Improving capacity for foot-and-mouth disease surveillance and prevention in Africa through direct community engagement

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Summary

Foot-and-mouth disease (FMD) poses a substantial threat to sustainable livestock development in sub-Saharan Africa. Research carried out in northern Tanzania has shown that FMD risks in rural communities are driven by livestock-related factors. Prevention of infection in livestock, including cattle vaccination and movement control, is therefore expected to be an effective approach towards reduction of national- and local-level impacts of disease. However, work is still required to develop vaccines relevant to local circulating virus strains, and to design appropriate control strategies. Knowledge exchange mechanisms allowing researchers to identify locally-specific prevention approaches likely to be effective in a given setting, and communities to make use of research findings to manage disease risks in their herds are critical for reducing FMD impacts. Here we describe the first of a series of workshops targeting traditional livestock-keeping communities of northern Tanzania. The workshop brought together a range of stakeholders including livestock owners involved in the research, government-level representation, people of authority in the village, field team members and scientists. The overall aim was to facilitate discussions on how scientists and communities could best work together to improve capacity and develop joint agendas for FMD surveillance and prevention in these settings. FMD epidemiology, risk factors and prevention mechanisms were firstly reviewed using participatory approaches, which allowed bilateral information exchange. Vaccination was identified as the most important prevention strategy overall. Interactive group work followed aimed at identifying available approaches, incentives, barriers, and solutions related to FMD surveillance and prevention in the Tanzanian context, as well as the stakeholders who would need to be involved. A demonstration was finally provided involving the use of devices developed to obtain an immediate in situ diagnosis. Workshop participants expressed a keen interest in continuing to be involved in research efforts, devising joint solutions and contributing to better communication between researchers and communities.

Foot-and-mouth disease (FMD) research platforms established by the Boyd Orr Centre for Population and Ecosystem Health (BO) in northern Tanzania have targeted local communities within agro-pastoralist, pastoralist and rural smallholder production systems. Feedback of research findings, critical to enhance community engagement and develop a locally-specific FMD control programme, has been slow and limited. The main reason for this has been the lack of local capacity for testing diagnostic material and

therefore the considerable time required to obtain and analyse diagnostic results through the World Reference Laboratory in the UK (The Pirbright Institute). As a result many disease events have gone unreported or unconfirmed. In addition, limited information provided to livestock owners on available strategies to prevent the introduction and spread of FMD into individual herds has resulted in multiple outbreaks with considerable household-level impacts.

In order to address these gaps, community-based workshops have been designed and planned in areas involved in FMD research activities in north-western Tanzania, including agro-pastoralist, pastoralist and rural smallholder systems. Here we report on the first of these workshops targeting agro-pastoralist communities of Serengeti District that have been monitored for FMD infection since 2011 (Fig. 1). The workshop was held on the 21st – 22nd of April 2015 in Mugumu (Fig. 1), where BO research platforms are located. The workshop brought together a range of stakeholders (56 participants) including livestock owners involved in the research, government-level representation (district veterinary and livestock field officers), people of authority in the village (village leaders), field team members and scientists.

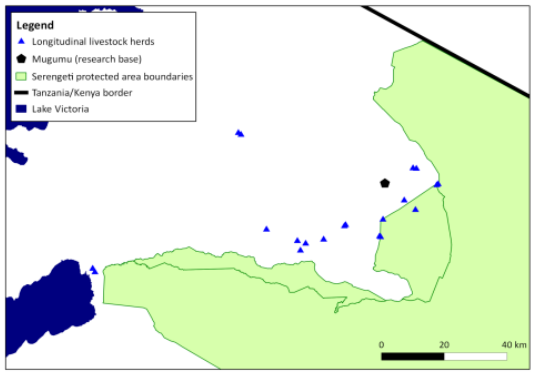

Fig. 1 – Location of longitudinal cattle herds routinely monitored for foot-and-mouth disease infection in agro-pastoralist areas to the west of the Serengeti protected area boundaries (northern Tanzania).

