REPUBLIC OF LIBERIA



NATIONAL RABIES STRATEGIC PLAN

2023 - 2027

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Abbreviations/Acronyms

ADSR	Animal Disease Surveillance and Response
AU-IBAR	African Union Inter-Africa Bureau of Animal Resources
CAHWs	Community Animals Health Workers
CASO	County Animal Surveillance Officer
CDC	Centers for Disease Control and Prevention
CLO	County Livestock Officer
CVL	Central Veterinary Laboratories
ECTAD	Emergency Centre for Transboundary Animal Disease
EPA	Environmental Protection Agency
DSRU	Disease Surveillance and Response Unit
DFA	Direct Fluorescent Antibody Test
DPM	Dog Population Management
FAO	Food and Agriculture Organization
FDA	Forestry Development Authority
GARC	Global Alliance for Rabies Control
GDREP	Global Dog Rabies Elimination Pathway
KAP	Knowledge Attitude Practice
LNP	Liberia National Police
LIS	Liberia Immigration Services
IDSR	Integrated Disease Surveillance and Response
IEC	Information, Education and Communication
MDV	Mass Dog Vaccination
MoA	Ministry of Agriculture
MoE	Ministry of Education
MoH	Ministry of Health
MMD	Material and Message Development
NPHIL	National Public Health Institute of Liberia
OH	One Health
OHCP	One Health Coordination Platform
WOAH	World Organization for Animal Health (formerly OIE)
WRD	World Rabies Day
PARACON	Pan-African Rabies Control Network
PEP	Post-Exposure Prophylaxis
RESIDDE	Regional Disease Surveillance Systems Enhancement
SARE	Stepwise Approach towards Rabies Elimination
SPERL	Strategic Plan for Elimination of Human Rabies in Liberia
SOPs	Standard Operation Procedures
TWG	Technical Working Group
WHO	World Health Organization

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- National Public Health Institute of Liberia (NPHIL)
- Rabies Technical Working Group
- The Swiss Tropical and Public Health Institute
- One Health Coordination Platform
- Regional Disease Surveillance Systems Enhancement (REDISSE), World Bank project
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Cover photo credit: Dr. Garmie Voupawoe
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+231 886 400 600 / garmievoupawoe@gmail.com

Foreword

Rabies elimination succeeded in much of the western world but remains a huge challenge in resource-limited countries. Despite being a preventable viral disease, which can be controlled through effective vaccination and population management in the reservoir species, an estimated 59,000 people still die each year and roughly 3 million remain at risk. Of these deaths, the majority occur in children in rural communities in Asia (60%) and Africa (36%), where domestic dogs are the main reservoir species [1, 2].

Rabies is endemic to Liberia and a notifiable disease per the Animal Disease Surveillance and Response (ADSR) and Integrated Disease Surveillance and Response (IDSR) under the Ministry of Agriculture and the Ministry of Health, respectively. In 2019, Montserrado, Nimba, and Bong recorded the highest number of dog bite cases. Because dogs are the main source of rabies in the country, tackling the disease in the host population is a recommended and cost-effective strategy. Rabies control is possible, as the tool needed to control the disease is available. Over the past years, we have observed a remarkable international engagement in rabies control. In 2015, the cooperation of international organizations such as the World Health Organization (WHO), the World Organization for Animal Health (WOAH), and the Food and Agriculture Organization (FAO) of the United Nations joined forces to produce a global strategic plan to end human deaths from dog-mediated rabies by 2030 [2]. The Vaccine Alliance decided to include rabies and cholera in its Vaccine Investment Strategy, which was approved in 2018 [3].

This Strategy Plan, **the revised version of the 2019- 2023 National Rabies Action Plan**, was developed (keeping in line with the global drive to eliminate dog-mediated human rabies death) to guide rabies prevention and control activities in Liberia through mass dog vaccination, pre-and post-exposure prophylaxis in humans, and public education. This strategy is based on activities planned within the Stepwise Approach toward Rabies Elimination (SARE), which, when followed, will progress the country to freedom from rabies.

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Hon. Leelia Rosamond Andrews
Deputy Minister
Department of Technical Services
Ministry of Agriculture
Republic of Liberia

Executive Summary

Rabies is a deadly viral disease that causes tens of thousands of deaths each year, mostly in Africa. Per annum, deaths (21,476) are underreported for the continent, and children below the age of 15 years are at greater risk. Despite being 99.9% vaccine-preventable, rabies remains a neglected public health threat in many parts of Sub-Sahara Africa. The timely administration of post-exposure prophylaxis averts rabies-related deaths to bite victims.

In Liberia, dog rabies is endemic, and surveillance systems and disease control activities are still being strengthened. However, rabies vaccination in humans has been documented since 1949. After the civil war from 1989-2003 and the devastating Ebola outbreak from 2014-2015, healthcare services and infrastructure were substantially weakened.

Dog-related rabies has been eliminated from most developed countries, including Western Europe, Canada, the USA, and Japan, with great strides from Latin American countries, which have reported no human rabies deaths from infected rabid animals. In addition, significant progress has been made in reducing the disease burden in countries like Bangladesh, Tanzania, South Africa, and Vietnam. The lessons learned in rabies control in these places are important in ending dog-mediated human rabies deaths in endemic countries, especially Sub-Saharan Countries.

In line with the global drive, this strategy aims to eliminate human-dog-mediated rabies in Liberia by 2030. Three main concepts guide the strategy, sustained mass dog vaccinations, pre-and post-exposure prophylaxis, and public education until the country is declared free from dog-related rabies. This strategy is based on activities outlined in the global Stepwise Approach to Rabies Elimination (SARE) that should enable the country to move from an endemic state to a disease-free status. SARE is a stepwise progression towards becoming a rabies-disease-free country. It consists of 6 stages (Stages 0 to 5), each with activities that continuously build on each other to reduce disease risk. A country is declared completely free of human dog-mediated rabies when it reaches Stage 5.

To Progress from one stage to the next, a set of targets must be met. Most important are the progressive stages; (i) developing and adopting a national rabies elimination strategy, ii) starting implementation of elimination plan in pilot areas, (iii) implementing the elimination strategy throughout the country, and iv) maintaining freedom from human-dog mediated rabies and canine rabies. The implementation of the strategy will begin with selected pilot areas to gain valuable lessons in creating and maintaining a rabies-free zone that will be used during the roll-out of the elimination campaign in the rest of the country.

1. CHAPTER ONE

1.1 INTRODUCTION

1.1.1 Rabies background

Rabies is a fatal but preventable zoonotic disease. It can be transmitted to humans through the bite or scratch of an infected animal. In endemic regions, domestic dogs are the main reservoir of the disease. Annually, about 59,000 deaths and 3 million people remain at risk. Of these deaths, the majority occur in Asia (60%) and Africa (36%), where children and their families living in marginalized communities are the most affected. In Liberia, the annual human rabies death is estimated at 155. Rabies surveillance is active and passive in both the human and animal sectors (IDSR and ADSR). However, the accurate estimate of the dog population in Liberia remains unknown[4].

Rabies is preventable in humans through prompt administration of post-exposure prophylaxis (PEP) to victims of animal bites, and the disease transmission can be eliminated at the source through sustained mass vaccination of the dog population achieving more than 70% of the dog population. However, these measures are either inadequate or lacking in most Sub-Saharan countries.

1.2 Background of Rabies

1.2.1 The Virus

The rabies virus (RABV) is the main etiological agent of the disease and belongs to the rabies *lyssavirus* species, one of the 17 officially recognized within the *Lyssavirus* genus, *Rhabdoviridae* family [5]. Full details of the virus taxonomy can be found on the via the follow link (https://ictv.global/report/chapter/rhabdoviridae/lyssavirus).

The virus is characterized by a single-stranded negative-sense RNA genome encompassing five genes, nucleoprotein (N), phosphoprotein (P), matrix protein (M), glycoprotein (G), and polymerase (L).

To date, 6 main phylogenetic clades of RABV are circulating worldwide, with 3 found in Africa, one of the most affected regions for rabies, with the Africa 2 and Africa 3 clades, as well as the Cosmopolitan clade with the Africa 4 and the Africa 1 lineages (and its numerous sub-lineages for the latter) [5,6].

This strategy focuses on Classical rabies virus.

1.2.2 Transmission

Rabies can be transmitted to humans through the saliva (via bite or scratch) of an infected animal. Less common transmission may occur through an open wound or a mucous membrane, including the mouth or nasal cavity. Person-to-person transmission through bite is possible but rare. In addition, rare transmission of rabies may be contracted via transplantation of an infected organ and inhalation, laboratory staff, of aerosolized (CDC, 2022).

All mammals are susceptible to rabies, but many are dead-end hosts, including cattle, Sheep, goats, and horses, who will unlikely transmit the disease.

1.2.3 Incubation and clinical signs of rabies in animals

Incubation of the disease: The incubation period can vary, however, for cats and dogs it can range between two to twelve weeks post-infection. Longer incubation timeframe has been documented as well.

Clinical signs: In addition to clinical signs of the disease in animal, rabies must be confirmed in the laboratory. Clinical signs vary considerably, including sudden behavioral changes and progressive paralysis leading to death. In some cases, an animal may die rapidly without showing significant clinical signs. There are two distinct forms of rabies in animals, the Furious and the Dumb forms of rabies.

Rabid dogs or cats may die within 10 days of onset of symptoms.

1.2.4 Incubation and clinical signs of rabies in humans

Incubation: In humans, the incubation period can range from two to eight weeks. However, depending on the biting site, the incubation period may vary from below one week to more than one year.

Clinical Signs: The first symptoms are likely non-specific, headaches, muscular pain, nausea, or coughing. The most suggestive early sign of impending rabies is numbness, tingling, and twitching at the site of the original bite. This is likely followed by a phase of agitation and confusion, followed by coma, respiratory failure, and death.

1.3 Diagnosis of rabies

In animals: The direct fluorescent antibody (DFA) test and the direct immunohistochemical test (dRIT) are antibody-based protocols for the detection of viral antigens - and the conventional or real-time-polymerase chain reaction (RT-PCR) assays molecular investigations for the detection of viral RNA - are the diagnostic assays recommended for post-mortem rabies diagnosis by the OIE [3].

Additional tests include the FITC (Fluorescein isothiocyanate) and the rapid immunochromatographic diagnostic tests (RIDTs) based on the lateral flow principle offer new opportunities for decentralized rabies diagnosis.

In human: The recommended human rabies diagnostic test is the DFA on brain tissue or cerebrum spinal fluid. Additional test includes, RT-PCR and dRIT.

1.4 Risk of Introduction

Liberia has a long porous land border, estimated at 1,587 kilometers, with Guinea, Cote d'Ivoire, and Sierra Leone in the North, East, and West, and makes it likely that rabies would be introduced through human-mediated dog movement. There are legal controls (quarantine Act of Liberia, SPS Measures # 15) on the entry of animals into the country to prevent diseases. However, this may be unstrict for pets (cats and dogs).

