Knowledge, attitudes and practices towards spotted fever group rickettsioses and Q fever in Laikipia and Maasai Mara, Kenya

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Abstract

Many factors contribute to misdiagnosis and underreporting of infectious zoonotic diseases in most sub-Saharan Africa including limited diagnostic capacity and poor knowledge. We assessed the knowledge, practices and attitudes towards spotted fever group rickettsioses (SFGR) and Q fever amongst local residents in Laikipia and Maasai Mara in Kenya. A semi-structured questionnaire was administered to a total of 101 respondents including 51 pastoralists, 17 human health providers, 28 wildlife sector personnel and 5 veterinarians. The pastoralists expressed no knowledge about SFGR and Q fever. About 26.7% of the wildlife sector personnel in Laikipia expressed some knowledge about SFGR and none in Maasai Mara. None of these respondents had knowledge about Q fever. About 45.5 and 33.3% of the health providers in Laikipia and Maasai Mara respectively expressed knowledge about SFGR and 9.1% in Laikipia expressed good knowledge on Q fever and none in Maasai Mara. The diseases are not considered amongst potential causes of febrile illnesses in most medical facilities except in one facility in Laikipia. Majority of pastoralists practiced at least one predisposing activity for transmission of the diseases including consumption of raw milk, attending to parturition and sharing living accommodations with livestock. Education efforts to update knowledge on medical personnel and One-Health collaborations should be undertaken for more effective mitigation of zoonotic disease threats. The local communities should be sensitized through a multidisciplinary approach to avoid practices that can predispose them to the diseases.

Introduction

Laikipia and Maasai Mara ecosystems have high levels of biodiversity and diverse land use practices ranging from pastoralism to commercial ranching, agriculture, wildlife conservation and ecotourism. Wildlife in most parts share habitats and other resources with humans and livestock which can be of particular concern in disease transmission,[1] including spotted fever group rickettsioses (SFGR) and Q fever which are important zoonotic diseases considered emerging or re-emerging worldwide.[2,3] The SFGR describe a group of tick-transmitted zoonotic diseases caused by the intracellular bacteria of the genus Rickettsia.[4] Q fever is also a zoonotic disease caused by the highly infectious intracellular bacterium *Coxiella burnetii*.[5]

The SFGR are transmitted by various species of ticks[4] and are characterized by non-specific clinical signs that include fever, headache, malaise, myalgia, nausea and vomiting.[6] Sometimes, the diseases can be severe and fatal.[7,8] They have been described as the second most common cause of fever among travellers returning from sub-Saharan Africa after malaria.[9] Q fever has different modes of transmission which include inhalation, contact with body fluids of infected animals[10,11] and consumption of infected animal products such as untreated milk.[11] Ticks are the natural primary reservoir of *C. burnetii* and responsible for transmission in wild and domestic animals.[5] The possibility of tick transmission of Q fever to humans has also been reported.[12] Q fever in animals is associated with various reproductive problems and if neglected in a herd, it can cause great financial losses in the long term.[5] In humans, Q fever presents either as an acute or chronic disease. The acute form is self limiting and characterized by non-specific symptoms such as fever, headache, fatigue, myalgia, nausea and vomiting and sometimes signs of pulmonary disease and granulomatous hepatitis.[12] The main presentations of the chronic form include endocarditis, osteomyelitis, granulomatous hepatitis or endovascular infection[11,12] as well as chronic fatigue syndrome and spontaneous abortions in pregnant women.[5]

Both SFGR and Q fever are underreported and underappreciated causes of illnesses in local populations in most sub-Saharan Africa despite being reported among tourists who visit game reserves.[6,13,14] This may be attributed to lack of awareness and the challenges of making diagnosis in febrile patients in Africa.[15,16] These diseases therefore may be amongst the *fevers of unknown origin* whose etiologies are often not the focus of health providers or are impossible to diagnose because of lack of diagnostic capacity.[16] This study evaluated the knowledge, attitudes and practices of local residents towards SFGR and Q fever at the livestock-wildlife interfaces in Laikipia and Maasai Mara ecosystems of Kenya. It was conducted amidst increasing reports in Kenya of SFGR[8,14,17] and Q fever.[13,18,19]