Specific objectives of the workshop were:

Objective 1) To review the epidemiology of and risk factors for FMD in the area based on local knowledge and the results of the research conducted so far;

Objective 2) To review available prevention mechanisms and the role that individual owners and the community more widely can play in FMD reporting and prevention;

Objective 3) To put the knowledge gathered through Objectives 1) and 2) into practice in order to develop a locally-specific FMD reporting and prevention plan considering:

a. What approaches are already available to the community;

b. What the incentives for FMD reporting / prevention are from the perspective of livestock owners in these communities;

c. What the current barriers to better FMD reporting / prevention are;

d. What options are available to address these barriers; and

e. The stakeholders who would need to be involved and could help implement the devised plan.

Objective 4) To discuss options which could be used to strengthen FMD surveillance capacity in remote locations and could improve community motivation to report outbreaks.

To address **Objectives 1)** and **2)** a range of participatory tools were designed, developed and used, recognising that local people have very rich knowledge about infectious disease problems affecting the health of their livestock. Workshop participants could therefore draw upon their knowledge while at the same time receiving feedback on research findings by the scientific team in order to advance their understanding of risk factors for FMD and strategies to prevent this disease in the area.

Objective 1) To review the epidemiology of and risk factors for FMD in the area based on local knowledge and the results of the research conducted so far

Participants were split into three groups and provided with a background scenario illustrating an FMD infected cow (Fig. 2). They had also access to a selection of cards showing factors involved and not involved in FMD infection (Fig. 3). Within each group participants were asked to select the cards they felt accounted for FMD infection in their herds / communities and then to rank their importance using "tokens". A total of 4 tokens were given to each person, who was then asked to place them on the cards which they considered described the factors most likely to result in FMD infection. Therefore, the greater the number of tokens on a given card, the more important the risk factor was ranked (Fig. 4). Each group was then asked to report their results (Table 1) to the rest of the participants. Discussions were subsequently held to provide clarifications as to the factors (i.e. livestock-related as opposed to wildlife-related), which research in the area has identified as most important in driving FMD infection in livestock.

Fig. 2 – Illustration showing a cow with clinical signs consistent with foot-and-mouth disease.

Fig. 3 – Examples of illustrations showing factors involved or not involved in foot-and-mouth disease transmission.

Fig. 4 – Cards illustrating potential factors associated with foot-and-mouth disease as selected by workshop participants. The number of tokens on each card relates to the relative importance of each factor as determined by the participants.

Table 1. Choice of factors related or not related to foot-and-mouth disease infection provided to workshop participants, and groups' selection. Numbers represent order of importance as determined by each group: the lower the number, the more important the risk factor as ranked by the group. Factors with the same number were ranked as equally important across groups. Purple cells = selected cards. Blank cells = cards which were not selected. RFNR = Risk factor identified by the group but not ranked.

Choice of risk factors provided to participants	Important in FMD transmission	Factors identified by each group		
		Group 1	Group 2	Group 3
Sharing of feed	Y	1=	5=	7
Sharing of communal watering hole	Y	1=	8=	1
Buying FMD infected animal	Y	3	1	2
Wind	Y	4=	3=	RFNR
Interactions with wildlife	Y	4=	5=	4
Going to markets	Y	4=	3=	3
Sharing of communal dip	Y	7=	2	7=
Sharing of farm equipment	Y	7=		RFNR
Putting animals in dirty bomas	Y	7=	11	RFNR
Sharing the village bull	Y	11=	5=	
Calves suckling milk	Y	11=	8=	RFNR
People	Y	RFNR		5=
Indigenous people	Y			
Milk collection/delivery	Y			
Vehicles/bikes	Y			
Dead animals	N	7=	RFNR	
Sun	N			5=
Rain	N			RFNR
Birds	N			7=
Ticks	N		8=	RFNR

