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A One Health framework for integrated service delivery in Turkana County, Kenya

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Abstract

Pastoralists in sub-Saharan Africa have limited access to public services due to their mobile lifestyle, economic and political marginalization, and the limited health infrastructure that is common to arid and semi-arid lands (ASALs) where they primarily reside. This often results in poor health outcomes, including increased rates of maternal, neonatal, and under-5 mortality. One Health approaches that integrate human and animal health service delivery can help to improve pastoralists' health through increased vaccine coverage and improved access to services. Kenya has institutionalized One Health at the national level; however, progress at the subnational level has been limited due to sustainability concerns, competing priorities, and insufficient coordination platforms. To address this gap, this paper presents a One Health framework (OHF) to aid in the implementation of integrated human and animal health policies in Turkana County, which can act as a model for other ASALs. Utilizing a grounded theory design, we conducted semi-structured interviews and focus group discussions with human health, animal health, and pastoralist stakeholders. Inadequate engagement with the public sector was identified as a major limitation by community members. Factors that contributed to this include distance to health facilities and restricted department capacities such as availability of vehicles, personnel, and cold chain maintenance. Our proposed OHF harnesses the existing structure of service delivery in Turkana and establishes an official coordination mechanism to implement One Health activities, through the form of mobile "One Health Huduma Centres", offering a range of public services. This innovative framework is supported by stakeholders in Turkana and can improve service delivery constraints thereby improving the health of Turkana pastoralists.

Keywords: One Health, One Health framework, One Health Huduma Centre, Turkana County, Integrated service delivery, Grounded theory

Introduction

Pastoralists, who primarily raise livestock in arid and semi-arid lands (ASALs) and rely on strategic mobility to access grazing and water resources, play an important socioeconomic role in sub-Saharan Africa. An estimated 268 million pastoralists in Africa contribute between 10 and 44% to their country's gross domestic product (Zoonotic Disease Unit 2013). Pastoralists are politically and economically marginalized, often lacking access to the

basic services available to more settled populations (Zinsstag et al. 2006). ASALs are geographically vast with poor road networks, communication and electricity infrastructure, contributing to this lack of access. In addition, due to their mobility, pastoralists are difficult to reach with conventional health delivery systems. This problem is compounded by financial, logistical, and service delivery constraints in the public health and veterinary sectors (Schelling et al. 2007). As a result, many pastoralist communities suffer from poor health compared to national averages (Zinsstag et al. 2015).

Pastoralists in East Africa are particularly at higher risk of zoonotic diseases, such as echinococcosis, rabies,

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brucellosis, bovine tuberculosis, and Rift Valley fever (RVF) due to their livestock keeping practices, consumption of animal source foods (e.g. drinking raw blood or milk), inadequate access to treatment, and living in harsh environmental conditions (Mangesho et al. 2017; Zinsstag et al. 2016; Desta 2016). In addition to their own health, pastoralists are greatly affected by the health of their livestock, upon which their livelihoods depend. Thus, livestock diseases that are prevalent in African pastoral regions, such as foot and mouth disease (FMD), Peste des petits ruminants (PPR), RVF, and contagious caprine pleuropneumonia (CCPP), threaten their livelihoods (Zinsstag et al. 2016).

In Kenya, ASALs occupy over 80% of the country's landmass and hold 36% of the human population, 70% of the national livestock, and 90% of wildlife (Barrow and Mogaka 2007; Schilling et al. 2012). As of 2012, Kenya's ASALs contained an estimated 13 million cattle, 25 million goats, 14.9 million sheep, 1.7 million donkeys, and 2.9 million camels (Schilling et al. 2012). These areas are characterized by marked variability in rainfall both spatially and temporally within and between years (African Union 2013).

Turkana is one of the ASAL counties in Kenya that has a primarily nomadic population. The system of governance in Turkana comes from the Constitution of Kenya (2010), which established a new system of county-based, decentralized government (i.e. devolution), which holds the responsibility for basic service delivery, including health services.

In Turkana County, information sharing and activity planning occur between various government departments and non-governmental organizations (NGOs) at the County Steering Group (CSG). The CSG is a coordination forum co-chaired by the county government and commissioner—hence bringing together two levels of government. Independently, each department is led by a county executive council member and chief officer.

In Turkana, veterinary services fall under the Ministry of Agriculture, Pastoral Economy and Fisheries and are primarily mobile, as bricks-and-mortar veterinary clinics and hospitals do not exist in Turkana. In contrast to veterinary services, human health services are based on existing health infrastructure and, thus, are not mobile in nature, except in isolated cases when NGOs or the government carry out mobile outreaches. The Department of Preventative and Promotive Health (DPPH), which falls under the Ministry of Health and Sanitation, is responsible for all public health programming. Roles of veterinary and public health personnel and local leaders in public health and animal health activities can be found in Table 1.

While the Turkana Government is primarily responsible for providing public services, NGOs assist in service delivery and disease surveillance in the human and animal health sectors. Often, county officials will plan activities and NGOs will provide monetary and logistical support. This coordination happens at the CSG.

In 2018, there were 13 hospitals, 19 health centres, 194 dispensaries, and 136 functional community health units (CHUs) in Turkana, with the average distance to the nearest facility of 35 km (Department of Health and Sanitation Services 2018). While this shows significant improvement on the infrastructure and human resources of health domains in Turkana since devolution, health facilities are still limited in Turkana. In comparison with the Kenya Essential Package for Health (KEPH) national norms and standards based on population, Turkana has a total deficit of 20 health facilities and 96 CHUs, with existing facilities skewed towards urban areas (Department of Health and Sanitation Services 2018).

