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6 **The World Organization for Animal Health (OIE)'s Engagement towards**
7 **Rabies Elimination in Africa**
8

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23 **Abstract**

24 This review article highlights the role of the World Organisation for Animal Health (OIE)
25 towards dog-mediated rabies elimination in Africa. It provides a brief description of rabies and
26 its global impact on humans and the role of the OIE in the elimination of dog-mediated human
27 rabies by 2030. In addition, it addresses the OIE international standards on rabies, the
28 *Performance of Veterinary Services (PVS)* Pathway as a tool to assess the quality of
29 Veterinary Services, the partnership with other international organizations under the "One
30 Health" umbrella as applied in the elimination of dog-mediated human rabies, the rabies
31 vaccine bank, the training of OIE national Focal Points, and laboratory twinning projects as a
32 means to enhance capacity in the fight against dog-mediated human rabies in Africa. The
33 article concludes by presenting certain specific pilot projects being undertaken by the OIE in
34 Africa - as proof of concept - in view of scaling up activities in the African continent.

35 **Keywords:** Rabies, Vaccine Bank, Africa, OIE

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40 Introduction

41 Rabies is one of the most deadly
42 zoonoses. It is listed among the World
43 Organisation for Animal Health's (OIE)
44 diseases under the category "multiple
45 species diseases, infections and
46 infestations"¹. It is estimated that
47 approximately 60,000 people worldwide die
48 each year because of rabies, mostly children
49 in developing countries of Asia and Africa ^{2,3}.

50 Globally, the vast majority of human
51 cases, more than 95%, are caused by
52 exposure to rabid dog bites. Other
53 mammals, particularly members of the
54 Orders Carnivora and Chiroptera , also
55 present a risk for human and animal
56 infections. Over 99% of human deaths
57 caused by rabies occur in Africa and Asia
58 where dog rabies is poorly controlled. The
59 disease mainly affects poor rural
60 communities where access to appropriate
61 post-exposure prophylaxis (PEP) is limited or
62 non-existent ^{4, 5, 6, 7}.

63 In contrast with many other diseases,
64 the tools needed to eliminate rabies already
65 exist. Elimination of dog-mediated human
66 rabies is perfectly feasible by vaccinating
67 dogs with good quality vaccines, in
68 combination with other tools such as public
69 education, promoting responsible dog
70 ownership, and by ensuring appropriate
71 human post-exposure prophylaxis^{5,9}.
72 Vaccinating 70% of dog population in high
73 risk areas is recommended as a way of
74 breaking the transmission cycle and
75 eliminating dog-mediated rabies ^{5,9}.

76 Materials and methods

77 *OIE's approach to rabies control and* 78 *elimination*

79 The OIE is an intergovernmental
80 organization created in 1924 with the
81 objective of improving animal health, animal
82 welfare and veterinary public health
83 worldwide. With its 181 Member Countries
84 and a global network of Reference
85 Laboratories and Collaborating Centres and

86 international experts, the OIE is deeply
87 committed to the global fight against rabies.
88 Through the adoption of science-based
89 international standards, guidelines and
90 recommendations, the OIE promotes the
91 development of safe and effective tests for
92 the diagnosis, production of high quality
93 veterinary vaccines, control, elimination and
94 -where possible - eradication of rabies. The
95 OIE further supports its Member Countries in
96 policy advice, strategy design and technical
97 assistance through training courses.

98 The courses are directed at OIE
99 national Focal Points for Animal Disease
100 Notification, Wildlife and Communication to
101 increase respectively their knowledge of
102 rabies, their reporting on the rabies situation
103 in domestic animals and wildlife, and the
104 appropriate communication of risks for rabies
105 infection in their respective countries. Using
106 the OIE laboratory twinning programme, the
107 OIE supports the improvement of the
108 capability and access of Member Countries
109 to rabies diagnosis, scientific expertise and
110 support to proficiency testing. To further
111 enhance control and elimination of rabies,
112 the OIE has set up a Rabies Vaccine Bank
113 for dog vaccination.

114 Control is defined by Dowdle (1998)¹⁰
115 as a reduction in the incidence, prevalence,
116 morbidity or mortality of an infectious disease
117 to a locally acceptable level; elimination as
118 reduction to zero of the incidence of disease
119 or infection in a defined geographical area;
120 and eradication as permanent reduction to
121 zero of the worldwide incidence of infection.