Objective 2) To review available prevention mechanisms and the role that individual owners and the community more widely can play in FMD reporting and prevention

A similar approach as described above was used to address this objective. Participants were provided with a background scenario illustrating a healthy cow (Fig. 5). A selection of visual illustrations of factors involved in the prevention of FMD infection as well as scenarios which would not help prevent disease was also available. Within each of the three groups mentioned above

Fig. 5 – Illustration showing a healthy cow and potential mechanisms to prevent foot-and-mouth disease infection.

participants were asked to select the cards illustrating most important preventive measures and to rank their significance using tokens (approximately 4 per person). Results were reported by each group (Table 2) and discussed in the context of mechanisms that the communities themselves may be able to implement given the current lack of vaccines relevant to local circulating strains. Vaccination was identified as the most important prevention strategy overall.

Table 2. Choice of foot-and-mouth disease prevention measures provided to workshop participants, and groups' selection. Numbers represent order of importance as determined by each group: the lower the number, the more important the prevention measure as ranked by the group. Purple cells = selected cards. Blank cells = cards which were not selected.

Choice of prevention measures provided to participants	**Important in FMD prevention**	**Prevention measures identified by each group**		
		Group 1	Group 2	Group 3
Vaccination	Y	1=	1=	2=
Do not buy sick animals when at the market	Y	1=	1=	5=
Separation of sick and healthy animals	Y	4=	7=	5=
No sharing of hay/food between sick and healthy animals	Y	6=	5	5=
No transfer of communal sick bull to farms with health animals	Y	6=	1=	2=
Do not take sick animals to market	Y	6=	4	1
Separation of animals from wildlife	Y	11=	6	2=
Do not take sick animals to communal areas (water/grazing/dips)	Y	10	9	8
No sharing of equipment	Y	6=		
Clean barns/pens etc. which have held sick animals	Y	14	10	
Control entry of people onto farms	Y			
Singing to your animals	N			
Washing cows with soapy water	N		7=	
Put facemasks onto cattle	N			
Put wellington boots onto sore feet	N			
Extra cards drawn by workshop participants				
Quarantine infected areas		3		
Designate areas for grazing		4=		
Reduce herd size		11=		
Politicians should not interfere		11=		

In the context of strategies for FMD prevention, separate discussions were held regarding vaccination as an approach which could be used to prevent FMD in rural Tanzanian communities. Participants were made aware of the complexities related to the epidemiology of the disease in northern Tanzania, with four serotypes known to be circulating, O, A, SAT 1 and SAT 2. These complexities were compared to other parts of the world, for example Latin America where only two serotypes are present or Europe where the disease is not present with the exception of rare outbreaks generally caused by one single serotype at any given time. To illustrate this point cards were produced whereby the different virus types were represented by given colours (Fig. 6). Syringes of the same colour as most of the viruses were also available to illustrate the concept that vaccination would only be effective if vaccines are available / produced which match circulating viruses (e.g. red virus – red syringe). In the pool of circulating viruses some colours were present for which there was no matching vaccine to explain the current situation in Tanzania. Great emphasis was placed on the important role played by communities (livestock owners / veterinary officers / people of authority in the village) in reporting outbreaks in order to generate samples for virus typing and vaccine selection / production purposes.

Fig. 6 – Vaccination and vaccine matching discussions.

Objective 3) To put the knowledge gathered through Objectives 1) and 2) into practice in order to develop a locally-specific FMD reporting and prevention plan

Workshop participants were divided into six groups. Each group was asked to discuss prevention and reporting strategies in their community, including:

a. What approaches are already available to the community;

b. What the incentives for FMD reporting / prevention are from the perspective of livestock owners in these communities;

c. What the current barriers to better FMD reporting / prevention are;

d. What options are available to address these barriers; and

e. The stakeholders who would need to be involved and could help implement the devised plan.