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Materials and Methods

Study design and setting

A semi-structured questionnaire was administered to local residents in selected areas in Laikipia and Maasai Mara ecosystems, which form some of the most important wildlife areas in Kenya. Laikipia ecosystem comprises the entire Laikipia County, which is about 9500 km^2. It is located in the central region of Kenya between latitude 0°53'N and 0°16'S and longitude 36°11' and 37°23'E and forms one of the most important areas for wildlife in Kenya with much of it covered by large private or community owned ranches populated by livestock sharing the land with free ranging wildlife. The interviews were conducted in Ol Pejeta Conservancy, Lewa wildlife conservancy, Laikipia national park, Nanyuki town as well as Ngare Ngiro and Mpala sub-locations. These sites represent different land

use practices. Ol Pejeta and Lewa wildlife conservancies are fenced private ranches that practice both commercial livestock ranching and wildlife conservation and eco-tourism. Laikipia national park is the newest park in Kenya created in 2011 and forms part of a larger conservation landscape within Laikipia ecosystem. Nanyuki is a cosmopolitan town and the headquarters for Laikipia County. The other two sites primarily practice mixed species livestock keeping which share pastures and watering points with wildlife. The Maasai Mara ecosystem comprises the Maasai Mara national reserve and numerous surrounding group ranches within Narok County in southwestern Kenya and on the northern tip of the Serengeti national park in Tanzania. The national reserve is approximately 1510 Km^2 and lies between latitudes 1°13' and 1°45'S and longitudes 34°45' and 35°25'E. The interviews were conducted in the national reserve and Nabosho community conservancy where wildlife conservation and eco-tourism are the predominant land use practices but the local community is allowed controlled access to graze and water their livestock. The other sites included Siana, Aitong, Talek, Nkoilale and Sekenani all outside the national reserve and main land use practice being livestock keeping with the animals sharing pastures and watering points with wildlife.

Study population

The participants included pastoralists, human health providers, veterinarians and personnel in the wildlife sector. The main population composition in Laikipia and Maasai Mara are the pastoral Samburu and Maasai communities respectively. The two communities are closely related, hold deep cultural and traditional practices and practice semi-nomadic lifestyles and therefore their settlements are widely dispersed. The respondents were selected through key informants who included village elders, chiefs, assistant chiefs and local opinion leaders such as human health providers and veterinarians. The key informants also provided other relevant information about the areas such as accessibility and availability of respondents. For purposes of this study, human health providers refereed to personnel who diagnose and treat human patients. In Kenya, this includes a range of personnel such as medical officers, clinical officers and nurses. The personnel operate in medical facilities that are either government, community, church or privately owned. The veterinarians referred to personnel who diagnose and treat animals and operate government or private veterinary facilities. The wildlife sector personnel were drawn from the Kenya wildlife service, the government entity that manages wildlife in Kenya, or private and community conservancies.

Table 1. Household positions of pastoralists interviewed in Laikipia and Maasai Mara, Kenya.

	Head	Spouse	Son	Employee
Laikipia	77.3	4.5	4.6	13.6
Maasai Mara	89.7	0	10.3	0

Data collection

A semi-structured questionnaire administered by the co-investigators was the main tool used to collect the data between October and December 2015. To ensure objectivity in collection of the data, field pretesting of the questionnaire was done in February 2015 on a small sample of the target respondents, which was not included in the study. The questionnaire was translated to the local Maasai and Samburu languages for pastoral respondents not conversant with English. The respondents from the pastoral communities and wildlife sector personnel were selected based on convenience of access to the sites, their availability and areas with livestock-wildlife interactions. A list of medical and veterinary facilities within the two regions was compiled and seven medical facilities from each area and three veterinary facilities in Laikipia and two in Maasai Mara were selected.

The questionnaire focused on specific issues for each category of respondents. For the pastoralists and wildlife sector personnel, these included interactions between livestock and wildlife and the types of problems encountered, diseases of importance shared between livestock and wildlife, zoonotic diseases including tick-borne and their clinical manifestations, modes of transmission of zoonotic infections and preventive measures taken against zoonotic infections. For the medical health and veterinary personnel, the issues included zoonotic diseases found in patients including tick-borne, clinical signs of SFGR and Q fever, number of patients diagnosed with SFGR and Q fever, differential diagnosis of SFGR and Q fever and laboratory diagnostic methods for SFGR and Q fever and whether laboratory diagnoses is routinely done in non-specific febrile illnesses.

Ethical issues

This was a non-invasive study since no samples were collected from the participants. Authority to conduct this study had been obtained from Kenya Wildlife Service whose personnel assisted in the study and as key informants. Government administrators and community leaders also participated in the study as key informants. Participation in the study was voluntary. Informed consent was obtained from individual respondents and community leaders. Ethical considerations were fulfilled by obtaining verbal consent and ensuring confidentiality.

