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Original Research Article

The one health approach: combating the persistent Visceral Leishmaniasis (Kala-azar) outbreaks in Isiolo County, Kenya

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ABSTRACT

Background: Visceral leishmaniasis has remained a public health problem in Kenya despite Ministry of Health's numerous efforts. This is associated with absence of a multidisciplinary response to outbreaks. We intended to analyze community's prioritization of causes of Visceral leishmaniasis as well as community awareness on the disease prevention and control.
Methods: This was a descriptive cross-sectional study design conducted between September 2023 to December 2023. 433 households' heads, 23 community leaders and health workers were study informants.
Results: Study findings showed clear proximity of human settlements and socioeconomic activities to the vector sandfly breeding sites. Environmental factors augmented by effects of climate change including flooding and high temperatures have sustained transmission including emergence of the disease in new foci. Low socio-economic status, environmental factors and climate change effects showed highly significant correlations with the disease and interplay with one another. Study results show lack of strategies and policies that promote effective prevention and control of Kala-azar. Stakeholders' analysis revealed limited community awareness regarding roles played by different individuals in Kala-azar prevention, control, and elimination.
Conclusions: There is a major gap in cooperation of partners in human, animal, and environmental health for achievements in public health strategies, therefore One Health approach should be adopted for integrated prevention, control, and elimination. The approach will sustainably improve and promote health while addressing the entire spectrum of disease control, including detection, preparedness, response, and management in addition to disease prevention averting this terrible disease from resurfacing in the future.

Keywords: Elimination, Integrated, Multidisciplinary, Sustainably, Visceral Leishmaniasis

INTRODUCTION

The One Health High Level Expert Panel (OHHLEP) defines One Health is an approach that aims to optimize and sustainably balance the health of people, animals, and ecosystems through an integrated and unifying approach. It acknowledges the interdependence and tight relationship between human health, that of domestic and wild animals, plants, and the larger environment, including ecosystems. One Health promotes the well-being and addresses threats to health and ecosystems by mobilizing a variety of sectors, disciplines, and communities at different societal levels.[1] Visceral Leishmaniasis is a neglected tropical disease (NTD) mostly affecting people living in poverty, in close contact with livestock and domestic animals, infectious vectors, and without adequate sanitation. Kenya is endemic for Visceral Leishmaniasis and in the world it is among the top 6 high-disease burden countries with the disease affecting mainly poorest individuals.[2] Understanding the interrelationships between environmental, animal, and human health systems can help develop sustainable

control techniques and improve our understanding of factors that contribute to disease. For this reason, given the association between human, animals, plants and their shared environment, the authors evaluated their interactions, because at their interface, a One Health approach can reduce and eliminate resultant health risks posed.

More than 75% of pathogens linked to developing diseases are zoonotic with 60% of them being transmitted from domestic or wild animals to people. Each year, there are 2.5 billion cases and 2.7 billion deaths globally attributable to these newly emerging zoonoses. Due to exponential growth of livestock and human populations, rapid urbanization and farming system changes, close interactions between wildlife and domestic animals which result in forest encroachment, habitat destruction, and ecosystem changes, and climate change, there is a higher risk of emerging and reemerging diseases spillover and burden.[3] This is particularly true in rural and low-resource environments, where livestock are an integral part of everyday life and people live in close proximity to them through shared living and regular husbandry tasks e.g. herding. Therefore, there is a risk of increased zoonotic pathogen transmission between animals and humans along the livestock value chain due to expanded and close human-animal interface.[4]

Animals have been the source of recent infectious disease outbreaks, such as those of SARS and Ebola. Therefore, it is imperative to develop a comprehensive strategy that tackles pandemic risks by taking a broader view of the intricate relationship between human health and the health of life as a whole. One Health is an illustration of this strategy which is becoming more and more well-known as the accepted global strategy for containing emerging infectious diseases and zoonotic threats.[5] Emerging zoonotic diseases including Rift Valley Fever (RVF) and H5N1 prompted CDC Kenya to work with Kenyan government to successfully build a sustainable One Health initiative at the national and county levels. This collaboration began in 2006 and has seen improved health by enabling the prompt identification and containment of zoonotic disease outbreaks at their source. These successes have uncovered gaps in diagnosis and surveillance, facilitated lobbying, and helped decision-makers control and prevent zoonotic infections. Notwithstanding, notable shortcomings persist in the execution of the One Health methodology at the county levels, these include issues related to sustainability, conflicting priorities, and insufficient resources.[4]

