradicating this disease at the regional level. Research findings are informing advocacy work, which is increasing. Success stories in the Philippines, Indonesia (Bali) and India have been recorded and disseminated. As a consequence, the media and the public authorities are giving greater attention to the disease. In 2015, OIE, FAO and WHO called for massive investment to eradicate it at the global level.

Another example is bovine tuberculosis, a disease affecting people with immunodeficiency because of parasitic and viral diseases or malnutrition, whose eating habits put them at risk (consumption of unboiled milk). Ecological and epidemiological studies by CIRAD (see box p. 4) are helping to advance knowledge in these areas. In Southern Africa, they have identified factors and risks of bovine tuberculosis transmission between wild or domestic animal species and humans. Based on these results, the studies propose methods for optimising surveillance and better controlling this disease.

Finally, identifying a disease as neglected helps to attract, pool and sustain financing and to coordinate disease control efforts, a requirement for conducting research and implementing

> Mobilising and coordinating all stakeholders.

> **Attracting, pooling and sustaining finance.** its findings on the ground, and also for mobilising the private sector and distributing drugs and vaccines.

Hence the proposal to identify certain animal diseases as “neglected”. Although progress has been made on these diseases, it is not enough to address the challenges posed, whether in terms of scientific knowledge or of control measures. Interdisciplinary research is required, associating biology, human science, social science (economics, health geography, sociology, anthropology) and mathematics (modelling). The findings of this research will be used to inform control plans.

Identifying criteria and the threshold for recognition

According to which criteria and from which threshold should an animal disease be officially recognised as neglected?

The first stage is to understand the production systems and activities of socially, economically or geographically marginalised populations that are impacted by the disease. This impact must then be evaluated: the risks it poses to household capital (loss of production) and to the functioning of markets and supply chains (lower prices, trade embargoes); and obstacles to intensification and modernisation, which keep households in the poverty trap. Contrary to human and zoonotic diseases, the criteria in this case are more economic and social in nature.

> **Further research to determine priorities.** Other elements of context can be taken into consideration, such as the risk of the disease spreading to other countries. For example, African swine fever virus, which is endemic to sub-Saharan Africa, Russia and Eastern Europe, has attracted substantial interest from European governments and the European Commission... since it began to threaten Europe. This interest could create an opening that researchers, donors and industries could exploit (there is as yet no vaccine). Another example, lumpy skin disease, which is endemic to sub-Saharan Africa, is now emerging in the Middle East and Turkey. It is responsible for substantial economic losses in terms of meat and milk production and causes major losses to the leather industry. It can result in regional or international trade restrictions.

Other effects of the official recognition of a disease as “neglected” are worth highlighting. This recognition for infectious diseases (e.g. contagious bovine pleuropneumonia) or parasitic diseases (e.g. intestinal worms) whose treatment is not always well managed could contribute to reducing resistance to antibiotics and antiparasitics, a major problem and time bomb for public health. The adverse effects of treatments on pathogen resistance could be more closely studied in partnership with pharmaceutical laboratories and users.

Studies by CIRAD (see box p.4) aimed at identifying prioritisation criteria and methods can be used to select the animal diseases to be recognised as “neglected”. Moving away from expert opinions, the goal of these studies is to develop more transparent, standardised and reproducible methods, using objective criteria: epidemiological data, impacts on animal production, global economic costs, social impacts, resources available, etc.

The diseases to be tackled as a matter of priority can be defined by comparing cost-effectiveness ratios. The costs include those generated by disease control in the field; effectiveness is measured in physical units (litres of extra milk produced, working hours of plough oxen saved, etc.).

Tools and methodologies can be adapted, such as the DALY synthetic indicator or MCDA modelling. DALYs (Disability Adjusted Life Years) measure the burden of disease. They are calculated based on the number of years lost due to disability linked to poor health and to premature mortality because of disease. This indicator is used in (human) public health to compare the impacts of diseases and to evaluate health interventions, without the need for monetisation. A similar indicator could be developed for animal diseases. It would supplement available impact indicators and help to better evaluate the socio-economic impacts of these diseases in order to prioritise them, then to assess the effectiveness of control measures.

MCDA (Multi-Criteria Decision Analysis) approaches are also interesting. They make it possible to combine different types of information in spatial or non-spatial forms (for example, the socio-economic impacts of a disease and the methods implemented to control this disease). They can help to define

A few words about...

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the threshold for recognition of a disease as neglected. Vulnerability mapping for human and animal populations produced by health geographers can be linked to health risk mapping drawn up by epidemiologists and geomatians. In addition to providing decision support for the identification of diseases as “neglected”, these can help to define the worst affected zones and populations, which should be targeted as a priority.