The most unlikely scenario Liberia might face rabies introduction is in the South with the Atlantic Ocean, a natural barrier, and the Roberts International Airport, where pets entering the country are subjected to rigorous and restrictive regulations.

1.5 Control of strays

The control of stray animals should be the responsibility of the local government/authority and necessary to prevent uncontrolled animals from becoming a reservoir for rabies. Local authorities, through the structure of the One Health platform, should have the power to seize animals (dogs, cats, and etc.) if the owner fails to comply with any control provisions. Local authorities should locate detention facilities and implement plans for rabies outbreaks. They should work closely with animal Surveillance Officers and CAHWs to monitor stray animals. The enforcement of these controls would require a significant commitment of local authority time and resources, so the likelihood of using this control method would increase in line with the severity of the incident. If an animal from the stray population presents with rabies, then controlling stray animals will be an essential disease control measure.

1.6 Control of rabies in Wildlife

Hunting wildlife for food is common in Liberia. It puts humans in direct contact with animals, and this could be a possibility of "spillover" infections into the domestic dog or cat population, once again putting human health at risk. Rabies in wildlife has the potential to remain undetected, thus establishing itself more widely before it is noticed. Rabies has been isolated from wildlife in Liberia (CVL reports, 2019), positive case in African Civet, monkey, and horse. So, surveillance activities must focus more on wildlife. Bat lyssaviruses have not been confirmed in bats in Liberia. However, the likelihood of contact between people and bats (apart from bat handlers) makes the human risk from this disease negligible.

1.7 Rabies Situation in Liberia

1.7.1 Background

In Liberia, rabies is endemic, and surveillance systems and disease control activities are still improving. However, human rabies vaccination has been documented since 1949 (Poindexter, 1953). The civil war (1989-2003) and the devastating Ebola outbreak (2014-2015) and Covid-19 pandemic substantially weakened the healthcare services and infrastructure [8, 9]. Although large parts of the country still lack electricity, cold chain maintenance for vaccines storage at selected health facilities around the country is supported through the One Health Platform of Liberia. A few studies have described rabies prevalence, molecular characterization, post-exposure prophylaxis (PEP) demand based on dog bites [10, 11] and KAP studies. However, data on the biting animals needs to be better captured from the animal health sector, including wildlife. During 2008-2012, records from the Public Health sector indicate that 488 dog bite cases were registered at several county hospitals, with children under ten years of age being the most affected group [12]. In 2018, the National Public Health Institute (NPHIL) registered 1,645 bite cases and ten related deaths (NPHIL, 2018 unpublished report). Olarinmoye et al. (2017) applied a decision tree model to human bite data for Monrovia, estimating 155 human rabies deaths annually and high demand for PEP. Despite these reports, the actual burden of rabies in Liberia remains unknown [4, 11]. PEP in Liberia is based on wound washing and post-exposure vaccination of exposed persons since rabies immunoglobulin (RIG) is unavailable. Rabies vaccine is limited to major cities, with remote and marginalized communities having no access to life-saving treatment. Public health and veterinary service collaboration continue to improve, but active rabies surveillance remains a substantial challenge, especially from the veterinary side.

Dog mass vaccination is challenging, as most dog owners cannot afford to vaccinate their dogs due to high cost of vaccines and the willingness of dog owners to vaccinate their dogs. As a result, the government mostly subsidizes dog vaccination because rabies control is a public good. Over the years, small-scale mass dog vaccination has been conducted. Free small-scale vaccination campaigns were conducted. Between 2012 and 2021, about 11'828 dogs (1% vaccination coverage), mostly from Monrovia, were vaccinated against rabies during the World Rabies Day (WRD) activities. Within the Global Health Security Agenda (GHSA) program, FAO is committed to improving Liberian national animal health services to assist the country's compliance with International Health Regulations (IHR, 2005). The technical re-orientation of the USAID-

funded FAO Emerging Pandemic Threats (EPT-2) led FAO Emergency Centre for Transboundary Animal Diseases (ECTAD) teams to develop work plans supporting the implementation of the GHSA against four Action Packages, including Zoonotic Diseases (ZD), Biosafety and Biosecurity (BB), Laboratory Systems (LS) and Workforce Development (WD). Under the ZD Action Package, GHSA countries are expected to conduct a national zoonotic disease prioritization process using the CDC One Health Zoonotic Disease Prioritization Tool (OHZDPT). Rabies was deemed a top five priority

zoonotic disease in all FAO GHSA countries, including Liberia. Lastly, Liberia was part of a larger study led by the Swiss Tropical and Public Health Institute (Swiss TPH) to estimate the burden of rabies in the Ivory Coast, Mali, Chad, and Liberia.

1.7.2 Burden of the disease

Rabies surveillance needs to be strengthened with a decentralized diagnostic capacity to improve disease underreporting. Although the surveillance (active and passive) system has improved over the years, the veterinary workforce is still understaffed in Liberia, thus limits the robust response to the disease situation throughout the country [10, 11]. For instance, only one surveillance officer is assigned per county to respond to animal disease outbreaks, including rabies. Of course, the limited staff coverage throughout the country compounded by the porosity of borders with neighboring countries (Guinea, Ivory Coast, and Sierra Leone) facilitates illegal human-mediated animal (especially, dogs and cats) movements, a potential threat of transboundary transmission of animal diseases [10].

Between 2017 and 2018, three animal rabies diagnostic tests (DFA, RT-PCR, and RIDT) were jointly implemented by Swiss TPH, FAO, Istituto Zooprofilattico Sperimentale delle Venezie (IZSVe-FAO Reference Center for rabies), and CVL Mali. Subsequently, the first animal rabies case was diagnosed and Liberia was flagged as a rabies endemic country.

Currently, the skills and laboratory capacity needed to diagnose human rabies is lacking in Liberia [4]

Suspected rabies cases in humans and animals are reported from all parts of the country. Between September 2017– January 2022, about 104 animal brain tissues and decapitated rabid suspected animal heads were collected from various parts of Liberia and shipped to the CVL for analysis. Sample collection (brain tissues) was mostly performed at the CVL, and brain samples were tested with the DFA and RIDT tests. Of these, 46 were positive of rabies (CVL Liberia records, GARC). (Figure 1).

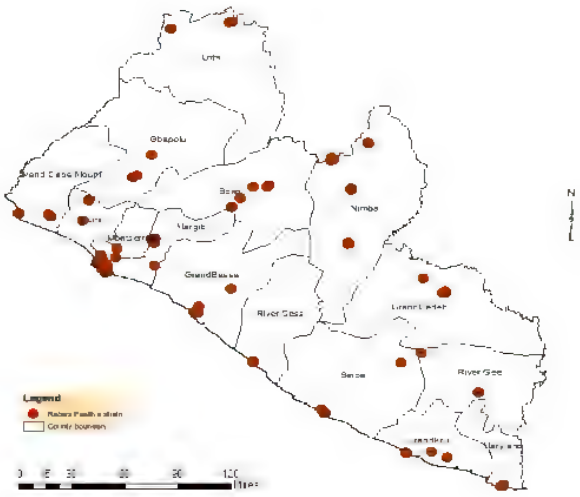


Figure 1: Collection sites of suspected animal rabies samples (2017 - 2022), Liberia

Rabies strains circulating in Liberia is distinct. Out of 46 genome sequences obtained, phylogenetic analysis revealed that all isolates belonged to the **Group H** of the **Africa 2 Clade**, where they strongly clustered together, forming a clear distinct Liberian cluster. However, only one sequence (in red circle in the diagram) was found outside of this Liberian cluster, and closely related to a sequence from Ivory Coast, suggestive of putative exchange between these two neighboring countries (Figure 2).

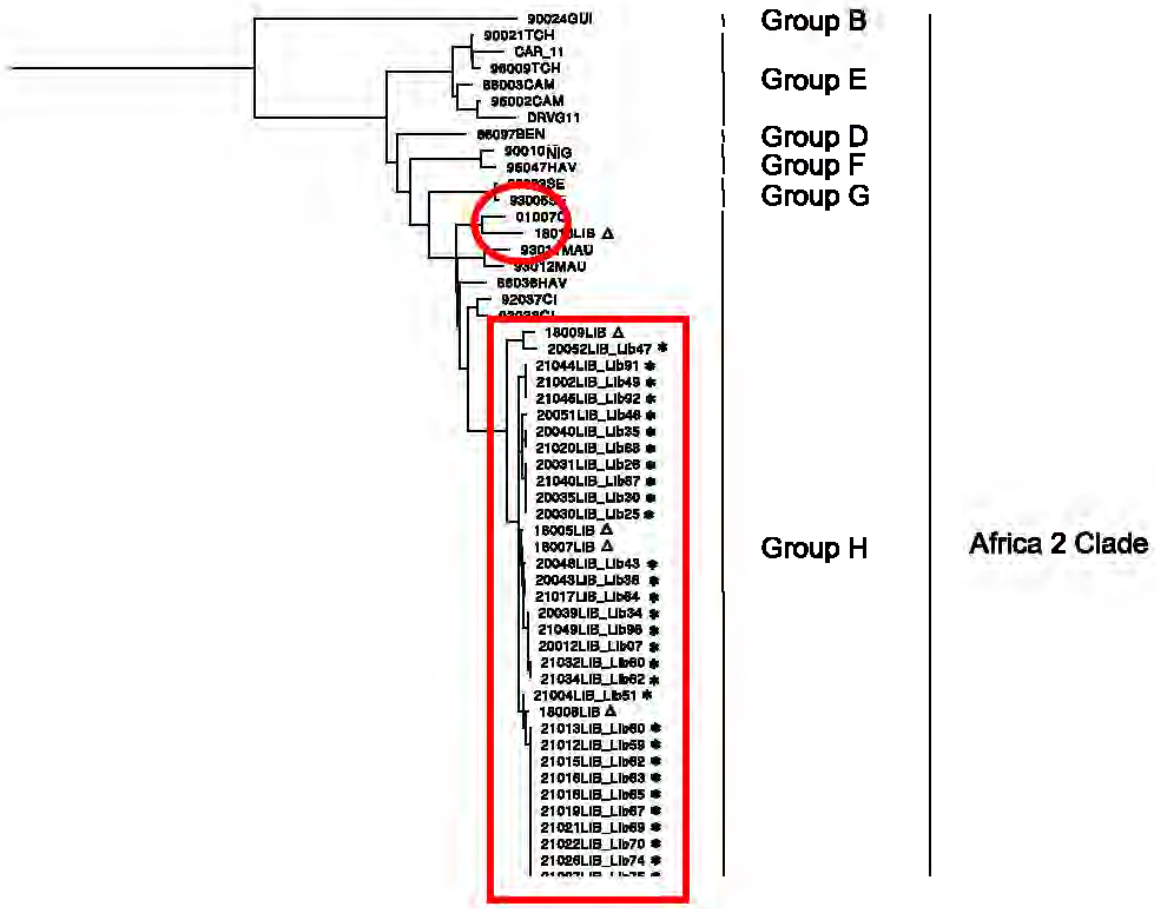


Figure 2: Phylogenetic analysis seven rabies samples characterized in Liberia.

