



report

REGIONAL WORKSHOP ON BRUCELLOSIS CONTROL IN CENTRAL ASIA AND EASTERN EUROPE

9 -11 April 2013
International Agricultural Research and Training Center (UTAEM)
Izmir, Turkey

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Introduction

The Food and Agriculture Organization of the United Nations' (FAO's) regional and subregional offices for Eastern Europe and Central Asia, in close coordination with the Animal Health Service (AGAH) at FAO Headquarters, organized a regional workshop on brucellosis control in Central Asia and Eastern Europe. The workshop took place in Izmir, Turkey from 9 to 11 April 2013.

Two representatives from each of ten countries participated: the Republic of Albania (ALB), the Republic of Azerbaijan (AZE), Bosnia and Herzegovina (BIH), Georgia (GEO), the Republic of Kazakhstan (KAZ), the Kyrgyz Republic (KYR), The former Yugoslav Republic of Macedonia (MKD), the Republic of Tajikistan (TAJ), the Republic of Turkey (TUR) and the Republic of Uzbekistan (UZB). Also participating were representatives of international organizations, including Mr Joseph Domenech from the World Organisation for Animal Health (OIE), Paris, France, Ms Hilde Kruse from the World Health Organization (WHO), Copenhagen, Denmark and representatives from the World Bank and the European Community; Mr David Ward, an FAO consultant; and Ms Wendy Beauvais from the Royal Veterinary College, London. Mr Abdul Baqi Mehraban from the Subregional Office for Central Asia and Mr Andriy Rozstalnyy from the Regional Office for Europe and Central Asia organized and chaired discussion sessions. Mr Ahmed El-Idrissi from FAO Headquarters, Rome was instrumental in planning and organizing the workshop.

Mr Nahit Yazicioglu, Head of Animal Health in Turkey's Ministry of Food, Agriculture and Livestock, opened the workshop on behalf of the Government of Turkey and chaired the first session.

Objectives of the workshop

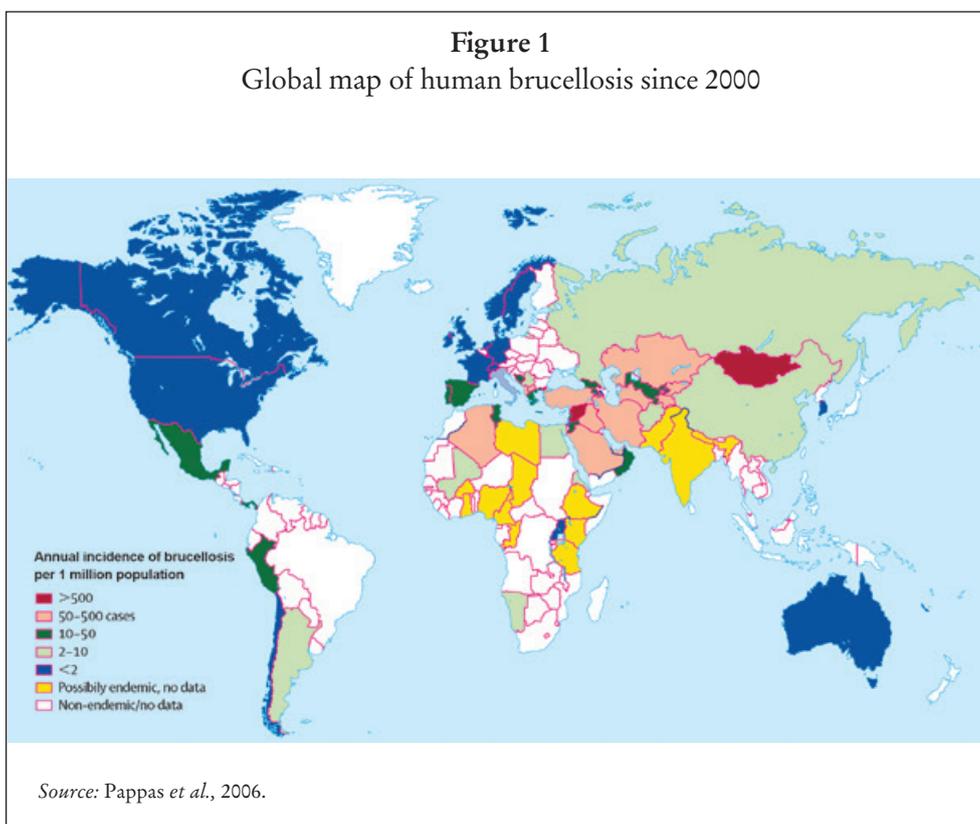
The workshop was organized as part of FAO's efforts to assist countries in Central Asia and Eastern Europe in developing and implementing sound strategies and policies for sustainable brucellosis control. Topics addressed included:

- an overview of the epidemiological situation of brucellosis and control programmes in each participating country;
- discussion of brucellosis control strategies in Central Asia and Eastern Europe;
- presentation and discussion of FAO's framework for progressive control of brucellosis as a guide to developing sustainable control programmes;
- essential elements in the development of subregional strategies for progressive control of brucellosis in Central Asia and Eastern Europe.

Brucellosis trends in the region

Countries in Central Asia and Eastern Europe face some of the highest human brucellosis rates in the world (Pappas *et al.*, 2006) (Figure 1): seven republics of the former Soviet Union are among the 25 countries with the highest incidences of brucellosis in humans; and brucellosis is endemic in all countries of the two subregions, where national authorities have struggled against the disease for many years.

