



EMPRES
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FAO works to curb the burden of brucellosis in endemic countries

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Summary

Brucellosis is recognized as a significant public health challenge, with major economic and financial burdens in countries where the disease remains endemic. To address the global threat of brucellosis for both animal health and public health, with funding from several donors, the Food and Agriculture Organization of the United Nations (FAO) has been advancing practical knowledge and experience of brucellosis in various countries and assisting the development of sound strategies and policies for sustainable control programmes. Technical support has been provided to selected countries where brucellosis has significant impacts on human health and the livestock on which households depend for income and food security.

The FAO brucellosis programme promotes capacity building; provides technical support, cutting-edge knowledge and practical experience in laboratory diagnostics and surveillance; and assists

the development and implementation of sound strategies for sustainable control programmes against brucellosis in livestock. The control strategies promoted by FAO in endemically infected countries aim to reduce prevalence and disease in susceptible species, therefore limiting spread within and among flocks and herds, using long-term vaccination as the main tool. The FAO brucellosis control programme in Tajikistan is one of the most successful in Central Asia and is a model for other countries in the region.

As part of ongoing efforts to assist member countries in launching and improving programmes aimed at controlling and eradicating brucellosis in animals and humans, FAO has developed a roadmap with a stepwise approach for progressive control of the disease. This roadmap is based on information from extensive research and practical experience in the field in many countries and over many years

The greatest challenge facing FAO's programme is how to tackle the huge brucel-

losis disease burden in countries where the disease is endemic or re-emerging. Achieving effective control of brucellosis in these countries will require long-term commitment from all parties, with application of appropriate policies and control strategies. Country programmes must be based on reliable, science-based data and information. Estimates of initial prevalence in both humans and livestock and of disease distribution are essential to ensuring that the country strategies planned have a high likelihood of success. To accomplish this, realistic impact analyses and cost-benefit studies will be needed to support selection and planning. Pilot studies in selected regions would also be beneficial. ●

Introduction

Zoonoses are diseases that are transmissible between animals (domestic and wildlife) and humans. Many of these diseases are well established (endemic) in developing countries and common in poor and marginalized populations. There are strong associations among endemic zoonoses, family poverty and livestock keeping. It is estimated that more than 600 million people worldwide depend on livestock, and livestock-dependent people represent up to 70 percent of the population in the most marginal areas. The control of endemic zoonoses is an increasing priority in international development efforts to alleviate poverty. Unfortunately, these diseases are often neglected by public health and veterinary services, despite causing a substantial health burden.

In a recent publication, the International Livestock Research Institute (ILRI, 2012) identified the 13 zoonoses that are most important to poor livestock keepers because of their impacts on human health, animal health and livelihoods. Brucellosis is one of the top zoonotic diseases in this list.

Brucellosis is caused by various *Brucella* bacteria, which infect cattle, sheep, goats, camels, pigs, yaks, buffaloes, dogs and some marine mammals. Most of these bacteria also have the potential to infect humans, with some species causing more severe symptoms than others do. *Brucella*

melitensis is the most virulent species in humans, and is capable of causing significant illness in communities that depend largely on sheep and goat raising for their livelihoods.

In livestock, the disease typically manifests as reproductive failure, often through abortion or the birth of weak, infected offspring. Complications in the genital organs and other parts of the body can also occur. Human clinical disease is characterized by severe flu-like illness, with a high fever that comes and goes (hence the name “undulating fever”), which may progress to a more chronic form with serious complications in joints (arthritis) or internal organs (heart failure). In this chronic, recurring form, humans can be so debilitated that they are no longer able to work and they become a health care burden on their families. Women and children, who often care for herds, are at high risk of the disease. Once infected, patients can take months to recover from the disease, and treatment and hospital stays can be long and costly.

Humans are easily infected through coming into contact with the birth fluids or fetuses of infected animals, drinking unpasteurized milk, or eating dairy products made from contaminated milk. Increasing demand for milk, the subsequent upsurge in peri-urban dairy production and a lack of adequate food safety practices have been identified as risk factors for human brucellosis in many developing countries.

So far, few countries have eradicated brucellosis or controlled it to very low levels in livestock. In developing nations with inadequate public health and veterinary services brucellosis represents a major public health challenge and economic burden.