122 In the specific case of rabies, the aim
123 of **elimination** is to reduce the incidence of
124 human rabies cases to zero, in whatever
125 geographical area, without necessary being
126 able to fully eradicate the disease in the
127 domestic animal host or in wildlife reservoirs.

128 *Standards*

129 As indicated above, the OIE adopts
130 science-based international standards,
131 guidelines and recommendations. It is
132 noteworthy that all the 54 African Member

133 Countries participate actively in the
134 transparent standards setting process which
135 culminates in their annual adoption during
136 the OIE World Assembly of Delegates. The
137 current standards on rabies in the 26th edition
138 of the OIE Terrestrial Animal Health Code¹¹
139 and in the 7th edition of the OIE Manual of
140 Diagnostic Tests and Vaccines for Terrestrial
141 Animals¹² are indicated in Table 1.

142 As requested by the OIE Specialist
143 Commissions and the Member Countries,
144 the OIE is currently working with international
145 experts to update the rabies-related OIE
146 international standards using the latest
147 scientific evidence in support of the 2030
148 dog-mediated human rabies elimination goal.

149 **Results**

151 *Performance of Veterinary Services (PVS)*

152 Through the OIE PVS pathway^{13,14},
153 the OIE has been able to support many
154 African governments to identify their
155 overarching needs in terms of enhancing
156 the delivery of veterinary services, upon
157 which hinges rabies control. Important
158 considerations in this regard are “critical
159 competencies” (CC) of Veterinary Services
160 pertaining to the professional and technical
161 staffing and competencies of the Veterinary
162 Services *viz* (CC.I.1.), operational resources
163 and funding (CC.I.12 – 15), veterinary
164 laboratory diagnosis (CC.II.1.),
165 epidemiological surveillance and early
166 detection (CC.II.5.), emergency response
167 (CC.II.6.), disease prevention, control and
168 eradication (CC.II.7.), animal welfare
169 (CC.II.13.), communication (CC.III.1.), the
170 participation of producers and other
171 interested parties in joint programmes
172 (CC.III.6.) and veterinary legislation
173 (CC.IV.1-2.), the latter both in terms of
174 adoption and law enforcement.¹³ To date
175 this information is available for 51 African

176 countries, in many cases through several
177 subsequent PVS Pathway mission reports
178 and formats, as conducted since 2006¹⁵.

179 *One Health (OH) Approach*

180 Working with the World Health
181 Organization (WHO) and the Food and
182 Agriculture Organization of the United
183 Nations (FAO) under the Tripartite One
184 Health¹⁶ approach, the OIE is united in a
185 common goal along with other partners such
186 as the Global Alliance for Rabies Control
187 (GARC) to eliminate dog-mediated human
188 rabies¹⁶.

189 Together, the Tripartite provides
190 strategic and technical guidance and is
191 building advocacy around rabies prevention
192 to ensure a more consistent and sustained
193 commitment underpinned by strong health
194 and veterinary systems¹⁷.

195 To further address the issue of
196 elimination of dog-mediated rabies, the
197 Tripartite with the support of GARC
198 organised a Global Conference on Dog-
199 mediated Human Rabies Elimination in
200 Geneva (Switzerland), in December 2015.
201 Discussions at the conference led to the
202 elaboration of the Global Framework for the
203 Elimination of Dog-Mediated Human
204 Rabies¹⁸ with a strategic vision of zero
205 human deaths from dog-mediated rabies in
206 participating countries by 2030. To rally the
207 global veterinary fraternity to support the
208 Global Framework for the elimination of dog-
209 mediated human rabies, the OIE World
210 Assembly of Delegates during its 84th
211 General Session held from 22 to 27 May
212 2016 in Paris (France) adopted resolution nr.
213 26 entitled “*Global elimination of dog-
214 mediated rabies*” and acknowledged that
215 controlling the disease in dogs remains the
216 most cost-effective way to prevent rabies in
217 humans¹⁹.

