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Using public health surveillance data to monitor the effectiveness of brucellosis control measures in animals.

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Abstract:

The current brucellosis control program in small ruminants consists in two major components the first is an intervention strategy through modification of host resistance by vaccinating the entire small ruminant's population using live attenuated Rev-1 strain of B. melitensis. The second is a post vaccination monitoring and surveillance system (MOSS) to monitor the efficacy of the mass vaccination. The MOSS is based on sampling vaccinated animals between 20 to 40 days post-vaccination and testing through Rose Bengal Plate Test in order to detect antibody presence and evaluate the vaccination sero-conversion and coverage. Rose Bengal test is recommended for screening of samples to determine flock prevalence and like other serological tests it cannot discriminate between natural infection and vaccination antibodies. The methodology used in the post vaccination MOSS during the mass vaccination campaigns of 2012 and 2013 demonstrated much strength upon which future MOSS should be built. However, the current system has also shown gaps in terms of missed opportunities to analyse information generated from other sources. Trends of disease in accidental hosts like humans have not been integrated within post vaccination MOSS. Given that the infection level cannot be estimated in small ruminants, data generated by public health surveillance system can be able to give an independent overview of the impact of the vaccination campaign. This paper will address in depth this issue by showcasing the value of integrated surveillance data in monitoring the success of brucellosis control measures in small ruminants as a one health approach in practise.

Key words: One Health, Brucellosis, Monitoring and Surveillance System, Small Ruminants

1. Introduction

Brucellosis The current brucellosis control program in SR consists in two major components. The first an intervention strategy trough modification of host resistance by vaccinating the entire SR population using live attenuated Rev-1 strain of *B. melitensis*, and the second a post vaccination monitoring and surveillance system [**3**].

3.1 Intervention strategy

The final objective of the intervention strategy is the eradication of the disease. However this is not possible in the foreseeable future. Therefore a progressive approach has been adopted based on the following objectives:

- Immediate objective: for the first two years control of the infection by mass vaccination;
- Mid-term objective: further decrease the disease burden by vaccination of replacement animals each year and introduction of strict movement control.
- Final objective: eradication by test and slaughter.

The vaccination is performed by Private Veterinary Practitioners (PVPs) whom are contracted by the regional veterinary services (RVS) [**3**]. The campaign is supported by the electronic veterinary information system called "RUDA" which contains a brucellosis vaccination module. This module is connected with national holding register, animal registration and identification, and brucellosis laboratory information system. PVPs have the duty to fill in the RUDA vaccination forms with number of vaccinated animals, date of vaccination for each farm and current farm inventory for each species. The compiled forms are handed over to the RVS staff which subsequently digitalize them onto RUDA system.

3.2 1.2 Post vaccination monitoring and surveillance system

The success of the vaccination will be controlled by a post vaccination monitoring and surveillance system (MOSS). The post vaccination MOSS described here has three aims: i) To estimate the immune response in vaccinated animals through serological surveys. The aim is to estimate the proportion of vaccinated animals that have been protected after vaccination and therefore the effectiveness of the vaccination campaign. A flock is deemed as protected if more than 80% of vaccinated animals are positive in Rosa Bengal Plate Test (RBPT). Blood is collected from animals in selected flocks by the RVS official veterinarians. Samples are taken between 21 and 42 days post vaccination because antibody response is higher in this period. Sample consignments are sent to be diagnosed in the serology reference laboratory at Food Safety and Veterinary Institute (FSVI); ii) To estimate coverage of vaccinated flocks. Vaccination coverage will be measured by implementation of a questionnaire survey that will be implemented by the end of each year, and; iii) To some extent estimate the performance of PVPs. For each PVP a farm will be selected and sero-conversion rate will be determined by RBPT results. Successful PVP will be declared on the basis of reaching a flock sero-conversion rate of 80% or above.

The approaches taken in the post vaccination MOSS has demonstrated many strengths upon which the future MOSS should build. However the current system have also shown gaps in terms of practicality and missed opportunities to analyze the generated information. Trends of disease in accidental hosts like humans have not been integrated within post vaccination MOSS. Given that the infection level cannot be estimated in small ruminants, because there are no tests available to discriminate between infection and vaccine induced antibodies, data generated by public health surveillance system can be able to give an independent overview of the impact of the vaccination campaign

2. Material and Methods

Human brucellosis data are captured by the Major Disease-Based Epidemiological Surveillance System (MDBSS), individual forms 14(2z-sh) operated by the Control of Infectious Diseases Department (CIDD) of Institute of Public Health. The records are kept on individual bases and indices of disease morbidity, medical care and hospitalisation rates are produced on regular basis [**4**].