While brucellosis is rare in countries where eradication programmes in livestock (cattle, sheep, goats and pigs) have been successfully implemented, it remains endemic in countries in the Mediterranean basin, the Near East, Eurasia, South America and parts of Africa. In recent years, increasing prevalence of the disease in humans has caused growing concern in many countries in Central Asia, Eastern Europe and the Near East. Seven former Soviet Union republics are among

the 25 countries with the highest incidence of brucellosis in humans worldwide. In part, this has been the result of conflicts, but major socio-political changes, outdated technology, and shortages of funds for public health programmes have also been major contributing factors.

Given the threat that brucellosis poses globally to both animal health and public health, the Food and Agriculture Organization of the United Nations (FAO) recognizes it as a serious infectious disease that should be controlled at the national and regional levels in the interest of the livestock industry, public health and human livelihoods. FAO is working in this direction by developing and implementing comprehensive and integrated control programmes to reduce the negative impacts of the disease on public health, food security and livelihoods. ●

Timely and effective assistance to countries

For more than a decade, FAO has been providing significant technical assistance for brucellosis control across several different fronts. The Organization has advanced practical knowledge and field experience of brucellosis control in several countries and has assisted regions in the development of sound strategies and policies for sustainable control programmes. To date, ten countries in the Near East, Central Asia, Eastern Europe and North Africa have benefited directly from support through FAO's Technical Cooperation Programme (TCP) or donor-funded projects.

The FAO brucellosis programme promotes capacity building; provides technical support, cutting-edge knowledge and practical experience in laboratory diagnostics and surveillance; and assists the development and implementation of sound strategies for sustainable control programmes against brucellosis in livestock. The strategies that FAO promotes in member countries use high-coverage vaccination as their main tool and are aimed at reducing the prevalence and level of disease in susceptible species. This limits the spread within and among flocks and herds and to humans. The FAO programme for

brucellosis control also calls for the implementation of an action plan comprising five essential components:

- a baseline survey of the prevalence of brucellosis infection in animals, using statistical methods to ensure that results are representative of the households and regions in the country;
- development and implementation of a twice-yearly, risk-based vaccination control strategy based on the survey findings;
- development of a surveillance system to ensure early warning of the spread of brucellosis disease or infection to new areas;
- monitoring of results for reporting progress and measuring changes in infection/disease incidence;
- review and updating of control strategies in response to these results.

In addition, public awareness, targeted educational programmes and collaboration between the veterinary and public health sectors are promoted to facilitate more effective and rapid prevention of the disease in humans. ●

Brucellosis control programme in Tajikistan: pathway to success

In many countries, brucellosis can best be addressed by long-term vaccination programmes, which bring disease rates down to sustainably low levels within ten years. Although this well-proven strategy presents financial challenges for countries in resource-poor settings, an innovative FAO start-up programme in Tajikistan has had notable success. Under the programme, government health agencies received technical support from FAO and financial support from donors to forge new partnerships with private veterinarians and farmers and to establish effective collaboration between the veterinary and public health sectors, demonstrating an effective way forward (FAO, 2011; 2012).

The FAO brucellosis control programme in Tajikistan is one of the most successful in the region and is a model for other countries. The programme started in 2004 in eight districts where brucellosis was



A veterinarian tagging the ear of a sheep to indicate it has been vaccinated for brucellosis.



A veterinarian administering a vaccine by eye drop to a goat during a vaccination campaign.

prevalent in sheep and goats and communities were voicing their concerns to government officials (Jackson *et al.*, 2007). The recommended strategy involved the mass vaccination of small ruminants in the first two years, followed by the biannual vaccination of all young animals and any non-vaccinated adults or flocks, coupled with ear notching to identify vaccinated animals. The vaccine used was *Brucella melitensis* Rev 1 applied by eye drop.

The five components of the FAO programme were successfully implemented by Tajik veterinarians and public health specialists, generating tangible results and positive impacts on both public health and farmers' livelihoods. These results included an 83 percent reduction in the prevalence of brucellosis in sheep and goats, to 1.9 percent, after six years of vaccination rounds in the eight best-vaccinated districts (Figure 1) (Ward *et al.*, 2012). In ten other districts where there was low vaccination coverage in some seasons, the infection prevalence was reduced by 40 percent. There were no changes in prevalence in districts where no vaccinations were carried out because of a lack of funds.