218 Table 1: The OIE standards on rabies

Standard	Chapter	Description
OIE Terrestrial Animal Health Code	Chapter 1.1	Provides a description of notification of all OIE listed notifiable diseases, infestations and infections, and provisions of epidemiological information. Under the OIE listing, rabies is classified under the multiple species diseases, infections and infestations category.
	Chapter 1.4	Provides a description of animal health surveillance as a tool to monitor disease trends, to facilitate the control of <i>disease</i> or infection, to provide data for use in risk analysis, for animal or public health purposes, and to substantiate the rationale for sanitary measures. The objectives of this chapter are to: a) provide guidance to the type of outputs that a surveillance system should generate; and b) provide recommendations to assess the quality of surveillance systems.
	Chapter 5.11	Provides a model veterinary certificate for international movement of dogs, cats and ferrets originating from countries considered infected with rabies.
	Chapter 7.7	Provides recommendations on how to deal with stray and feral dogs, which pose serious human health, animal health and animal welfare problems and which have a socio-economic, environmental, political and religious impact in many countries. Human health, including the prevention of zoonotic diseases, notably rabies, is a priority. Dog population management is an integral part of rabies control programmes.
	Chapter 8.13	The chapter describes infection with rabies. The aim of this chapter is to mitigate the risk of rabies to human and animal health and to prevent the international spread of the disease.
OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals	Chapter 2.1.17	The chapter provides diagnostic techniques for the identification of rabies including sample collection, shipping of samples and vaccine production requirements.

220 The Global Framework has five pillars of
221 rabies elimination (STOP-R) that include
222 aspects of socio-cultural, technical,
223 organisational, political, and resources
224 mobilisation. The Framework also defines
225 the critical factors that are required for the
226 successful implementation in the elimination
227 of dog-mediated human rabies.

228 The participants of the Geneva
229 conference also recognised the need to
230 agree on a business plan for rabies
231 elimination. The business plan, currently in
232 development by the Tripartite and GARC,
233 uses the Global Framework to define the
234 goals, objectives, anticipated challenges and
235 strategy to create the appropriate
236 environment for countries to achieve zero
237 human rabies deaths from dogs by 2030. The
238 aim is to empower national entities to
239 develop national elimination plans, and
240 define their own needs, strategies and
241 resource requirements.

242 *OIE Rabies Vaccine Bank*

243 In a bid to speed up the elimination of
244 dog-mediated human rabies, the OIE
245 established a Rabies Vaccine Bank in 2012,
246 initially with the financial support of the
247 European Union, followed by additional
248 support received notably from Australia,
249 France and Germany. The OIE Rabies
250 Vaccine Bank, which is a virtual¹ vaccine
251 bank, guarantees the availability of high-
252 quality vaccines that comply with the OIE's
253 international standards²⁰. The vaccines are
254 provided rapidly and at minimal cost, since
255 the interested and eligible suppliers compete
256 through an international call for tender
257 selection process.

258 One of the intentions is that the
259 vaccines acquired through the OIE Rabies

260 Vaccine Bank act as triggers for the
261 implementation of mass dog vaccination
262 campaigns in countries because the
263 vaccines are lowly priced and are delivered
264 in large quantities to the countries' port of
265 entry. Using the OIE Rabies Vaccine Bank
266 usually is an attraction to donors who in turn
267 may provide more support essential to any
268 effective national rabies elimination
269 strategies. After 5 years of operation (2012 –
270 August 2017), the OIE Rabies Vaccine Bank
271 has already delivered 19.1 million vaccine
272 doses to 27 countries, principally in Asia and
273 Africa with the support of the
274 European Union, Australia, Germany,
275 France, Canada and Japan.

276 The purchase of the rabies vaccines
277 through OIE Rabies Vaccine Bank is
278 conducted through either of the following
279 three channels: (i) by the OIE with financial
280 support from donors in which case the
281 vaccines and their transport are paid for by
282 the OIE; (ii) by an international organisation
283 (e.g. WHO); or (iii) by a Member Country who
284 has been granted access (Direct Purchase)
285 to the OIE Vaccine Bank by the OIE Director
286 General.

