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More appropriate disease control policies for the developing world

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ABSTRACT

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Investment in disease control should be targeted to critical points that provide the greatest benefit to the livelihoods of livestock-dependent stakeholders. Risk-based targeting should balance the impacts of diseases against the feasibility of their control. This requires sensitive and specific surveillance systems that provide representative overviews of the animal health situation for accurate assessment of disease impact and transmission patterns. Assessment of impact should include household and market effects. The key in surveillance is involving livestock owners using active methods that ensure their disease priorities are addressed. Epidemiological targeting of interventions to critical points in disease transmission cycles should be done to obtain maximal disease reduction. Interventions should be delivered in full partnership with both private and community-based stakeholders to assure high uptake and sustainability. In developing countries, approaches such as participatory disease surveillance and community-based animal health programs have been effective and comply with international animal health standards.

CONTEXT

The world trend is towards increasing demand for livestock products as consumers' incomes increase (Delgado, Rosegrant, Steinfeld, Ehui & Courbois 1999). However, this change is taking place in the context of globalization, climate change and increasing requirements for quality and safety. Producers in Africa are now competing in the Middle East export markets with those from Mongolia, Brazil and the Ukraine (Mariner 2006). Will producers in developing countries be able to benefit from increasing demand in local, regional or international markets? Or will other players capture this opportunity?

Beyond trade, there are other important considerations. In developing countries, the majority of farmers are small-scale producers. In addition to contributions to the national wealth, livestock production has the important function of providing livelihoods and social foundation for the bulk of the population (Grace, Jost, McGregor-Skinner & Mariner 2008). Eighty-five percent of all farmers are small-scale farmers and most of these are in developing countries (Nagayets 2005). Disease control policies need to consider the economic, social and political impacts of both the disease itself and the actions taken to control disease on diverse groups of stakeholders (McDermott, Mariner, Rich & Omore 2007).

Within the past few years, there has been renewed recognition that the emergence of new infectious diseases is an on-going natural process (Jones, Patel, Levy, Storeygard, Balk, Gittleman & Daszak 2008). There is evidence that the changing interactions of man, livestock and the environment further accelerate the emergence of new pathogens. Considerable resources have been made available for technical interventions to reduce the perceived threat of emerging diseases, but mostly with short-term objectives. There have been calls by some to reshape livestock production systems to reduce the threat of the emergence of new agents, but in general these proposals have neglected to address the socio-economic benefits of and incentives for existing production systems. As a result, proposals to date for restructuring have had limited impact. The real opportunity is to use the current interest in emerging disease and one health (American Veterinary Medical Association 2008) to drive sustainable change in health institutions through careful analysis of the political and socio-economic forces shaping production and disease control institutions.

OBJECTIVES OF DISEASE CONTROL

The principal objectives of animal disease control are to:

- Encourage increased production to support economic growth.
- Enhance access to markets and add value to livestock products.
- Enhance the livelihoods of producers and reduce vulnerability to adverse shocks.
- Protect the health of the public through the reduction in zoonotic and food-borne illness.

COMPONENTS OF APPROPRIATE DISEASE CONTROL POLICIES

It is important to recognize at the outset that each country will have its own unique socio-economic context and that there is the risk of being overly prescriptive in describing appropriate animal health policy. In a general analysis, it is best to describe characteristics of appropriate policies rather than propose specific policies.

Disease control policies and health objectives are very much intertwined. Policies often fail because the objectives that they set out to accomplish were not achievable within the existing or attainable resource base and social context. The first test of a policy should be a balanced assessment of resources and feasibility.

Policies that capture market forces and are driven by natural incentive systems are the most likely to succeed. In such cases stakeholders will be rewarded for adhering to policy. If the strategy requires individuals to take significant actions that are counter to their self-interest, failure is probable. Negative incentives to enforce compliance with unpopular regulations are problematic at best and unlikely to succeed.

Strategies that mobilize civil society organizations such as veterinary associations, producer associations, community institutions and non-governmental organizations to work towards shared disease control goals are highly advantageous. To accomplish this, disease control authorities must be willing to share both the ownership and decision-making in the disease control programs with civil society. This does not mean that national veterinary authorities cede any of their regulatory and certification responsibilities as defined by the Terrestrial Animal Health Code (OIE 2006). It does mean that authorities work with civil society to define priorities and select methods from among options of demonstrable efficacy.

Uncertain legal environments discourage investment in animal health institutions because of the increased economic risks associated with the lack of a predictable investment environment. In order for civil society to contribute effectively, the rule of law in the health sector must be solidly established. This means that appropriate legislation and subsidiary regulations must be in place and enforced. The objective is to provide potential health investors with a sense of security.

Institutions control disease. Institutions are the organizations, individuals, rules, practices, technologies, values and customs that all work together to achieve an end. Often animal health professionals focus on specific technical interventions, such as the type of vaccine and vaccination schedule to be applied, rather than design an effective institutional model for the selection of vaccines and their delivery. More appropriate disease control policies will involve a wider range of actors and take a holistic view of problems.