This *Perspective* is the result of research in ecology, epidemiology, modelling, entomology, and economics conducted by several teams at CIRAD and their partners, on both zoonoses identified as “neglected” by WHO, and the socio-economic impacts and prioritisation of animal and zoonotic diseases.

On neglected zoonoses, research was conducted within the platforms in partnership GREASE (Management of Emerging Risks in Southeast Asia, <http://www.grease-network.org/>) and RP-PCP (Production and Conservation in Partnership Research Platform, <http://www.rp-pcp.org/>) and, for some diseases, in collaboration with the Institut Pasteur International Network. This research has given rise to several publications, including:

Caron A., de Garine-Wichatitsky M. & Roger F., 2014. Bovine tuberculosis: a double-edged issue at the human/livestock/wildlife interface in Africa. In: FAO. EMPRES-Animal Health 360, n° 44. Rome. <http://www.fao.org/3/a-i4257e.pdf>

Tarantola A., Goutard F., Newton P., de Lamballerie X., Lortholary O., Cappelle J. et al., 2014. Estimating the Burden of Japanese Encephalitis Virus and Other Encephalitides in Countries of the Mekong Region. PLoS Negl Trop Dis 8(1): e2533. DOI: 10.1371/journal.pntd.0002533

The InterTryp joint research unit (IRD-CIRAD) conducts research on human and animal trypanosomiasis within different programmes: <http://umr-intertryp.cirad.fr/>

FIND OUT MORE

Mablesen H.E., Okello A., Picozzi K., Welburn S.C., 2014. Neglected zoonotic diseases-the long and winding road to advocacy. PLoS Negl Trop Dis. 2014 Jun 5;8(6):e2800. doi: 10.1371/journal.pntd.0002800

Perry B.D., Grace D., Sones K., 2013. Current drivers and future directions of global livestock disease dynamics. Proc Natl Acad Sci USA. 110(52):20871-7. doi: 10.1073/pnas.1012953108.

A vast field of research thus needs to be explored. But to achieve this and to ensure access to the tools required to develop substantiated arguments, it is essential to inform policy makers and stakeholders – international organisations, research donors, private foundations and laboratories – about the importance and benefits of identifying diseases as “neglected” in order to mobilise the human and financial resources needed. <

On the socio-economic impacts of animal and zoonotic diseases and their prioritisation, research has been conducted or coordinated by the AGIRs unit (Animal and Integrated Risk Management, <http://ur-agirs.cirad.fr/en>), in particular in Ethiopia and Thailand: doctoral theses by students from the southern countries; summaries of activities in the least developed countries; and the ENHanCE project with the University of Liverpool (<http://bit.ly/1M2x9Tq>). These studies have given rise to several publications, including:

Bordier M., Léger L., Kasemsuwan S., Wongnarkpet S. & Roger F., 2015. Methods for Prioritisation of Diseases: Case Study of Zoonoses in Southeast Asia. In: Socio-Ecological Dimensions of Infectious Diseases in Southeast Asia, p. 231-256. Springer-Verlag Singapur. <http://www.springer.com/us/book/9789812875266>

Gari G., Bonnet P., Roger F., Waret-Szkuta A., 2011. Epidemiological aspects and financial impact of lumpy skin disease in Ethiopia. Prev Vet Med. 102(4):274-83. doi: 10.1016/j.pvetmed.2011.07.003

Furthermore, as part of the ALive African Livestock programme, CIRAD has developed foresight tools for the quantitative evaluation of interventions and policies in livestock systems, supply chains and the economy of the sector, which are included in a toolbox: V. Alary, C. Dutilly, P. Bonnet, M. Lesnoff, X. Juanes, 2014. Le guide Élevage-Pauvreté (LSIPT Livestock Sector Investment and Policy toolkit) : diagnostic phase modules 3 and 4. CIRAD. <http://umr-selmet.cirad.fr/en/publications-et-ressources/documents-techniques>

Pigott D.M., Howes R.E., Wiebe A., Battle K.E., Golding N., Gething P.W., 2015. Prioritising Infectious Disease Mapping. PLoS Negl Trop Dis 9(6): e0003756. doi:10.1371/journal.pntd.0003756

Thomson G. R., Fosgate G. T. and Penrith M.-L., 2015. Eradication of Transboundary Animal Diseases: Can the Rinderpest Success Story be Repeated? Transboundary and Emerging Diseases. doi: 10.1111/tbed.12385