In addition, health indicators are still below the national average. For example, maternal mortality rate (per 100,000 births) is 1594 compared to 362 nationally, neonatal mortality rate (per 1000 births) is 80 compared to

Table 1 Government personnel and local leaders involved in public health and animal health activities in Turkana County

	Personnel	Role
Directors (county)	County director of veterinary services (CDVS)	Disease and vector control activities, veterinary public health activities
	Director of preventative and promotive health (DPPH); Deputy director (DD)	Preventive and promotive health service programmes
Implementors (subcounty/ward/village)	Subcounty veterinary officer (SCVO); Livestock health officer (LHO)	Vaccination implementation, treatment, surveillance, livestock movement control, and laboratory diagnosis
	Community disease reporter (CDR)	Symptomatic disease surveillance, assist with implementation of activities
	Subcounty public health officer (SCPHO)	Management and coordination of public health services
	Community health unit (CHU): one community health extension worker (CHEW), 1+ community health volunteer (CHV)	Basic community health services (health promotion, disease prevention, first aid, community disease surveillance, mobilization for immunization, and referral)
Local leaders	Emuron	Entry point to a community
	Chief/subchief	Report disease events; mobilize communities for outreach activities

22 nationally, and under 5 mortality rate (per 1000 births) is 74 compared to 52 nationally (Department of Health and Sanitation Services 2018).

Livestock play a critical role in the livelihoods of pastoralists. They are also an important national commodity in Kenya, with pastoral meat providing 28% of total consumption with an estimated value of 0.389 billion USD (Nyariki and Amwata 2019). Infectious diseases pose a serious threat to these livestock. For example, the 2007 PPR outbreak caused an estimated 19.1 million USD in losses in Turkana and spread out to other ASALs in Kenya (FAO 2009; Kihu et al. 2015a). In 2015, the PPR seroprevalence in Turkana was estimated at 40% and 32% in goats and sheep, respectively (Kihu et al. 2015b). Similarly, the CCPP seroprevalence was recorded at 63.9% in Turkana West subcounty (Kipronoh et al. 2016). More recent estimates of relative prevalence are 17% and 13.3% for CCPP and PPR, respectively (Veterinary Services 2019). A study in 2019 found the average annual economic loss due to CCPP for a standard flock of 100 goats in Turkana was 1712.66 euros, equivalent to 1,932.99 USD (Renault et al. 2019). These and other endemic livestock diseases, such as helminths, haemorrhagic septicaemia, and tick-borne infections, threaten pastoral livelihoods in Turkana. Thus, there is a serious need to improve human and animal health service delivery in Turkana.

One Health approaches to health service delivery hold the potential to address these gaps. At its core, One Health is rooted in understanding the interdependence of human and natural systems, and can be defined as integrative effort of multiple sectors working to attain optimal health for people, animals, and the environment, involving different collaborative models across and within countries, with the aim of improving efficiency and effectiveness in managing health threats (Vesterinen et al. 2019). Additionally, Zinsstag et al. (2011) define One Health as any added value in terms of human and animal health, financial savings, or environmental benefit from closer cooperation of human and animal health sectors at all levels of organization.

One Health service delivery for nomadic pastoralists has demonstrated to be successful in other contexts. Joint human-livestock vaccination has reduced total costs for veterinary and public health departments through shared transport, logistics, and equipment, while increasing vaccination coverage among pastoralist children (Schelling et al. 2007; Ward et al. 1993; Bomoi et al. 2016; Abakar et al. 2016). A One Health combined delivery platform for Maasai pastoralists combined mass drug administration for soil-transmitted helminths in humans and mass dog rabies vaccination in Tanzania. This approach was highly

regarded among the community and saved costs and time (Lankester et al. 2019). In Uganda, the integration of vaccination and health education to combat brucellosis was perceived by pastoralists and health service providers as feasible and desirable (Kansiime et al. 2015). In addition, mobile clinics are a more suitable method of service delivery for pastoralists and often more cost-effective, as they mirror their nomadic lifestyle (El Shiekh and van der Kwaak 2015; Weibel et al. 2008; Mocellin and Foggin 2008). Thus, integrated, mobile service delivery can improve pastoralist health. In order to implement this approach, new coordination mechanisms and health system infrastructure in ASALs is needed (Kansiime et al. 2015).

Efforts to institutionalize One Health in Kenya have been guided by two policies: the Kenya Health Policy (KHP; 2012–2013) and the Kenya Veterinary Policy (KVP; 2016). The KHP recognized the need for collaboration with other sectors whose functions impact human health, which can be achieved by adopting a One Health approach (Ministry of Health 2014). The KVP expanded on this approach that espouses inter-disciplinary cooperation for successful intervention in matters that affect human, animal, and environmental health. It called for the establishment of collaborative platforms at the national and county levels, in partnership with stakeholders, for managing zoonotic disease events and other animal-based hazards to public health (Ministry of Agriculture, Livestock and Fisheries, Republic of Kenya 2015).

These efforts have been generally successful at the national level, notably through the efforts of the Zoonotic Disease Unit (ZDU). The ZDU has provided an institutional body to address One Health issues of concern (e.g. zoonoses, antimicrobial resistance) through capacity building, research, workforce development, and coordinated investigation and outbreak response (Munyua et al. 2019). The expansion of One Health at the subnational level has mainly consisted of the ZDU and partner organizations setting up county One Health units to enhance communication between health and livestock sectors to address zoonotic diseases. While adoption of One Health at the national level is significant, more progress is needed at the county and subcounty levels. Challenges include sustainability, competing interests, and a lack of coordination platforms (Munyua et al. 2019; Kimani et al. 2016). Further, One Health policy can do more to address the specific challenges of service delivery constraints experienced by pastoralists.