In Eastern European countries, human incidence ranges from 21 to 64 cases per million people in the population, except in The former Yugoslav Republic of Macedonia, which reported 148 cases per million people. In Central Asia, rates are generally about ten times higher, with reported cases in humans ranging from 116 per million people in Kazakhstan to 362 in Kyrgyzstan. Only Uzbekistan reported a lower rate – of 18 cases per million people. These rates compare with 4.1 cases per million people in the Russian Federation, 21 in Greece, 0.3 each in Germany and the United Kingdom of Great Britain and Northern Ireland, and 0.09 in Canada. Public health officials also acknowledged that brucellosis incidence in humans is severely underdiagnosed. In the mid-2000s, brucellosis was a fairly significant human disease in Central Asian and Eastern European countries, and it was heartening to note that seven of the ten countries participating in the workshop reported falling numbers of human cases in recent years.



The economic cost of brucellosis in humans and livestock is not well studied in individual countries. In Kyrgyzstan, the economic cost was recently estimated at between US\$5 million and US\$15 million annually at current rates of infection. In a World Bank study, the net total benefits from investing in brucellosis control were estimated at US\$44.6 million in Kazakhstan, US\$55.1 million in Kyrgyzstan, US\$17.3 million in Tajikistan and US\$18.3 million in Uzbekistan, at current United States dollar values.

Tables 1–3 summarize the information reported during workshop presentations and discussions of the brucellosis sanitary situation and trends over recent decades. Updates were provided on the findings from similar data and information reported in 2009 by countries participating in a workshop in Dushanbe, Tajikistan (FAO, 2009).

Country representatives were pleased to hear that governments are being assisted by international donors, development institutions such as the World Bank, the European Union and FAO, and/or bilateral assistance, with eight of the ten countries represented receiving active support for their national brucellosis control programmes. It was also reassuring to know that internationally recommended control strategies for small ruminants, based on ocular Rev 1 vaccination, were proving effective and receive full support from stakeholders in countries where they are used. Epidemiologic management methods were recognized as essential in monitoring the delivery of vaccination campaigns, with periodic serological surveys to monitor changes in brucellosis prevalence over several years. More work is needed, particularly in implementing cost-effective control or eradication strategies against brucellosis in large ruminants. Experience from the last 60 years in many countries will be useful in informing adoption and application in countries in Eastern Europe and Central Asia.

Table 1. National strategies for brucellosis control in sheep and goats in Eastern Europe and Central Asia, 2013

	ALB	AZE	BIH	GEO	KAZ	KYR	MKD	TAJ	TUR	UZB
Strategy	Control	Control	Control	Control	Eradicate	Control	Control	Control	Brucellosis-free flocks	Control
COMPENSATION										
Sheep/goats	?	Y ¹	Y?	N	Y ²	Y ³	Y ⁴	N	Y ⁵	N
COST RECOVERY										
	N	N	N	N	N	N ⁶	N	Y ⁷	N	N
CONTRACTS FOR VETS										
	?	Y	?	N	Y	Y ⁸	?	Y	?	?
VACCINATION										
Annual whole-flock vaccination				N	N					
Whole-flock vaccination for several years then only of young replacements	Y ⁹	Y ¹⁰	Y ¹¹	N	N	Y ¹²	Y ¹³	Y ¹⁴	Y ¹⁵	
Twice-yearly vaccination	?	Y	?			Y	?	Y	N	
Intermittent/selective vaccination				N				Y ¹⁶	N	Y ¹⁷
Slaughter of sero-positive/vaccination of sero-negative animals	N	N	N	N		N	N	N	N	N
Test and slaughter: whole country every year				Y						
Test and slaughter: outbreaks only					Y		Y ¹⁸		Y	Y
Outbreak: slaughter of sero-positive/vaccination of sero-negative animals										Y

¹ 25 percent of market value.

² 100 percent of market value since 2012.

³ 75 percent of market value since 2009.

⁴ 100 percent of market value.

⁵ 90 percent of market value.

⁶ Plan for farmers to pay full costs of brucellosis vaccinations by 2013.

⁷ In 2008/2009, following a willingness-to-pay study, sheep and goat owners were paid US\$0.12 for each animal vaccinated and ear-notched.

⁸ Private veterinarians sign contracts with national and local veterinary departments and are paid 6 som per female vaccinated and ear notched; livestock owners are willing to pay for livestock vaccination and ear notching.

⁹ Rev 1 ocular vaccination of all small ruminants since 2012; whole-flock vaccination in first year, vaccination of only replacement animals for six or seven years, then test-and-slaughter strategy.

¹⁰ Rev 1 ocular vaccination in pilot districts since 2007 following a randomly stratified prevalence survey of the whole country; only females vaccinated.

¹¹ Rev 1 ocular vaccination since 2009, across whole country since 2011; whole-flock vaccination in year 1, replacements only thereafter.

¹² Rev 1 ocular vaccination in pilot districts in Ak-Telaa in 2008/2009, across whole country since 2011; only females vaccinated.

¹³ Risk-based strategy: high-prevalence regions/districts receive whole-flock vaccination with Rev 1 ocular for first year(s) then only of replacements; median-prevalence regions/districts receive vaccination with Rev 1 ocular of only replacement stock.