Data analysis

Responses were examined for completeness, errors and inconsistencies before being entered into MS Access database. Analyses were performed using STATA/SE 11.2 and MS Excel packages. The results were summarized and presented in tables and graphs. The Z-test and chi-square were used to test relationships.

Results

The questionnaire was administered to 101 respondents comprising pastoralists (n=51), medical health providers (n=17), wildlife sector personnel (n=28) and veterinary personnel (n=5) in different sites in both study areas.

Pastoralists

Of the 51 pastoralists interviewed, 22 (43.1%) were from Laikipia and 29 (56.9%) from Maasai Mara. The positions of the respondents in the household are summarized in Table 1. Majority of the respondents were men who were the household heads.

The mean age of the respondents was 50 years in Laikipia and 40 years in Maasai Mara. In Laikipia, the respondents were from Mpala sub-location, Ngare Ngiro sub-location, Ol Pejeta conservancy and Lewa wildlife conservancy. In Maasai Mara, the respondents were from Aitong, Nkoilale, Sekenani, Siana and Talek.

The main livestock kept by the respondents were cattle, sheep and goats. Cattle were kept by all households in both study areas. Goats and sheep were kept by an equal number of households at a proportion of 17/22 (77.3%) in Laikipia. In Maasai Mara, goats were kept by all the households and sheep by 28/29 (96.6%) of the households. Other livestock kept included donkeys, camels, chicken and rabbits by much smaller proportions of the households.

All respondents in both study areas expressed that wildlife was present in their localities where it interacted with their livestock in grazing fields and watering points. Transmission of diseases between livestock and wildlife and predation were listed as the main problems arising from this interaction at equal proportions of 21/22 (95.5%) and 27/29 (93.1%) of the respondents in Laikipia and Maasai Mara respectively. This was followed by competition for pastures and water at 18/22

(81.8%) in Laikipia and 20/29 (69.0%) in Maasai Mara. Other problems such as destruction of crops and properties by wildlife and injuries to humans and livestock were listed by less than 20% of the respondents.

All respondents in both study areas had knowledge about tick-borne diseases and gave examples including anaplasmosis, East Coast Fever (ECF) and babesiosis. A significant proportion of the respondents had knowledge that tick-borne diseases can infect humans. These were 13/22 (59.1%) in Laikipia and 18/29 (62.1%) in Maasai Mara. A smaller proportion of 6/22 (27.3%) in Laikipia and 8/29 (27.6%) in Maasai Mara said there are no tick-borne diseases that can infect humans while 3/22 (13.6%) in Laikipia and 3/29 (10.3%) in Maasai Mara said they did not know.

The respondents who were aware about tick-borne zoonotic diseases however listed diseases such as ECF, babesiosis and anaplasmosis, which are not zoonotic except one in Laikipia who listed African tick-bite fever. They described the clinical signs in humans to include fever, vomiting, wounds, abortion, coughing, headache, itching, joint pains, swelling and watery eyes. This was interpreted to mean that despite not knowing the diseases by specific names, they were aware tick-borne diseases could infect humans. The respondents in both study areas do not undertake any deliberate efforts to minimize tick bites.

The respondents were asked to give examples of other zoonotic diseases not necessary tick transmitted. At least half of the respondents, 11/22 (50%) in Laikipia and 16/29 (55.2%) in Maasai Mara, listed at least one of the following diseases: anthrax, brucellosis, helminthoses, leptospirosis, trypanosomiasis and diarrheal diseases. They listed the modes of transmission to include consumption of meat and untreated milk, contact with sick animals, handling materials from sick animals, inhalation, ecto-parasites (lice, fleas and ticks) and sharing sleeping quarters with animals. Sharing of sleeping quarters with sheep and goats was a common practice identified during the study particularly for young boys and respiratory problems attributed to allergy were said to be common by 8/22 (36.4%) and 4/29 (13.8%) of the respondents in Laikipia and Maasai Mara respectively. The respondents did not name any diseases that resembled SFGR or Q fever in livestock and humans.

Some practices were identified as potential risk factors that can predispose the pastoralists to SFGR and Q fever. These included sharing of human living accommodations with livestock by some households, consumption of raw milk and own treatment of livestock including attending to parturition due to inadequate veterinary presence in both Laikipia and Maasai Mara.

Wildlife sector personnel

The respondents included wardens, managers of private conservancies, rangers and researchers. Of the 28 respondents, 15 (53.6%) were from Laikipia and 13 (46.4%) from Maasai Mara. The respondents in Laikipia were from the Kenya Wildlife Service (2/15), Lewa wildlife conservancy (8/15) and Ol Pejeta conservancy (5/15). The respondents in Maasai Mara were from inside the reserve (10/13), Kenya Wildlife Service (1/13) and Nabosho community conservancy (2/13).