In addition to the vaccination of livestock, the brucellosis programme in Tajikistan encompassed a wide range of supporting activities such as training to improve the knowledge, attitudes and practices of both

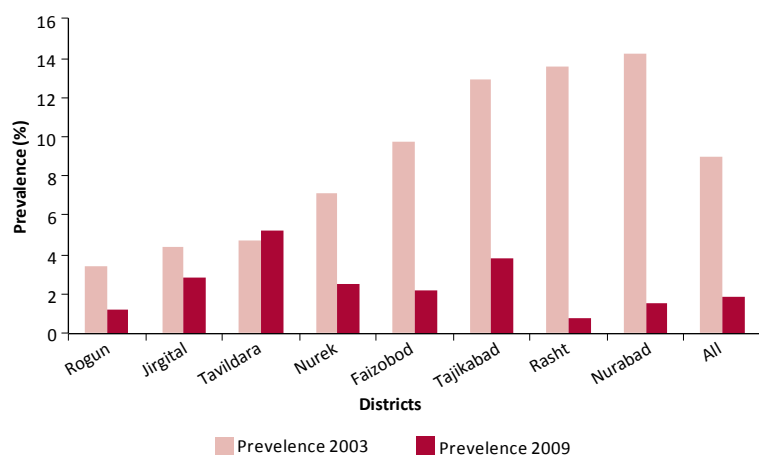
veterinarians and primary care physicians. It also built awareness of brucellosis and its associated risks among animal owners and villagers and invested in the improvement of diagnostic techniques in clinical laboratories.

Since 2004, vaccinations in Tajikistan have been supported by donor funding totaling US\$5.2 million, from Canada, Norway, Sweden, the European Commission and – recently – Turkey. Achievement of an 80 percent decline in infection rates in animals in less than six years is clear proof of success. Farmers in targeted districts are healthier and better off, nutritionally and economically, and are now willing to pay part of the cost of vaccinations that are currently subsidized with donor funds (FAO, 2009b). Farmers pay US\$0.12 per vaccinated and marked head from their own funds, using the revenue they generate from livestock raising and milk production. The next step is for the Government of Tajikistan to take on this investment as a public good.

To promote the Tajikistan brucellosis programme as a model for neighbouring countries, in 2009, FAO organized a regional workshop in Dushanbe, attended by national experts and chief veterinary officers from Central Asia and Eastern Europe and major stakeholders from the World Bank, the private sector and vaccine suppliers.

Figure 1

Prevalence of brucellosis in sheep and goats in Tajikistan, 2003 and 2009



Source: Ward et al., 2012.

The workshop provided an opportunity for stocktaking on deliverable results, best practices and lessons learned from brucellosis control in Tajikistan with a view to promoting regional approaches for cost-effective control measures against the disease (FAO, 2009a). ●

A stepwise approach for progressive control of brucellosis in livestock

Selection of the most appropriate control strategy for each country depends on several factors, including animal husbandry practices, social cultures and the epidemiological pattern of the disease. It also depends on the infrastructure and funding of veterinary services, the value of the livestock economy, and political commitment at the national level. Several possible strategies may be applied, ranging from the elimination of infected animals to the vaccination of susceptible animals, or a combination of both. A long-term plan is often necessary to decide the steps for brucellosis control and the transition between strategies for the achievement of reduced infection in livestock and, ultimately, protection of public health.

As part of ongoing efforts to assist member countries in launching, improving and

pursuing brucellosis control programmes aimed at controlling and eradicating brucellosis in animals and humans, FAO has developed a roadmap with a stepwise approach for progressive control of the disease (FAO, 2013a). This roadmap is based on information from extensive research and practical experience in the field in many countries and over many years. When adequately followed by member countries, the roadmap leads to reduced brucellosis in livestock and humans and, if desired, to the self-declaration of brucellosis-free status under the World Organisation for Animal Health (OIE) Terrestrial Animal Health Code.

The roadmap is designed for clear and easy access to information for countries' chief veterinary officers or chief veterinary inspectors and their staffs responsible for disease control. It consists of four stages, each with desired outcomes and activities for reaching these outcomes. The four stages of the roadmap (Figure 2) are carefully crafted to allow veterinary authorities easily to determine the specific stage at which any livestock system in a particular zone, or the entire country, may currently be.

The roadmap is accompanied by practical information on controlling brucellosis, complete with literature references. This information incorporates up-to-date

practical experience, accepted international opinion, lessons from the field and innovations from research to provide basic information on brucellosis control tools and strategies as a reference point for the user. Links to technical tools and supporting literature or accepted international opinion give national veterinary authorities additional confidence in undertaking roadmap activities.

Externalities and enabling factors that might influence the course of progressive brucellosis control and support the roadmap are highlighted. Examples of externalities and the prerequisites for implementing specific control options provide national authorities with insights into essential management considerations and recognized best practices. These examples emphasize the importance of components such as competent field and laboratory services, enabling legislation, effective animal movement control, and a compensation system for farmers who lose infected animals in test-and-removal campaigns.