¹⁴ From 2004 to 2010, twice-yearly vaccination of males and females in 20 districts, using quality-assured ocular Rev 1; Sughd Oblast vaccinated in 2010; ocular Rev 1 vaccination restarted in 2012 in the eight districts in the Rasht Valley that were the original 2004 pilot districts.

¹⁵ Rev 1 ocular vaccination since 2012.

¹⁶ Intermittent vaccination with ocular or subcutaneous Rev 1 used on remaining State farms and to control outbreaks on other farms.

¹⁷ Rev 1 full dose (1 x 10⁹) subcutaneous vaccination used without revaccination since 2005.

¹⁸ Test and slaughter in low-prevalence regions/districts.

(cont.)

Table 1. (cont.)

	ALB	AZE	BIH	GEO	KAZ	KYR	MKD	TAJ	TUR	UZB
Strategy	Control	Control	Control	Control	Eradicate	Control	Control	Control	Brucellosis-free flocks	Control
VACCINE TYPE										
Rev 1	Y	Y	Y ¹⁹	N		Y	Y	Y	Y	Y ²⁰
Strain 19				N	²¹	²²				
VACCINATION METHOD										
Rev 1 ocular	Y	Y	Y			Y	Y	Y	Y	
Rev 1 subcutaneous								Y ²³		Y
Strain 19 subcutaneous										
PERMANENT IDENTIFICATION/MOVEMENT CONTROL										
Ear notch/tattoo	?	Y	?	N	N	Y ²⁴	?	Y	N	N ²⁵
Ear tag with individual number/other	?	N	Y?	N	Y ²⁶		?		Y	N
Movement control effective	No data	No data	No data	Not effective ²⁷	No data	No data	No data	No	Vet permit required	No data

¹⁹ Rev 1 ocular vaccination since 2009.

²⁰ Strain 19 used in small ruminants until 2005, now using Rev 1 produced in the Russian Federation.

²¹ *Brucella abortus* strain 19 used in small ruminants before vaccination ban in 2007.

²² Strain 19 vaccine used in sheep and goats in 1992–2006.

²³ Rev 1 subcutaneous vaccine may be used on State farms, in intermittent vaccination areas or in outbreaks.

²⁴ Different location of ear notch each year of vaccination.

²⁵ Ear notch used in some districts but not common.

²⁶ Establishing a multi-year programme for ear-tagging and registering all livestock in all oblasts.

²⁷ Mamisashvili *et al.*, 2013.

Table 2. National strategies for brucellosis control in large ruminants in Eastern Europe and Central Asia, 2013

	ALB	AZE	BIH	GEO	KAZ	KYR	MKD	TAJ	TUR	UZB
Strategy	Control	Control	Control	Control	Eradicate Zones	Control	Eradicate	Control	Brucellosis-free flocks	Control
COMPENSATION										
Cattle/buffaloes	Y ²⁸	Y ²⁹	Y?	N	Y ³⁰	Y ³¹	Y ³²	N	Y ³³	N ³⁴
COST RECOVERY										
	N	N	N	N	N	N	N	Y ³⁵	N	N
CONTRACTS FOR VETS										
		Y			Y	Y		Y		
VACCINATION										
Vaccination of heifer calves		Y		N	N ³⁶	Y ³⁷	N	Y ³⁸		
Repeat or selective vaccination									Y ³⁹	Y ⁴⁰
Slaughter of sero-positive/vaccination of sero-negative animals	N	N	N		Y?	N	N	N	N	N
Test and slaughter: whole country, every year	Y ⁴¹	Y	Y		Y ⁴²	Y ⁴³	Y	N	N	
Test and slaughter: outbreaks only				Y					Y	Y ⁴⁴
Outbreak: slaughter of sero-positive/vaccination of sero-negative animals										

²⁸ Approximately EUR 800 for cattle.

(cont.)

²⁹ 25 percent of market value

³⁰ 100 percent of market value in 2012.

³¹ 75 percent of market value since 2009.

³² 100 percent of market value.

³³ 90 percent of market value.

³⁴ Compensation inconvenient and inefficient; veterinarians boil the slaughtered meat at selected abattoirs and return it to livestock owners.

³⁵ Livestock owners pay market prices for all livestock vaccinations.

³⁶ Vaccination of cattle or buffaloes officially banned since 2007; starting in 2013, the Government planned to test different vaccines for several years on different farms to study the efficacy of the vaccines.

³⁷ RB51 vaccination used on dairy cattle at established dairies.

³⁸ S82 calf vaccination repeated two months before insemination; used only on remaining State farms, not country-wide.

³⁹ In 2013, all female cattle (young and adult) vaccinated twice with ocular *Brucella abortus* Strain 19 vaccine. In subsequent years, only female calves vaccinated with ocular vaccine, until brucellosis prevalence drops to about 1 percent.

⁴⁰ Strain 19 for intermittent vaccination in outbreak areas and for protecting imported cattle.

⁴¹ *Brucella melitensis* identified in cattle in some outbreaks.

⁴² Test and slaughter in defined geographic zones.

⁴³ Test and slaughter with 75 percent compensation country-wide since 2011.

⁴⁴ "Ring" or limited vaccination in problem areas following test and slaughter of seropositive reactors.

Table 2. (cont.)