In the same way as zoonotic diseases, Leishmaniases have become a constant public health problem in the arid and semi-arid parts of the country with intermittent transmissions and a predisposition to recede and reappear which is constraining the already weak healthcare system. Data from Ministry of Health indicates that about 5 million people mainly children under five years are at risk of Kala-azar attributable to presence of risk factors in their ecosystems.[6] Today, about 30 sub-counties in Kenya still struggle with Leishmaniasis making the disease as of great public health importance. Prevention and control measures directed to reservoirs of the disease are difficult to implement particularly when human reservoirs are involved justifying the rationale of One Health approach for unified prevention, control, and elimination.

The purpose of this study was to identify community's prioritization of the causes of Visceral leishmaniasis in Isiolo County. The study approach, Participatory Epidemiology encouraged participation of all stakeholders' seeking solutions to common health problems in the community. The approach was applied due to its ability to ensure that all important health concerns affecting communities are pointed out and effectively addressed as per community's local preferences for control options. This article indicates the need for multi-sectoral approach utilizing a mix of intervention strategies across disciplines and sectors in controlling the disease given its complexity and multifaceted nature. A collaborative and multidisciplinary approach spanning boundaries of animal, human, and environmental health is required to curb the continuing outbreaks.

METHODS

Research design

This was a descriptive cross-sectional survey. Data was collected using a mixed method approach in 18 study villages in Merti and Garbatulla Sub-Counties. For quantitative data (n=433) collection, Participatory Epidemiology (PE) exercises were conducted in the study villages. For qualitative data collection, semi-structured interviews were conducted using community members and key informant interviews (KIIs). Data was collected from September to December 2023.

Sampling procedures and sample size

The study sites were purposively selected based on analysis of Kala-azar hotspots in Isiolo County from District Health Information System (DHIS2). Selection of study sites was guided by interviews with County Health Management Teams and Local Administrators. Sample size was calculated according to the prevalence formula with 95% confidence based on assumption of prevalence of 50% and a precision of 0.05.[7] Due to lack of information on Visceral Leishmaniasis prevalence in Isiolo County, sample size was calculated assuming an expected infection prevalence of 50% to obtain an optimum sample size for the study. Prevalence value was estimated from previous studies published in the study domain. Therefore, at 95% confidence level and 5% precision, a minimum of 385 households was required to satisfy study objectives. In addition, extra sample size was calculated at 10% to account for bias, refusals or non-response, and inaccessible villages during the study period bringing the sample population to a total of 424.

Inclusion criteria

Households in study villages identified as Kala-azar hotspots with well-established and functional community health units (CHUs) were included as research participants.

Exclusion criteria

Areas not considered as Kala-azar hotspots and with no notable Kala-azar risk factors, non-resident population, and non-responders were excluded from the study.

Data analysis

Most of the data produced by participatory approach methods was ordinal data and therefore statistical tests were used to summarize data using mean, median, range, and 95% confidence interval (95% CI) for the mean, and median. R Programming 4.3.2 software was used for statistical analysis and data visualization. To measure reliability of generated data, reproducibility of the different participatory approach methods was assessed. The Researcher assumed that within a specified Ward, local conditions and livelihood activities were the same and data generated by various participatory approach methods employed on different study informants was the same. Consequently, duplicability of data was conducted by assessing level of agreement between different informants' groups in each of the study villages. SPSS V25-Kendall's Concordance Coefficient *W* was used to assess this agreement between informant groups. Monte Carlo Significance was used to predict possible outcomes of uncertain events during the exercises. Validity of the findings was confirmed by cross-checking findings against other information sources which included key informant interviews (KIIs) and review of literature.