Through semi-structured interviews (SSIs) and focus group discussions (FGDs) with stakeholders and an appraisal of the current human and animal health services in Turkana County, this study sought to develop a One

Health framework (OHF) to aid in the implementation of One Health policy in Turkana.

Study area

Turkana County is one of the largest counties located in the northern frontier of Kenya. It is situated within the Karamoja Cluster, a region along the borders of Kenya, Ethiopia, South Sudan and Uganda that is primarily inhabited by pastoralists. Turkana is bordered by West Pokot and Baringo Counties to the south, Samburu County to the south-east, and Marsabit County to the east (Fig. 1). Internationally, it borders Uganda to the west, South Sudan to the north, and Ethiopia to the north-east (Fig. 1). It is 77,000 km² in total area. Administratively, Turkana

County is divided into seven subcounties and 30 wards. The human population of Turkana County is 926,976 (Kenya National Bureau of Statistics 2019). Livelihoods in Turkana consist of 60% pastoralism, 20% agro-pastoralism, 12% fisheries, and 8% wage employment and others, with livestock providing the main source of food and cash income for 80% of the population in Turkana (Tullow Oil 2017). Goats and sheep make up the largest livestock populations in Turkana, with 5,994,881 and 3,519,148, respectively (Kenya National Bureau of Statistics 2010). According to the 2010 census, there were: 1,534,612 cattle, 832,462 camels, 558,189 donkeys, 165,349 indigenous poultry, and 15,449 commercial poultry in Turkana County (Kenya National Bureau of Statistics 2010).

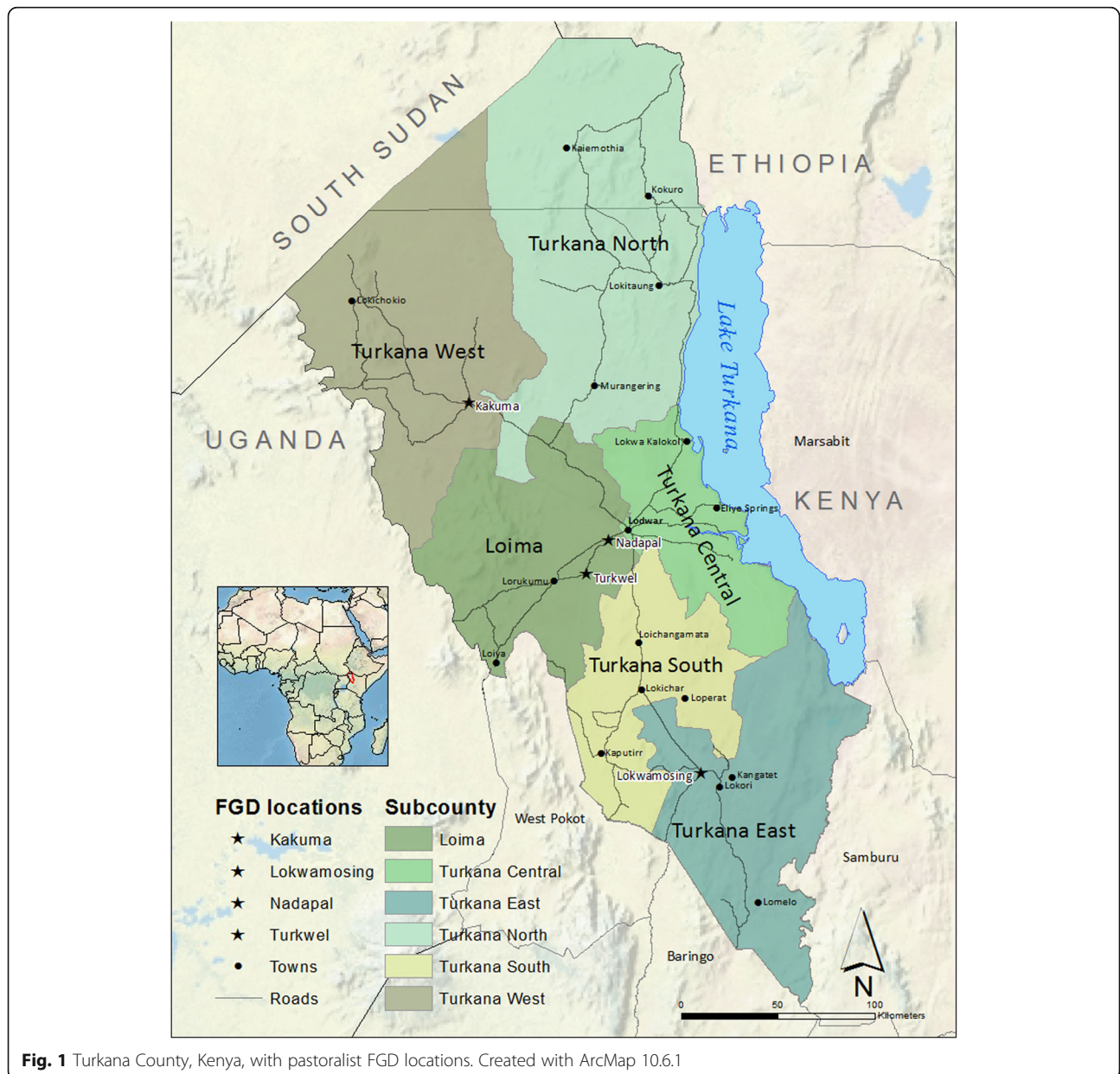


Fig. 1 Turkana County, Kenya, with pastoralist FGD locations. Created with ArcMap 10.6.1

Methods

Study design

This qualitative study consisted of SSIs and FGDs with officials in the human and animal health sectors and with community pastoralists. We used a grounded theory (GT) approach throughout the design and analysis phases of the project. Notably, we designed data collection tools based on preliminary research and knowledge on human and animal health concerns in Turkana, conducted concurrent data collection and analysis, created codes and categories based on preliminary emergent themes, and analysed data based on thematic saturation (Charmaz and Belgrave 2007). The study protocol, SSI, and FGD interview guides were submitted to and received approval from the Tufts University Institutional Review Board. Verbal consent was obtained following an explanation of the project's objectives and procedures, and human subject considerations were taken into account prior to conducting all SSIs and FGDs. Consolidated criteria for Reporting Qualitative research (COREQ) were followed to enhance transparency and credibility (Tong et al. 2007).