Between 2017 and 2022, domestic dogs accounted for the highest number of confirmed animal rabies cases; however, with no documented case in livestock and bat. Figure 1 below shows the distribution of confirmed rabies cases across animal species.

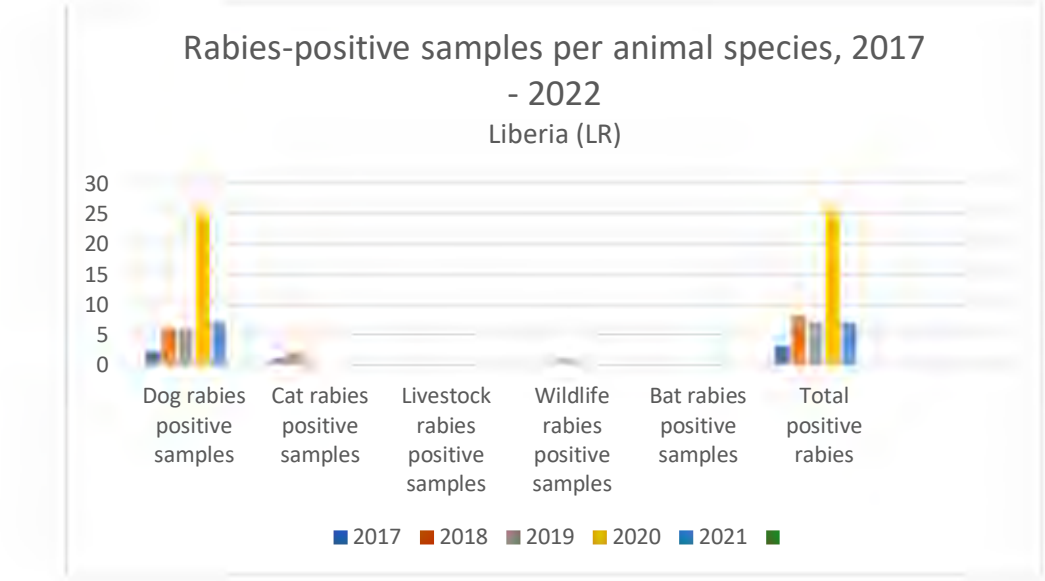


Figure 3: Rabies-positive samples per animal species (2017 - 2022), Liberia. Source: GARC Rabies Epidemiology Bulletin (Rabies Epidemiological Bulletin | Global Alliance for Rabies Control (rabiesalliance.org)).

In human, although dog bite cases are common, rabies cases are sporadic. For example, a total of 16 human deaths were reported in 2016 (5 human deaths), 2019 (6 human deaths), and 2020 (5 human deaths), accounting for about 0.32 deaths per 100,000 population (Figure 3).

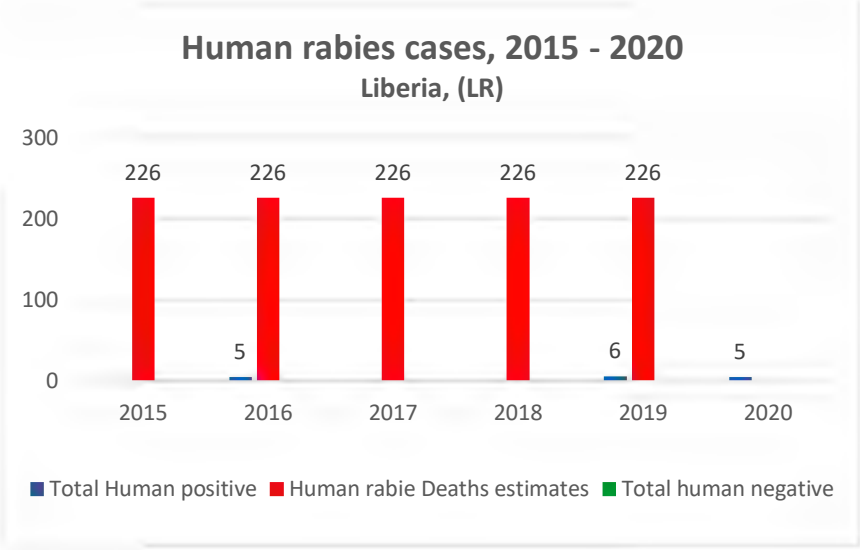


Figure 4: Human rabies cases (2015-2020), Liberia. Source: GARC Rabies Epidemiology Bulletin (Rabies Epidemiological Bulletin | Global Alliance for Rabies Control (rabiesalliance.org))

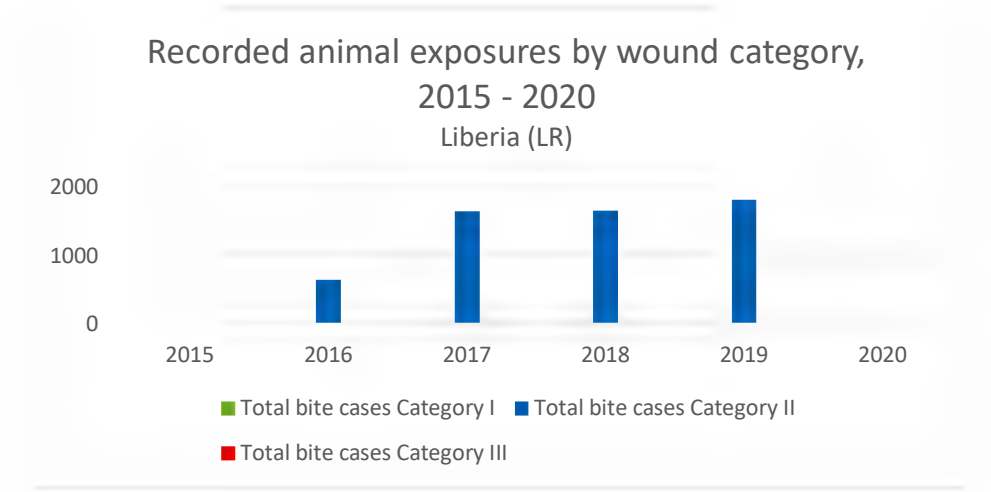


Figure 5: Recorded animal exposures by wound category (2015-2020), Liberia. GARC Rabies Epidemiology Bulletin (Rabies Epidemiological Bulletin | Global Alliance for Rabies Control (rabiesalliance.org))

Between 2019 – 2021, small-scale mass dog vaccination campaigns were conducted in selected counties. A total of 11'828 animals were vaccinated through the support of MOA, MOH, FAO, REDISSE, and other rabies stakeholders.

Table 1: Mass animal vaccination per county, Liberia (2019 - 2021)

County	Y2019	Y2020	Y2021	Total
Bomi	0	0	306	306
Bong	0	0	500	500
Gbarpolu	0	0	320	320
Grand Bassa	0	325	302	627
Grand Cape Mount	0	0	299	299
Grand Cape Mount	0	0	299	299
Grand Gedeh	0	0	261	261
Grand Kru	0	0	301	301
Lofa	763	0	602	1365
Margibi	1006	439	419	1864
Maryland	0	0	305	305
Montserrado	1181	1944	932	4057
Nimba	0	0	722	722
River Cess	0	0	314	314
River Gee	0	0	304	304
Sinoe	0	0	283	283
Grand total	**2950**	**2708**	**6170**	**11,828**
Vaccination per animal species				
Species	**Y2019**	**Y2020**	**Y2021**	**Total**
Dog	2939	2680	5885	11504
Cat	10	27	276	313
Monkey	1	1	9	11
Total	**2950**	**2708**	**6170**	**11828**

1.7.3 Securing rabies vaccines/ Control measure

Rabies is vaccine preventable. Timely administration of expensive PEP can 99.9% prevent rabies, and tackling the disease in the host population by mass dog vaccination is a cost-effective and recommended approach to controlling the disease. However, there is a serious challenge with the availability of anti-rabies vaccines in Liberia. These lifesaving vaccines are often imported and too expensive [1]

Mostly, rabies control activities are centered around World Rabies Day by stakeholders. In 2019, the Ministry of Agriculture procured 10'000 doses of animal vaccine from the World Organization for Animal Health. These were used to vaccinate animals in high-risk areas. On the other hand, the Ministry of Health procured human vaccine through the NPHIL and the WHO (National rabies report, 2021).

1.7.4 Legal framework for rabies control

Rabies is a reportable disease in Liberia. Some existing laws have empowered the Ministries of Agriculture and Health in preventing and controlling diseases. However, the Ministry of Agriculture needs to have exclusive laws such as compulsory dog vaccination and population management to control rabies.

Below is a list of draft laws and enforced laws that promote rabies control in the country.

Draft Animal Disease Law: This law is yet to be enforced.

The law will empower MoA and other line ministries, agencies and partners to conduct all necessary measures for disease control actions to control notifiable disease in Liberia

Agriculture Law, Chapter 1 "Plant and quarantine act"

The purpose of this act is to prevent entry into Liberia of injurious plant and animal pests and diseases existing in foreign countries; to prevent the spread of such pests and diseases should they become established in Liberia

Revised Public Health Law

Provides legal authority to ensure the conditions for people to be healthy.

Draft Liberian Animal Welfare Law; The Act aims to protect the lives and well-being of animals, based on the inherent worth of all sentient beings and the responsibility of human beings to protect animals and treat them humanely.

National Wildlife Conversation and protected area management Law 2016, Chapter 6: section 6.3.4 (b) & Chapter 8: section 8:3

1.7.5 Rabies surveillance systems

Rabies is a zoonotic disease that requires joint effort. Primarily, control measures fall between the animal and human health sectors. Currently in Liberia, surveillance activities are carried out by the Ministry of Agriculture, Ministry of Health, and the National Public Health Institute (NPHIL).

In the Ministry of Agriculture, rabies is an immediately reportable Priority Zoonotic Disease under the Animal Disease Surveillance and Response (ADSR) strategy. Despite being a priority disease, surveillance is mostly passive in most parts of the country but robust within the capital and its environs. Workforce strategy and number of animal surveillance officers is limited to cover and keep active surveillance of rabies cases throughout the country. For instance, an estimated additional 106 veterinary para-professionals are needed for public service alone (PVS report, 2018). The CVL, confined to the capital, is the only laboratory with animal rabies diagnostic capacity in the country.

In the Ministry of Health/NPHIL, rabies is a priority under the Integrated Disease Surveillance and Response (IDSR) system. Human rabies and dog bite are immediately and weekly reportable conditions in the IDSR. Cases of dog bite and or suspected clinical detected at community or health facility levels should be notified to the next level for detailed epidemiological investigation and management of affected persons with a copy sent to the district Surveillance Officers (revised IDSR technical guideline 2022).