Ethical approval

Ethical approval was obtained from Meru University of Science and Technology (MUST) Institutional Research Ethics Review Committee (MIRERC) and from National Commission for Science, Technology, and Innovation (NACOSTI/P/23/29291). Additional approval was obtained from the County Department of Health. Written and oral consent for participation in the study was obtained voluntarily from all study informants prior to data collection.

RESULTS

Causes of Kala-azar

Respondents were asked to indicate what causes Kala-azar. This was determined by responses on community's prioritization of causes as either bite by an insect, poverty, witchcraft, curse, or other causes. The results show that majority (98.8%, 428/433) of respondents mentioned Kala-azar is transmitted by bite of an insect (sandfly), indicating a strong consensus in the community regarding the primary cause of the disease (Figure 1).

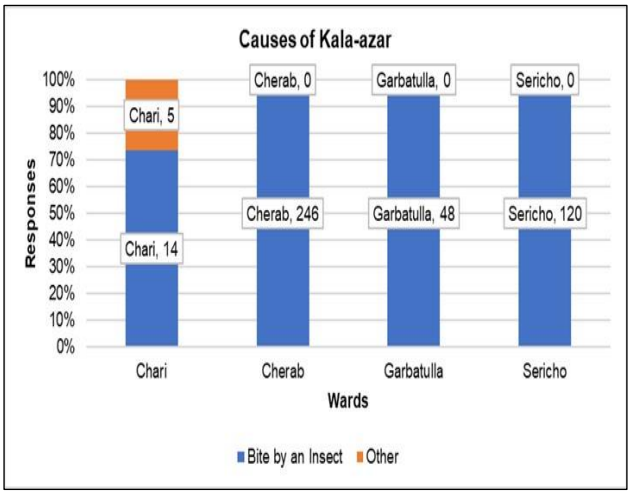

Figure 1: Causes of Kala-azar.

Sandflies breeding area

Respondents were asked to indicate where sandflies breed. Majority of respondents (93.76%, 406/433) mentioned that sandflies breed in cracks and crevices, indicating a strong community perception of these areas as potential sandflies breeding sites. A considerable number of respondents (11.32%, 49/433) mentioned animal burrows, 37(8.55%) respondents mentioned livestock sheds, and 28(6.47%) respondents mentioned termite mounds.

Factors contributing to the prevalence of Kala-azar

The study aimed to identify factors contributing to the prevalence of Kala-azar. A number of factors have been implicated with the persistent and frequent outbreaks. Majority of respondents 350 (80.8%) indicated that environmental factors were the major risk factors associated with Kala-azar in the County. Interestingly, one of the Wards had a relatively higher percentage (42.1%) of respondents indicating limited awareness on factors contributing to prevalence of Kala-azar. Other responses to this question included poor access to treatment, and diagnostic related challenges (Table 1).

Season Kala-azar is most prevalent

In their accounts of seasons when Kala-azar is most prevalent in the study areas, 252 (69.6%) households which had Kala-azar cases indicated that cases were common during dry seasons. Other respondents mentioned high prevalence during different stages of the rainy season, 11 (30.6%) at the beginning of the rainy season, 8 (32%) at the end of the rainy season, and 2 (66.7%) at the peak of the rainy season (Table 2).

Table 1: Factors contributing to Kala-azar prevalence.

Ward	What makes kala-azar common in the area?	Environmental factors (%)	Expensive to treat (%)	I do not know (%)	No health facility for diagnostic services (%)	Other (%)	Total (%)
Chari		2 (10.5)	0 (0.0)	8 (42.1)	0 (0.0)	9 (47.4)	19 (100.0)
Cherab		214 (87.0)	1 (0.4)	3 (1.2)	5 (2.0)	23 (9.3)	246 (100.0)
Garbatulla		48 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	48 (100.0)
Sericho		86 (71.7)	0 (0.0)	1 (0.8)	0 (0.0)	33 (27.5)	120 (100.0)
Total		350 (80.8%)	1 (0.2%)	12 (2.8%)	5 (1.2%)	65 (15.0)	433 (100.0)

Table 2: Season Kala-azar is most prevalent.

