ZERO HUMAN RABIES DEATHS: A ONE HEALTH APPROACH TO RABIES ELIMINATION IN ZAMBIA

Perspective

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Zero Human Rabies Deaths: A One Health approach to rabies elimination in Zambia

Key Messages

- In 2015 the WHO launched a global strategic plan to have zero human rabies deaths by 2030
- Zambia is a signatory to the global strategy to end rabies in 2030
- On average Zambia reports about 20 human rabies deaths annually

Problem Statement

In 2015 the World Health Organisation (WHO), Food and Agriculture Organization (FAO), International Organisation for Animal Health (OIE), and the Global Alliance for Rabies Control (GARC) adopted a common strategy to achieve "Zero human rabies deaths by 2030", of which Zambia is a signatory.

Rabies is a viral disease that is primarily spread by bites and scratches from infected animals. Globally, nearly 99% of human rabies cases are transmitted via domestic dog bites and 59,000 people die due to rabies. About 80% of human rabies cases occur in rural areas, and 40% of human rabies cases occur in children under fifteen years of age.1 Currently, the burden of rabies is disproportionately borne by persons living in Africa and Asia. Global estimates of dog bite incidence do not exist, however studies suggest that dog bites account for tens of millions of injuries annually.

Zambia, which on average reports 20 rabies deaths per year from health facilities (a figure likely to be an underestimate due to the omission of community-based deaths) is a signatory to the "Zero human rabies deaths by 2030" global strategy. Research has shown that the true number of rabies deaths can be 10-100 times higher than the reported number of cases.2 Once a person presents with rabies symptoms, the disease is nearly 100% fatal. However, death can be prevented if a patient receives a complete course of post-exposure prophylaxis (PEP) prior to the onset of symptoms. Despite PEP being almost 100% effective, the treatment is expensive, time intensive, and not always available. Complete PEP treatment consists of five doses of rabies vaccine administered over the course of five clinic visits, and the average cost per patient in Africa is $40 USD.3

In 2018 Zambia reported over 16,000 dog bites and 23 rabies deaths, yet only about 12% of dog bite victims accessed PEP at public

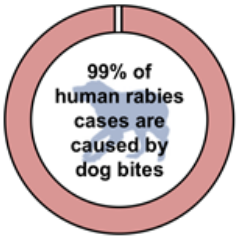
Rabies transmission can be disrupted if 70% of the dog population is vaccinated.4 Large-scale mass dog vaccination campaigns have proven to be an effective strategy for achieving high levels of vaccine coverage amongst dog populations.5 In Zambia, dog owners are responsible for routine dog vaccinations and only 4.5% of dogs are vaccinated against rabies.

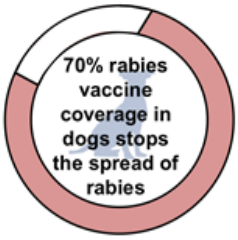
Policy Options

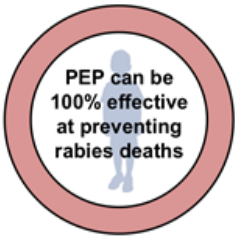
Rabies deaths are preventable, but there are possible financial and logistical limitations to every prevention strategy. Below are proposed policy options for rabies elimination and their expected outcomes:

1. **Maintain status quo**

What: Currently, dog owners in Zambia are responsible for routine dog vaccinations. The government will conduct dog rabies vaccination campaigns in response to an outbreak. Vaccine supply to district veterinary offices is through the Central Veterinary Research Institutes' (CVRI) vaccine production unit. However, the unit has been unable to produce rabies vaccine for three years due to inadequate funding. The vaccine is now imported at a greater cost. Less than 5% of dogs in Zambia are vaccinated against rabies. Dog owners are also required to register their dogs at a fee with the Department of Local Government. About 1% of dogs in Zambia are registered. Over 16,000 dog bites and about 23 human rabies deaths were recorded in Zambia in 2018. PEP is almost 100% effective if a patient receives a complete course of post-exposure prophylaxis (PEP) prior to the onset of symptoms. In 2018, the government of Zambia procured 20,000 doses of rabies PEP.