In addition to the two systems, an integrated bite case management (IBCM), a One Health approach for rabies surveillance and control, is facilitated under the One Health Platform of Liberia. Under this scheme, joint investigation is conducted to assess the risk of rabies in animal bite victims to increase rabies case detection, improve PEP administration, and save lives.

1.8 Strengthens, Weakness, Opportunities, and Threats

These are the Strengths, Weakness, Opportunities, and threats in the prevention and control of rabies in Liberia as indicated below.

Strengths

- Presence of well-structured human health delivery facilities
- Presence of diagnostic laboratory infrastructures in the capital
- Presence of trained and skilled laboratory technologists
- Presence of integrated disease surveillance systems
- Existence of legal framework for regulation of biologicals and vaccines
- Presence of One health Coordination Platform

Weakness

- Inefficient cold chain system in animal sector at the district and community level.
- Lack of rabies diagnostic capacity at the regional and county levels
- Inadequate numbers of public and animal health/livestock extension staff
- Lack of adequate funding
- Inadequate budget
- Bad road network (connections during the rainy season)

Opportunities

- Establishment of One Health coordination structures
- Collaboration with international laboratories
- Presence of partnership and collaboration with international partners
- Possibility of multisectoral collaboration
- Commitment in rabies elimination by partners (FAO, WHO, WOAH, RIWA, GARC)

Threats

- Inadequate power supply
- High cost of PEP
- Inadequate skills for data collection and simple analysis
- Lack of availability of RIG & human rabies vaccination
- Lack of guaranteed supply of rabies vaccine
- Weak political and institutional engagement
- Weak Institutional linkages
- Long porous border
- Inadequate budget
- Bad road network (Bad Road connections during the rainy season)
- *Lack of regional rabies laboratory*

2. Chapter TWO

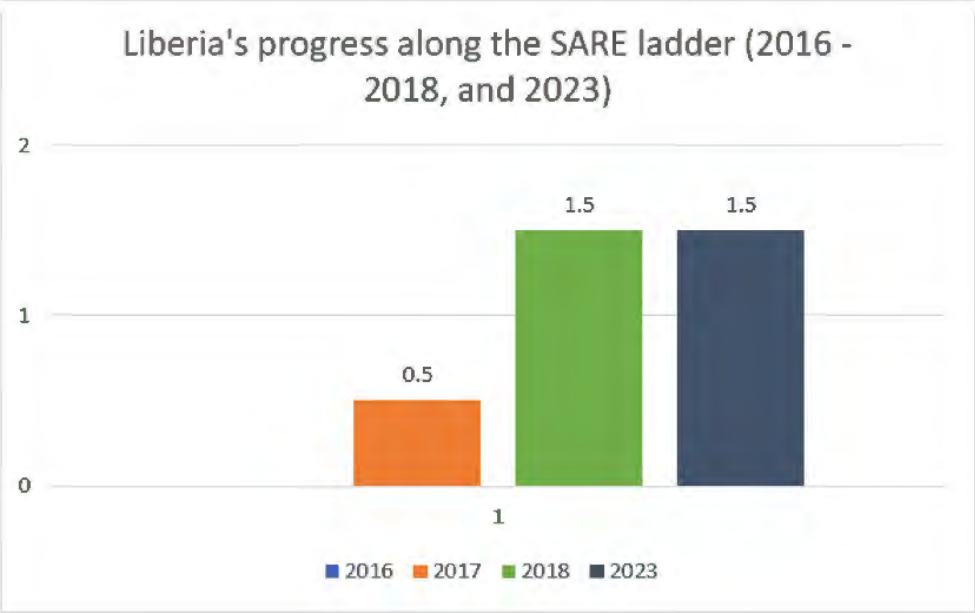
2.1 Overview of the SARE assessment process

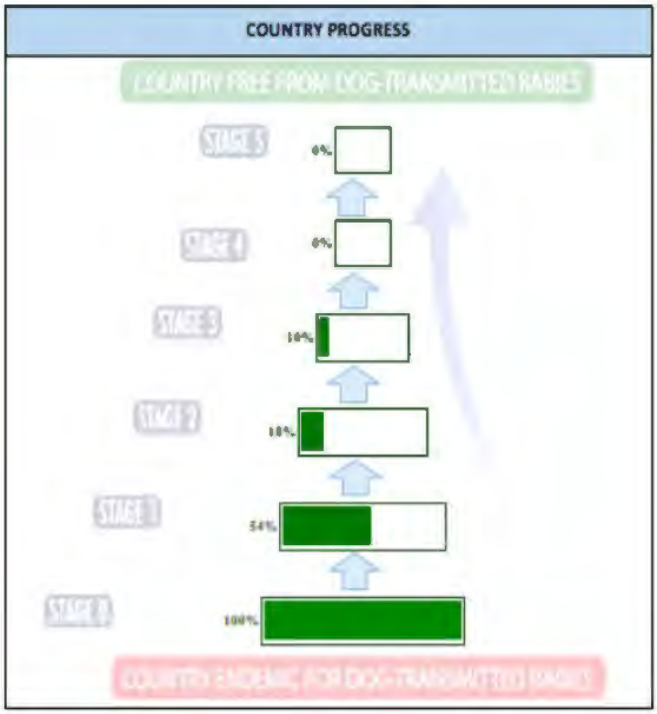
The Stepwise Approach towards Rabies Elimination (SARE) tool was developed in 2012 as a self-assessment and a practical guide to the development and implementation of national rabies control programs as a joint effort between the FAO and GARC [4]. The Microsoft® Excel-based SARE tool relies on user input to asses more than 100 activities that have been aggregated into different categories that correlate with the STOP-R framework [5], namely legislation; data collection and analysis; laboratory diagnosis; information, education and communication; prevention and control; dog population-related matters; and cross-cutting issues. The SARE tool, therefore, delves deeper into the specificities for a successful intervention strategy, breaking down the complex tasks associated with implementing a successful rabies elimination program into smaller and more manageable steps. Once the 10 assessments have been completed, the SARE tool provides the users with direct, actionable activities that have been designed to follow a logical flow of progression, typically from a small-scale to nation-wide implementation. By focusing available resources to the pending activities identified in the SARE assessment, countries further their efforts towards rabies control and elimination, and progress within the SARE score pathway from Stage 0 (being endemic for rabies canine-mediated rabies) to Stage 5 (freedom from canine-mediated rabies) [6].

2.2 SARE assessment results for Liberia

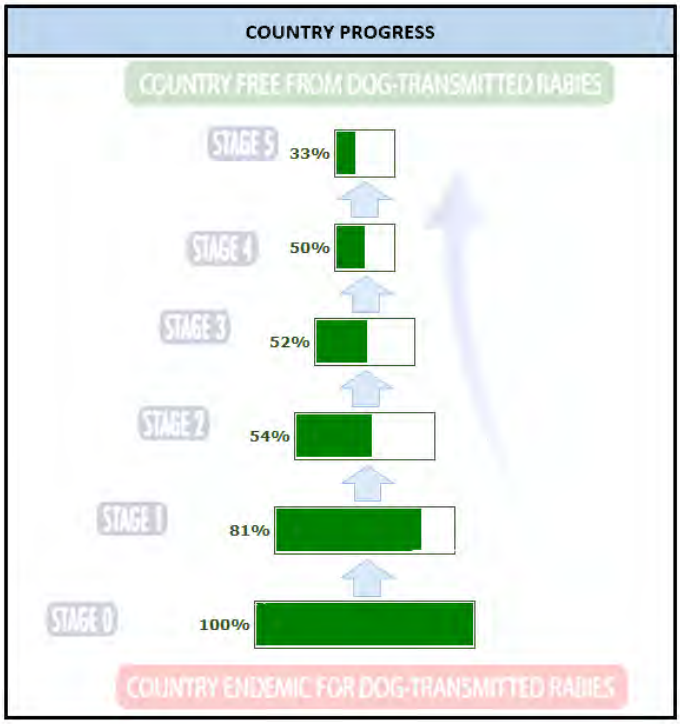
An in-country rabies workshop was held between 28th May and 1st June 2018, and representatives from all governmental stakeholders involved in canine-mediated rabies control in Liberia participated in a SARE assessment. Liberia achieved a nationally-endorsed SARE score of 1.5 out of 5, clearly showing that the country is progressing toward rabies control. Subsequently, a Practical Work plan (National Rabies Action Plan 2019-2023) was automatically generated and enforced for four years.

Similarly, between June 1st and 2nd, 2023, an in-country workshop was held to pre-validate and validate the first National Rabies Strategic Plan (2023-2027) document. The SARE tool was again assessed to determine the current SARE score of the country. After four years of implementing the National Rabies Action Plan, Liberia retained the SARE score of 1.5 out of 5, with few improvements in some assessment categories. For Liberia to progress along the SARE ladder and thus achieve freedom from dog-transmitted human rabies by 2030, the national stakeholders need to deliver upon the programmatic activities described in this NRSP 2023 -2027.





Country's progress, 2018



Country's progress, 2023

ACTIVITY SUMMARY FROM SARE ASSESSEMNT, 2018		
COMPONENTS	**PENDING ACTIVITIES**	**ACCOMPLISHED ACTIVITIES**
Data collection and analysis	12	10
Prevention and control	18	8
Laboratory diagnosis	8	5
Dog population-related issues	12	0
Information, Education, communication	17	2
Cross-cutting issues	7	4
Legislation	3	9

ACTIVITY SUMMARY FROM SARE ASSESSEMNT, 2023		
COMPONENTS	**PENDING ACTIVITIES**	**ACCOMPLISHED ACTIVITIES**
Data collection and analysis	0	22
Prevention and control	12	14
Laboratory diagnosis	3	10
Dog population-related issues	9	4
Information, Education, communication	12	9
Cross-cutting issues	3	9
Legislation	3	10

3. Chapter Three

The Strategy Framework

3.1 Key principles of the rabies control Strategy

- Rabies elimination is a public good; elimination of human rabies in Liberia requires a multi-sectorial collaborative approach.
- Mass dog vaccination is the most cost-effective approach for sustainable elimination of dog rabies and subsequent reduction of expensive PEP and human disease deaths
- Sustained mass dog vaccination of at least 70% of dog population eliminates rabies in domestic dogs, and subsequently in humans and other domestic animals
- Robust surveillance and diagnostic, mostly in remote communities, is vital for monitoring control and post-elimination
- In Liberia, domestic dogs maintain the rabies cycles; Evidence of sylvatic rabies is unknown
- At least 36% of households in rural and urban settings own one dog
- Rabid domestic dogs transmit at least 92% of human rabies in Liberia and rabies has been diagnosed in wildlife
- Closer cooperation between national rabies stakeholders and Mano River Union (MRU) countries is essential for sustainable control in the region.