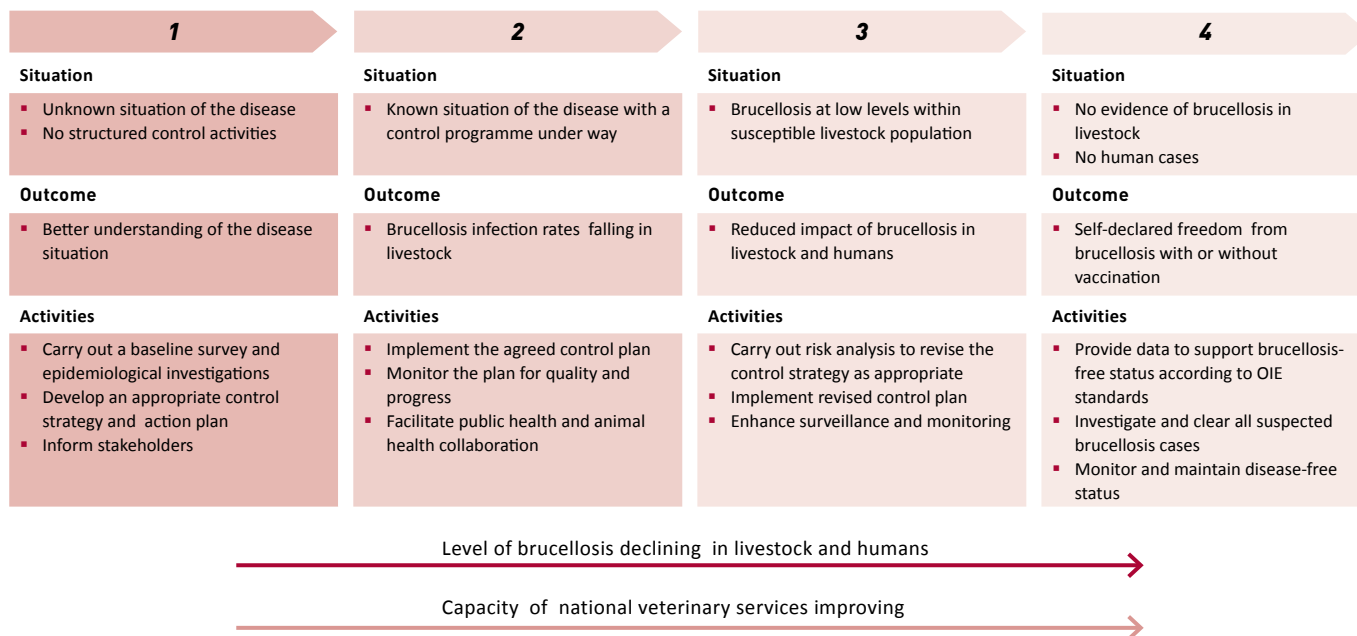
The roadmap was tested at a regional meeting in April 2013 in Izmir (Turkey), with the participation of chief veterinary officers or their representatives from ten countries in Eastern Europe and Central Asia and representatives from OIE, the World Health Organization (WHO) and FAO collaborating centres (FAO, 2013b). The workshop was organized to support FAO's assistance to countries in the region in developing and implementing sound strategies and policies for brucellosis control. There are plans for similar meetings in other parts of the Near East and Africa in 2014 for rolling out the roadmap in selected countries as a guide for developing sustainable national control programmes. ●

Importance of regional cooperation and networking for brucellosis control

Brucellosis control at the national level should be implemented as part of coordinated regional initiatives to control the disease across whole regions. This approach facilitates the harmonization of national priorities in disease prevention

Figure 2

Roadmap for progressive control of brucellosis



Source: FAO 2013a.

and control and builds synergy and efficiency in laboratory and epidemiological expertise, leading to more efficient disease prevention and control at the global level. Support at the regional and national levels ensures that countries have the ability to adapt shared information and the resources to deal with local environments and contexts while retaining consistency with global strategies.

FAO has been very active in promoting this regional approach for cooperation and networking not only for brucellosis control but also for controlling all transboundary animal diseases under the FAO/OIE Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs). FAO encourages regular, formal discussions among the countries in subregions with similar ecological and epidemiological contexts to promote open and transparent sharing, harmonized strategies and control methods, diagnostic protocols, and disease monitoring as essential pillars for effectively controlling brucellosis and coordinating initiatives at the regional level. Over the past four

years, FAO has organized three important meetings for advancing experience and knowledge on brucellosis control, with the participation of core actors from member countries, international development finance organizations and internationally recognized experts.

