



The benefits of 'One Health' for pastoralists in Africa

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'One health' is particularly suited to serve mobile pastoralists. Dinka pastoralists in Sudan inspired Calvin Schwabe to coin the term 'one medicine', indicating that there is no difference in paradigm between human and veterinary medicine. Our contemporary definition of 'one health' is any added value in terms of improved health of humans and animals or financial savings or environmental services resulting from a closer cooperation of human and animal health sectors. Here we present a summary of 'one health' studies with mobile pastoralists in Africa which were done in research partnership, demonstrating such an added value. Initial joint human and animal health studies revealed higher livestock vaccination coverage than in the pastoralist community, leading to joint animal and human vaccination intervention studies which demonstrated a better access to primary health care services for pastoralists in Chad. Further simultaneous animal and human serological studies showed that camel breeding was associated with human Q-fever seropositivity. In Borana communities in Ethiopia, human cases of *Mycobacterium bovis* infection could be related to strains isolated from cattle. A challenge remained with regard to how to assess vaccination coverage in mobile populations. With the advent of mobile phones, health and demographic surveillance could be established for mobile pastoralists and their animals. This presents vast possibilities for surveillance and control of human and animal diseases. Pastoralists prefer a 'one health' approach and therefore contribute toward the validation of this concept by showing real added value of the cooperation between human and animal health services.

Introduction

The Human and Animal Health Unit at the Swiss Tropical and Public Health Institute, Basel, Switzerland, is a multidisciplinary research unit working with partner institutions in nine countries in Africa (Ethiopia, Kenya, Chad, Mali, Mauritania, Côte d'Ivoire) and Asia (Kyrgyzstan, Mongolia, Vietnam). We focus on health research for mobile pastoralists and the control of zoonotic diseases in developing countries. Several of these diseases are emerging and many zoonotic diseases are also categorised as neglected diseases. Pastoralist populations in these countries are often marginalised by government healthcare systems because of the remote location of their camps and villages or high mobility (Schelling *et al.* 2010). Several of our studies have shown that the application of the 'one health' concept is especially valuable in the settings of mobile pastoralism (Schwabe 1964). This review summarises the importance of 'one health' for pastoralists in Africa.

The Sahel ecosystem and its inhabitants

The Sahelian belt is a semi-arid zone which borders the southern aspect of the Sahara Desert, spanning Africa east to west from Ethiopia to Mauritania. It forms a corridor through the continent where highly mobile populations have lived for a long time. The ecological zone in the central regions includes a rainy season from June to September and a dry season from October to May. This unique ecosystem led to the development of specific agricultural inventions. One important form is mobile pastoralism which allows for the breeding of large herds of cattle, camels, goats and sheep by following the cycle of pasture growth during the seasons (Wiese 2004). Many different ethnic groups practise this way of life in the Sahelian belt. In Chad, for example, the Fulani, Gorane and Arab groups prevail in the Lake Chad basin (Cerezo *et al.* 2011; Jean-Richard *et al. in press[a]*). Social science and anthropological studies have investigated the requirements for adequate healthcare in different mobile pastoralist ethnic groups. These studies show, amongst other things, that it is crucial to plan health interventions for populations with respect to their cultural definition of the human body and the forces influencing their health (Münch 2012).

The evolution of 'One Health'

In the early 1960s, Calvin W. Schwabe, a veterinarian with a background in biology working in Southern Sudan at the time, observed that Dinka pastoralists maintained an integrated attitude

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toward humans and animals. Inspired by this observation, Schwabe developed the concept of 'one medicine', stating that 'human and veterinary medicine share a common body of knowledge in anatomy, physiology, pathology and the origins of diseases in all species' (Schwabe 1964) and thereby recognising the mutual benefits available through the connection of veterinary medicine and human health. Today, this concept is expanded to 'one health': further recognising the inextricable linkage of human, livestock, companion animal and wildlife health and implying an added value to the health and wellbeing of humans and animals (Zinsstag *et al.* 2011). Closer cooperation of human and animal healthcare provision can also lead to financial savings in different sectors (Zinsstag *et al.* 2005). The concept of 'one health' has important potential, especially in developing countries such as many of the Sahelian nations, where our unit works in close collaboration with local partners, communities and ministries.

Past research, results and consequences

A 1999–2000 study on the health of mobile pastoralists in Chad, where approximately 1000 people and animals were examined, found hardly anyone who did not report a health problem (Daugla *et al.* 2004). More cattle had been vaccinated than children and women; and no children had been vaccinated completely according to the standards of the Expanded Programme on Immunization of the United Nations (EPI). Nevertheless, the people rarely sought care in health centres, coming only at late stages of illness, with the result that many diseases remained untreated (Schelling *et al.* 2005). Similar studies in Mali showed higher child mortality in mobile pastoralist populations than in the sedentary population (Münch 2012). In addition, mobile pastoralists face a higher risk for zoonotic diseases than do sedentary populations because of their deep dependence on and close contact with their livestock (Dean *et al.* 2013). Practices such as consumption of raw milk and meat favour the transmission of brucellosis, bovine tuberculosis and anthrax. It has also been possible to show the direct relationship of camel breeding and human Q-fever seroprevalence (Schelling *et al.* 2003). On the basis of these findings, a first collaborative intervention project applying 'one health' was initiated, planning and implementing a joint vaccination campaign for both livestock and children in mobile pastoralists in Chad (Béchir *et al.* 2004; Schelling *et al.* 2007; Zinsstag *et al.* 2005). This campaign showed not only a health benefit but also the economic benefit in terms of savings made by the Chadian Public Health and Animal Health Ministries from closer cooperation between the public health and veterinary sectors. It laid the foundation for further joint health interventions in the country.