	ALB	AZE	BIH	GEO	KAZ	KYR	MKD	TAJ	TUR	UZB
Strategy	Control	Control	Control	Control	Eradicate	Control	Control	Control	Brucellosis-free flocks	Control
VACCINE TYPE										
Strain 19		Y		N				Y ⁴⁵	Y ⁴⁶	Y ⁴⁷
Strain 82				N						
RB51				N		Y ⁴⁹				
VACCINATION METHOD										
Strain 19 subcutaneous of calves		Y ⁵⁰								Y
Strain 19 ocular vaccine								Y ⁵¹		Y
Strain 82 subcutaneous										
RB51										
PERMANENT IDENTIFICATION/MOVEMENT CONTROL										
Ear notch/tattoo/other	?	Y	Y	Y	Y ⁵²	Y	Y	N	Y	N ⁵³
Movement control effective	No data	No data	No data	Not effective ⁵⁴	No data	No data	Poor	No	Vet permit required	No data

⁴⁵ Strain 19 used in 1955–1973; Strain 82 used intermittently on remaining State farms in 1975–1999.

⁴⁶ Ocular *Brucella abortus* Strain 19 vaccine (5–10 x 10⁹ CFU per ml) used.

⁴⁷ Strain 19 full dose subcutaneous for heifers, with up to five low-dose boosters (1/25 dose) every 15 months in problem areas only.

⁴⁸ Limited vaccine available and only for cattle on remaining State farms.

⁴⁹ RB51 vaccination of heifers of selected dairy breeds that are permanently identified and kept on dairies.

⁵⁰ Also vaccinate adults with Strain 19.

⁵¹ *Brucella abortus* Strain 19 ocular vaccine used on heifer calves and adults (twice) in the first years of the campaign, then only on heifer calves.

⁵² Permanent identification (tags or microchips) and registration of all cattle not yet completed in all oblasts.

⁵³ A few modern farms use ear tags for cattle.

⁵⁴ Mamisashvili *et al.*, 2013.

Table 3. Trends in brucellosis disease rates in ruminants and humans in countries in Eastern Europe and Central Asia, 2013

	ALB	AZE	BIH	GEO	KAZ	KYR	MKD	TAJ	TUR	UZB
Sheep/goats		Steep decline ⁵⁵	Variable ⁵⁶	+/- same ⁵⁷	Declining but no data	Steep decline ⁵⁸	Steep decline ⁵⁹	Decline in vaccinated districts ⁶⁰	Outbreaks rose 2007-2012 ⁶¹	No data
Cattle		No change ⁶²	Stable, low level ⁶³	+/- same ⁶⁴	Declining but no data	Decline ⁶⁵	+/- same ⁶⁶	Not well measured ⁶⁷	Outbreaks rose in 2012 ⁶⁸	No data
Humans	787 cases ⁶⁹	Decrease in 2012 ⁷⁰	Steep decline ⁷¹	No data	Steady decline	Steady decline ⁷²	Steep decline ⁷³	Decline ⁷⁴	Slow decline ⁷⁵	No data

⁵⁵ Cases declined from 1 300 in 2008 to 497 in 2012.

⁵⁶ From 2009 to 2012, no real change in number of outbreaks or cases in sheep, but a marked drop in outbreaks in goats.

⁵⁷ Calculated apparent prevalence for sheep and goats is 5.15 percent (Mamisashvili *et al.*, 2013).

⁵⁸ 60–75 percent reduction in seropositive animals after 2.5 years of Rev 1 ocular vaccination.

⁵⁹ Steep decline in annual cases since 2008 when ocular Rev 1 vaccination began; from 11 percent of flocks infected in 2008, to 0.4 percent in 2012.

⁶⁰ From 2003 to 2009, individual animal prevalence decreased by 80 percent in well-vaccinated districts (eight), by 40 percent in less well-vaccinated districts (ten) and was unchanged in non-vaccinated districts (19) (Ward *et al.*, 2012).

⁶¹ In 2011, 4.7 percent of sheep flocks and 30 percent of goats were infected.

⁶² Under vaccination of calves with Strain 19 vaccine and a test-and-slaughter strategy, the number of cases remained about the same: 1 200 in 2003 to 1 500 in 2012.

⁶³ 260 bovine cases in 2008; fewer outbreaks and cases since 2011/2012 when small ruminants were vaccinated with Rev 1; bovine prevalence about 0.02 percent in 2011/2012.

⁶⁴ Calculated apparent prevalence for cattle is 9.31 percent (Mamisashvili *et al.*, 2013).

⁶⁵ 30 percent decline in bovine brucellosis seroprevalence where sheep and goats are vaccinated with ocular Rev 1 vaccine.

⁶⁶ Only slight or no decline since 2010 under test-and-slaughter strategy for cattle; 78 infected herds in 2010 and 64 in 2012; individual animal prevalence ranged from 0.15 to 0.39 percent over three years but was not consistent. The Government is considering starting vaccination in cattle.

⁶⁷ 2012 national disease outbreak case data indicate that the number (not prevalence) of reported brucellosis cases in cattle was much lower in districts in the Rasht Valley where brucellosis in sheep and goats declined by 80 percent over five years; reported cattle cases were fewer than ten in the Rasht Valley, but in double digits elsewhere in the country

⁶⁸ For cattle, individual animal prevalence was 2.6 percent, with 6.9 percent of herds infected in 2011; larger herds were affected with outbreaks, particularly in 2012.

⁶⁹ Mainly of females; too soon to determine trend following start of Rev 1 vaccination in 2012.

⁷⁰ From 2003 to 2011, only slight drop in human cases (about 400 to about 360); in 2012, 275 new human cases were reported, four to five years after start of pilot control.