287 A significant portion (92.5%) of the
288 19.1 million doses cited above were
289 deliveries made in Asia on the framework of
290 purchases managed by WHO through the
291 OIE Rabies Vaccine Bank. Five million doses
292 were delivered directly by the OIE to 18
293 Member Countries to aid their national
294 vaccination programmes. An additional 14.1
295 million doses were ordered by countries or
296 international organisations. Of these, as per
297 August 2017, 13.8 million doses of rabies
298 vaccines were purchased by WHO through
299 the OIE Rabies Vaccine Bank for delivery to

¹ A virtual vaccine bank is different from a physical vaccine bank in that it doesn't stockpile vaccines, but agrees with selected pharmaceutical

suppliers (through a legally binding agreement) which vaccines are to be delivered, under which circumstances, at what price and within which time span (a mechanism to manage production on demand).

300 the Philippines, South Africa, Tanzania and
301 Central African Republic.

302 This model guarantees the availability
303 of high quality vaccines complying with OIE
304 intergovernmental Standards, their smooth
305 delivery on the ground, as well as a price
306 obtained after a global competition between
307 potential providers.²⁰

308 In Africa, the beneficiary countries so
309 far include Burkina Faso, Gambia, Ghana,
310 Kenya, Mali, Namibia, Senegal, Togo and
311 Tunisia through purchases managed by the
312 OIE thanks to donor support; Chad and Mali
313 through purchases supported by the Swiss
314 Tropical and Public Health Institute; and
315 Central African Republic, South Africa and
316 Tanzania through WHO support, part of
317 which was funded by the Bill & Melinda Gates
318 Foundation (BMGF) project². Indeed, in the
319 framework of the Tripartite Alliance (WHO,
320 OIE, FAO) on rabies control, the WHO has
321 decided to place its procurement orders for
322 canine vaccines through the OIE Rabies
323 Vaccine Bank.

324 Besides the donor support, individual
325 countries have purchased vaccines through
326 the OIE Rabies Vaccine Bank. The case in
327 point are Asia Member Countries namely
328 Singapore, Malaysia and the Philippines.
329 The Philippines case is of interest because
330 the vaccines, initially provided though the
331 WHO support, are now being repaid by the
332 Philippines government's national budget
333 through the WHO that was acting as
334 intermediary. In Africa, Burkina-Faso and
335 Ghana have used the Direct Purchase

336 mechanism and paid directly to the vaccine
337 manufacturer.

338 Through the framework of the Global
339 Strategic Plan for Dog-mediated Human
340 Rabies Elimination by 2030 whose
341 implementation starts in 2018, there is a
342 potential to increase future direct purchases
343 from individual OIE Member Countries. The
344 OIE will support access to the Rabies
345 Vaccine Bank by individual countries if their
346 request is supported by a national strategy
347 and a comprehensive and structured Rabies
348 control programme. This information has
349 already been provided to the OIE Member
350 Countries through their OIE Delegates
351 attending the 85th General Session in 2017
352 and the OIE Regional Commission meetings.

353 To enhance the visibility of the OIE
354 Rabies Vaccine Bank, the OIE, on the
355 occasion of World Rabies Day 2016,
356 released a video and infographics to explain
357 the operation of the Vaccine Bank.²¹ By the
358 end of 2017, the video had been viewed
359 3,500 times on the social media.

360 *Capacity building*

361 The needs of OIE Member Countries
362 in pursuing the objective to eliminate rabies
363 are not limited to the provision of the vaccine
364 only. Countries also need support during the
365 development of their national rabies
366 elimination strategies. Such support includes
367 areas in risk communication and awareness
368 raising, planning, implementation and
369 evaluation of the vaccination campaigns, and
370 dog population management.

371 Hence, in addition to the contribution
372 of the OIE Rabies Vaccine Bank, and to a

²The WHO Department of Control of Neglected Tropical Diseases has received a project grant of nearly US\$ 10 million from the Bill & Melinda Gates Foundation to demonstrate the feasibility of, and promote an evidence-based strategy for, controlling and eliminating human rabies in low-income countries through control and elimination of the disease in the domestic dog.

373 limited extent in the framework of specific
374 projects supported by some donors, the OIE
375 contributes to activities such as training of
376 staff responsible for canine vaccination,
377 producing educational materials and creating
378 media campaigns promoting responsible dog
379 ownership. The OIE has also conducted
380 specific training workshops in Africa related
381 to rabies control ^{22,23,24,25,26,27}.