Combined investigations of zoonotic disease surveillance, performed simultaneously in both humans and animals, have also been shown to be highly effective in terms of identifying epidemiological linkages. Studies in Ethiopia on

bovine and human tuberculosis demonstrated that bovine tuberculosis can be transmitted to humans and vice versa (Gumi *et al.* 2012).

Human nutrition includes a wide variety of animal-source foods. For mobile pastoralists, their entire diet depends on their livestock, as meat and milk are consumed directly or sold in order to gain money to buy cereals (Münch 2012). This strong dependence of the people on their livestock shows clearly the importance of healthy herds. Herd losses as a result of prolonged dry seasons or disease have a direct effect on the mobile pastoralists, resulting in malnutrition and vitamin deficiencies. Because fruits and vegetables are not part of the mobile pastoralist diet, milk is the primary source of vitamin A. This interrelationship was shown by studies on vitamin A in Chadian mobile pastoralists which demonstrated a direct relationship between the retinol levels in the women's blood and in the livestock's milk (Béchir *et al.* 2012b; Zinsstag *et al.* 2002). Such findings serve as indicators for the health status not only of humans but also the ecosystem, as vitamin A levels in milk depend on the pasture quality which is, in turn, dependent on climate (Zinsstag *et al.* 2002). The hostile environment where pastoralists live exposes them to wind, dust, humidity, heat and lack of access to safe drinking water. These conditions also favour the prevalence of parasitic infection which is very high at 63% amongst women (95% CI: 55–72) and 60% amongst children (95% CI: 53–77) (Béchir *et al.* 2012a).

Demography and health surveillance of mobile pastoralists

An estimated 20 million–30 million mobile pastoralists live in the Sahelian belt. In most countries, little demographic data is available and, in particular, the assessment of mobile populations was originally very difficult with previously-existing technologies (Weibel *et al.* 2011). Today, communication tools such as mobile phones and the expanding mobile communication network open up completely new possibilities. A study aiming to exploit these new capabilities and their usefulness for the development of demographic and health surveillance systems amongst mobile pastoralists was carried out from 2010 to 2012 in Chad (Jean-Richard *et al.* 2014). Groups of mobile pastoralists were enrolled in the study and contacted regularly by mobile phone in order to gather information on the birth, death and health status of the community. About half of the groups already owned mobile phones at the time of enrolment. The study showed that the use of mobile phones for obtaining plausible demographic and health surveillance data is both feasible and well accepted, indicating future promise with regard to expanding the project in Chad and adapting the system to mobile populations in other Sahelian countries. During this study, demographic data on livestock herds was also collected, revealing the potential to combine both human and animal health surveillance using mobile phones (Jean-Richard *et al. in press*[a]).



Continuing 'One Health' projects

Building upon the long-standing relationship with the mobile pastoralist community and the partner institutions in Chad, new projects were developed which aimed to meet the demands that arose from the mobile pastoralists. An early perception of the pastoralists was that although access to veterinary care was limited, human health needs were addressed even less often. This led to further work to assess vitamin A status more broadly in the human population and cattle, as well as to explore the link between pasture and cattle. Subsequently, their priority was the important economic losses as a result of infection of the livestock with *Fasciola gigantica*. This infection weakens the animals, leading to reduced milk and meat production and an increased number of abortions. *Fasciola gigantica* is a parasite which has a freshwater snail as its intermediate host. This is also the case for *Schistosoma haematobium* and *Schistosoma mansoni*, two parasite species which infect humans. In Chad, currently, more data is available on livestock fascioliasis than on human schistosomiasis (Jean-Richard *et al.* in press[b]; Massenet, Abakar & Karifene *et al.* 1995; Massenet *et al.* 2012). An ongoing project will further deepen the understanding of the epidemiology of human schistosomiasis and livestock fascioliasis in mobile pastoralists and their livestock in Chad. Our work expands the 'one health' approach to 'health in social-ecological systems', addressing the dynamics of both human and animal populations and their ecosystem determinants (Zinsstag *et al.* 2011; Zinsstag 2012).

Conclusion

The shared objective of all research in the unit is to improve human and animal health in a sustainable way. The research ideally contributes to the development and implementation of locally adapted and accepted health interventions which are supported by the communities as well as the ministries. Applying the 'one health' approach in challenging settings such as the Sahelian belt has proven to be successful in many of these projects. Involving representatives of the mobile pastoralists, the research community and the ministries in the planning of projects and interventions is crucial and leads to strong engagement for common goals and solutions.

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Competing interests

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

Authors' contributions

J.Z. (Swiss Tropical and Public Health Institute; University of Basel) was the project leader. E.S. (Swiss Tropical and Public Health Institute; University of Basel), J.-R.V. (Swiss Tropical and Public Health Institute; University of Basel), M.B. (Centre de Support en Santé Internationale), L.C. (Swiss Tropical and Public Health Institute; University of Basel) and H.G. (Swiss Tropical and Public Health Institute; University of Basel) were responsible for experimental and project design and performed most of the experiments. E.S., I.O.A. (Institut de Recherche en Elevage pour le Développement) and B.B.

(Centre Suisse de Recherches Scientifiques) made conceptual contributions. H.G. wrote the manuscript.

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