The concept of one health (American Veterinary Medical Association 2008), which recognizes that human, animal and environmental health are intertwined, is a synergistic approach that offers considerable advantage in terms of enhancing the efficacy of disease surveillance, prevention and control. The professions involved have significant technical capacities that complement each other. However, information-sharing, joint coordination of activities and integrated mitigations are limited. Overcoming constraints to the implementation of one health strategies will primarily require new institutional models developed in the context of national professional culture and infrastructure.

A recurring theme in successful animal disease control programs is participation and empowerment of a diverse set of actors under the overall facilitation and regulation of the national veterinary authority. Existing policies should be assessed to establish the extent to which they adhere to these principles.

TECHNICAL PRINCIPLES FOR MORE EFFECTIVE DISEASE CONTROL POLICIES

At the technical level, disease control programs must be based on strong epidemiological principles and risk-based approaches. This was a key lesson of the rinderpest eradication program. Programs should seek to target critical control points where interventions will have maximum impact to reduce disease risk either by reductions in disease circulation or exposure (May & Anderson 1984). This includes targeting of surveillance inputs to high-risk populations within the national system.

Disease transmission analysis may suggest key populations that play pivotal roles in the maintenance or amplification of pathological agents. On the other hand, a step in the disease cycle or a particular exposure may offer an entry point to control of the disease or elimination of its impact.

The risk-based approaches engendered in the Sanitary and Phytosanitary (SPS) Agreement (WTO 2008) and expanded upon in the Terrestrial Animal Health Codes (OIE 2006) are leading to new strategies such as compartmentalization and commodity-based trade. These strategies shift the focus away from mass control designed to change the disease status of a region or country to smart approaches that channel resources to mitigate disease risk at the spot where they can directly add value to products. An important concept of the SPS Agreement is the focus on results in terms of an achievement of acceptable level of risk rather than on the prescription of specific sanitary methods. This opens the door to experimentation and the search for more effective methods adapted to local constraints and opportunities.

Many believe that key technical innovations can solve disease control problems by themselves. Sometimes they do. More often, technological innovation requires institutional innovation that allows the benefit of the new technology to be captured. An important area is action research to develop, demonstrate and document methods to effect institutional change and the benefits of institutional change. Two examples of the power of technological solutions coupled to institutional change are community-based vaccination programs that utilize thermostable vaccines (Mariner, Akabwai, Toyang, Zoyem & Ngangnou 1994) or participatory surveillance systems that use rapid diagnostic test technology (Mariner, Hussein, Roeder & Catley 2003). The history of the adoption of these technological innovations highlights the institutional challenges to effective exploitation of new technologies.

EXAMPLES

A success story: Rinderpest

Rinderpest eradication is an apparent success story with many lessons. Initially, the rinderpest eradication strategy focused on standard technical interventions such as mass vaccination delivered through classical disease control infrastructure. This approach achieved some important initial gains in terms of disease suppression and the eradication of rinderpest from West Africa, but was insufficient to eradicate the disease from more challenging remote and unstable areas of East Africa.

Institutional innovations were also targeted such as international control of vaccine quality, promotion of the private sector and strengthening of legislation.

At the technical level, thermostable rinderpest vaccine created new options for the delivery of vaccine to remote and unstable areas. This lead to successful experimentation with community-based approaches to vaccination in remote areas that ultimately made eradication possible in the most challenging areas of East Africa (for example South Sudan, Karamoja in Uganda and the Afar region of Ethiopia) (Mariner *et al.* 1994). This was a major shift in stakeholder roles within animal health institutions. Livestock owners were becoming service providers as well as the principal customers of the system. Existing veterinary service providers felt threatened and were the focus of resistance to change.

As community animal health worker networks became established in rinderpest endemic areas, epidemiologists gained access to traditional information networks that proved to be highly efficient mechanisms for gathering epidemiological intelligence on the occurrence of rinderpest. The learning processes that evolved to tap this valuable resource became formalized as participatory disease surveillance. This methodology was key to identifying the final foci of rinderpest for eradication and is a methodological legacy.

Beyond the obvious benefits of the elimination of a major animal health scourge, rinderpest eradication left behind more capable institutions that were better adapted to local conditions and able to control disease.

A disease that re-emerged: Contagious bovine pleuropneumonia

Contagious bovine pleuropneumonia (CBPP) is an example of a disease threat that was once largely controlled but has re-emerged as a major problem due to the evolving political economic context. In the colonial period and the era of early independence, CBPP was controlled through a combination of vaccination with a vaccine of limited efficacy, strict movement control and culling of apparently infected animals (Hammond & Branagan 1965). In recent times, control programs based on this strategy have broken down as stringent movement control and culling is often no longer politically feasible. Veterinary services have continued to target CBPP as a disease of public interest and attempted to retain a monopoly on the mandate for control interventions based on a policy of free vaccination, despite inadequate resources to actually implement mandates.