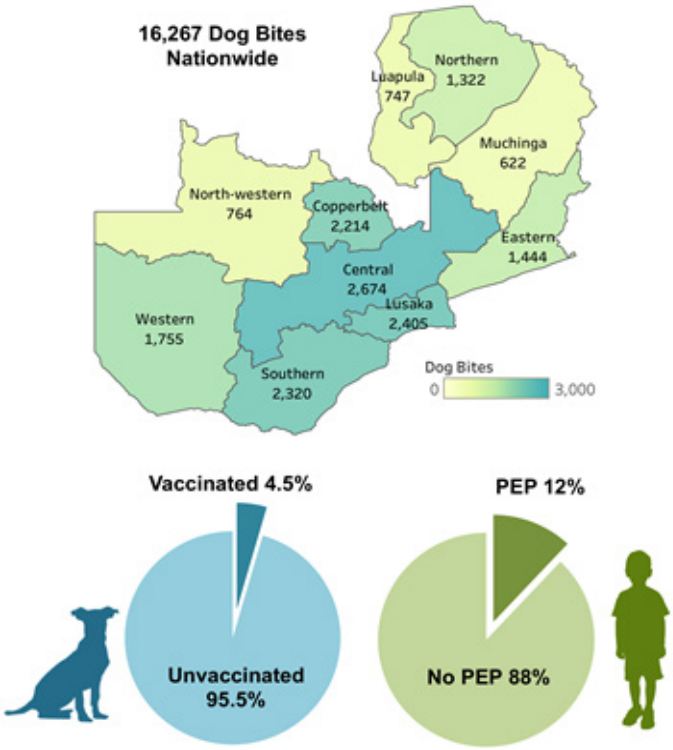




However, with over 16,000 dog bites and about 23 human rabies deaths recorded in 2018 (each dog bite requiring five doses per bite), the amount was not enough PEP to ensure treatment for all dog bite victims. Therefore, many dog bite victims had to personally purchase rabies PEP from private pharmacies. An estimated 12% of Zambian dog bite victims accessed PEP at a public health facility.
Why: Continuing with the status quo requires the least resources.
Feasibility: Low. Based on the model, if the status quo maintains, approximately 327,607 rabid dog cases and 2,260 human rabies deaths will occur in the next 10 years.

2. **Increase PEP availability at public health facilities**
What: Government will procure a sufficient number of PEP doses to treat all potentially exposed dog bite victims and distribute PEP to all public health facilities.

Why: PEP is nearly 100% effective at preventing rabies infection if it is administered promptly and comprehensively. The WHO recommends that PEP be administered to every dog bite victim unless the offending dog's vaccination status can be proven. Currently PEP is not always available at public health facilities due to high costs, stockouts, and insufficient cold chain facilities. Ensuring that all dog bite victims have access to PEP will decrease the number of rabies deaths by 2,234 over the course of 10 years at a cost of $4,270 USD (K55, 510) per human death averted. In Zambia the average life expectancy is 55 years, yet the average age at death due to rabies is 16 years. Implementation of policy option 2 would result in 45,034 healthy years of life saved over 10 years at a cost of $212 USD (K2, 756) per disability adjusted life year (DALY) averted.
Feasibility: Low. The overall cost of increasing supply of PEP over the course of 10 years is $10,854,637 USD (K141, 110,281); however, this number is likely an underestimate due to underreporting of dog bites. Moreover, increasing PEP alone does nothing to eliminate rabies in the dog population. Over time, as the dog population increases, dog bites and the number of PEP doses required for treatment will also increase, thereby making this option economically unsustainable.



3. Biannual dog vaccination & registration campaigns

What: Government through the Department of Veterinary Services will conduct biannual dog vaccination and registration campaigns in each district (with the first campaign around March/April and the second around September /October). The annual vaccination coverage target is 70% of the dog population (35% coverage per campaign). Three teams per district consisting of a vaccinator, dog handler, and record keeper will conduct 14 daylong vaccination campaigns during school holidays. In conjunction with the vaccination and registration campaign, the government will also organize rabies education for the community.
Why: Sustained 70% rabies vaccination coverage among dog populations for five years can effectively eliminate rabies in a region.7 Mass dog vaccination campaigns have been shown to be the most cost effective way to reduce human rabies deaths. For $1.77 USD per dog vaccinated and registered, 2,173 human deaths due to rabies could be averted over 10 years at a cost of $4,923 USD (K63, 999) per death averted. Implementation of policy option 3 would result in 43,803 healthy years of life saved over 10 years at a cost of $244 USD (K3, 172) per disability adjusted life year (DALY) averted.
Feasibility: High. Similar mass dog vaccination campaigns have been successfully conducted in neighboring countries and have proven effective at controlling rabies transmission.8 The model predicts that biannual mass dog vaccination campaigns with a target of 35% coverage per campaign will reduce the number of human rabies deaths to zero by year three. Increasing the vaccination coverage to 70% per campaign would double the costs of the program and result in limited health benefits.