3.2 Vision

To make Liberia a rabies free nation

3.3 Mission

To eliminate rabies in dogs and humans through sustained mass dog vaccination and prompt administration of post-exposure treatment.

3.4 Goal

To eliminate human dog-mediated rabies in Liberia and to declare the country free of the disease

3.5 General Objective

To eliminate and maintain freedom from dog-mediated human rabies

3.6 KEY STRATEGIC OBJECTIVES FOR RABIES CONTROL AND ELIMINATION

No.	Strategic priority	Objectives
1.	Elimination of rabies in domestic dogs	To conduct, county level, dog population census To carry out mass dog vaccination targeting at least 70% of dog population coverage annually for three consecutive years. To create legislation and implement policies on dog population management such as education, legislation, registration, sterilization, holding facilities, euthanasia and controlling access to garbage and left overs To promote responsible dog ownership
2.	Prevention of human rabies	To provide adequate awareness about rabies in high-risk areas at the national and local levels. To timely administer post-Exposure treatment (Wound washing for 15 minutes with soap, and vaccination) to all suspected rabid animal bite victims. To Increase knowledge and skills among animal and human health workers on rabies in general and post-exposure management. To timely administer PreEP and PEP to population of interest (VET, ETC). To develop SOPs for the proper disposal of rabies suspected and infected animal carcass.
3.	Strengthen Surveillance and response to outbreak	To strengthen surveillance to monitor and evaluate key indicators To strengthen preparedness and response to rabies outbreaks To establish sufficient and efficient country-wide diagnostic laboratories and surveillance network. Strengthen rabies surveillance in wildlife To enhance a responsive cross border, surveillance system between MRU countries
4.	Conduct rabies operational research	To conduct and promote operational research to support implementation of rabies control activities To conduct immunogenicity studies in animals targeted of vaccination before the initiation of mass vaccination programmes. To conduct post vaccination test to ensure animal developed antibiotics.
5.	Advocacy, communication and social mobilization	To increase community awareness and education on rabies prevention and control through Risk Communication and community Engagement (RCCE) To increase awareness of rabies prevention and control at all levels To advocate for rabies prevention and control to policy makers To improve social behavior, change for rabies prevention and control

6.	Enhance Partnerships and Multi-sectoral Coordination	To strengthen capacity for planning, partnerships and coordination of the National Rabies Elimination Strategy To enhance partnerships and multi-sectoral collaboration among institutions To establish a functional multi-sectoral rabies coordinating body to oversee the rabies control program at all levels
7.	Resource mobilization	To mobilize resources to support rabies elimination program To attract interested development partners to participate and manage aspects of the program Source free animal vaccines from OIE vaccine bank.

3.6.1 Elimination of Rabies in Domestic Dogs

In humans, domestic dogs are the main source of rabies infection. However, surveillance activities should broaden to consider wildlife. Mass dog vaccination is the recommended and cost-effective rabies control and elimination strategy. Such a strategy has proven successful in much of the Western world.

Based on empirical evidence and theoretical observations worldwide investigating the relationship between vaccination coverage and reduction in rabies incidence, the World Organization for Animal Health and World Health Organization recommends the critical percentage of dogs that need to be vaccinated to prevent rabies cases and outbreaks should be at least 70%. A study in Chad revealed that rabies transmission was successfully interrupted after two consecutive citywide dog mass vaccination campaigns. However, rabies cases resurged due to imported rabies-exposed dogs outside the vaccinated city limits [13].

In this light, Rabies control and elimination in Liberia will implement the recommended mass dog vaccination campaigns for at least 4 years followed by a maintenance phase. Dogs of all ages will be vaccinated and responsible dog ownership practices such as registration and ensuring annual vaccination for owned dogs will be promoted.

Dog rabies control and elimination in Liberia will consider the following measures:

- Conduct nationwide dog census
- Mass dog vaccinations
- Dog population management
- Promotion of responsible dog ownership

Table 2: Phases of Implementation of mass dog vaccination campaign

Implementation Ph	Phase I: Preparation			Phase II: Scale-up dog vacci			Phase III: Sustained 70% dog vaccination						
Program year	1	2	3	4	5	6	7	8	9	10	11	12	13
Expected dog vax coverage	<18% (Current rate			18%-35%	35%-53%	53%-70%				≥70%			
Activities achieved	Field studies			Pilot implementation			Mass vaccination of dogs						
	Workforce training			Scaling-up vaccination cover			Surveillance to establish disease burden and assess progress						
	Strengthening lab capacity			Logistical improvements									
				Operational equipment									
Cost estimates:				Expected vaccination coverag			Vaccination of 70% of the dog population						
				Infrastructure Improvements*									

Figure 6: Mass dog vaccination Implementation Phase

3.6.2 Prevention of Human Rabies

In humans, rabies prevention strategies will focus on protecting those at highest risk of exposure, post exposure treatment and supportive management for the clinically ill. Prevention activities will include:

a. Early and appropriate post-exposure treatment

First aid treatment of wounds; reducing the rabies virus at the site of bite by washing the wound using soap and water for 15 minutes

ii. Rabies Immunoglobulin (RIG); the anti-rabies immunoglobulin provides passive immunity before vaccine takes effect.

iii. Human anti- rabies vaccines; use of the cell culture vaccines based on the management guidelines will be enhanced.

b. Pre-exposure vaccination; this will be provided to high risk groups including animal health workers, animal handlers and catchers, wildlife wardens, and laboratory staff handling the virus and potentially infected material.

c. Training health workers on proper dog bite wound cleaning and management- Continuous education of health professionals on proper dog bite wound cleaning and management and administration of PEP is necessary to provide effective prevention of human rabies.

3.6.3 Strengthen Surveillance and Response to outbreak

According to the International Health Regulations (IHR), surveillance is defined as the “systematic, ongoing collection, collation, and analysis of data for public health purposes and the timely dissemination of public health information for assessment and public health response as necessary.” A robust surveillance system is a critical component in rabies

elimination, which enhances early detection and reporting of cases in humans and animals.

A One Health approach is an effective rabies surveillance strategy built upon decentralized, laboratory-based surveillance and clearly defined disease indicators and case definition. Rabies surveillance should not cease even when a country is declared free of rabies. However, the objectives of the surveillance in the post-elimination phase should change and adapt accordingly.

Outbreak response will be coordinated through a One Health Approach. These activities will include:

- Strengthening of existing surveillance systems and linkage between veterinary and medical surveillance systems. This will involve enhancing the collection and reporting of data on animal bites and rabies cases in humans and animals and surveillance for adverse events following vaccinations. Cross-border surveillance will also be a key component.

- Stakeholder engagement; involvement of government, private sector, NGOs, civil society organization and the community as partners in surveillance.
- Strengthening capacity for field sample collection, handling, transport and laboratory diagnosis Rapid Immuno Diagnostic and fluorescein isothiocyanate (FITC) Test (RIDT for animal rabies diagnostic) for humans and animal rabies.

3.6.4 Conduct rabies operational research

Research on specific areas, as listed below, will generate evidence to inform the implementation of the program. Outcome from various research findings will as well guide decision-makers and ensure the best use of available resources and provide evidence of what is achievable in community-based settings. This will aid in validating the status of progress towards eradication of rabies in Liberia and the region. Key research areas will include

- Studies on the basic parameters of dog populations including number owned per household, turnover, accessibility and ownership status in different dog sub-populations
- The role of wildlife in the epidemiology of rabies in Liberia needs to be clarified.
- Conduct post vaccination surveys to assess vaccination coverage
- Impact assessment surveys to determine reduction in rabies incidence, PEP usage and cost analysis
- Assessment of best social behavior change approaches to increase awareness about rabies and to improve healthcare-seeking behavior for PEP
- Evaluation of diagnostics, drugs recommended for the rabies elimination program
- Evaluation of the rabies surveillance system

- Socio-economic impact of rabies elimination Health utilization survey
- Conduct research in other mammals

3.6.5 Advocacy, Communication and Social mobilization

Public education and awareness on rabies and its prevention are some of the key components of successful disease intervention campaigns. The public needs an understanding of rabies, the dangers of the disease and the challenges faced with controlling the disease. Without public knowledge and participation, mass vaccination campaigns will be unsuccessful, and the rabies control program will likely fail. Thus, successful community engagement and awareness campaigns should ideally rely on a structured Information, Education and Communication (IEC)/Material and Message Development (MMD) plan that has agreed on objectives, audiences, SBC messages, channels and timelines to increase awareness of, and participation in, rabies prevention and control.

- To raise public awareness about rabies at National and subnational local levels
- To enlighten and educate high-risk groups such as
- Children
- Public health workers
- Veterinarians/ Animal health workers
- Vaccinators,
- Animal handlers and catchers
- Dog meat butchers,
- Wildlife and protected area officers
- Environmental health workers
- To improve awareness and practices on dog-bite management
- To influence social behavior, change to improve rabies prevention and control outcomes.
- To mobilize resources to support the rabies elimination program.

A communication (IEC) plan will be developed and implemented thorough this strategy. The target audience(s) will be identified, developing and testing the messages, selecting media and channels of distribution of messages and implementation plan will be carried out at national and subnational levels.

3.6.6 Enhance Partnerships and Multi-sectoral Coordination

Partnerships and multi-sectoral collaboration among national and county governments, NGO's, civil society groups, and all rabies stakeholders will be required for successful implementation of the rabies elimination program and for best utilization of the available resources.

International organizations like World Health Organization (WHO), World Organization for Animal Health (OIE), Food and Agriculture Organization (FAO) and Centers for Diseases Control and Prevention (CDC) are also important in giving technical and financial support for the planning and implementation of the program.

A coordinating body, the National Rabies Elimination Committee (NaREC), or a similar body, with representation from the various sectors involved in rabies control will be established at the national level. This multi-sectoral task force will provide stewardship and be responsible for the implementation of the different components of the National rabies elimination strategy. Health facilities at regional, district and village levels will be strengthened to enable them oversee the rabies control activities in their respective areas.

3.6.7 Resource Mobilization

Without resources, rabies elimination will be unsuccessful. Therefore, implementation of the rabies elimination strategy requires resources in a sustainable manner including human resources, infrastructure and finances. Areas of spending include procurement of diagnostics, vaccines, immunoglobulins, animal birth control, operational research, surveillance, monitoring and supervision.

