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(Left) Sheep and goats are often herded together and can be infected with Brucella melitensis: small ruminant pen in Mongolia. Photo: J. Zinsstag (Right) Milk cream separator in Kyrgyzstan. Unpasteurised dairy products are a health risk in brucellosis-endemic areas. Photo E. Schelling

It's time to control brucellosis in Central Asia

Case studies featured here were conducted in: Kyrgyzstan

Policy message

- Brucellosis is a highly contagious livestock disease that can be transmitted to humans through direct contact and the consumption of unpasteurised milk and milk products. In Central Asia, it is profitable for society as a whole to control it by mass vaccination of sheep, goats, cattle, and yaks.
- At least 80% of the animals should be vaccinated each year. If less than 1% of livestock are affected, vaccinations can be restricted to young replacement animals only.
- Treatment of humans should be supported by education campaigns and by ensuring that diagnosis and treatment services are available at the district level.
- Vaccinating animals is the best way to reduce human infections. Education on safe animal handling and the boiling of milk can also considerably decrease the number of cases in humans.

Brucellosis is a livestock disease that is transmissible to humans, so is of major public health concern. Industrialised countries have eliminated brucellosis with massive financial and technical interventions, but these are currently not feasible in Central Asian countries. Brucellosis has re-surfaced as a major health risk in the region after the end of the socialist period (1990). Can brucellosis be controlled under current financial, technical, and political constraints? Epidemiological and economic studies in people and livestock show promising options for the effective control and elimination of brucellosis in the region, provided appropriate knowledge and technology are available and there is political will for change.

Re-emergence of brucellosis in Central Asia

During the socialist period, public health and veterinary medical services in Central Asian countries were entirely state-led and effectively kept zoonoses (diseases transmissible between animals and humans) under control. But after the end of the socialist period at the beginning of the 1990s, public and animal health systems collapsed and livestock production was privatised. Surveillance of animal diseases was limited, and controls were ineffective. In the following decade, many different zoonoses, including tapeworm and rabies, re-emerged. Brucellosis is one of the most important of these.

Alarmingly high numbers of human brucellosis cases prompted the World Health Organization to assess options for controlling the disease. International experts recommended interventions in livestock to reduce human health risks. An economic assessment of a ten-year livestock mass-vaccination campaign in Mongolia showed that brucellosis control is profitable and cost-effective for society as a whole, including the public-health and animal-production sectors. If costs are shared between the livestock and public-health sectors proportionally to their benefits, the intervention is in the most cost-effective band of public-health interventions.

Featured case studies

Joint human and animal brucellosis studies

Blood testing for brucellosis was done simultaneously in nomadic pastoralists and their livestock in Chad. When medical doctors and veterinarians worked together directly, the sources of human brucellosis could be identified. This study was used as a model for the work in Central Asia (Schelling et al. 2003).

A model of animal-human brucellosis transmission in Mongolia

A mathematical model of livestock-human brucellosis transmission showed how human brucellosis can be reduced by interventions in animals. This model was used for the economic assessment mentioned below (Zinsstag et al. 2005).

Human health benefits of livestock vaccination for brucellosis

A case study of cross-sector societal economic assessment of the profitability of brucellosis mass vaccination showed that the societal benefits were three times higher than the cost of the intervention (Roth et al. 2003).

Towards a "one health" research-and-application toolbox

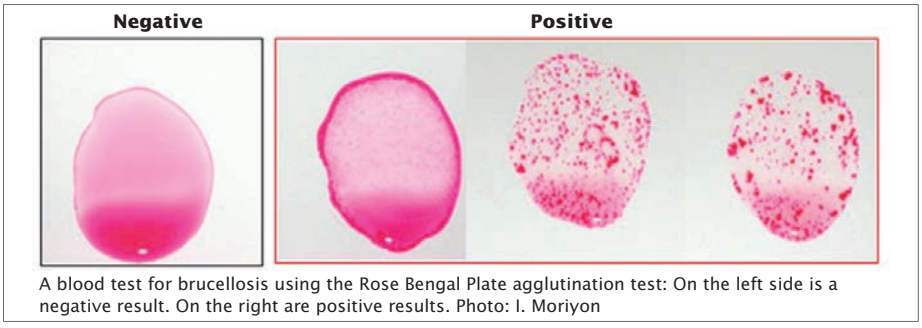
Integrated human and animal disease monitoring and surveillance was tested in Kyrgyzstan. This method can serve public health and veterinary services to join efforts for monitoring and surveillance and save scarce logistic and human resources (Zinsstag et al. 2009).