In collaboration with WHO and OIE, FAO convened a technical meeting of brucellosis experts in Rome in May 2009 with the participation of international experts and chief veterinary officers from Central Asia, Eastern Europe and the Near East. The meeting made recommendations and provided guidance for countries on either commencing or improving national control programmes as part of regional initiatives to tackle the disease at a regional level (FAO, 2010). ●

Applying the One Health approach to brucellosis control

The One Health approach can be used across disciplines and sectors to address health risks at the human-animal-

environment interface. FAO's collaborative efforts in response to brucellosis and other neglected zoonoses in pilot countries in Africa (e.g., Uganda) and Central Asia (e.g., Tajikistan) have been good examples of One Health in action. Complementary activities at the community level, where local veterinary and public health services interact and cooperate, have facilitated the control of animal and human brucellosis through locally adapted approaches for improving surveillance, enhancing community awareness, promoting milk pasteurization and hygiene practices and delivering effective vaccination campaigns. ●

New challenges for brucellosis control

New challenges for brucellosis control include the growing incidence of *B. melitensis* infections in cattle (which are more usually infected by *B. abortus*) and camels, particularly in the Near East and Central Asia. This emerging threat is challenging the efficacy of standard bovine vaccination campaigns, which immunize cat-

tle with a different Brucella vaccine whose ability to protect against *B. melitensis* infection remains largely untested. *Brucella melitensis* Rev 1 is the best vaccine available for controlling brucellosis caused by *B. melitensis* and has been applied successfully on a large scale in many countries to reduce the infection in sheep and goats. However, there are concerns regarding its use in cattle, camels and buffaloes, and its ability to protect these species when they are infected with *B. melitensis*. On several occasions, FAO has been requested to advise member countries and livestock owners facing this new challenge.

In response, FAO has collaborated with partners to develop a programme for studying the safety and efficacy of *Brucella melitensis* vaccine in cattle and camels. In the first phase of the programme, FAO commissioned two field studies to determine the safety of the *Brucella melitensis* vaccine in camels and to assess the shedding of the vaccine strain (which is virulent for humans) in the milk of lactating female camels after administration of the vaccine. Preliminary results of these studies are encouraging and show that vaccinated female camels do not shed Brucella vaccine strain in their milk. This finding and other results from these studies could contribute significantly to improving control strategies against *B. melitensis* in camel populations (Benkirane *et al.*, no date). ●

Conclusion

The greatest challenge facing this programme is how to tackle the huge brucellosis disease burden in countries where the disease is endemic or re-emerging. The aim is to minimize the significant negative impacts on both human and livestock health. Success will not be obtained overnight. Achieving effective control of brucellosis in these countries will require long-term commitment from all parties, with application of appropriate policies and control strategies. Governments will have to provide most of the necessary funds, but there may be opportunities for cost-sharing contributions from the livestock farming sector. Success will depend on adopting a concerted, collaborative ap-

proach involving all actors, coupled with financial sustainability.

Over the past decade, with generous contributions from funding partners, FAO has assisted more than ten countries in developing and monitoring new programmes, building capacity for surveillance, and promoting regional cooperation. Lessons have been learned and practical options and approaches have been tested. The most successful experience has been in Tajikistan where the infection rate in small ruminants was significantly reduced within about six years in one-third of the country. Although brucellosis control programmes are country-specific, FAO is working with other countries in the region to replicate Tajikistan's successful experience, making the necessary modifications for each country.

Country programmes must be based on reliable, science-based data and information. Estimates of initial prevalence in both humans and livestock, and of disease distribution are essential to ensuring that the country strategies planned have a high likelihood of success. To accomplish this, realistic impact analyses and cost-benefit studies will be needed to support selection and planning. Pilot studies in selected regions would also be beneficial.

Successful experiences in many developed countries have shown that brucellosis can be controlled only when there is strong political and producer support, an appropriate legal framework for enforcing control measures, and active participation of all stakeholders in finding practical and affordable control options that are suitable for each country and each epidemiological context. ●

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The Emergency Prevention System (EMPRES) is an FAO Programme, founded in 1994, with the goal of enhancing world food security, fighting transboundary animal and plant pests and diseases and reducing the adverse impact of food safety threats. EMPRES-Animal Health is the component dealing with the prevention and control of transboundary animal diseases (TADs).

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