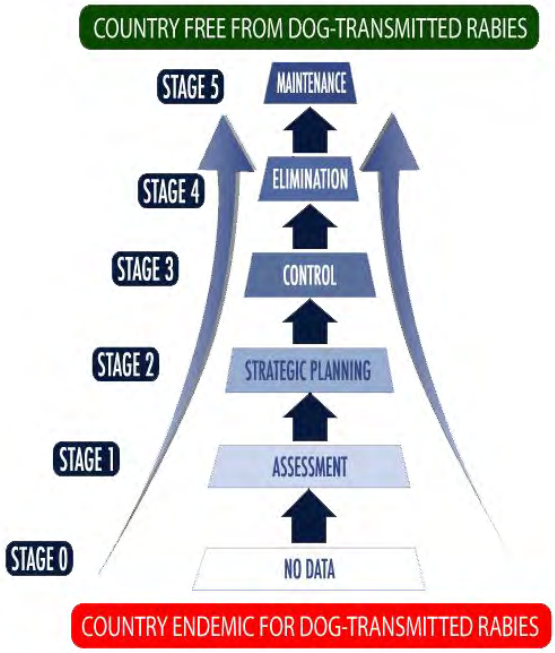
A funding plan will be developed to ensure that funds are available for every stage of the plan. Funding will be sourced from the line government ministries (Ministry of Agriculture and Ministry of Health), County Governments as well as local and international partners. Partners, regional and international organizations and NGOs interested in dog rabies control will be invited to support and sustain rabies elimination program in Liberia.

4. Chapter four

Implementation Plan of the Strategy

The strategy is based on the stepwise approach (SA) as recommended by FAO/GARC. The Stepwise Approach towards Rabies Elimination (SARE) is a comprehensive risk-based model that proposes a graduated approach in the reduction of disease risk, allowing for regional or synchronized activities towards disease elimination. The Rabies SARE consists of six stages (stage 0 to 5).

Each stage has a set of activities that build on each other to continuously reduce the risk of disease, with the area and or country being declared completely free of dog mediated human rabies when it reaches stage 5.



The 6 stages are summarized below;

Stage 0: Rabies suspected to be present but limited information is available, **Stage 1**: Development and adoption of the National Rabies elimination strategy **Stage 2:** Implementation of the National Rabies Elimination Strategy in pilot areas, **Stage 3**: Rabies risk reduction through full scale implementation of the strategy **Stage 4**: Maintaining freedom from dog mediated human rabies and canine rabies **Stage 5**: Declaration of freedom from canine rabies

Liberia is currently at stage 1.5 out of 5. For the country to progress from one stage to the next, a set of targets must be reached and verified. For instance, to progress from stage 1 to stage 2, the country must have developed a national rabies elimination strategy.

4.1 Planning for implementation of the strategy

4.1.1 Establishment of a National Rabies Elimination Committee (NaREC)

Rabies is a zoonosis disease; thus, elimination measures require closer cooperation between sectors. The government, civil society groups, research institutions, international partners, and the public must work closely to eliminate the disease. A rabies elimination committee shall be established under the One Health Coordination Platform of Liberia to coordinate the implementation of the strategy.

Members of the NaREC will include the following stakeholders:

- Central Agriculture Research Institute (CARI)
- Civil Society Organizations
- Developmental partners, such as FAO, WHO, OIE, AU-IBAR
- Environmental Protection Agency (Compliance and Enforcement, Environmental Research Radiation Standard and Intersectoral Departments)
- Forestry Development Authority
- Liberia Medical and Health Regulatory Authority (LMHRA)
- Ministry of Agriculture; National Livestock Division
- Ministry of Defense (AFL)
- Ministry of Health
- Ministry of Internal Affairs
- Ministry of Information Culture and Tourism
- Ministry of Commerce
- Ministry of Justice (LNP, LIS)
- National Fisheries and Aquaculture Authority
- National Public Health Institute of Liberia (NPHIL)
- One Health Platform of Liberia

NaREC will be a technical sub-committee of the OHTC

Technical teams at the County and District levels will be established to implement the rabies elimination strategy. These teams will comprise the County Rabies Elimination Committee (CREC) and the District Rabies Elimination Committee (DREC) at the County and District levels. The NaREC will coordinate activities with CREC and DREC to ensure strategy implementation.

Roles of the NaREC

The overall role of the NaREC shall be to provide technical guidance to the County and District levels committees on implementing a rabies elimination strategy.

The roles shall include:

- Guide various rabies committees at lower levels.
- Resource mobilization
- Training and capacity building
- Internally monitor (progress reports) implementation of the strategy
- Receive and review reports from lower-level sub-committees,
- Provide technical advice on rabies to the nation.
- Provide regular updates to the public and stakeholders on implementing rabies and elimination strategies.
- Propose changes and amendments to regulations and laws on rabies control
- Advise the Permanent Secretaries on issues about rabies
- Provide public awareness using prints and electronic media
- Regular meetings
- Enforce Risk communication and communication Engagement (RCCE) activities

4.1.2 Establishment of County Rabies Elimination Committee (CREC)

Rabies Elimination Coordination Committee will be formed at the County levels to coordinate activities of the rabies elimination strategy. The co-chairs of the CREC shall be the county directors of veterinary services and health.

The CREC will include:

- County Health officers
- County Agriculture Coordinator
- County Animal Health Officer (Veterinary Officers)
- County Surveillance Officers (Human, Animal, Environmental, Plant health, and Wildlife)
- County Livestock Field Officers
- County Education officer
- Natural Resources and Tourism Officers
- FDA Regional staff
- EPA Inspectorate Unit
- Representatives from Non-Governmental Organizations/Community-Based Organizations
- Representative from the private sector
- Representative of the Ministry of Internal Affairs
- Representative from the community

Roles of CREC

- Coordinate rabies elimination strategy activities at the county level
- Provide progress report to the NaREC
- Resource mobilization
- Advocacy
- Supervise activities of the Sub County levels
- Provide regular updates to the public on progress of the rabies elimination strategy

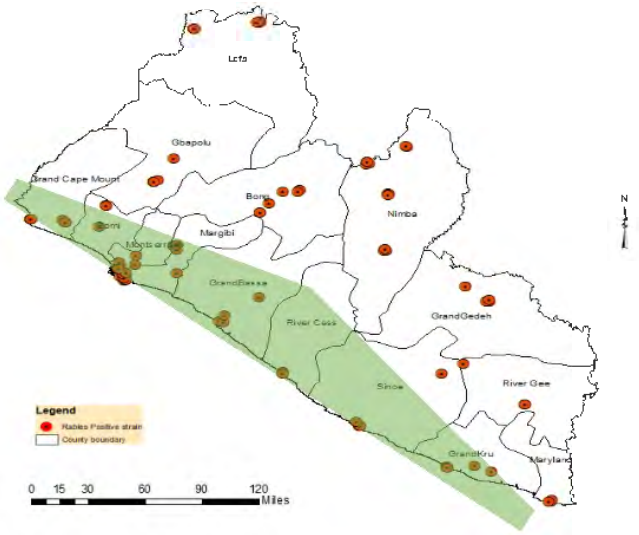
Similar group shall be formed at the district (District Rabies Elimination Committee, DREC) and community levels.

4.1.3 Selection of focal pilot areas

The initial implementation of the strategy will be conducted in pilot areas to demonstrate success before activities are scaled up to the rest of the country.

The pilot areas have been selected based on the presence of natural barriers, the Atlantic Ocean, which may reduce rabies introduction in and out of the pilot areas.

The first pilot area will focus on coastal counties of Liberia, followed by counties without defined natural barriers but endemic to high numbers of human rabies cases.



Lessons (challenges and best practices) learned during the implementation of the pilot phases will be recorded and utilized when scaling up rabies elimination activities to the rest of the country.

4.1.4 Strengthen Surveillance and response to outbreak

A well-functioning rabies surveillance systems are important to provide reliable data to increase successful and sustainable rabies control. The existing surveillance systems within the MOA (ADSR) and MOH (Implemented through IDSR) will be enhanced to improve data quality and reliable epidemiological data. These separate systems will be effectively coordinated under the One Health Platform of Liberia. A “One Health” perspective for rabies brings a clear added value by strengthening inter-sectoral cooperation, which will be adapted to local settings.

Table 3: Type of Surveillance and Data source

Data type	Data source
Data on dog bites and suspected human and animal rabies cases	Households, community, CHT, NPHIL, Veterinary services, Health facilities, private practitioners, and NGOs
Dog vaccination data and PEP usage	MOA, FAO, MOH, NPHIL, private practitioners
Suspected and laboratory confirmed rabies cases	CVL, NRL, public and private human and veterinary laboratory

Data collected at the household and community levels will be channeled through the district, county and then to the national level. A feedback approach will be used, i.e., the bottom-to-top and top-to-bottom approach.

Other activities to implement include:

- Strengthen national database on rabies based on the existing surveillance data
- Establishing regional animal rabies laboratories and capacities

4.1.5 Development of Guidelines

The following guidelines will be developed to standardize the implementation of rabies activities throughout the country.

- Post-vaccination coverage guidelines and dog ecology survey guidelines
- Strengthen /Design of Mass Dog vaccination campaigns
- Animal (dogs & cats) handling guidelines during vaccination campaigns
- Outbreak response guidelines
- Rabies surveillance guidelines

- SOPs for Rabies suspect sample collection and transportation
- SOPs for Suspected rabies carcass handling and disposal procedures
- SOPs for PPE use when dealing with rabies suspected samples
- Animal (dog, cat) bite management guidelines
- Rabies management guidelines
- Protocol for providing pre-exposure prophylaxis to high-risk persons/groups
- Stray dog environmental control measures
- Responsible dog ownership
- Tools for Monitoring and evaluation
- Rabies awareness guideline
- Establish dog feeding center for homeless dogs to get vaccinated by injecting vaccines in the dog fed.

4.1.6 Securing of Human and Animal Vaccines

Current rabies vaccinations offer a safe and very high level of protection against the classical rabies virus when given pre-exposure. Vaccination immediately after exposure will also help reduce the risk of rabies developing. Rabies immunoglobulin is also given as a post-exposure treatment to prevent the development of the disease. There are vaccines available for human use as well as for use in animal populations. The vaccines are considered both safe and effective.

- To conduct an assessment on human and dog anti-rabies vaccines requirement
- Procurement and proper storage of required numbers of human and dog anti-rabies vaccine
- Establish a vaccine bank at the regional levels
- Human rabies vaccines are supposed to be available throughout the country
- A vaccine bank should be established and maintained to ensure a continuous flow of rabies vaccine during outbreaks and to alleviate the effect of procurement breakdowns.
- Train and promote the establishment of animal vaccine production in Liberia

4.1.7 Conduct and promote operational research

Results obtained from operational research will support the implementation of the rabies control strategy. The following research areas will be prioritized;

- Survey on animal bites and rabies cases
- Studies on stray dog population specifically; identifying factors and sources, estimating numbers, distribution, and ecology
- Molecular and phylogenetic analysis of circulating rabies strains
- Ascertain the impact of surveillance activities on rabies control

- Assessment of best approaches to increase awareness about rabies and to improve healthcare-seeking behavior for PEP.
- Assessment of control measures in place

4.1.8 Develop Communication Plan

A communication strategy to ensure responsible accurate and informative reporting that promotes awareness and prevention of rabies locally and nationally.
Key components of the communications plan will include:

- Agreed key messages that cover several strands (awareness, risk reduction, context and proportionality, acceptance and support for government interventions)
- Public awareness campaigns to increase knowledge of the risks and the various risk reduction measures that people can take
- Targeted communications aimed at dog owners and those at higher risk of coming into contact with suspect cases to facilitate cooperation with control measures, either voluntary or compulsory. Appropriate channels of communication will be identified for relaying key information to various audiences.
- Communications plan for each stage of an outbreak including onset, during the outbreak and post the outbreak stages.