The system for collection of animal diseases and related data was set up in 2005 by the National Veterinary Epidemiology Unit (NVEU) of the Food Safety and Veterinary Institute. The system called RUDA is developed in a web-based environment and has proven a particular value in terms of automation and routine reporting like brucellosis vaccination data, outbreak reports and diagnostic laboratory information.

The post vaccination MOSS has been further analysed to evaluate the strengths and weaknesses as defined by current conditions, anticipated future needs, and other technical challenges.

The assessment of strengths and weaknesses has been developed through careful evaluation of the information collected by veterinary and public health agencies. NVEU and CIDD staffs have been closely collaborating by identifying both human and animal cases to the level of family and farm holdings as the primary epidemiological units and created joint databases at the level of commune and district.

Descriptive analysis with appropriate statistical methods and GIS spatial distribution maps have been used to analyse the information.

3. Results and Discussion

Brucellosis is the most frequent zoonosis in Albania and it accounts for 87.7% of total cases of all zoonotic diseases reported to CIDD during the last decade. In the period 2003 to 2012, cumulatively about 7214 cases have been reported among humans.

The highest percentage 44.6% is among 15 - 44 years old age group followed by 26.7% in 45 -59 years age group. Sporadic cases were also reported children 4-15 years old, accounting for 4.1 % of the cases reported. The incidence estimated equal to 31.6 cases per 10^5 population in 2003 and 14.4 cases per 10^5 population in 2012.

Based on the human data before and after the mass vaccination the success of the vaccination has been mostly marked in the southern districts of the country which have been always problematic. The decrease of the disease have been substantial in central districts as well. On the other hand, the disease has been increasing in the north of the country. However the two yearly disease percent change is a relative measure of the burden of disease, if compared in absolute terms (i.e. total no. of cases) the increases in the north is almost negligible in comparison with the southern districts where the total number of cases is still high.

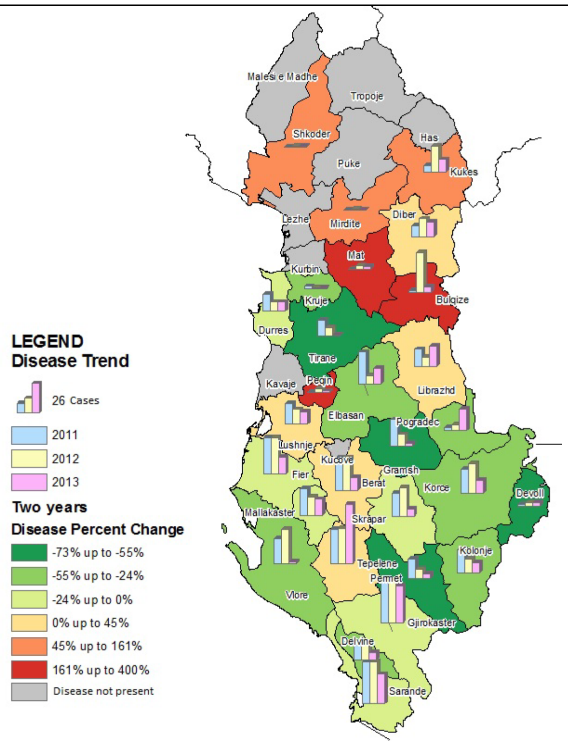

Figure 1. Disease trends in humans for the period 2011 up to 2013 and a comparison of disease levels between: 2010-2011 .vs 2012-2013.

Taking into the account the human infection rates the MOSS implementation during 2012 -2013 has shown both strengthens and weaknesses and it needs further adjustment to better serve the policy orientation:

3.3 Strengths

- Current system can assess the vaccination effectiveness.

Data generated by the post vaccination sero-prevalence survey have been able to give an indication on the immune response in vaccinated flocks.

- Current system is technologically empowered.
- RUDA database has been crucial in managing information's on the on-going vaccination activities at farm level, provided accurate data on the target population thus assisting in the creation of a reliable sampling frame and allowed data integration with laboratory results.
- Current system allows rapid corrective actions.