⁷¹ Marked decline in human cases reported: 994 in 2008 to 53 in 2012; cases decreased by about 50 percent after first year of Rev 1 vaccination.

⁷² Steady decline in new human cases reported in pilot districts, from about 70 new cases reported in 2007 to 30 in 2012; nationwide decline reported in second year following start of Rev 1 vaccination in pilot districts.

⁷³ Steep decline in human incidence since 2008 when ocular Rev 1 vaccination began; 485 cases in 2008 to 82 in 2012.

⁷⁴ Reported cases declined from 1 476 in 2006 to 841 in 2012.

⁷⁵ Reported human cases were about 15 000 in 2005 and about 7 000 in 2012.

Discussion of disease control strategies

REGIONAL COORDINATION

The participants recognized that brucellosis is endemic in countries in both subregions. They agreed that regional collaboration in controlling brucellosis and other transboundary animal diseases (TADs) and zoonoses could leverage national efforts and enhance the effectiveness of disease control. Regular and formal consultations for discussing mutual problems, sharing information, harmonizing strategies, control methods and diagnostic protocols, and monitoring disease control progress were all considered essential for effective control of brucellosis and TADs in the subregions.

Most countries in Eastern Europe and several in Central Asia are making good progress in reducing brucellosis prevalence in small ruminants. To protect the investments already made, the neighbours of these countries need to enhance control measures within their own borders. If neighbouring countries fail to reduce brucellosis rates in small ruminant livestock, there is a high risk of reinfection, and the progress being made in some countries will be slowed.

All the country representatives considered the seasonal movement of livestock within countries and across borders to be a major risk factor in spreading brucellosis and other TADs. Uncontrolled animal movements could compromise progress in controlling the disease in vaccinated areas and pose a threat to the five countries where brucellosis rates have been significantly reduced over recent years.

BRUCELLOSIS CONTROL IN SMALL RUMINANTS

Veterinary and human health authorities in participating countries are struggling to reduce brucellosis rates in livestock and humans. As a first step in controlling the disease in sheep and goats, participating countries have had good results from whole-flock vaccination of all non-pregnant females (adult and immature) in the initial one or two years, followed by vaccination of only replacement stock for four to six years. The veterinary services in all countries except Georgia, Kazakhstan and Uzbekistan use the internationally recommended strategy of whole-flock vaccination with ocular Rev 1 vaccine. Five of these seven countries have significantly reduced brucellosis disease in small ruminants; it was too soon to measure changes in the other two countries using the strategy. Kazak veterinary authorities plan to conduct research by testing various *Brucella* vaccines on several individual farms in a pilot study starting in 2013 and lasting for several years. Uzbek authorities continue to undertake ring vaccination, with test-and-slaughter strategies in infected districts. Georgian authorities have not yet adopted a control strategy.

Participants recognized that husbandry systems, the status of national veterinary services, funding and political will differ across the regions. Evidence that ocular Rev 1 vaccination strategies are controlling the disease in small ruminants under these varying conditions was most gratifying. This success demonstrates that national veterinary services in these countries have the capacity to apply quality-assured Rev 1 vaccine and adapted vaccination strategies effectively. The participants

identified specific gaps in understanding of brucellosis control in their countries, and benefited from the exchange of experiences.

BRUCELLOSIS CONTROL IN LARGE ANIMALS

Strategies for controlling or eradicating brucellosis in large ruminants are much less effective. Serological testing with slaughter of sero-positive animals is not always cost-effective in large ruminants. The reasons for lack of progress need careful review and analysis in each country, but experience shows that test-and-slaughter strategies are not successful unless:

- movement controls are effective;
- each animal is identified with its own permanent number;
- livestock owners receive adequate compensation promptly;
- livestock owners support the control strategy and cooperate with veterinary authorities;
- veterinary and public health physicians cooperate in control;
- effective legislation is enacted;
- a long-term strategy is supported by stakeholders.

Five of the ten countries reported intermittently using vaccines (S19, S82 or RB51) to control bovine brucellosis. In the other five countries, brucellosis control strategies involve from test and slaughter alone or test and slaughter plus vaccination, with vaccination being nationwide, only in outbreak districts or only on remaining State farms. In 2013, Turkey used both adult and calf (strain 19 ocular) vaccination and test and slaughter. Regardless of the control strategy, most countries reported that bovine brucellosis is not under satisfactory control and veterinary authorities are rethinking strategies for controlling or eradicating the disease in large ruminants.

It was interesting to note that bovine brucellosis has been reduced in two or three countries – Bosnia and Herzegovina, Kyrgyzstan, and possibly also Tajikistan – where ocular Rev 1 vaccine has significantly reduced brucellosis prevalence in small ruminants. These countries are urged to investigate this trend and gather additional data documenting changes in bovine brucellosis prevalence.

VARIATION OF CONTROL STRATEGIES AMONG COUNTRIES

The workshop participants were pleased to note that open debate among the participating countries was based on recent successful experience in controlling brucellosis in small ruminants. The strategies and practices of 30 years ago are being challenged and phased out based on recent field experience from individual countries. Through their own experiences and lessons from neighbours, countries are developing an up-to-date understanding of the principles for effective brucellosis control in small ruminants. The complexity of brucellosis control in large ruminants is also recognized, and new strategies based on epidemiological methods and international experience are gradually being applied.