SSIs and FGDs with officials were conducted in English and each lasted approximately 60 min. An interview guide was developed and tested in the field prior to study implementation. The guide included open-ended questions on department/organizational structure, vaccination protocols and challenges, intersectoral collaboration, integrated service delivery, perceived benefits of integrated service delivery, and recommendations for implementing integrated service delivery in Turkana County. Probes and follow-up questions were used to explore and clarify points raised by participants.

Following pilot testing, FGDs with pastoralists took place in private, centrally located areas and were conducted in the Turkana language and thereafter translated into English. FGDs lasted 60 min and included open-ended questions on human and animal healthcare access and limitations, and perceptions on integrated service delivery.

Data saturation was reached when consensus and no new themes emerged. Interviews and FGDs were conducted over a 3-week period in August 2018. Audio recordings of each interview, transcripts, and field notes were stored in a password-protected cloud-based drive. Transcripts and field notes were analysed using NVIVO 12.

Study sample

SSI and FGD participants were recruited purposively from the following two groups:

1. Animal health sector, comprising government and NGO officials with knowledge of vaccination

practices and mobile service delivery in Turkana County

2. Human health sector, comprising government and NGO officials with knowledge of vaccination practices and mobile service delivery in Turkana County

Recruitment was conducted in person, by telephone, or by email. SSIs were conducted with animal health and human health government and NGO officials. FGDs were conducted with public health officials and NGO officials. Further information on participant composition can be found in Table 2.

FGDs with pastoralists were conducted in four locations throughout Turkana County (Fig. 1; Table 3). Subcounty locations were selected randomly, while villages/towns were purposefully sampled to get diverse experiences and perspectives from respondents closer to towns (Nadapal and Turkwel), away from towns (Lokwamosing), and close proximity to refugee camps (Kakuma). Participants from each location were selected using convenience sampling based on availability. Equal representation of male and female participants was prioritized and achieved when possible.

Data analysis

Following the first round of interviews and routinely throughout the study, we iteratively developed a list of codes that encompassed emergent major and minor themes. Initially, this consisted of open coding to develop concepts and categories. Axial coding was used to identify the relationship between open codes. Finally, selective coding was used by relating developed codes to the core concept of integrated service delivery. A schematic of the resulting OHF was built using *Creately*, an online diagramming tool. During the coding process, we

Table 2 SSIs and FGD with government and NGO officials in the human and animal health sectors

Sector	Personnel interviewed
Animal health sector	SSIs: veterinary department leadership ($n = 1$); SCVOs ($n = 4$); LHO ($n = 2$)
Human health sector	SSIs: SCPHO ($n = 2$) FGDs: public health officials (one group, two participants)
NGOs	SSIs: Feinstein International Center ($n = 1$), Food and Agriculture Organization (FAO; $n = 1$), Luther World Federation ($n = 1$), Afya Timiza ($n = 1$), Caritas (Catholic Diocese of Lodwar; $n = 1$), International Rescue Committee ($n = 1$), Agency for Pastoralists Development ($n = 1$) FGDs: Turkana Pastoralist Development Organization (one group, seven participants), Veterinary Sans Fronteir Germany (one group, two participants)

Table 3 Composition and location of FGDs with pastoralists

Location	FGD composition
Nadapal village, Loima subcounty, Turkwel ward	Two woman, three men
Turkwel village, Loima subcounty, Turkwel ward	Five men
Kakuma town, Turkana West subcounty, Kakuma ward	Seven men
Lokwamosing village, Turkana East subcounty, Kachodin/Kokori ward	Four women, six men

used field and coding memos to develop thoughts and future directions.

Coding was performed by one primary coder, and coded transcripts were routinely reviewed by the study co-authors to ensure consistency throughout. Any disagreements in coding were resolved by consensus.

Results

Intersectoral collaboration

Interviews with government officials provide evidence of several existing intersectoral collaborations between the human and animal health sectors. These include meat inspection, rabies control, zoonotic disease extension services, and subcounty officer meetings.

It was reported that rabies control activities are shared among veterinary and human health officials. Veterinarians carry out dog baiting for stray dogs and cats and sterilization procedures for population control, while public health officers are in charge of disposing of dog carcasses via burial. There are also examples of informal disease reporting and case finding (e.g. animal health official inquiring about rabies cases at a health centre). Collaboration also occurs during livestock vaccination campaigns with public health officials disposing of waste such as syringes.

The results showed that intersectoral extension, or human and animal health officials educating community members together about zoonotic disease, also occurs. For example, in Turkana West, veterinary and human health officials will conduct these types of outreaches together on an ad hoc basis.

In Loima subcounty, the subcounty veterinary officer (SCVO), subcounty public health officer (SCPHO), and subcounty environmental officer meet on a quarterly basis, or in the event of disease outbreak event, to better coordinate disease surveillance and outbreak response. Subcounty officials noted this has proven to be an effective measure to quickly respond to disease outbreak events.