Kala-azar cases in HHs	No (%)	Yes (%)	Total (%)
Season Kala-azar is most prevalent?			
At the beginning of the rainy season	25 (69.4)	11 (30.6)	36 (100.0)
At the peak of the rainy season	17 (68.0)	8 (32.0)	25 (100.0)
At the end of the rainy season	1 (33.3)	2 (66.7)	3 (100.0)
During the dry season	110 (30.4)	252 (69.6)	362 (100.0)
I don't know	7 (100.0)	0 (0.0)	7 (100.0)
Total	160 (37.0)	273 (63.0)	433 (100.0)

Household members mosquito net usage

The study provided an overview of mosquito net usage across the study villages. Most respondents (77.6%, 336/433) reported sleeping under a mosquito net at home. Cherab (88.6%) and Garbatulla (85.4%) wards reported higher percentage of study informants using mosquito nets, while Sericho ward had a relatively lower percentage (54.2%) (Table 3).

Table 3: Household members mosquito net usage.

Do you sleep under a mosquito net at home?	No (%)	Yes (%)	Total (%)
Ward			
Chari	7 (36.8)	12 (63.2)	19 (100.0)
Cherab	28 (11.4)	218 (88.6)	246 (100.0)
Garbatulla	7 (14.6)	41 (85.4)	48 (100.0)
Sericho	55 (45.8)	65 (54.2)	120 (100.0)
Total	97 (22.4)	336 (77.6)	433 (100.0)

Table 4: Kala-azar cases and mosquito net usage frequency.

Mosquito net usage	Daily (%)	Frequently often (%)	Rarely (%)	Sometimes-occasionally (%)
Kala-azar cases				
No	1 (0.6)	18 (11.2)	29 (18.1)	112 (70.0)
Yes	2 (0.7)	14 (5.1)	68 (24.9)	189 (69.2)
Total	3 (0.7)	32 (7.4)	97 (22.)	301 (9.5)

Mosquito net usage frequency and Kala-azar cases

The study sought to establish relationship between frequency of mosquito net usage and Kala-azar cases reported. Statistical tests on Kala-azar cases and frequency of mosquito net usage revealed that most of the Kala-azar cases 189(69.2%) were reported among respondents who used mosquito nets sometimes, occasionally (Table 4).

Availability of domestic animals at home and Kala-azar cases

Respondents were asked if they had domestic animals at home. Cross-tabulation of responses on Kala-azar cases and presence of domestic animals at home revealed that a notable number (60.6%) of households without any reported Kala-azar cases did not have domestic animals at home. Further analysis showed that 39.4% of households without any reported Kala-azar cases had domestic animals at home. A notable proportion (45.4%) of households with reported Kala-azar cases did not have

domestic animals at home. Interestingly, it was observed that a significant proportion (54.6%) of households with reported Kala-azar cases had domestic animals at home (Table 5).

Table 5: Availability of domestic animals at home and Kala-azar cases.

Are domestic animals available in your home?	No (%)	Yes (%)	Total (%)
Is there anybody in your household who has suffered from Kala-azar in the last 5 years?			
No	97 (60.6)	63 (39.4)	160 (100.0)
Yes	124 (45.4)	149 (54.6)	273 (100.0)
Total	221 (51.0)	212 (49.0)	433 (100.0)

Table 6: Availability of domestic animals in the house yard and Kala-azar cases.

Animals at night in the house yard where you and your family sleep	No (%)	Yes (%)	Total (%)
Kala-azar cases			
No	93 (58.1)	67 (41.9)	160 (100.0)
Yes	124 (45.4)	149 (54.6)	273 (100.0)
Total	217 (50.1)	216 (49.9)	433 (100.0)

Availability of domestic animals in the house yard and Kala-azar cases

When respondents were asked if there are usually animals at night in the house yard where they slept together with their families, responses revealed that among households with no Kala-azar cases, there was higher percentage (58.1%) of those with no animals in the house yard where family members slept. Conversely, households with Kala-azar cases showed a higher percentage (54.6%) of having animals in the house yard where family members slept (Table 6).