The technical limitations of all currently available tests, and the limited funding available make brucellosis control and eradication a long process, lasting well over 20 years in most countries. These many years of work and expense require strong leadership from veterinary and public health authorities to help maintain a country's political will to battle the disease.

Participants engaged in open debate on technical and institutional issues for controlling brucellosis in livestock and humans. One of the many contentious and unresolved issues concerned the diversity of countries' strategies for controlling brucellosis in small ruminants (Table 1). In some countries, both female and male small ruminants are vaccinated, while in others only adult and/or immature females are. Data on this issue were not consistently collected for country presentations. Where large ruminants are vaccinated, only female animals are involved, generally when they are calves – although in Turkey both adult and immature females are initially vaccinated (with ocular Strain 19).

Control strategies for large ruminants also varied (Table 2): Kazakhstan has banned vaccination in large ruminants; some countries vaccinate female calves in the entire bovine population (Turkey) or only on selected farms (Tajikistan and Uzbekistan); others do not vaccinate, and use only test and slaughter (Albania, Bosnia and Herzegovina, Georgia, Kazakhstan and The former Yugoslav Republic of Macedonia); and others vaccinate only around the villages, farms and districts where brucellosis disease persists (Tajikistan, Uzbekistan), with test and slaughter following vaccination in these infected areas.

Participants recognized that countries have not yet established effective animal movement controls. Uncontrolled movements of brucellosis-infected livestock, including sales in livestock markets, are a well-recognized risk for spreading the disease and have been documented in some countries. More effective systems for recording and controlling livestock movements are essential for progressing from a vaccination to an effective test-and-slaughter strategy. Movement control and individual animal identification are essential for cost-effective eradication of brucellosis by test and slaughter.

REMOVAL OF SERO-POSITIVE ANIMALS

None of the countries represented at the workshop reported carrying out test and removal of sero-positive animals prior to vaccination with Rev 1 (or other) vaccine. As no undesirable effects have been detected when using quality-assured Rev 1 vaccines without prior test and removal of sero-positive animals, these countries avoid the cost of pre-vaccination serological testing, holding it to be unnecessary.

Experience in the subregions and globally shows that vaccinating *Brucella*-infected livestock with Rev 1 vaccines is not harmful, although it does not cure the infected animals. The Rev 1 vaccine label includes the instruction to vaccinate only healthy animals, which is a generally recognized good veterinary medical practice. However it is also recognized that commonly used serological tests for brucellosis, particularly the rose bengal and enzyme-linked immunosorbent assay (ELISA) tests, are less than 100 percent sensitive or specific, so not all *Brucella*-infected animals are detected in a single sero-testing round. Therefore, even if detected sero-positive animals are removed, some infected animals will be missed by the sero-testing and will subsequently be vaccinated; despite the hundreds of thousands of animals vaccinated each year, no harm has ever been detected from this practice.

Other animals missed by sero-testing include immature animals in the early stage of infection, which do not produce antibodies, and the 5 to 10 percent of calves infected *in utero* from their *Brucella*-infected mothers, whose infection cannot be detected by standard tests until they mature and give birth themselves (if female).

TRANSMISSION OF *BRUCELLA* THROUGH INFECTED MEAT

The role of animal meats as a risk factor for brucellosis transmission has been discussed. There are no reports in the literature that brucellosis can be transmitted from meat to humans (Robinson, 2010).

COMPENSATION STRATEGIES

A critical issue for all countries is the availability of compensation when sero-positive animals are eliminated by government order. Payment of compensation was only recently introduced in some countries, with rates varying from 25 to 100 percent of the animals' market value. In Uzbekistan, livestock owners are compensated with the boiled meat of their slaughtered sero-positive animals. Even where compensation is available, less than full market prices are received because of practical constraints (Azerbaijan), the use of inefficient and inconvenient in-kind compensation (boiled meat in Uzbekistan) or lack of local abattoirs for sanitary slaughter (many countries). Other countries lack the funds even to consider paying compensation (Tajikistan). International donors have agreed to finance cash compensation for at least a limited period.

Economic theory recommends that governments compensate owners quickly and fairly when the State confiscates private property, even when the property is livestock infected with a zoonotic disease such as brucellosis. Experience from many countries shows that if fair and timely compensation is not paid, the disease will only be "nearly eradicated" because livestock owners and regulatory authorities will collude to avoid the slaughter of sero-positive animals. Without adequate compensation, animals identified as diseased are frequently sold, spreading the disease wider and faster.

FAO's framework for progressive control of brucellosis in livestock

To assist member countries in launching and pursuing programmes for controlling and eradicating brucellosis, FAO has designed a framework for progressive disease control using a stepwise approach with activities that will lead to reduced brucellosis in livestock and humans, eventually leading to self-declaration of brucellosis-free status as defined by the World Organisation for Animal Health (OIE) Terrestrial Animal Health Code.

A draft of the framework, entitled *A Stepwise Approach for Progressive Control of Brucellosis in Livestock and Humans – Principles, Stages, Strategies and Tools* was presented at the workshop and participants reviewed the first chapters describing the four stages of the framework.

The framework is designed to allow national veterinary authorities to identify the stage that corresponds to the situation in each livestock system in a particular zone or across the whole country. Veterinary authorities can then start applying the framework at the most appropriate stage for each situation. When implementing activities, veterinary authorities must ensure effective surveillance and monitoring of the quality of inputs, the effectiveness of work carried out, and progress along the control pathway. Good collaboration between public health and veterinary authorities is another necessary component for effective and documented control of brucellosis in both humans and animals.