Thirteen out of the 15 (86.7%) and 12/13 (92.3%) of the respondents in Laikipia and Maasai Mara respectively said there is interaction between livestock and wildlife in their localities. Transmission of diseases was placed third in both areas after predation and competition for water and pastures as the most common problem arising from this interaction. The proportions were 9/15 (60%) in Laikipia and 5/13 (38.5%) in Maasai Mara. Predation and competition had proportions of 13/15 (86.7%) and 12/15 (80%) of the respondents in Laikipia, and equal proportions of 6/13 (46.2%) in Maasai Mara. habitat destruction was given by a small proportions of the respondents in both areas.

Significant proportions, 10/15 (66.7%) in Laikipia and 8/13 (61.5%) in Maasai Mara, had knowledge that diseases can be transmitted at the livestock-wildlife interfaces. These diseases were listed as foot and mouth disease (FMD), anthrax, ECF, Malignant Catarrhal Fever (MCF), anaplasmosis and babesiosis.

A smaller number of the respondents in both study areas had knowledge that tick-borne diseases can affect humans. These were 6/15 (40%) in Laikipia and 2/13 (15.4%) in Laikipia. An equal number in Laikipia, 6/15 (40%), said there are no human tick-borne diseases and a slightly higher proportion of 7/13 (53.9%) in Maasai Mara responded the same. Smaller proportions of 1/15 (6.7%) in Laikipia and 1/13 (7.7%) in Maasai Mara said they did not know if this is possible. When the respondents were asked to give examples of human tick-borne diseases, only 4/15 (26.7%) of the respondents in Laikipia listed African tick-bite fever. There were no respondents in Maasai Mara who could name an example of a human tick-borne disease.

The respondents with knowledge of human tick-borne diseases listed the clinical signs as fever, headache, nausea, pneumonia and itching and skin rash on tick-bite areas. One out 15 (6.7%) respondents in Laikipia listed orchitis as a clinical sign. Eleven out of 15 (73.3%) and 6/13 (46.2%) in Laikipia and Maasai Mara respectively, said people with tick-associated problems seek medical attention but they were not aware of the diagnoses made. Some of the measures undertaken to prevent tick bites were listed as use of insect repellents, tucking trousers inside socks, avoiding foot patrols in areas with thick vegetation as well as burning or trimming of grass and bushes.

Health providers

Eleven out of 17 (64.7%) health providers interviewed were from Laikipia and the rest, 6/17 (35.3%) from Maasai Mara from 7 medical facilities in each study area that were either public (government), private, community or faith-based. In Laikipia, one was a government facility (Nanyuki district hospital), four were private (Aga Khan Hospital, Nanyuki cottage hospital, Lewa dispensary and Kamok dispensary) and two were church funded (Huruma Pope John Paul dispensary and Mary Immaculate dispensary). In Maasai Mara, one was a government facility (Sekenani health centre), three were community owned (Aitong health centre, Koyoin community clinic and Talek community health centre) and the other three were private (Manyatta medical clinic, Mara medical clinic, Naibor medical clinic).

The respondents consisted of personnel who examine, diagnose and treat patients such as doctors, nurses, clinical officers or those who analyze samples such as laboratory technicians (Table 2). In Talek community health center in Maasai Mara however, a pharmacology technician was found to be examining, making diagnosis and treating patients and was subsequently interviewed.

The doctors and one nurse had training up to degree level. The other nurses, the clinical officers and the laboratory technician had training to diploma level and the pharmacology technician had a certificate in pharmacology. On average, the respondents had 3.7 and 2.7 years in the facilities they operated in Laikipia and Maasai Mara respectively.

Table 2. Number of health providers interviewed in Laikipia and Maasai Mara, Kenya.

	Doctors	Nurses	Clinical Officers	Lab Technicians	Pharmacology Technicians	Total
Laikipia	3	4	3	1	0	11
Maasai Mara	0	3	2	0	1	6

Nine out of 11 (81.8%) and 5/6 (83.3%) of the respondents in Laikipia and Maasai Mara respectively indicated that they receive patients with zoonotic diseases. They gave examples as brucellosis, rabies, bovine tuberculosis, Rift Valley Fever, Echinococcosis (hydatid disease), trypanosomiasis, anthrax, helminthoses and sarcoptic mange (scabies).