382 These workshops held in Kenya,
383 Tunisia and Mali have enhanced the
384 participants skills in risk communication,
385 traditional media and social media
386 communication, hierarchical decision-
387 making as well as dog capture and stray dog
388 management in the control and elimination of
389 rabies. The OIE will continue providing
390 training, guidance and technical support in
391 future development and tailoring of regional
392 and national plans, including promoting of
393 existing tools to enhance capacity for the
394 control and elimination of rabies.

395 *Laboratory twinning*

396 Establishment of an appropriate level
397 of laboratory capacity is also important in
398 achieving elimination of dog-mediated
399 rabies. In Africa, the OIE has supported
400 laboratory twinning agreements, notably
401 between one of the OIE Reference
402 Laboratories for rabies, based at the
403 Onderstepoort Veterinary Institute (ARC-
404 OVI) in Pretoria (Republic of South Africa)
405 and the National Veterinary Research
406 Institute (NVRI) in Vom (Nigeria).

407 The twinning project which started in
408 2010 and ran up to 2012 saw the exchange
409 of personnel between the two laboratories to
410 enhance diagnostic capabilities for rabies at
411 the NVRI. This has now enabled the NVRI
412 to participate in an annual international
413 proficiency test for rabies, which is
414 coordinated by the French Agency for Food,

415 Environmental and Occupational Health &
416 Safety (ANSES ²⁸), an OIE Reference
417 Laboratory for rabies. The twinning
418 programme has also enabled NVRI to attain
419 ISO 17025 accreditation, enhance its
420 regional capacity for rabies testing and
421 increase sample submissions.

422 *Other Projects*

423 *i. Namibia*

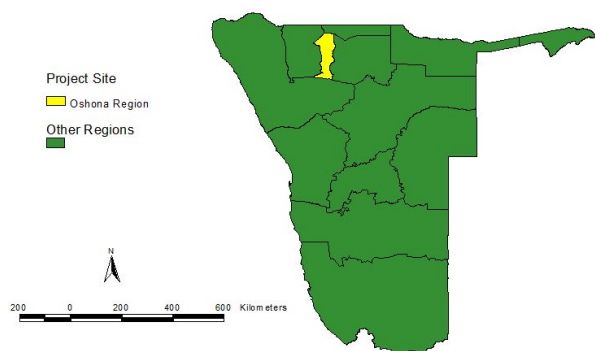
424 With support of the Government of Namibia,
425 the “*Technical Support for Namibia in*
426 *Eliminating Rabies in Dogs*” project funded
427 by the Federal Republic of Germany was
428 launched in March 2016 in the Oshana
429 region (Figure 1), with dog vaccination
430 campaigns targeting dog-mediated human
431 rabies in the Northern Communal Areas
432 (NCA).

433 This first (pilot) phase of the project
434 which lasted one year enabled the Veterinary
435 Services of Namibia vaccinate 30,000 dogs
436 with vaccine procured through the OIE
437 Rabies Vaccine Bank. In addition, an
438 awareness campaign on dog-mediated
439 human rabies was carried out under the
440 project, reaching 42,000 children in 119
441 schools from 11 constituencies of the
442 Oshana region.

443 The second phase of the project was
444 launched in April 2017 and ran up to May
445 2018 focusing on controlling rabies in 8
446 regions of the NCA of Namibia.

447 A total of 300,000 doses of rabies
448 vaccines were successfully procured from
449 the OIE Rabies Vaccine Bank, thus
450 furthering mass dog vaccination efforts in
451 northern Namibia.

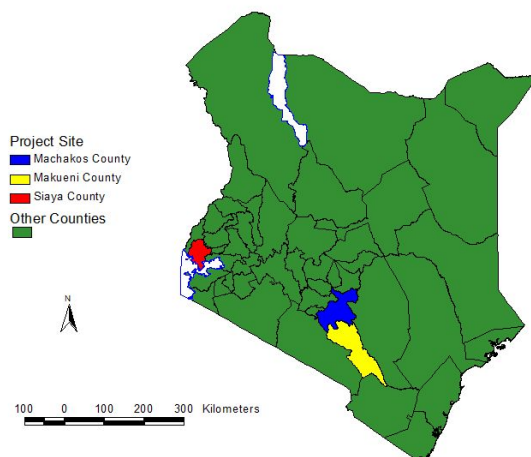
452



453
 454 Figure 1: Map of Namibia showing the Oshona
 455 region where the rabies vaccination of dogs was
 456 carried out.