Insecticides application

Respondents were probed for application of insecticides both indoors and to animals as a vector control measure. The results show that a significant majority (97.9%, 424/433) of households did not apply insecticides indoors and to animals (85.2%, 369/433) respectively.

Presence of acacia trees in homesteads

In response to the question, "Are there acacia trees in your homestead and neighbouring homesteads?", most of those surveyed (64.0%) indicated not having acacia trees in their homestead or neighbouring homesteads while a sizeable proportion (36.0%) indicated having acacia trees either in their homestead or neighbouring homesteads. Of those with acacia trees, majority (76.9%) estimated having 1 to 10 trees, while a smaller portion (23.1%) estimated having more than 10 trees.

Major risk factors of Kala-azar

The study outlined major risk factors of Kala-azar in Isiolo County as mentioned during key informant interviews (KIIs). Human behavior was indicated as the major risk factor (100%) for Kala-azar infection where respondents cited sleeping outside and outdoor evening activities during the dry seasons. Environmental and climate changes was indicated by majority (95.7%) of respondents who linked population migration, drought, famine, and floods to increased Kala-azar risk. Low socio-economic status was also quoted as a major risk factor by most (91.3%) respondents. The significant socio-economic status mentioned were low-income levels, poor housing, poor sanitation conditions, and crowded housing (Figure 2).

Stakeholders involved in Kala-azar control

Respondents were asked to state stakeholders involved in prevention and control of Kala-azar in the County. Majority of respondents 404 (93.3%) indicated the government while 11(2.5%) of respondents indicated NGOs. No respondent mentioned community members as stakeholders involved in Kala-azar prevention and control (Figure 3).

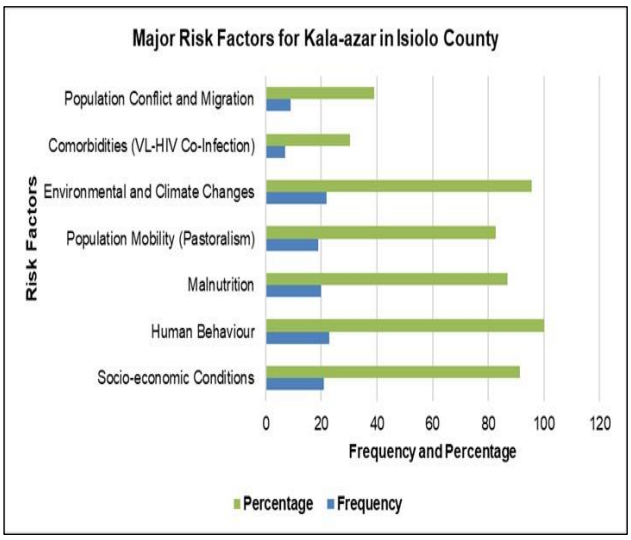

Figure 2: Major risk factors for Kala-azar in Isiolo county.

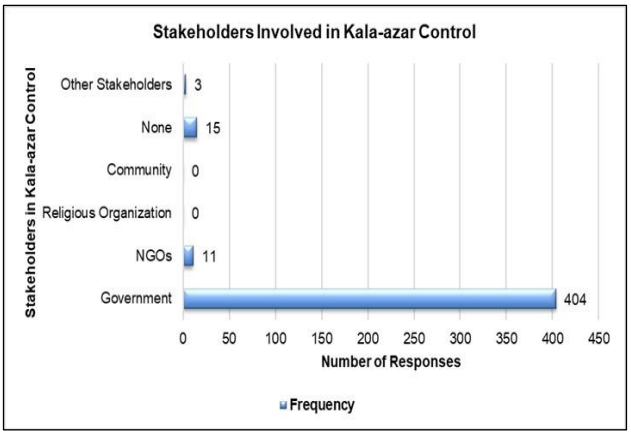

Figure 3: Stakeholders involved in Kala-azar control.