The framework provides basic information on control tools and strategies, such as reviews of control options, recent practical experiences, accepted international opinions, lessons learned from the field, and innovations from research. Links to technical tools (tool kits) and supporting literature or international opinion give national veterinary authorities additional confidence in undertaking framework activities. Major issues are discussed, and the text clearly stipulates instances where information is lacking or data are controversial or contradictory.

Externalities and enabling factors that might influence the course of progressive brucellosis control are highlighted in the framework text. Examples of the prerequisites for implementing control options provide national authorities with insights into essential management considerations and recognized best practices.

Unfortunately, because of high translation costs and the need to incorporate extensive peer review comments, only the introductory chapters describing the four stages of the framework were translated into Russian for review and discussion at the workshop. Participants strongly recommended that the entire draft document be translated into Russian and that both the English and Russian drafts be distributed to national veterinary authorities with a request for their feedback to FAO within 60 days of receipt.

The process for developing this technical document was described to workshop participants who appreciated the process of internal review at FAO, review and comment by OIE and WHO, formal peer review, and regional workshops – such as this one in Turkey – where national authorities have the opportunity to comment on the document.

The first change recommended by participants was to remove reference to humans from the title as the document is directed mainly to national veterinary authorities. Nevertheless, participants recognized that control of brucellosis in livestock benefits humans by reducing the disease incidence. Participants recommended that an economic analysis of the costs and benefits of brucellosis control include the direct and indirect costs incurred by patients and their families when people become infected.

Noting the participants' reservations and suggested changes, FAO welcomed the workshop's general endorsement of the draft document. The participants agreed that a stepwise approach to controlling brucellosis is very appropriate, and that major domestic livestock species and common species of *Brucella* should all be considered in one document rather than in several species-specific documents.

FAO's Animal Health Service planned to revise the draft document by reviewing all the suggested changes to the text, taking into account other observations from the workshop. FAO hoped to complete this revision in 2013 and to send the document to relevant countries for comments.

Conclusions and recommendations

The national authorities of most countries in the two subregions are responding to the resurgence of animal and human brucellosis by implementing revised control programmes for small ruminants while continuing to rely on test-and-slaughter strategies – with or without vaccination – for large ruminants. Control of brucellosis in large ruminants is generally weak and country authorities need to review their current strategies.

Brucellosis control in small ruminants generally relies on field-tested strategies using quality-assured ocular Rev 1 vaccine in whole-flock vaccination for one or more initial years, with vaccination of replacement stock in subsequent years. Frequent out-of-season breeding of sheep and goats necessitates twice-yearly vaccination to ensure that animals are immunized at the youngest practicable age and to avoid vaccinating pregnant females and risking vaccine-induced abortions. Vaccinated small ruminants are usually identified by ear notches. In countries where strategies using Rev 1 vaccination have been introduced since about 2007 – or 2004 in Tajikistan – initial monitoring indicates reduced sero-prevalence in small ruminants and usually also declining incidence in humans. There is evidence from Bosnia and Herzegovina, Kyrgyzstan and Tajikistan that where brucellosis sero-prevalence in small ruminants has been significantly reduced using ocular Rev 1 vaccination over several years, the incidence of brucellosis in cattle also declines. Veterinary authorities in Kazakhstan reported that brucellosis control programmes implemented over recent years did not reduce the disease in livestock, despite the large sums of money spent annually. Kazakh veterinary authorities plan to conduct pilot tests of various vaccines for controlling the disease in small and large ruminants.

Control programmes for large ruminants are based primarily on test and slaughter in countries with a capable and adequately funded national veterinary service. Brucellosis sero-prevalence in large ruminants is generally not well monitored; where statistically sound surveys have been carried out, prevalence seems to have been static for the last ten years or more. Azerbaijan, Kazakhstan and The former Yugoslav Republic of Macedonia are re-evaluating their test-and-slaughter strategies in light of this lack of progress and continuing high costs.

CONCLUSIONS

The two working groups at the workshops reached agreement on the following conclusions:

1. FAO's stepwise approach for progressive control of brucellosis serves its intended purpose by providing generic guidelines for country veterinary authorities preparing and managing brucellosis control programmes.
2. The guidelines should include control strategies for all major domestic livestock species in one document.
3. FAO is requested to prepare a chapter providing national authorities with comprehensive guidelines on how to prepare national strategy documents on brucellosis control (chapter headings, background, rationale, etc.), including logical frameworks/roadmaps and indicators.

4. The early chapters of the stepwise approach were reviewed during the workshop and adjustments were suggested. The workshop report should be published in both English and Russian and be circulated to countries with a request for written feedback.

While recognizing the usefulness of the framework guidelines, the participants spent considerable time discussing the text and proposing changes, including to the order in which some sub-activities are carried out and suggestions for additional text. FAO is requested to include these changes in the final framework document.

The participants also recognized that intersectoral collaboration between veterinarians and public health professionals is essential for a technically sound and effective strategy for controlling brucellosis at the national level.

RECOMMENDATIONS TO FAO

FAO is asked to revise the proposed *Stepwise Approach for Progressive Control of Brucellosis in Livestock and Humans – Principles, Stages, Strategies and Tools*, taking into account the workshop discussions and the changes proposed and with due regard to comments from workshops in other regions. The title should be changed to *Stepwise Approach for Progressive Control of Brucellosis in Livestock – Principles, Stages, Strategies and Tools*, dropping reference to humans as it includes few recommendations on controlling brucellosis in humans.