The PVPs have been monitored on individual basis and the data generated has assisted the RVS to take corrective action on low performing PVPs by revaccinating their respective villages.

- Current system provides standardized laboratory results.

Since all diagnostics tests have been performed at FSVI the accuracy and uniformity of reading the RBPT reaction and standardized reagents has been guaranteed by strict protocols and experienced staff. This procedure has overcome diagnostic discrepancies seen in the past when the diagnosis was performed in the regional laboratories.

3.4 3.2 Weeknes

- Current system cannot estimate the vaccination coverage.

In the protocol the vaccination coverage survey was foreseen to be estimated with questionnaire surveys of farmers. However its practical implementation was not possible. The problem is of administrative nature rather than technical since RVS had neither the financial nor the human recourses to visit the selected farmers to be interviewed. Furthermore there exists also a lack of engagement from the official veterinarians whom are not used and trained to perform questionnaire surveys.

- Current systems ignores individual animal prevalence.

The RBPT is recommended for screening of samples to determine flock prevalence since the test is highly sensitive but it lacks in specificity **[2]**. These properties of the test hampers the correct evaluation of the sero-prevalence at the individual level however for a national program the flock's sero-conversion rates are quite appropriate. On the other hand, individual based prevalence is quite important in relation to the PVP performance since within a flock sample there will be some false-positive results which might lead to erroneously believe that certain PVPs, border-lining an 80% flock sero-prevalence, are performing well.

- Current system does not make best use of available information from other sources.

Trends of the disease in other accidental hosts like humans have not been integrated within post vaccination MOSS. The RBPT test like other serological test cannot discriminate naturally infected and vaccination antibodies in the first month after vaccination [**5**]. Given that the infection level cannot be estimated in small ruminants data generated by different branches of surveillance can be able to give an independent overview of the impact of the vaccination campaign.

3.5 Oportunities and inmprovements

- Coverage

In order to overcome this glitch two possible options are available: i) including in the sero-prevalence survey also the coverage estimates. This would imply changing the sampling protocol toward a multistage sampling which on the other hand might increase the sample size, or; ii) introduce some coverage performance indicators that can be measured by the data provided by RUDA system, like the population Coverage (No. of vaccinated animals / No. of animals in inventory), this indicator measures the ratio of the population which has been reached with the vaccine. The indicator is crude and inaccurate because it does not take into consideration doses gone to waste, so it should be accompanied with a wastage indicator. Another estimate that can be derived is flock coverage (No. of reported vaccinated flocks / No. flocks in holding register), this indicator measures the ratio between numbers of vaccinated flocks over total registered flocks. This is another form of coverage estimate which can be used to monitor potential “receptive pockets” within villages.

- Individual animal prevalence

Appropriate evaluation of sensitivity and specificity values of the RBPT should be assessed and factored in the sample size estimations and analysis of results. Furthermore the testing schema can be improved by including a serial testing on the positive samples with confirmatory tests.

- Use of available information from other sources

Performance indicators in other species like humans should be included. A quick measure for this purpose is the percent variation of human incidence rate (IR change = (IR 2013 – IR 2014) x 100), this indicator measures the variation of IR in human’s prior vaccination and the level actually achieved. The informative value of this indicator as the most independent and reliable indicator has been shown in the results given above. Nevertheless, such information needs further investigation because the vaccine strain is pathogenic to humans [1].

4. Conclusions

The strategy proposed for the period from 2014 to 2016 is to limit vaccination to replacement animals entering the breeding population. Following 2016, it is proposed to suspend vaccination and to monitor the susceptible population using serological tests. Any outbreaks identified will be controlled by slaughtering affected animals and their contacts. In this way, the veterinary authorities are planning to achieve disease-free status [**3**].

The data shown in this paper suggests that overall success of the mass vaccination in small ruminants in reducing the disease in humans is evident. Nevertheless, the propagation of the disease in northern districts is a sign that the control strategy is not succeeding entirely its aim. This means that the mass vaccination of SR should be further continued and should not be replaced by the vaccination of replacement stock as foreseen by the current strategic plan. On the other hand the monitoring of the vaccination campaign has shown some gaps which need to be addressed and as a final conclusion it can be said that the cooperation of veterinary and public health authorities is essential for the control of the disease.

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