457 *ii. Kenya*

458 The “*Strengthening Veterinary*
 459 *Services in Developing Countries*” project
 460 with a rabies control component (SVSDC+R)
 461 funded by the European Union commenced
 462 in December 2015 and ran up to December
 463 2018. In Kenya the project assisted the
 464 relevant competent authorities establish the
 465 National and County Rabies Elimination
 466 Coordination Committees (NRECC and
 467 CRECC, respectively) and launch a rabies
 468 campaign website.²⁹ In addition, a toll-free
 469 line for the reporting of dog bites was
 470 commissioned and a total of 200,000 doses
 471 of rabies vaccines were delivered to Kenya
 472 from the OIE Rabies Vaccine Bank. As of
 473 July 2017, a total of 47,000 dogs were
 474 vaccinated in Siaya County and active rabies
 475 surveillance and dog ecology studies are
 476 being undertaken in Siaya, Machakos and
 477 Makueni counties (Figure 2).



478
 479 Figure 2: Map of Kenya showing the SVSDC+R
 480 project sites

481 *iii. Tunisia*

482 In March 2017, the SVSDC+R project
 483 delivered 200,000 doses of rabies vaccine in
 484 Tunisia through the OIE Rabies Vaccine
 485 Bank. These were used in a vaccination
 486 campaign that was launched shortly after the
 487 receipt of the vaccines. A workshop to train
 488 dog vaccination teams in dog handling,
 489 capture and vaccination in the field was held
 490 in May 2017.³⁰ A second one was held in
 491 September 2017 to review the Tunisian
 492 rabies control strategy. Similar workshops
 493 are earmarked for Algeria and Morocco.

494

495 *World Rabies Day (WRD)*

496 Each year, on the 28th of September,
 497 the international community comes together
 498 to promote the fight against rabies. World
 499 Rabies Day (WRD) is a day of action and
 500 awareness raising and offers opportunities
 501 for individuals, institutions and governments
 502 to join the global movement in the fight
 503 against rabies.³¹ Every year the OIE
 504 promotes the participation of its Member
 505 Countries in WRD and also coordinates
 506 activities with the Tripartite (FAO/OIE/WHO),
 507 such as joint communication messages. In
 508 2016, the main theme for the OIE WRD was

509 “Educate, Vaccinate, Eliminate”³² while the
510 theme for 2017 was “Rabies: Zero by 2030”,
511 a clear reference to the goal of eliminating
512 dog-mediated human rabies by 2030.

513 **Conclusion**

514 In order to fight rabies with the
515 objective of eliminating dog-mediated
516 human rabies by 2030, it is important that
517 national governments support the
518 development of public awareness
519 campaigns and the education of target
520 communities to participate in these
521 campaigns.

522 Improving surveillance (and post-
523 vaccination monitoring/surveillance), as
524 currently implemented by the Zoonotic
525 Disease Unit (ZDU) in Kenya as part of the
526 SVSDC+R project, is also an important pillar
527 that supports the understanding of trends
528 and guides action in rabies elimination.
529 Substantial evidence from modelling studies
530 and empirical data indicates that vaccination
531 of 70% of dogs will be sufficient to eliminate
532 canine rabies.^{5,30} This target threshold
533 applies to dog populations across a wide
534 range of settings in Asia and Africa
535 regardless of dog density or ownership
536 patterns^{33, 34, 35, 36, 37}. Improving access to
537 affordable and efficacious dog vaccines and
538 human post-exposure prophylaxis vaccines
539 through regional vaccine banks are
540 therefore of paramount importance to the
541 successful control of rabies.

542 Finally, the One Health approach is
543 crucial and the OIE will continue to work
544 with the Tripartite to raise global and
545 regional awareness.

546 **Author contribution**

547 All the authors contributed equally to the
548 manuscript.

549

550 **Declaration of Interest**

551 There authors report no conflict of interest.

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