The changes that FAO is asked to incorporate include:

1. covering cross-cutting activities and outputs, where practical, in the chapter on Externalities, such as strengthening veterinary services, capacity building, legislation issues and training;
2. adding a chapter on activities and outputs that are recommended but not essential to a strategy for reducing brucellosis transmission, such as value chain activities and socio-economic studies.

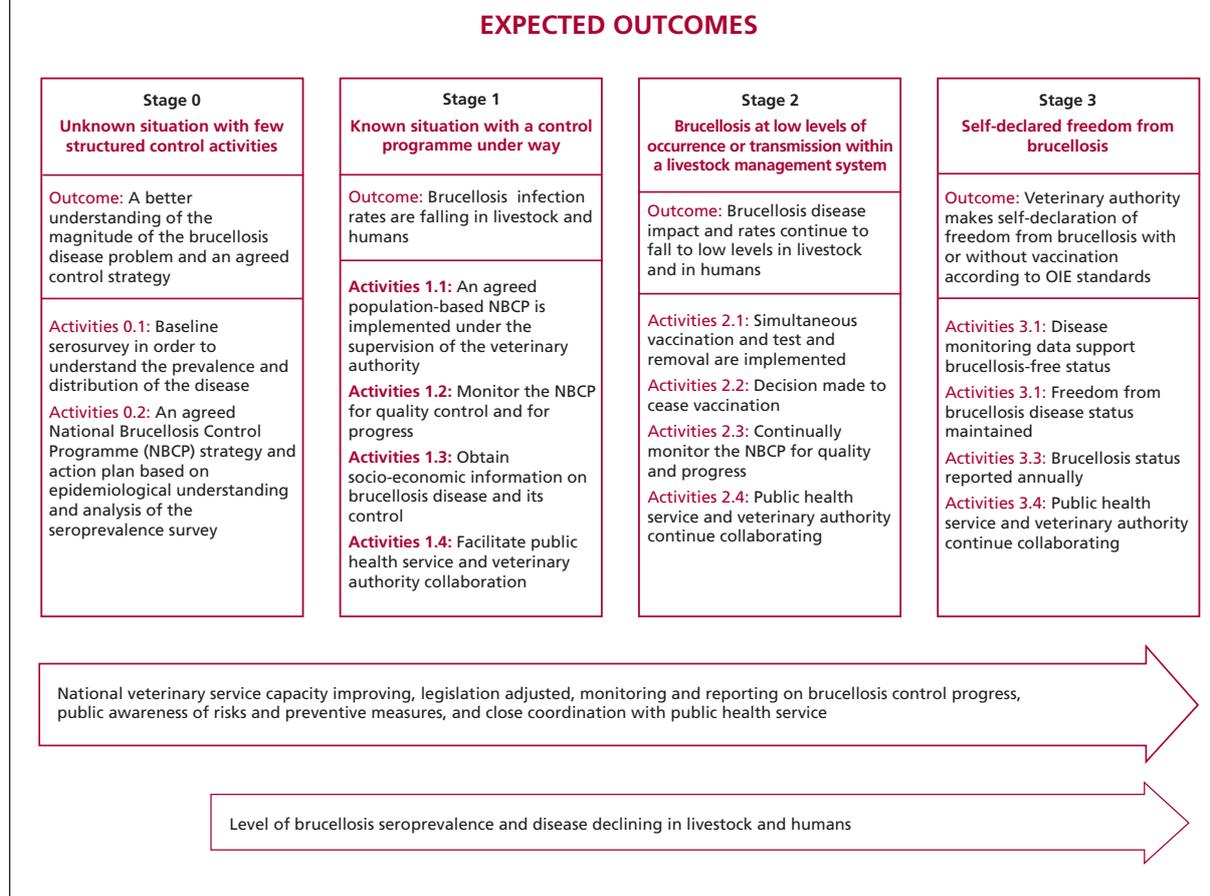
Workshop participants prepared two flow charts of activities and expected outcomes (Figure 2) to assist presentation and facilitate understanding of the framework. Suggested changes in the numbering of framework stages would reflect the brucellosis sanitary status in a country at the start of strategy implementation (stage 0) and the final status of national brucellosis control under current OIE standards (stage 4a or 4b). The flow charts also depict the cross-cutting issues for ensuring comprehensive and holistic enhancement of national veterinary services' capacity to proceed through the various stages.

RECOMMENDATIONS TO OIE

Recognizing OIE's mandate for the global dissemination of official animal disease information and the setting of standards for control of animal diseases, and the considerable experience of FAO and WHO in advising countries on implementing activities relating to priority diseases, the participants recommended that OIE:

1. proceeds with adopting and publishing revised Terrestrial Animal Health Code standards on brucellosis;
2. considers including representatives of FAO and WHO as members of the ad hoc group on brucellosis;
3. considers contributing to the preparation of guidelines on national control strategies and other related documents.

Figure 2
Flow chart of activities and expected outcomes of national brucellosis control programmes



RECOMMENDATIONS TO PARTICIPATING COUNTRIES

1. National authorities are encouraged to continue sharing data, information and experience related to brucellosis with neighbouring countries.
2. National veterinary authorities and public health authorities are encouraged to establish or strengthen formal mechanisms for collaborating and exchanging information on brucellosis.

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