The group work process was conducted using Ketso kits (www.ketso.com) for each of the six groups (Fig. 7), allowing the teams to progressively move from task a. to d.

Fig. 7 – Workshop participants discussing foot-and-mouth disease prevention and reporting approaches that may be suitable for their community.

Each group was then requested to report the outcomes of their discussion back to the overall group. Common themes were identified for each of the objectives (a. to d.) detailed below and potential stakeholders (e.) who would need to be involved in the solutions were discussed by the group as a whole.

FMD PREVENTION

Approaches which are already available to the community:

1. Avoid sharing of feed;
2. Clean /do not share equipment;
3. Do not buy sick animals / separate sick and healthy animals, including during grazing;
4. Do not share feeding equipment;
5. Do not move sick animals;
6. Separation of grazing areas;
7. Vaccination;
8. Do not share bulls during outbreaks;
9. Use designated areas for watering in given grazing areas;
10. Do not buy cattle from outbreak areas;
11. Avoid livestock grazing in areas where an outbreak has been reported;
12. Restrict animal movements from and into outbreak areas;
13. Establish foot baths (containing citric acid) at entry / exit points where animals are housed;
14. Make vaccines available before outbreaks;
15. Avoid mixing herds with those of neighbours during outbreaks;
16. Develop plans for FMD control;
17. Develop policy for good land use;
18. Education of livestock owners.

Incentives for FMD prevention:

1. To reduce spread and incidence;
2. To reduce mortality, losses and disease burden more generally;
3. To improve animal health;

4. To avoid a disease which threatens livestock production;
5. To increase local- and national-level income;
6. Improved productivity of livestock / better products (milk, meat);
7. To prevent other infections;
8. To secure national and international market opportunities;
9. To ensure the health of draught animals;
10. It has a social implications (e.g. sick animals cannot be used for marriage);
11. No need to close livestock markets;
12. To avoid treatment costs;
13. To increase the value of animals (sales, market opportunities).

Barriers to better FMD prevention:

1. Herd size;
2. Lack of knowledge / awareness about the disease;
3. Lack of vaccines suitable for these given settings;
4. Lack of financial resources to procure vaccines;
5. Several viral strains;
6. Political interference;
7. Lack of political will;
8. Sharing of watering;
9. Rampant livestock movements;
10. Lack of awareness amongst livestock owners as to how to recognise signs of disease;
11. Sharing of dip tanks;
12. Insufficient land for grazing;
13. Lack of diagnostic facilities.

Options available to address these barriers and stakeholders who should be involved:

1. Employ and train more veterinary professionals and paravets.
   Stakeholders: local and central government, non-governmental organisations, and private sector;
2. Better engagement with researchers, and training.
   Stakeholders: international and national researchers (to be responsive to the community needs), communities (to be cooperative with respect to the agenda of the researchers), government (training and translation of research into action/policy to improve prevention), and private sponsors (training and funding);
3. Resources for better engagement with researchers and generating outputs.
   Stakeholders: government;
4. Proper land use and management plans.

Stakeholders: central government (financial issues), local government (land allocation), and communities (herd sizes);

5. Explore other sources of income (non-livestock related);
6. Ensure that politicians do not to interfere with professionals.
   Stakeholders: government, and politicians themselves;
7. Reduce corruption.
   Stakeholders: communities, and government (to strengthen corruption prevention unit);
8. Enforce the animal health act through developing / improving infrastructure (e.g. quarantine stations).
   Stakeholders: government and donors to help support infrastructure;
9. Empower the District Executive Director to take responsibility for enforcing laws within the animal health act.
10. Vaccination.
    Stakeholders: government and communities;
11. Improve infrastructure;
12. Re-establish veterinary scouts in under-staffed areas;
13. Improve communication despite decentralisation of veterinary services.