Another example of the One Health approach is The Kimormor Program. Participants noted that this programme is run by Afya Timiza, an NGO funded by the United States Agency for International Development

(USAID), and uses integrated service delivery (i.e. preventative and curative human and animal health services, provision of national identification cards and birth certificates, sign-up campaigns for the National Hospital Insurance Fund (NHIF), and provision of services provided by the National Drought Management Authority) to improve immunization coverage and access to public services. Observed benefits of this programme, according to an Afya Timiza official, include increased turnout and resulting increases in immunization coverage and reducing the distance that pastoralists in Kibish subcounty have to travel for services.

Finally, the CSG has previously planned and implemented integrated service delivery activities. For example, in 2014, Kenyan and Ugandan human and animal health officials treated pastoralists and livestock in Kotido, Kaabong, and Moroto Districts in the Karamoja region of Uganda. Noted benefits from Turkana officials who participated directly included improved access to services, zoonotic disease extension, and use of services as a “peace dividend”, resulting in an improvement in relationships between the Karamojong and Turkana peoples.

Human and animal healthcare limitations

Limited engagement with the public sector, due to distance to health facilities and insufficient veterinary personnel, was identified by community members as barriers to receiving services (Table 4). In addition, the

Table 4 Limitations of human and animal healthcare identified by pastoralists in FGDs

Theme	Location			
	Nadapal	Kakuma	Lokwamosing	Turkwel
Limitations of human health services				
Distance to health facilities			✓	✓
Insufficient funds to buy drugs		✓		
Drug shortages		✓		
Poor quality		✓		
Limited supply	✓			
Limitations of animal health services				
Insufficient time to treat		✓		
Delayed response		✓		
Limited veterinary staff	✓		✓	
Insufficient funds to buy drugs	✓			✓
Fluctuating drug prices				✓
Drug shortages	✓		✓	✓

availability and quality of drugs were also identified as limitations of health services.

Vaccination challenges identified by human and animal health officials

Officials identified a number of overlapping/common challenges associated with vaccination, which are summarized in Table 5. These included a lack of routine access to vehicles, inadequate cold chain maintenance, the nomadic lifestyle of pastoralists, and insufficient personnel to implement vaccination campaigns. Human health officials, for example, emphasized the commonality of defaulting from vaccination programmes, i.e. when vaccination schedules are not completed, as a result of the nomadic lifestyle. Difficulty in mobilizing communities for outreach activities directly contributes to defaulting.

Veterinary officials also described several examples of cultural norms and practices that affect pastoralists’ involvement in animal vaccination activities. For instance, they noted a common perception among pastoralists that livestock should not be vaccinated during the dry season, when animals are in their poorest body condition. Veterinary officials refer to this as “resistance” to vaccination. Strategies identified to overcome this include adding value to vaccination services by deworming and using pour-on insecticides. One deputy subcounty veterinary officer described that providing medications increased motivation for vaccination: “sometimes you tell them, if you do not accept the vaccines, I will not give you the drug.”

Human health officials emphasized that health centres located at far distances from community members reduce vaccine uptake. Pastoralists will often opt for traditional medicine rather than travel to these centres. This

supports what community members said in Lowkamosing and Turkwel (Table 4). Insecurity, caused by armed conflict between pastoral groups that restricts health service delivery activities, was mentioned by veterinary officials, but not human health officials. This reflects the fact that veterinarians carry out mobile campaigns and operate in border regions, while human healthcare is generally non-mobile and based on a fixed facility structure.

Benefits of integrated service delivery identified by community members and service providers

Interviewees and FGD participants identified multiple benefits of integrated service delivery that are summarized in Table 6. Both community members and service providers identified improved access to care and holistic care as a potential benefit of integrated service delivery. For example, in both Nadapal and Kakuma, participants highlighted that health service providers will go to communities located outside of town centres, reducing the distance required to travel to receive services. This would save on travelling resources. One community member in Nadapal said, “many people will get services, those people where you can’t reach. They can just walk up on the day.” In Kakuma, they also noted that human and animal health officials working together would improve the availability of both human and animal drugs, a noted limitation in care.

Several service providers mentioned improved access to care. Specifically, one subcounty public health officer said, “it will take services closer to the people and therefore, because people really move long distances, not only for health, but for other services, for example registry. They come for [national] identity cards. So, by moving closer to all these departments and services the community will not have to move.”

Cost sharing between departments was identified by the majority of animal health and several human health

Table 5 Challenges of vaccination identified by officials in the human and animal health sectors through SSIs and FGDs

Theme	Sector	
	Human health	Animal health
Challenges of vaccination		
Limited vehicles	✓	✓
Maintaining cold chain	✓	✓
Nomadic lifestyle	✓	✓
Insufficient personnel	✓	✓
Distance of health centres from the community	✓	
Distance of communities from town centres	✓	
Road infrastructure		✓
Resistance to vaccination		✓
Insecurity		✓

Table 6 Perceived benefits of One Health service delivery identified by service providers and pastoralists through SSIs and FGDs

Theme	Identified by whom	
	Service providers	Pastoralists
Benefit to the community		
Access to care	✓	✓
Holistic care	✓	✓
Benefit to service providers		
Cost-sharing	✓	
Increased turnout	✓	✓
Improved zoonotic disease extension	✓	
Avoid duplication of services	✓	

officials. They said it would help to overcome logistical limitations (e.g. vehicle and fuel costs) in each sector. One subcounty public health officer emphasized that “when Ministries pool resources, the impact will be much higher.”

Improved mobilization of communities for outreaches was highlighted as a benefit by several animal and human health officials. Public health officers emphasized that increased turnout will help the departments reach their objectives (e.g. increasing immunization coverage). In addition, officials in both sectors identified the presence of livestock as the factor driving increased turnout. For example, a subcounty public health officer said, “when veterinary mobilizes, those who are interested in the animals vaccinated will come and the Ministry of Health will take advantage of such a population. There are people who we never reach [during] our outreaches. We are usually told they are gone, maybe to look for pastures elsewhere. So, such people will be available during the One Health approach.”