Obstacles to controlling brucellosis in humans

People with brucellosis suffer from long-term recurring fever, joint pain, weakness and fatigue. But there are no specific symptoms that make the disease easy to identify. That means that unless adequate laboratory tests are available, brucellosis is often under-diagnosed and hence under-reported. Curing brucellosis takes years – even a decade – of treatment, and its control is often not considered profitable because the disease is only seen either in humans or livestock, but not together – and doctors and veterinarians often fail to communicate. It is not possible to vaccinate humans against the disease.

Stepwise brucellosis elimination: Choosing the right approach

To choose the best option of control, detailed information is needed on the distribution and the number of new cases in a country. However, if the disease is present (independent of its prevalence in animals), it is recommended to start annual mass vaccination campaigns of animals (covering over 80% of animals every year) for 5–10 years, before moving on to vaccinating young replacement stock along with testing and slaughtering. The test-and-slaughter strategy can be advised only if public funds are available to compensate farmers for culled stock and if other enabling conditions are in place (see below). Both interventions require well-functioning veterinary field and laboratory capacity.



A blood test for brucellosis using the Rose Bengal Plate agglutination test: On the left side is a negative result. On the right are positive results. Photo: I. Moriyon


Cattle in peri-urban dairy production in Bishkek, Kyrgyzstan. Cattle are usually infected by Brucella abortus, but can also be infected by Brucella melitensis. Photo: J. Zinsstag

Integrated baseline assessment

Almost everyone who is infected with brucellosis has come into contact with infected livestock or livestock products. Detecting brucellosis in humans depends on suitably equipped laboratories in health centres, and access to such centres, especially in rural areas. A lack of such conditions leads to the under-reporting of human cases. Studies in Kyrgyzstan and Mongolia show only 5 to 20% of cases are ever reported officially. As a novel approach, we recommend the simultaneous assessment of human and livestock disease frequency, which provides a good overall picture of the distribution and transmission of the disease (see case studies).

Enabling environment

Effective interventions against brucellosis rely on important enabling conditions:

- Public or private veterinary services that cover fully the area of intervention and have sufficient equipment and staff.
- Human and veterinary laboratory capacity at district and provincial levels with sufficient capacity to handle the testing of blood samples, and at the central level a laboratory that can grow and identify the pathogen.
- Electricity to produce vaccines and to keep the vaccines cooled until they reach the animals to be vaccinated.
- If test-and-slaughter systems are implemented, sufficient public funds to compensate farmers for culled stock and a relatively corruption-free environment (if farmers are not compensated, they may sell infected animals illegally, which contributes to continued transmission of the disease).
- Animal registration and movement traceability.
- Appropriate management and monitoring of the control programme.

Choice of vaccine for livestock mass vaccination

If brucellosis is detected in livestock, mass vaccination of livestock should be the first option, regardless of the number of animals infected. It is safer

to vaccinate using eye drops than the more usual syringe. Different species need different types of vaccine: sheep and goats should be vaccinated with *B. melitensis* Rev-1, and cattle and yaks with an attenuated *B. abortus* S19 strain. Sheep and goats of any age and sex can be vaccinated, including lactating animals, but vaccination should take place before the mating season, as vaccinating pregnant sheep can provoke abortion. In cattle, female animals of all ages can be vaccinated, but never males. More than 80% of the animals in an area should be vaccinated every year to reduce the risk of disease transmission.