FMD REPORTING AND SURVEILLANCE

Approaches which are already available to the community:

1. Report to veterinary personnel any clinical signs consistent with FMD including foot / mouth lesions, lameness, lack of appetite, signs of salivation, reduction in milk yield, wounds on teats and abortions;
2. Report to the local administration at all levels;
3. Communicate outbreaks to the whole community and other owners using any forms of gathering;
4. Share information – livestock owners to report to livestock field officers (LFOs) or local administration, or, in their absence, to the ward or the district veterinary officer;
5. Make resources available:
    a. Phone credit to facilitate communication
    b. Motivation / incentives to report;
6. Empower veterinary staff to diagnose the disease;
7. In each village identify personnel to whom to report;
8. Define a clear reporting / surveillance plan, including:
    a. Understanding clinical signs by livestock owners
    b. Early reporting to LFOs
    c. LFOs to collect samples
    d. Confirmatory testing
    e. Inform the relevant authority
    f. Feed-back to the livestock owners

9. Organise series of seminars or dissemination of information so that livestock owners know how not to spread the disease.

Incentives for FMD reporting:

1. To understand the disease, its magnitude and patterns of outbreaks in any given setting;
2. To obtain advice from the LFOs and animal health specialists;
3. To avoid disease transmission;
4. To avoid losses due to mortality and low productivity (milk losses, crop production);
5. To avoid losses due to the burden associated with preventing the disease;
6. To protect local markets;
7. To avoid quarantine and movement restrictions;
8. To understand which viruses are responsible for the disease in this area and allow the identification of correct vaccines for prevention;
9. To develop the correct vaccination strategy.

Barriers to better FMD reporting:

1. Insufficient number of livestock extension officers;
2. Insufficient training of and resources (e.g. office infrastructure, transport, consumables) for veterinary personnel;
3. Lack of knowledge amongst livestock owners;
4. Lack of diagnostic laboratories;
5. Weak chain of information and communication breakdowns between livestock owners and veterinary professionals;
6. Insufficient feedback to livestock owners by the researchers;
7. Most livestock owners do not see the need to report because they are used to living with the disease or believe that nothing can be done;
8. Lack of vaccines or a clear treatment plan;
9. Lack of reinforcement of veterinary laws.

Options available to address these barriers and stakeholders who should be involved:

1. Increase knowledge and awareness of farmers about the disease.
   Stakeholders: government to educate the professionals (animal health workers) so that they can educate the farmers, professionals, and communities;
2. Better feedback from researchers on research findings facilitated by more direct communication mechanisms between researchers and communities (rather than through official channels, e.g. through district veterinary and central offices).
   Stakeholders:
   a. Researchers - This gives reassurance to the community regarding their involvement in devising solutions against this disease. Provision of

research findings to the government will allow implementation of prevention strategies.

b. Government - To provide financial support so that laboratory results can be reported back to the farmers;

3. Improve laboratory diagnostic facilities;
4. Educate and increase capacity of animal health specialists;
5. Improve animal health policies.

Objective 4) To discuss options which could be used to strengthen FMD surveillance capacity in remote locations and could improve community motivation to report outbreaks

A valuable option for improving FMD detection in remote field settings is provided by newly developed FMD later-flow diagnostic test kits (SVANODIP® FMDV-Ag test) which have been recently validated for field use in northern Tanzania as part of project activities. A demonstration was provided on the use of these devices as a direct method for the detection of FMD antigen with the ultimate objective of providing the livestock owners themselves with the kits to obtain an immediate in situ diagnosis (Fig. 8). An important additional advantage of these kits is the potential for recovery of RNA and virus characterisation[1]. Such options are currently being explored at TPI using material generated as part of this study.

Fig. 8 – Demonstration of the use of lateral-flow diagnostic test kits for foot-and-mouth disease antigen detection.

1. Recovery of viral RNA and infectious foot-and-mouth disease virus from positive lateral-flow devices (2014) Fowler VL, Bankowski BM, et al. PLOS one 9(10):e109322.