Less than 50% of the respondents in both study areas had knowledge of human tick-borne diseases with a proportion of 5/11 (45.5%) in Laikipia and 2/6 (33.3%) in Maasai Mara expressing some good knowledge. These respondents listed African tick-bite fever as an example of a tick-borne zoonotic disease. The other disease listed was Lymes disease by 2/11 (18.2%) in Laikipia and no respondent in Maasai Mara. Four out of 11 (36.4%) human health providers in Laikipia and 4/6 (66.7%) in Maasai Mara expressed no knowledge on human tick-borne diseases while 2/11 (18.2%) in Laikipia and none in Maasai Mara said they did not know.

One out of 11 (9.1%) respondents in Laikipia expressed very good knowledge on Q fever while none expressed any knowledge on the disease in Maasai Mara. The respondent further indicated SFGR and Q fever as illnesses diagnosed in international travellers in the medical facility. This was the only facility in both Laikipia and Maasai Mara that finds it necessary to confirm rickettsial infections and Q fever in patients with fever particularly international travellers.

Veterinary personnel

The veterinary personnel operated government owned facilities and had training to degree level. Four out of five were from Laikipia, two each from Ol Pejeta and Lewa wildlife conservancies and 1/5 was from Sekenani in Maasai Mara. On average, they had 3.6 and 2 years in their current stations in Laikipia and Maasai Mara respectively. All the respondents had knowledge of tick-borne diseases in animals that included anaplasmosis, babesiosis, ECF and ehrlichiosis. They also had knowledge of potential zoonotic nature of tick-borne rickettsioses and Q fever amongst other diseases such as anthrax, bovine tuberculosis, rabies and brucellosis. None of the respondents has come across either disease in animals and humans and neither do they find it necessary to confirm these diseases in animals.

Discussion

This study shows that there is low level of knowledge about SFGR and Q fever amongst the respondents, being more marked in pastoralists. This is despite a significant proportion (>50%) of the pastoralists having very good knowledge about diseases shared between livestock and wildlife. The finding is consistent with other studies[19] which reported that the local pastoralists in Laikipia had no knowledge about Q fever but most of the other interviewees that included conservation professionals, human healthcare providers, veterinary practitioners and rangeland management experts expressed both awareness and concern about Q fever. They attributed the pastoralists' lack of familiarity with Q fever to the absence of a specific word for the disease in local dialects. The same could be said for the findings in this study for despite demonstrating good familiarity with and concern about livestock and zoonotic diseases such as brucellosis, trypanosomiasis, helminthoses, anthrax, diarrheal diseases, leptospirosis, FMD, MCF, ECF, anaplasmosis and babesiosis amongst others, the diseases described in their local dialect did not resemble either SFGR or Q fever. Sharing living accommodations with animals, consumption of untreated milk and attending to parturition were identified as some practices that can predispose the pastoralists to zoonoses including SFGR and Q fever. Generally within the east African region, there seems to be a low level of knowledge towards many zoonotic diseases raising concerns about their under-diagnosis and under-reporting. For example some studies have reported low level of knowledge amongst communities and medical practitioners towards different zoonotic infections such as non-malarial febrile illnesses, rabies, echinococcosis, trypanosomiasis, anthrax and bovine tuberculosis.[20-22]

The low level of knowledge on SFG rickettsioses and Q fever amongst most respondents raises concerns about the potential risks posed by the diseases in local residents. These findings also suggest that the diseases could be circulating unnoticed in the two areas especially because most medical facilities do not investigate the possibility of presence of the diseases in febrile patients even when the etiology is not established. Thus, the diseases could be amongst the *fevers of unknown origin* recorded in most medical facilities.

The study further identified certain practices, which could also predispose the local residents to zoonotic transmission of the diseases. These included consumption of raw milk and treatment of own livestock including attending to parturition which can predispose humans to Q fever should the animals be infected.[11] Sharing living accommodations with livestock can promote transmission of Q fever through inhalation of dust contaminated with fluids and secretions from infected animals as well as direct contact with these materials.[10,11] Further, such close contact with the animals can expose the owners to tick bites, the main mode of transmission of SFG rickettsioses[2] and sometimes Q fever.[12]

Conclusions

Low level of knowledge to SFGR and Q fever was found amongst most respondents. This was more marked in the pastoralists who had no knowledge on both diseases. There is need to undertake education efforts to update knowledge particularly on medical personnel as well as strengthen One-Health collaborations in order to effectively mitigate the zoonotic threats of these diseases. The local communities should also be sensitized through a multidisciplinary approach to avoid practices that can predispose then to the diseases.

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