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A “One Health” surveillance and control of brucellosis in developing countries: Moving away from improvisation

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ABSTRACT

Although a “One Health” approach has been successfully implemented for emerging infectious zoonotic diseases with pandemic potential, we still lack a conceptual framework to address enzootic diseases like brucellosis. The vast majority of published brucellosis studies in the developing world rely solely on serology. An important shortcoming of brucellosis serology is the impossibility to infer which (smooth) *Brucella* spp. induced antibodies in the host. In this respect, mixed farming and especially raising small ruminants along with cattle, a common practice in the developing world, is reported to be a risk factor and a central question that has to be answered is whether cattle are infected with *B. melitensis* or with *B. abortus* or with both *Brucella* species. Therefore the isolation, identification and molecular characterization of *Brucella* spp. in human and the different livestock species needs to be undertaken to define a sound conceptual framework, identify the source of infection and plan appropriate control measures.

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1. Introduction

In its foreword of the book “People, Pathogens, and Our Planet” – Volume 1: Towards a One Health Approach for Controlling Zoonotic Diseases, Juergen Voegelé, Director of Agriculture and Rural Development,

The World Bank writes the following: “A global surveillance and control system that is established primarily for emerging infectious zoonotic diseases with pandemic potential can be readily improvised to address the endemic diseases that are a priority in many developing countries, few of which have the capacity or resources necessary to monitor or control them effectively” (http://siteresources.worldbank.org/INTARD/Resources/PPP_Web.pdf).

In other words, to date there is no “One Health” surveillance and control system for endemic (i.e., enzootic) diseases like brucellosis, particularly – but not exclusively – in

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developing countries. Such a strong statement contradicts our intuitive feeling that there are benefits for public health and society to be gained by implementing sound control and eradication brucellosis programs for livestock, although such benefits need to be demonstrated, particularly in countries with scarce resources [1]. Should such benefits be documented, does this however mean that they are the outcome of a conceptually sound “One Health” approach?

It is fair to say that there are many unknowns and misconceptions that may lead to the implementation of improvised control measures for endemic diseases as written by Juergen Voegele. It is important to stress that there is an inherent risk that improvised measures might beat best not justified and would not help in providing a sustainable solution or worse, improvisation may be counter-productive or even detrimental. In order to be successful, a “One Health” approach has to be truly multi-disciplinary and every component of a global/holistic approach has to be addressed proficiently in its own right. More, given the changes in the livestock sector, its contact with wildlife and the resurgence and emergence of zoonotic diseases linked to it, a new “One Health” research and policy-generation strategy has to be defined [2]. It is in this context that the World Animal Health Organization (OIE) is endorsing a “One Health” approach which will result in a deeper and sustainable political support for the coordinated prevention of high public health and animal impact diseases at the human-animal interface (<http://www.oie.int/en/for-the-media/onehealth/>).

The aim of the manuscript is to highlight some of the unanswered questions related to the biology of *Brucella* spp. infections in humans and livestock, as well as questions related to brucellosis control measures that besides being efficient should also be realistic in developing countries where human and financial resources are scarce. Such information is needed for the definition of a “One Health” conceptual framework for zoonotic brucellosis in the developing world.

Control and eradication programs of animal brucellosis are implemented in the developed world whereas resources are often not allocated to such programs in developing countries. Epidemiological studies in these countries rely almost exclusively on brucellosis serology. Shortcomings of serology will be highlighted by reviewing scientific publications from Uganda, one of the few developing countries where brucellosis has been extensively studied for the last 15 years. From the human health perspective, the benefit of mass vaccination of livestock and the dramatic public health consequences following the absence or the discontinuation of animal vaccination campaigns will be illustrated by situations prevailing in Mongolia and Greece. Risk factors related to husbandry practices like nomadism and mixed herds will be addressed and the importance of non-classical livestock species and wildlife as a source of *Brucella* spp. for people will be highlighted. Finally, recommendations related to targeted actions will be made in the context of a sound conceptual brucellosis “One Health” approach.

2. Brucellosis control and eradication programs

Currently, about half a million human brucellosis cases are annually reported worldwide but the estimated number of unreported cases due to the unspecific clinical symptoms of the disease is supposed to be 10 times higher. In endemic countries prevalence rates often exceed 10 cases per 100,000 population [3]. Brucellosis is transmitted to humans from direct contact with livestock (occupational disease for abattoir personnel, farmers and veterinarians for example) or more often by ingestion of unpasteurized milk or milk products [4]. In heifers that aborted, *B. abortus* is found in the uterus, in milk, in the mammary glands and associated lymph nodes [5]. Of significant epidemiological importance, *B. abortus* was also found in weak and healthy calves born from experimentally infected heifers [5].

The consumption of cattle, sheep and goat meat does not seem to play a role, although meat from animals that appear to be sick at the time of slaughter should not be consumed [6]. However, bacteria can be transmitted to humans by unsafe butchering and consumption of undercooked meat. A recent report from Botswana suggests that household bush meat processing practices represent a significant *Brucella* spp. exposure risk to family members and the community [7].

Person to person transmission of brucellosis through breast feeding or by sexual intercourse, although reported [8] is epidemiologically anecdotal and therefore brucellosis in humans almost always originates from an animal reservoir and results from different risk factors and behavioral traits [1,4].

In the developed world, for more than four decades, control and eradication programs of brucellosis in livestock have been implemented by national veterinary services. Classically after a first phase in which the infection is controlled by compulsory vaccination, then vaccination is gradually restricted and eventually prohibited whereas a “test and slaughter” policy is implemented in order to eradicate the infection. More than a decade is usually needed to complete the brucellosis eradication program by a “test-and-slaughter” policy and key for success is a sufficient financial compensation scheme for farmers for their culled livestock. In the European Union (EU), such national programs are co-financed by the EU and the Member States (MSs). This policy has been successfully implemented for bovine as well as ovine and caprine brucellosis in Northern MSs (with the notable exception of bovine brucellosis in the United Kingdom), whereas eradication programs, particularly ovine and caprine brucellosis eradication programs are not yet completed in some Southern European MSs (http://ec.europa.eu/food/animal/diseases/eradication/eradication_bovine_sheep_goats_brucellosis_en.pdf).

Countries are reporting on the national animal health situation to the OIE via the World Animal Health Information Database (WAHID) Interface. This interface provides access to all data held within OIE and can be accessed following the link: <http://web.oie.int/wahis/public.php?page=home>. Unfortunately, the information related to brucellosis that is provided by some developing countries is scarce or absent. In such resource poor countries, the implementation of

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