Children queue for dog vaccination

4. Biannual dog vaccination & registration campaigns and increase availability of PEP at public health facilities

What: Government will conduct biannual dog vaccination and registration campaigns as well as procure and distribute a sufficient number of PEP doses to treat all potentially exposed dog bite victims.

Why: Mass dog vaccination and increased PEP access offers the most comprehensive solution to preventing human rabies deaths. The combined approach both eliminates rabies in the dog population as well as ensures access to lifesaving prophylaxis in case of human rabies exposure. As the years go on and the percentage of documented vaccinated dogs in the population increases, the need for costly PEP will decrease. Over 10 years, policy option 4 will prevent 2,253 human deaths due to rabies at a cost of $2,903 USD (K37, 739) per death averted. Furthermore, 45,427 healthy years of life will be saved at a cost of $243 USD (K3, 159) per DALY averted.

Feasibility: High. Policy option 4 prevents the most human deaths due to rabies. While costly for the first three years, the expenses associated with policy option 4 decrease over time, as the national dog vaccination coverage increases and the demand for PEP decreases.

Economic Evaluation

The economic evaluation for implementation of each policy option was completed using a 'Rabies Econ Tool'.9 If Zambia specific data were not available to include in the model, East African estimates from the tool were used. Even where Zambia specific data were used some were estimated to bridge the gap of underreporting. The estimates presented are cumulative over a ten year period.

Economic Evaluation over a Ten Year Period, baseline for rabid dogs = 33,909

Recommendations and next steps

Policy option 4 is recommended as it has the highest number of human deaths averted at a lower cost after ten years. Therefore a One Health approach is recommended, combining PEP and vaccination campaigns to eliminate rabies. A policy option that only alleviates human rabies deaths but does not address the prevalence of rabies in the dog population is shortsighted. A synchronized One Health approach is needed to achieve the WHO goal of zero human rabies deaths by 2030.

The Ministry of Health, Ministry of Livestock and Fisheries, and Ministry of Local government have assembled to form a Rabies Elimination Taskforce. The Rabies Elimination Taskforce has already met and completed a preliminary draft of a Rabies Elimination Plan for Zambia. Next steps include finalizing the Zambian Rabies Elimination Plan by incorporating cost effectiveness analysis and delegating costing responsibilities to each ministry. Additionally, to lower overall costs associated with mass dog vaccination programs, money should be allocated to reinstate and scale-up domestic production of the rabies vaccine by CVRI.

	Rabid dogs	Human deaths	Human deaths averted	DALYs averted	Cost per human death averted	Cost per DALY averted
Option 1	327,607	2,260	-	-	-	-
Option 2	327,607	26	2,234	45,034	$4,270 (K55, 510)	$212 (K2, 756)
Option 3	13,770	87	2,173	43,803	$4,923 (K63, 999)	$244 (K3, 172)
Option 4	13,770	6	2,253	45,427	$4,903 (K63, 739)	$243 (K3, 159)

LIST OF REFERENCES

1. Rabies. Available at: https://www.who.int/news-room/fact-sheets/detail/rabies. (Accessed: 8th February 2019)
2. Cleaveland, S., Fèvre, E. M., Kaare, M. & Coleman, P. G. Estimating human rabies mortality in the United Republic of Tanzania from dog bite injuries. Bull. World Health Organ. 80, 304–310 (2002).
3. World Health Organization, null. Rabies vaccines: WHO position paper, April 2018 - Recommendations. Vaccine 36, 5500–5503 (2018).
4. Bilinski, A. M., Fitzpatrick, M. C., Rupprecht, C. E., Paltiel, A. D. & Galvani, A. P. Optimal frequency of rabies vaccination campaigns in Sub-Saharan Africa. Proc. Biol. Sci. 283, (2016).
5. Lembo, T. et al. The feasibility of canine rabies elimination in Africa: dispelling doubts with data. PLoS Negl Trop Dis 4, e626 (2010).
6. Mulipukwa, C. P., Mudenda, B. & Mbewe, A. R. Insights and efforts to control rabies in Zambia: Evaluation of determinants and barriers to dog vaccination in Nyimba district. PLoS Negl Trop Dis 11, e0005946 (2017).
7. Knobel, D. L. et al. Re-evaluating the burden of rabies in Africa and Asia. Bull. World Health Organ. 83, 360–368 (2005).
8. Fitzpatrick, M. C. et al. Cost-effectiveness of canine vaccination to prevent human rabies in rural Tanzania. Ann. Intern. Med. 160, 91–100 (2014).
9. Borse, R. H. et al. Cost-effectiveness of dog rabies vaccination programs in East Africa. PLoS Negl Trop Dis 12, e0006490 (2018).