DISCUSSION

The transmission of *Leishmania* spp. is complex as a consequence of intricate relationship between sandfly vectors, animals, and human. We found respondents had a strong consensus that sandfly is the major vector for transmission of Kala-azar. Understanding relationships and interdependencies between people, animals, and the environments that hosts and vectors live in is unquestionably crucial, as over 60% of infectious diseases that affect humans are zoonotic. Therefore, it is essential to implement a "One Health" strategy in order to control Leishmaniases.[8] It is anticipated that Africa, where over 70% of the population lives in rural areas, will be more affected by climate change due to emergence of new settlements and widespread environmental alteration, which may encourage the creation of more vector breeding sites. Results of this study indicate awareness of the sandfly breeding grounds among respondents which were consistent with findings of other researchers who associated Kala-azar incidence with cracking black cotton soil and termite mounds.[9] The existence of specific plant species, formation of land cracks and crevices by seasonal rainwater channels, presence of animal sheds, and other environmental conditions surrounding homesteads are assumed to create damp vector preferred hiding and breeding places affecting vector's activity and presence.[10] Spread of Leishmaniasis in Kenya has been changing overtime as a result of number of factors including environment factors as mentioned by respondents, human behavior, demography, and socio-economic levels of affected populations. These variables have an impact on Leishmaniasis case detection, diagnosis, treatment, and prevention efforts, particularly in Countries with limited resources. Creating effective control strategies requires an understanding of the ecology of sandflies.[11]

On seasons when Kala-azar is most prevalent in the area, this study results indicates that cases are common during dry seasons. There are several possible explanations for this result. These include most community members sleep outdoors because of hot weather conditions. Consequently, these are the seasons when sandflies are abundant, breeding in the cracks and crevices on the ground increasing human exposure to vectors. Similar results have been proved in Morocco by the work of Omari et al (2020), who showed that variations in climatic conditions cause variations in increased population and activity of vector sandflies. Biology and ecology of vectors, and consequently the likelihood of disease transmission, is impacted by variations in temperature, precipitation, and humidity.[12]

Cross-tabulation results of data on mosquito net usage frequency and Kala-azar cases indicated a positive correlation between Kala-azar cases and mosquito net usage. Therefore, public health strategies should be planned engaging communities to enhance awareness on protective measures against vectors. To pursue the goal of effective universal access to mosquito nets, policy planning should also serve as a guide for government, legislators, and stakeholders as they design strategic health communication interventions.[13]

Among the strategies Bangladesh engaged to become the first country globally to receive official validation for having eradicated Kala-azar, as a public health problem were integrated vector management and social mobilization. We recommend these efforts to enhance community's knowledge, attitudes and practices towards Kala-azar prevention and elimination.[14]

The study revealed that generally majority of the population keep domestic animals at home which is linked to an increased risk of Kala-azar. Just over half (54.6%) of households with reported Kala-azar cases had domestic animals at home. The results propose a potential link between availability of animals at home and Kala-azar transmission. More statistical analysis revealed that over half (54.6%) of those surveyed kept animals in house yards where families slept at night. The presence of animals in the house yard has been associated with factors contributing to the occurrence of Kala-azar in previous studies. The increase in zoonotic disease outbreaks and transmission represent a serious threat to human health, necessitating the adoption of one health strategy for effective prevention and control engaging partnership among stakeholders in animal, human, and environmental health.[15]

When respondents were asked, "Do you apply insecticides indoors and to animals?", majority indicated that they do not. This could be indicative of low community awareness or lack of access to insecticides maybe due to cost or unavailability. A systematic review on indoor residual spraying for control of Visceral Leishmaniasis by Faber et al (2022) confirmed effects of indoor residual spraying as positive in terms of availability and effectiveness. The review demonstrated that indoor residual spraying as an effective vector control strategy. The study recommended design of cost-effective ways of using indoor residual spraying together with other vector control strategies like insecticide treated

nets along with early diagnosis in the community for prevention and control of Visceral Leishmaniasis.[16]

Living near, resting, or sleeping under acacia trees during the day to keep off burning sun during dry seasons increases possibility of exposure to sandflies and has been identified as an increased Kala-azar risk. This has been confirmed by a case-control study by Dijk et al (2023) on risk factors for Visceral Leishmaniasis in West Pokot County, Kenya. Increased Visceral Leishmaniasis risk was associated with house proximity to acacia trees species where a species of sandflies *Phlebotomus martini* was reported feeding on acacia trees.[17]

These results suggest that community social mobilization on environmental management should be done in areas with acacia trees near homesteads. Moreover, these results advocate for further research on ecology of sandflies in the region, where acacia trees may provide forage and alternative breeding grounds for the vector sandfly.