A majority of animal health and a single human health official mentioned improved zoonotic disease extension as a benefit. They explained these diseases have animal and human components (e.g. transmission). Therefore, if human and animal health officials work together, the community will understand all aspects of the disease.

Perceived challenges of implementing integrated service delivery

Participants anticipated multiple challenges with integrated service delivery, including difficulties with coordination, limited time in the field, and the fact that livestock handlers, not the entire family, are found with livestock. Coordinating across Ministries is difficult, especially when outreaches are scheduled for different times. Coordinating activities also require planning by department heads. Integrated service delivery that includes health and public services will require a long time in the field. This was discussed as a challenge, because the longer these outreaches take, the more expensive they are. Finally, a veterinary officer mentioned that when they go to the field during the dry season, often-times, only adolescent herd boys or other relatives of the livestock owner accompany the animals. They cannot make the decision on whether the animals should be vaccinated or not, leaving them unvaccinated. Furthermore, if livestock owners and their families are not always with the livestock, they cannot be reached with other services during these times. However, another subcounty veterinarian noted that women or girls are usually present at watering points to water the livestock. Therefore, they suggested these areas can be targeted for integrated service delivery.

Suggestions for implementing integrated service delivery
Participants provided suggestions on the structure, implementation, and mobilization of integrated service delivery in Turkana County. Several suggested One Health Committees (OHCs) should be created, composed of department directors and NGO officials at the county level and subcounty officers at the subcounty level. These committees would provide an official structure for cooperation at director and implementor levels, allowing for the actualization of integrated activities.

To coordinate activities, participants suggested that a shared work plan should be created by department directors and NGOs on the county OHC. Subcounty officers, in communication on the subcounty OHC, should be in charge of implementing these work plans. They should communicate with local leaders, other officials, and administrators to carry out integrated service delivery.

Notably, participants described implementing integrated service delivery as a potential mobile “Huduma Centre”, combining government human and animal health services. In Kenya, Huduma Centres offer government public services from a single location. Taking this one-stop shop for service approach, participants suggested that government officials and NGOs could travel together, delivering public services to remote parts of the county. This would not supersede current mobile delivery operations (e.g. veterinary vaccination campaigns), but instead be undertaken based on the needs of specific areas. In describing the advantages of this approach, one government official said, “[mobile, integrated service delivery] is more like devolution. It’s a devolved function but delivered multifaceted at once. It’s the Huduma centre that comes to the people.”

Critical to integrated service delivery is mobilizing the community. The role of Emurons in mobilization was emphasized by several interviewees, who noted Emurons are critical in Kimormor as they identify how many kraals there are. These kraals are subsequently targeted for mobile delivery outreaches. Other officials also noted that chiefs are an excellent entry point to mobilize the community, because they are community authority figures who have established communication channels.

Discussion

Proposed One Health framework

Our results demonstrate that there already exists a coordination mechanism for One Health activities through the CSG and that intersectoral collaboration occurs as dictated by national law between veterinary and human health officials in Turkana County. For example, rabies control in Kenya is guided by the Rabies Act of 1967, revised in 2012 and now under revision as part of the One

Health Strategic Plan for the Elimination of Human Rabies in Kenya 2014–2030 (Zoonotic Disease Unit 2014). The sharing of responsibilities in Turkana is in line with the national policy. However, what requires improvement is the formalization of information sharing/reporting.

The limitations we identified in this study were primarily logistical and resource-based, highlighting the need for increased collaboration between government and NGO service providers. Furthermore, our results demonstrate that coordination among partners and the government is still inadequate in Turkana County, illuminating the need for an improved coordination structure. Our results support previous research on limitations of healthcare delivery to pastoral populations, including distance to health facilities and limited resources and logistical capacities of government departments (Zinsstag et al. 2006; Schelling et al. 2007). Thus, a mobile, integrated approach to service delivery can help to improve pastoralists' access to services in Turkana.

In order to overcome these limitations, we developed an OHF for integrated service delivery, which can act as an official coordination mechanism for One Health activities in Turkana County (Fig. 2). We suggest creating One Health Committees (OHCs) at the county and subcounty levels. The county OHC can help to coordinate government and NGO activities through a shared work plan. The subcounty OHC, made up of implementors, can then carry out these work plans. In addition, there is a need to formalize the intersectoral collaboration, especially in regard to disease reporting, happening among implementors at the subcounty level. The subcounty OHCs can also serve this purpose.

Further, we suggest that mobile, integrated service delivery in Turkana County takes the form of "One Health Huduma Centres" that offer human and animal health services; national identification cards; birth certificates; health insurance (NHIF); drought management services (NDMA); water, sanitation and hygiene (WASH) services; economic services; and other essential government services. Importantly, as integrated activities will be formalized through a shared work plan, any combination of these services can be delivered based on the current needs identified by government and NGO officials and community members. Thus, our proposed framework offers flexibility in addition to a formalized structure that facilitates intersectoral collaboration.