Scaling up to from Stage 1 to 2 on the SARE ladder

The following indicator must be carried out.

- Development and adoption of rabies elimination strategy
- National Rabies Control/Elimination Committee is operational.
- Establishment of an up-to-date database on rabies
- Existence of guidelines supporting implementation of the strategy
- Approved budget plan for vaccine procurement and distribution
- Approved budget plan for vaccine procurement and distribution

4.2 Implementation of the elimination strategy in pilot areas

Stage two describes how the strategy activities will be conducted in the selected pilot areas of the country.

The below-listed activities will be implemented in the pilot areas:

- Information, Education and Communication
- Training of human and animal health staff
    - This will be conducted as part of building capacity to implement the strategy. Training guidelines will be developed by NaREC and rolled out in the field by the sub-national teams.

    - Animal and human health workers will be trained to improve their skills and knowledge in rabies awareness and prevention. Courses will include animal handling, dog vaccination campaigns, rabies surveillance, dog bite wound management, laboratory diagnosis, community mobilization and sensitization, dog population management, animal welfare and responsible dog ownership.
    - GARC Education Platform (GEP) offers a set of free online courses in this regard.

- Resource mapping of laboratory diagnostic and health facilities, human resource capacity, and cold chain facilities
- Procurement and distribution of human and animal vaccines and other supplies
- Collating existing rabies-related baseline data
- Enhancing existing rabies surveillance system in the pilot areas. This should incorporate modern technology, including mobile phone-based surveillance, to improve reporting.
- Conducting mass dog vaccinations based on the guidelines
- Operational research

- Post vaccination surveys
    - Impact assessment - the outcome measure in humans will be the number of animal bite cases, PEP usage, and human rabies cases. In animals, the outcome measure will be the number of confirmed animal cases.
    - Cost Analysis - Accurate records of all expenditures on rabies control efforts will be useful for performing the cost analyses during the implementation or at the end of the program

- Cross-border engagements and synchronizing of activities to reduce the risk of re-introducing disease in the implementation areas
- Pre-positioning of the vaccines and other biologicals to sub-counties with vaccine storage facilities.
- Outbreak response in areas within and outside the pilot zone

4.2.1 Organization of a pilot vaccination campaign

The One Health Platform is crucial in these steps. When administering a pilot vaccination campaign, operations should be decentralized in the pilot counties. Each county has several health facilities and veterinary establishments, which could provide infrastructure, equipment, and professionally trained staff. Local staff of the Ministry of Agriculture (e.g., CAHWs) and the Ministry of Health should be involved in every county. Vaccinators must be enrolled from each county and trained. Both ministries have previously conducted joint vaccination activities for Rabies and PPR, so such experience should be utilized.

The vaccination campaigns must be planned properly to consider seasonal variation. During the rainy season (May to October), vaccination activities are almost impossible in some parts of the countries due to bad road conditions. However, vaccination activities can be conducted in accessible cities.

4.2.2 Public engagement

Public engagement plays a key role when planning the campaign. Providing precise information to the public reduces unnecessary inquiry, thus reducing campaign costs. Information about the campaign should be disseminated through agreed upon IEC approaches, including, but not limited to; posters displayed in public places, flyers given to dog owners, radio broadcasts, and megaphone announcements in communities. Radio announcements may be broadcast in local vernaculars to understand the campaign better. Before a campaign begins in any county, a One Health stakeholder meeting should be held with local authorities. Local government should further disseminate the information about the campaign to community members for ease of operation. Then an SMS can be sent to remind the public about the campaign dates.

4.2.3 Vaccination scenarios

Based on previous small-scale vaccination campaigns conducted in Liberia, we can assume the following for the feasibility and budget planning of the campaign. It is assumed that a vaccinator can vaccinate between 50 and 60 dogs per day. Therefore, we assume that a vaccinator, on average, can vaccinate 50 dogs per day for a nationwide campaign [15].

Table 4:Scenarios of vaccinators

	Scenario 1	Scenario 2	Scenario 3
Vaccinators available	30	20	20
Dogs vaccinated per vaccinator per day (rate)	50	50	50
Campaign vaccination in months	18	24	36

Scaling up from Stage 2 to 3 on the SARE ladder

At least 70% dog vaccination coverage annually for the four years

More than 70% reduction in the incidence of dog rabies after the first campaign and over 95% after the second campaign.

There should be no human deaths due to rabies reported for not less than 12 months in the pilot areas.

4.3 Scaling up rabies elimination strategy to the rest of the country

The scale up campaign will follow the logic of the provisional proposal for a coordinated approach for dog rabies elimination in Africa (Mauti et al, 2019). Using the geographical barriers, which prevent the importation of new rabies cases, of the Atlantic Ocean in the South of Liberia, the mass vaccination will start from coastal counties and move toward Cote d'Ivorie, Guinea, and Sierra Leone. It is advisable to synchronize mass vaccination activities with neighboring countries.

Key activities in the stage will include:

- Rabies elimination activities similar to those conducted in the pilot areas.
- Routine dog vaccinations in the pilot areas.
- Adopting best practices and lessons from implementing the strategy in the pilot areas.

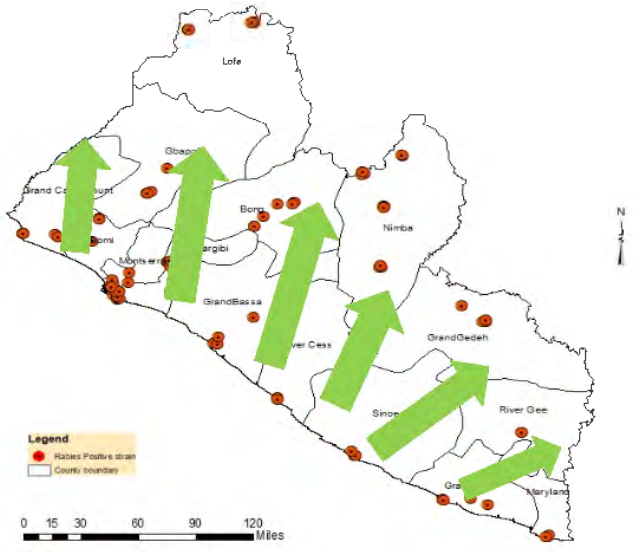


Figure 7: Scenario of a possible spatio-temporal coordinated dynamic of dog rabies elimination in Liberia

International cross border engagements

Regulation of human-mediated animal movements at ports of entry shall be ensure. Strengthen International Cross Border Engagements and livestock (especially cats and dogs) controls at border crossings and ports of entry (e.g., zoo-sanitary inspection points, police checkpoints, sea ports, and airports) and road checks for evidence of vaccination against rabies.

Identification of rabies free zones

Vaccination of dogs can be discontinued in defined areas where no incidences of dog rabies have been reported for two consecutive years, provided adequate surveillance is in place. If there are no rabies cases within six months when vaccinations have been discontinued within an area/ zone, then the area can be declared as having achieved "freedom from rabies." This will be a self-declaration of freedom by the Director of Veterinary Services as guided by the regulations for self-declaration as stipulated in the Rabies Act.

Surveillance for rabies will be sustained, and adequate vaccine stocks and resources for an emergency response to contain new outbreaks should be available.

Advocacy, communication, and social mobilization will continue in this phase.

Scaling up from Stage 3 to 4 on the SARE ladder

- No human-dog-mediated rabies cases for at least 12 months
- Over 70% reduction in the incidence of dog rabies after the first campaign and over 95% after the second campaign.

4.4 Maintaining freedom from human dog-related rabies and elimination of canine rabies

To declare an area free of rabies, based on WHO/WOAH guidelines, the following measures must be considered:

- Routine dog vaccinations
- Enough stocks of vaccines and biological for outbreak response
- Continue with surveillance
- Outbreak response plan – outbreaks addressed immediately
- Cross border surveillance -international
- Continue advocacy, communication and social mobilization
- Internal monitoring of dog movement between counties.
- Leverage on the existing vaccine co-chain storage at all facilities.
- Supply of rabies vaccines to major health facilities across the country
- Establishment of vaccination and co-chain facilities for rabies

Indicator for movement from stage 4 to 5

- No human rabies cases or deaths for at-least two years.
- No dog rabies cases for two years

4.5 Maintain freedom from rabies in humans and dogs

In the final stage, stage 5, the country with substantial transdisciplinary effort will be officially declared free from rabies and the VS will apply for certification from international bodies. However, once accomplished, pre-elimination activities must still be place, as sustainable measures are essential for maintaining zero human deaths of rabies in future generations. Governments need to maintain commitment and active epidemiological surveillance for early disease detection in humans as well as dogs and ensure quick response. Combined strategic efforts are necessary, keeping the high turnover rate of dogs in mind. With these steps, the public health sector will be able to save a considerable amount of money due to reduction in costs of human PEP [17]. However, reintroduction can only be prevented if countries are highly coordinated in their efforts; otherwise, spillovers through rabid dogs crossing international borders are inevitable.

5. Chapter Five

5.1 Monitoring and Evaluation

Monitoring, assessment, and evaluation will be done under the program at all levels to ensure implementation as per plan. A set of objectively verifiable indicators will be used to assess and measure the progress towards the elimination of rabies and its transmission. The M&E Plan is aligned with the regional strategy to enable comparatively measures and progress at sub regional and regional level for coordination. An external independent evaluation will be used to assess the progress towards the overall objectives. This will be done midway, and towards the end of the strategy to inform lessons learned for further improvement.

Under the framework of the One Health's M&E Technical Working Group, the M&E Technical working group will establish a framework for monitoring the activities and progress towards to the objectives of the Strategic Plan. The M&E Technical Working Group will lead a joint participatory field assessment to assess the progress of the implementation of planned activities

Monitoring: The M&E Technical Working Group will lead quarterly performance monitoring meetings to review implementation progress against targets as defined in the annual work plan. The purpose of the quarterly review meetings will be to inform the stakeholders of the progress of the implementation, to inform continued learning and to address implementation challenges.
Bi-annual stakeholder performance monitoring and review meetings at county and national levels will also review performance against targets, address any constraints to implementation and refocus activities if needed.

Routine Data Quality Assessment: In addition to leading the quarterly performance monitoring, the M&E Technical Working Group will also lead an annual data quality assessment and make official routine rabies surveillance data available.