The study results show the multi-faceted nature of Kala-azar risk factors in Isiolo County. These risk factors match those observed in earlier studies and therefore this current study strongly recommends the intensification of social mobilisation and health education to increase community awareness on Kala-azar. These findings further support the idea of strong and consistent donor funding, availability of tools for early and effective diagnosis and treatment, vector management, case identification, as well as political commitment all which have been indicated to have contributed to the success of South Asia's mission to eradicate Visceral Leishmaniasis. However, this is not the case in East Africa where there has been a dearth of donor financing, inadequate vector control mechanisms, inadequate infrastructure for healthcare in endemic areas, and poor patient access to healthcare.[18]

Respondents in this study exhibited limited community awareness regarding roles played by different stakeholders in Kala-azar prevention, control, and elimination. A possible explanation for this result is there is no community engagement and participation in the prevention and control strategies.

Additionally, there is also no involvement of all stakeholders in community-based interventions with no strategies and policies in the County that promote effective prevention and control of Kala-azar. One of the issues that emerges from these findings is that collaboration and partnership from different stakeholders is critical for the success of Kala-azar prevention and control programmes. Moreover, the success of community-based interventions relies upon the level of community engagement and participation, and allocation of resources and infrastructure to support the strategies. Consequently, economic context, political environment, social relationships, and individual behaviours must be considered when designing holistic and comprehensive community-based interventions. This should entail working in collaboration with all relevant stakeholders to develop policies and strategies that promote effective prevention and control of Kala-azar.[19]

Limitations

This study is limited to populations living in the Kala-azar hotspots of the County. The patriarchal nature of communities in the study area was also a limiting factor, and consensus building on key information generated during the participatory epidemiology exercises was augmented by arranging informant groups sitting arrangements by gender which facilitated an environment where women were comfortable and ably shared their opinions and ideas.

CONCLUSION

Controlling Leishmaniases is an ongoing worldwide public health problem made more difficult by the numerous environmental and biological factors that contribute to the disease spread. Our results show challenges of Visceral Leishmaniasis prevention and control are multi-sectoral. Sustainable development goals suggest multi-sectoral approach for health and development including for management of vector-borne diseases. In addition, the rising environmental impact of humans is causing Leishmaniases to reappear in endemic places and to emerge in non-endemic areas. Considering intricacy of the disease, adopting One Health approach is crucial for managing the condition. In conclusion, One Health has evolved from a theory or notion to a strategy that many countries, including Kenya, are adopting. Therefore, understanding the complex interrelationships between human, animal, and environmental health holistically is becoming more and more important as One Health concept gains traction.

Recommendations

Considering the conclusions above, we recommend that Isiolo County Government finalize development of County One Health Strategic Plan with a mission to foster cooperation among many sectors and stakeholders, ultimately aiming to protect public health, avert zoonotic illnesses, and guarantee sustainability of ecosystems. Operationalization of the strategy will improve public health response to priority events affecting humans, animals, and environment, as well as strengthen implementation of One Health approach at county and sub-county levels which depends on coordination, collaboration, communication, and on effective and shared governance.

For One Health strategy to be successfully implemented in Isiolo County, the authors advocate for a supportive policy environment, creation of institutional frameworks, strengthening of institutional capacity across all levels of

the government, community engagements, political goodwill, acknowledgment of stakeholders' roles, creation of multidisciplinary and multisectoral partnerships and collaborations in management of public health threats with strengthened surveillance to sustain gains achieved in the elimination efforts.

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