We present the OHF as an innovative approach to overcoming the limitations of public service delivery experienced by pastoralists in Turkana County. It will also institutionalize One Health at a subcounty level through an official coordination mechanism, which previous research has identified as lacking in Kenya, and is needed to implement integrated service delivery to pastoral communities (Kimani et al. 2016; Kansiiime et al. 2015)

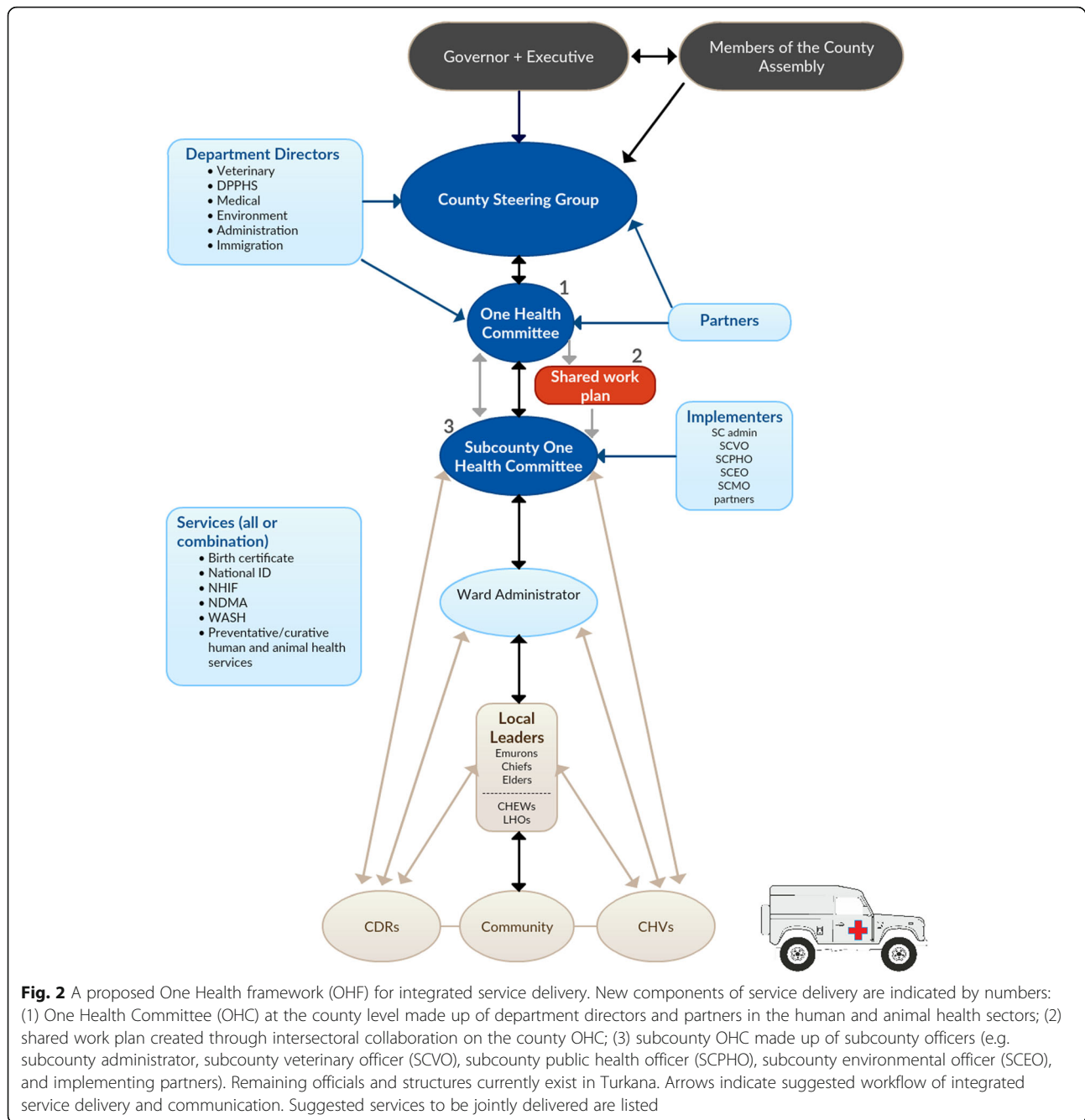
The OHF may increase access to services by bringing them to the people and, through resource sharing, overcome logistical changes identified by officials in the human and animal health sectors. Importantly, this approach incorporates all stakeholders to identify opportunities for joint service delivery and synergies in health service delivery through OHCs at the county and subcounty level. This is important when trying to improve health service delivery for pastoralists (Abakar et al. 2016).

One Health in Turkana County

Our study establishes that in Turkana, gaps and deficiencies in human and animal healthcare provision are location-specific (Table 4). We hypothesize that geographic differences (e.g. distance to the nearest health facility or hospital) or the existence of development programmes likely contributed to this observed variation. One major difference regarding challenges of vaccination between sectors was people refusing the vaccination, described by veterinarians (Table 5). Importantly, they described adding value with non-vaccination services (e.g. deworming) that help to improve vaccination coverage of livestock. This provides direct evidence that additional services increase the value of mobile outreach. This conclusion is supported by previous and ongoing integrated activities (e.g. Kimormor and the Karamoja exercise) and the perceived benefits of future activities identified by study participants (Table 6).

In most cases, participants addressed collaboration between government departments for zoonotic disease prevention and food safety, areas where veterinary medicine and public health have traditionally overlapped. Importantly, our study found that informal zoonotic disease reporting occurs between departments in Turkana County. The need for official reporting, however, is evident, especially considering the threat that zoonoses pose to pastoralists (Mangesho et al. 2017). Therefore, we suggest that improved disease reporting can be facilitated by the OHF. Specifically, subcounty officers can communicate at the subcounty OHC to either rapidly respond to disease outbreak events or report zoonotic disease cases to their superiors on the county OHC (Fig. 2). Importantly, this model has been adopted in Loima subcounty and has proven to be an effective measure to quickly respond to disease outbreak events. The creation of subcounty OHCs will formalize zoonotic disease reporting and can help to combat these diseases in Turkana County.

Our results highlight that animal health officials believe that joint zoonotic disease extension (ZDE) is best suited to explain the risks and prevention strategies



associated with these diseases to pastoralists. However, this type of extension is sporadic at best. Therefore, we recommend that joint ZDE, with both public health officials and veterinarians, should be adapted whenever possible in Turkana. This can be uniformly implemented through the use of shared work plans.