Annual review meeting: As part of the commitment to performance monitoring, all stakeholders will meet annually to review achievements against targets and milestones in the strategic and annual work plans.

EVALUATION PLAN

MIDTERM EVALUATION
A proposed evaluation questions shall be developed for the midterm evaluation
1. 2. 3. 4. 5.
A proposed evaluation questions shall be developed for the final evaluation
1. 2. 3. 4. 5.

6. Chapter Six

6.1 Annexes

ANNEX 1: MONITORING AND EVALUATION PLAN

IMPLEMENTATION OF THE STRATEGIC PLAN IN PLAN IN SELECTED PILOT AREAS, LIBERIA

Summary of Objective	Indicator(s)	Means of verification (Source)
Goal: To eliminate dog transmitted human rabies in pilot areas	Reduction to below 1% the incidence of rabies in the defined pilot geographical	
PURPOSE- Adoption and implementation of the strategies outlined in the rabies elimination document to eliminate and prevent rabies	% decrease in rabies in humans	Surveillance records
	% decrease in rabies in animal	Surveillance records
	Increase in surveillance system sensitivity and data quality and adoption of a national rabies outbreak response plan	Evaluation study report
	Number of rabies studies whose results have been disseminated	Annual report, study report
	% of households who are aware about rabies, its prevention and control	Study report
	Formation of NaREC, CREC and DREC	
STRATEGY OUTPUTS		
Elimination of Rabies in Domestic Dogs		
To vaccinate more than 70% of dog population in the pilot areas for 3 consecutive years from the start of implementation	Proportion of dogs vaccinated in pilot areas	Post vaccination surveys in each of the sub-counties.
	% of sub-counties with 70% vaccination coverage within the pilot counties	Number of doses of rabies vaccine
To reduce proportion of stray dogs by 25% in 5 years	Proportion of stray dogs	Ecology study report
	% of sub-counties with reduced dog populations	Ecology study report
Raise awareness on responsible dog ownership in the implementation areas in 5 years	% households aware of responsible dog ownership	KAP survey done every 3 years
Prevention of Human Rabies		
To increase timely and appropriate post exposure treatment to rabies exposed persons in 5 years		
To increase awareness on importance of local wound treatment after bite within	% of patients that present at facilities having washed the wound with soap and water for at least 15 minutes	Hospital records

households in pilot area by 95% in 5 years		
To increase proportion of people washing bite wounds presenting in health facilities by 80%	% of people who have knowledge on proper wound washing after bites	KAP study
To increase RIG use in 80% of the designated health facilities	% of designated health facilities with no RIG stock-outs	Review of annual report on RIG use in the pilot area
To avail PEP in 90% of vaccination facilities	% of eligible cases receiving RIG	Hospital records
To increase PEP completion rate among eligible rabies exposed cases by 80 % in 5 years	% of vaccination facilities with no PEP stock outs	PEP stock cards
	% of eligible cases with PEP completed	Review of annual report on PEP coverage
To provide Pre-exposure Prophylaxis to 95% of most at risk population in pilot areas in 5 years	% of most at risk occupational groups personnel that receive complete dose of Pre-exposure prophylaxis	PEP vaccination register
To train staff in 100% of the health care facilities on proper dog bite wound cleaning and management in 5 years	Number of staff trained in facilities	Number of certificates issued
		Participants List
	% of facilities with trained staff with the bite wound management guidelines	Regular supervision reports
Strengthen Surveillance and Response to Outbreak		
To improve sensitivity of the surveillance human surveillance system to 80% in 5 years	improved surveillance system attributes sensitivity and representativeness	Surveillance system evaluation report / Records review
To improve sensitivity of the animal surveillance to 90% in 5 years	% of rabies cases captured by surveillance system	Surveillance system evaluation report / Records review
To improve representativeness of the animal and human surveillance systems by 80% in 5 years	% of facilities reporting in the surveillance system	
To respond to 100% of the reported dog bite/ rabies outbreaks in the implementation areas	Proportion of the outbreaks responded to in time	Outbreak reports
	% of staff trained	
Development of a rabies outbreak response plan	Rabies outbreak response plan	
To increase laboratory diagnostic capacity for humans and animal rabies in 5 years	% of laboratories equipped with diagnostic facilities in the pilot areas	Laboratory assessment reports
	Number of samples submitted and tested	
	Number of staff trained	Training logs
Conduct Rabies Operational Research		
4.1. Baseline surveys in pilot areas - To be completed in first year of implementation	% of applicable studies done in each pilot area	Study reports
4.2 Conduct studies to support implementation of the strategy	Number of the studies done in each pilot area	Study reports
Advocacy, Communication and Social Mobilization		

increase public awareness to 95% about the risk of rabies and dog-bite prevention behaviors in 5 years	% of population aware of rabies and its prevention and control	KAP survey
Enhance Partnerships and Multi-sectoral Coordination		
To establish partnerships and multi-sectoral collaboration among line ministries the OHPL, other government agencies, NGO and private sectors for successful implementation of the rabies control program	No. of international organizations/ funding agencies providing support to the project	Memorandum of Agreement with OHPL by the funding agency
To have a functional NaREC in the first year of implementation	Number of meetings	List of nominated persons
To have functional CREC in implementing counties by end of the first year	Number of meetings	Terms of reference
		NaREC meeting minutes
Formation of committee in each sub-county in the pilot areas	Number of meetings	Terms of reference
Resource Mobilization		
To mobilize resources to support the rabies elimination program	Budget for rabies prevention and control provided to the OHP for SPERL	Approved budget and record of budget allocation to OHP for SPERL
	% of counties in the pilot areas allocate funds for SPERL	SPERL pilot areas budget
To invite interested development partners to participate and manage aspects of the project	Numbers of partners involved in the project	Budget report

ANNEX 2: BUDGET OF THE RABIES ELIMINATION STRATEGY

PROJECTED BUDGET 2023-2027 IN PILOT COUNTIES (USD)

STRATEGY	ACTIVITIES	2023	2024	2025	2026	2027
ENANCE PARTNERSHIPS AND INTER-SECTORAL COORDINATION						
Localize program implementation	Launching of the strategy	21,000				
	Formation of NaREC	5,000				
	Formation of CREC & sub-county levels in plot counties	14,200				
ELIMINATION OF RABIES IN DOMESTIC DOGS						
To conduct mass dog vaccination targeting 70% of the dog population (County level)	- Logistics management Estimated dog population in the pilot counties 500,000 Targeting of 70% = 316,294 dogs Vaccination cost approx. $ 3.25 USD per dog	308,386	547,458	547,458	547,458	177,746
	To promote responsible dog ownership and population management (county level)	0	0	0	0	0
PREVENTION OF HUMAN RABIES						
Prevention of human rabies	Provision of anti-rabies vaccines, RIG and other supplies	1,000,000	1,801.919	1,982,111	1,982,111	1,081,151
Capacity building	Conduct Training Needs Assessment	3000	0	0	0	0
	Training of staff in the pilot counties	0	85,000	106,647	106,647	15,000
STRENGTHENING SURVEILLANCE AND RESPONSE OUTBREAK						
Strengthening surveillance	Strengthen surveillance in the pilot counties	40,000	58,000	28,000	17,000	15,000
	Strengthening (decentralize) rabies diagnostic capacity	70,000	0	0	0	0
SURVEILLANCE OF RABIES IN WILDLIFE						
Surveillance	Develop SOPs (in collaboration with FDA) on					

	Strengthen surveillance in wildlife protected areas					
CONDUCT OPERATIONAL RESEARCH						
Survey	Conduct base-line survey in pilot counties	50,000	0	0	0	0
	Impact assessment surveys in pilot counties	7,500	8,500	10,600	10,600	10,600
ADVOCACY, COMMUNICATION AND SOCIAL MOBILIZATION						
Health promotion	Conduct ACSM	17,000	56,000	56,000	56,000	56,000
RESOURCES MOBILIZATION						
Raise resources from Government and partners		0	0	0	0	0
SUB-TOTALS		**1,536,086**	**2,556,877**	**2,730,816**	**2,719,816**	**1,355,497**
GRAND TOTAL		**US $ 10,899,092**				

ANNEX 3: SUMMARY COST MASS DOG VACCINATION CAMPAIGN

Equipment, consumables, and personnel costs are referenced from the 2020 animal vaccination campaigns conducted in Monrovia. The cost analyses are based on the Global Dog Rabies Elimination Pathway (GDREP) tool.

Resources needed (annual)	
Total dog population	857,728
Dogs vaccinated	8,577
Dogs unvaccinated	849,151
Number of additional vaccinated dogs required	591,833
Average cost per dog vaccinated	$3.00
Estimated years until elimination	13
Vaccinators needed during peak campaign years	500
Total costs to eliminate	
Net present value (NPV) Phase I	$609,845
Net present value Phase II	$3,579,944
Net present value Phase III	$12,608,607
NPV of dog rabies elimination (average)	$16,798,395
NPV of dog rabies elimination (lower-upper)	($11,198,930 - $22,397,860)
Additional costs to government	$16,463,881
Range (lower-upper)	($10,975,921 - $21,951,841)

ANNEX 4; ECONOMIC COST OF VACCINATION CAMPAIGN

Item	Unit	Working days	Average cost
Dog population	594’640	N/A	N/A
Vaccines (10% wastage)	654’104	N/A	$0.91
Syringes and needles (10% wastage)	654’104	N/A	$0.05
Vaccination certificates	594’640	N/A	$0.13
Dog marking	594’640	N/A	$0.05
Supervisor (training)	1	N/A	$55.00
Supervisors (Vaccination)	6	N/A	$45.00
Supervisor(information)	1	N/A	$42.50
Driver	2	N/A	$38.00
Vaccinators (training)	30	N/A	$12.50
Vaccinator (vaccination)	30	N/A	$22.50
Veterinarians	2	N/A	$45.00
Community health worker	30	N/A	$13.00
Delegate of the Ministry of agriculture	2	N/A	$92.50
Superintendent of counties	15	N/A	$55.00
Human vaccine	70	N/A	$85.00
Tables	0	N/A	$0.00
Chairs	0	N/A	$0.00
megaphones	15	N/A	$65.00
First-aid	20	N/A	$52.00
Cooling Element	100	N/A	$2.50
Cooling box	17	N/A	$5.00
Muzzles	30	N/A	$22.00
Gloves	100	N/A	$35.00
Radio talk show	15	N/A	$310.00

Electronic media coverage	5	N/A	$80.00
Print media coverage	3	N/A	$80.00
commuication cards	50	N/A	$10.00
Documentary	15	N/A	$35.00
Banner	15	N/A	$155.00
Flyers	594’640	N/A	$0.10
T-shirt and caps	30	N/A	$18.00
Vehicle	2	N/A	$2’500.00
Gasoline	N/A	N/A	$3.00
Motorcycle	15	N/A	$3’000.00

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