CBPP is a chronic, insidious disease that is able to persist indefinitely in relatively small populations. The prospects for elimination from even small populations with existing vaccines in an era when stringent movement control is no longer achievable are poor (Mariner, McDermott, Heesterbeek, Thomson, Roeder & Martin 2006). This suggests that policies should shift towards sustainable control where recurrent costs to government are minimized until more effective control tools become available.

In this environment, farmers and field veterinarians began to experiment with antibiotics as the only available control option. Official conventional wisdom held that treatment of clinical cases with antibiotics gave rise to persistent infections and their use in the treatment of CBPP was banned in most countries. Despite the ban their use in the treatment of CBPP became widespread. The popularity of antibiotic treatment and the public perception of positive results with antibiotics led to research trials that demonstrated suppression of transmission in treated herds and an official reassessment of the role of antibiotics in CBPP control (Ayling, Baker, Nicholas, Peek & Simon 2000; Huebschle, Godinho, Rowan & Nicholas 2004; Huebschle, Ayling, Godinho, Lukhele, Tjipura-Zaire, Rowan & Nicholas 2006). This is an example of innovation in civil society leading to the development of an evidence base for an institutional shift in policy.

The willingness of livestock owners to invest in CBPP treatment combined with statements of their willingness to purchase vaccination, if it were available for purchase, suggests that livestock owners are sufficiently motivated to invest in integrated CBPP control options such as treatment of cases and vaccination of in-contact animals. Policies should be liberalized to allow private farmers to purchase comprehensive control from their private veterinarian that includes an appropriate vaccination schedule.

Static animal health policies in a changing political economic environment hindered rather than facilitated control and probably contributed to the resurgence of the disease. Historic control policies were not achievable in the present political economic context due to the limited public resources available for animal health and the low potential for effective movement control. As a result:

- Technical targeting of policies became inappropriate.
- Policies did not harness prevailing financial incentives to control the disease.
- Strategies constrained rather than sought to actively mobilize civil society partners.
- Unrealistic regulatory environments lead to a breakdown of official coordination and control.
- Market forces ultimately lead to innovation and the prospect of more effective control strategies.

A recurring challenge: Rift Valley fever

In arid and semi-arid areas, explosive Rift Valley fever (RVF) epidemics are associated with high rainfall and flooding. The disease is transmitted by mosquitoes and conditions that favour the rapid expansion of mosquito populations lead to outbreaks. Once predisposing weather conditions are in place, the sequence of events leading up to an outbreak is relatively predictable. However, the short time courses of outbreaks make timely response to unfolding epidemics very difficult. Historically, most interventions have been applied after the peak of the outbreak and have had little if any impact on the course of the disease (ILRI 2008; Jost, Nzietchueng, Kihu, Bett, Njogu, Swai & Mariner, in press).

To predict the 2006/07 RVF outbreak in East Africa early warning models took advantage of the normalized difference vegetation index (NDVI), collected by remote sensing, in addition to other indicators linked to regional rainfall (FAO 2006). As NDVI is based on vegetative change, the 'early warnings' were issued subsequent to actual onset of conditions on the ground that was favourable for mosquito population explosions. Retrospective assessments of the outbreak using participatory epidemiological techniques indicated that livestock owners were well aware of clinical presentation of RVF, which Somali pastoralists referred to as *sandik* (Jost *et al.,* in press). Construction of event timelines for Kenya provided evidence that the livestock outbreak had begun prior to the early warnings and that communities recognized the first human cases followed an average 17.5 days after the first livestock cases. Essentially no response by either human or animal health authorities was undertaken prior to the change in official disease status on 4 December 2006 caused by the first diagnosis of RVF on a hospitalized human patient. This was 50 days after the first clinical livestock cases described by livestock producers.

This experience shows that rather than an all-or-none approach to decision-making based on confirmed diagnoses, responses to RVF need to be undertaken using a risk-based approach to decision-making. Effective responses require true early warnings based on escalating risk of predisposing climatic events. In the case of East Africa, sea surface temperature changes are an appropriate early indicator that should trigger the first action steps. The warnings produced in 2008 indicate that this lesson has been taken on board (FAO 2008). Decision-making should be phased and appropriate actions taken in steps calibrated to match the evolving level of risk. In the case of the 2006/07 outbreak, the following lessons should be considered:

- A risk-targeted, one health approach should be taken to surveillance that tracks environmental, veterinary and human indicators of RVF.
- Early warning forecasts should begin with seasonal weather forecasts and communicate evolutions in risk profiles.
- Decision-making for disease prevention and control should be risk-based and matched to evolving conditions.
- Responses should be timely, phased and epidemiologically-targeted to critical control points that can affect the evolution of the outbreak.

CONCLUSION

Veterinary, health and environmental services will need to link with civil society partners to form strong, innovative disease control and quality assurance institutions that fully mobilize human and economic resources to respond rapidly to changing health needs.

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