Our results suggest that the One Health approach is not limited to zoonoses and can be used to target the social determinants of health, through a One Health Huduma Centre. Previous research proves that better access to health services, without other social

improvements to marginalized groups, may not have a positive impact on health (Abakar et al. 2016). Thus, improving access to public services in totality will improve health to a greater extent than simply focusing on health services.

In addition, the structure of the OHF is based on the county, subcounty, and ward administrative units and associated personnel that are generally uniform throughout Kenyan counties. Thus, this framework could be used in other ASAL counties in Kenya to improve the health of pastoralists. Furthermore, while not identical, similar

administrative structures exist in other regions of sub-Saharan Africa with pastoralist populations. Therefore, the principles of the OHF (e.g. OHCs at the director and implementer levels and shared work plans for integrated activities) can be adopted and adapted to improve healthcare and other services for marginalized populations in these areas. Other non-pastoralist, resource-poor communities that lack access to public services in Kenya could also benefit from a similar approach.

Examples from Turkana, like Afya Timizia, illuminate how NGOs can conduct integrated service delivery. The principles of the OHF, e.g. shared work plans and coordination of activities throughout administrative levels, can be adopted by NGOs working in ASALs. We found that previous and current examples of integrated service delivery and intersectoral collaboration have contributed to a One Health landscape in Turkana. Our study establishes how interest and positive attitudes surrounding One Health and future intersectoral collaboration can be leveraged to institutionalize One Health, in this case through an innovative model that includes sharing of resources, joint planning, and implementation of activities.

Kenya is currently considering the 2019 Animal Health Bill (AHB) that would establish county One Health Committees (OHCs) consisting of animal, wildlife, medical, plant, and environmental health services. These committees are intended to address issues regarding zoonotic diseases, antimicrobial resistance, and response to any other “One Health” matter (Parliament of Kenya 2019). The OHF fits within the AHB but gives specific structures and recommendations for Turkana that will help to overcome service delivery constraints in the county and improve access to healthcare for Turkana pastoralists.

Study limitations

We only conducted four FGDs with pastoralists, a limitation of the study. Also, we failed to interview service providers in non-health sectors. Another limitation of our study was that we did not perform an economic analysis of our proposed model for service delivery.

Conclusion

In Turkana County, pastoralists and officials in the human and animal health sectors support integrated service delivery for a variety of reasons. Participants believe that integrated services will improve the overall access to animal and human healthcare, that cost-sharing among departments will keep integrated services affordable, and that such integration will increase community participation in health outreach events. Our proposed OHF provides a versatile and innovative method that may improve service provision as well as the health and livelihoods of pastoral communities in Turkana County,

Kenya. The OHF should be pilot tested, and outcomes should be evaluated, which may provide useful knowledge about the facilitators, barriers, and impacts of integrated multi-level service delivery within Turkana County and in pastoralist communities throughout sub-Saharan Africa.

Recommendations

We recommend that the Turkana CSG create a One Health strategic plan that delineates (1) a cooperation model—committees and hierarchy (i.e. OHF)—and (2) joint service delivery priorities—diseases, services, location, and timing. In light of the fact that the economic components of our described service delivery are unknown, we recommend a trial implementation period, during which all the costs and health/other outcomes are recorded. This will help to understand the economic and health implications of our proposed model of service delivery. We suggest the trial implantation focus on Loima and Turkana West subcounties that have remote locations that lack health facilities and have poor access to services.

Abbreviations

APaD: Agency for Pastoralist Development; ASALs: Arid and semi-arid lands; CBPP/CCPP: Contagious bovine and caprine pleuropneumonia; CDRs: Community disease reporters; CDVS: County director of veterinary services; CHEWs: Community health extension workers; CHVs: Community health volunteers; COREQ: Consolidated criteria for REporting Qualitative research; DPPH: Department of Preventative and Promotive Health; FAO: Food and Agriculture Organization of the United Nations; FGDs: Focus group discussions; FMD: Foot and mouth disease; IGO: Intergovernmental organizations; IRC: International Rescue Committee; LHA: Livestock health assistant; LWF: Luther World Federation; NDMA: National Drought Management Authority; NGO: Non-government organizations; NHIF: National Health Insurance Fund; OHC: One Health Committee; PE: Participatory epidemiology; PPR: Peste des petits ruminants; SCDSO: Subcounty disease surveillance officer; SCEO: Subcounty environmental officer; SCPHO: Subcounty public health officer; SCVO: Subcounty veterinary officer; SSIs: Semi-structured interviews; TUPADO: Turkana Pastoralist Development Organization; VSF-Germany: Veterinaries sans Frontières-Germany; WASH: Water, sanitation and hygiene

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Relevant background (data collection)

EFG is a DVM/MPH dual degree student with a Master of Science in Conservation Medicine with training and experience in participatory epidemiology methodology. JRK is a subcounty veterinarian in Turkana County with a Master of Science in Veterinary Preventive Medicine and extensive training and experience in participatory epidemiology methods.

Authors' contributions

EFG, JRK, TK, and JCM designed and planned the study. TOA acted as an in-country mentor. EFG and JRK collected the data. EFG did the initial data analysis with help on the interpretation from other authors. EFG wrote the first draft of the manuscript with organizational help from HA, TK, and AHR. All authors edited and approved the final manuscript.

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Availability of data and materials

The datasets used/analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The study was approved by the Social Behavioral & Educational Research Institutional Review Board at Tufts University. It was granted exempt status. Prior to participation in the study, objectives and procedures of the research were explained to respondents and informed verbal consent was obtained. Community disease reporters (CDRs) fluent in English and local languages were used to interpret/translate during FGDs with pastoralists.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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