Mass vaccination should be followed immediately by an annual monitoring programme to assess the proportion of vaccinated animals. The recording of new human cases, conducted at adequate intervals (2–4 years) after vaccination, provides additional information on how effective the vaccination has been. The number of new human cases should drop, although not immediately, as infected animals are not culled during a mass vaccination and will remain for several years until they are eliminated by natural replacement. The vaccine quality should be tested prior to the annual campaign.

From mass vaccination to test and slaughter

Once annual mass vaccinations have begun, it is necessary to identify individual animals (e.g., though ear tags) and control livestock movements to prevent infected stock from entering the vaccinated area. After 5–10 years of livestock mass vaccination, once less than 1% of the flocks are infected and the disease is restricted to certain areas, it is possible to change the control policy: only young replacement animals need be vaccinated, and the adult animals should be blood-tested. Animals that test positive must be culled and destroyed. Their owners should be compensated adequately, depending on the market value of the animals. Failure to compensate farmers effectively will lead to illegal sales, jeopardising efforts to stop further transmission and to eliminate the disease. Once no new clinical livestock and human cases occur, and no blood samples test positive, the country can apply to the World Organisation for Animal Health (OIE) for certification of freedom from the disease. This certification requires annual representative surveys demonstrating the absence of positive animals.

Prevention of human exposure

At the same time as the interventions in livestock, humans should be provided with access to care and adequate treatment free of charge. Efforts should be made to prevent human exposure through direct contact with livestock and the consumption of unpasteurised milk and milk products. Information, education, and communication campaigns using the mass media, new information and communication technologies, schools, and engagement with communities, herders, and opinion leaders should be used to create awareness, motivate people to change their behaviour, and seek health care if necessary.

Joint human and cattle blood sampling for Brucellosis diagnostic in Kyrgyzstan. Photo: Joldoshbek Kasymbekov

Definitions

Brucellosis: A bacterial disease causing abortions in sheep, goats, and cattle. Humans get infected by direct contact with livestock and the consumption of raw milk and milk products.

Disease incidence: The number of newly reported cases per time and population at risk. The incidence of human brucellosis was 78 cases per 100,000 per year in Kyrgyzstan in 2007.

Human incidence of disease: The number of infected people who applied for medical assistance as a proportion of the total population.

Prevalence: The proportion of humans or animals reacting to a serological test. Prevalence is not time-dependent and is often reported as percentage.

Sentinel: An animal or human that is monitored for a disease in order to indicate its presence. A sentinel can be used to predict the presence of a disease in another species.

Rose Bengal Test: A test of blood serum used to diagnose brucellosis. It can be used for both animals and humans. A drop of serum is mixed with a reagent; if it forms granules, it indicates the presence of the disease.

Test and slaughter: A control strategy in which animals are tested for brucellosis. The animals that test positive are culled.

Vaccination coverage: The proportion of animals effectively vaccinated among all animals during a vaccination campaign. For effective brucellosis control, vaccination coverage should be at least 80%, optimally 100%.

Vaccination route: Brucellosis vaccines can be applied under the skin with a syringe and needle ("subcutaneous") or with a dropper into the eye ("conjunctival application"). This second method is safer than the former, so is preferable.

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Policy implications of NCCR North-South research

Adapt technologies to the local context

NCCR North–South research shows that brucellosis is massively under-reported, and that its control would be profitable in Central Asian countries. Simple laboratory tests, which can be implemented at the district level, enable it to be diagnosed in humans and animals. Well-monitored mass-vaccination campaigns of livestock would reduce the number of newly infected animals until it is possible to start a regime of testing animals and slaughtering those that are infected. The goal is to eliminate the disease.

Close cooperation between human and animal health services

Closer cooperation between public and animal health services would increase the benefits of interventions against brucellosis in livestock to prevent risks to human health.

Enabling conditions

Effective interventions against brucellosis rely on adequate public and private veterinary services and laboratory capacity. There should be sufficient electricity and storage facilities to maintain a cold chain. The application of a test-and-slaughter campaign requires the adequate development of veterinary services, the ability to identify all animals individually, and the effective control of animal movements. It also depends on sufficient public funds to compensate farmers for culled stock. Animal registration is an essential factor for successful animal disease control.

Further reading

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