 Dog vaccination –
barriers and solutions
Version 1, December 2023



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1.0. Using this document

The United Against Rabies (UAR) Forum recognizes that unless rabies is eliminated in dogs, the source of rabies in humans will never reduce, and costly demand for human post-exposure prophylaxis (PEP) will escalate. ‘Zero by 30: the Global Strategic Plan to end human deaths from dog-mediated rabies by 2030’ (*Zero by 30*) states that mass dog vaccination is a proven, cost-effective way to save human lives by stopping transmission of rabies at its source. However, implementation of dog vaccination campaigns can face barriers that must be overcome to reach and sustain herd immunity at sufficient scale.

The UAR Forum conducted a literature review (carried out by the UAR Forum workstream on ‘Main constraints to rabies control and elimination’ in 2021) and global online survey to explore the barriers and constraints to sustained and effective dog vaccination campaigns. This guide indicates the guidance and tools that can form solutions to those priority barriers revealed through the research.

The [Stepwise Approach to Rabies Elimination \(SARE\)](#) provides an overarching assessment of a country's current rabies status, provides a way to measure progress, and generates a work plan to help address gaps and needs. Of the 7 key components included in the SARE, many include activities that relate in some way to the solutions below. The SARE is a key element of the [UAR Rabies Roadmap](#) and we recommend engaging with this comprehensive tool in addition to the signposting to specific solutions provided in this guide.

It is important to note that the inclusion of these tools and resources in this guide does not suggest any endorsement or recommendation by the UAR Forum members, nor is this guide likely to capture all available resources.

Where possible, the UAR Forum recommends stakeholders to refer to the [United Against Rabies Toolbox](#) to explore tools that have been evaluated by experts. The UAR Forum also encourages tool developers to submit their tools for evaluation so that more robust recommendations can be made for stakeholders involved in the implementation and scaling up dog vaccination campaigns.

This guide will be updated regularly by UAR Forum members, and users of this document are

encouraged to [provide feedback](#) if there are additional resources that should be included, or additional evidence to support the use of any of these tools and resources.

The UAR Forum is a community of rabies experts that are available to provide technical assistance should there be questions or concerns regarding the implementation or scaling up of dog vaccination campaigns.

For more information, please contact globalrabiescoordinator@woah.org

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2.0. Barriers

Category: Lacking estimates of population size and coverage

Barrier 1: Lacking data on dog population size.

Not knowing the total dog population size within the campaign area can appear to be a barrier to dog vaccination campaigns as this is informative for planning and budgeting, however this should not prevent launching initial vaccination campaigns. Vaccination campaigns allow for refinement of initial population estimates using post-campaign monitoring, including measuring vaccination coverage, which is then compared to the number of vaccinations delivered (see methods proposed below). There are many methods available for estimating dog population size (e.g. mark-resight, distance sampling, direct counts plus detection estimates) however they all require investment in time and resources to implement; the solutions we share here are selected because they require relatively fewer resources or create the benefit of immediate impact through rabies vaccination whilst concurrently building data for dog population estimation.

- [Solution 1: Using published human: dog ratios initially, then refine using post-campaign monitoring](#)
- [Solution 2: Including dog ownership in census questions](#)
- [Solution 3: Including dog ownership questions in household surveys initiated for other purposes](#)

Barrier 2: Not knowing what vaccination coverage was achieved by the campaign.

Vaccination coverage needs to be high enough to sustain the proportion of immune dogs above the critical threshold until the next vaccination campaign. To compensate for population turnover between annual campaigns, the vaccination campaign coverage should reach at least 70% of the susceptible dog population, in a homogeneous manner, i.e. without 'pockets' of low vaccination coverage. 'Susceptible' dogs are those that are unvaccinated and have unsupervised interaction with other dogs, including roaming owned dogs and unowned dogs - this does not include confined dogs living with responsible owners, vaccination of these dogs protects their owners in the case of rabies transmission to their owned dog (very low risk but possible) but does not contribute to enzootic (between dogs) transmission. Post-campaign monitoring assesses the effectiveness of the campaign, and identifies gaps where delivery needs improving, by measuring whether 70% has been achieved. If measured to be below 70%, or a particular area is recognised to have been missed, immediate additional campaign effort may be launched, potentially using a different vaccination strategy to reach unvaccinated dogs, and/or this information will be used to inform and improve future campaign rounds. While estimating the post-vaccination coverage is a core function of dog vaccination programs, the true measure of vaccination effectiveness is a measurable and sustained decline in dog rabies cases, which can only be shown if there has been investment in rabies surveillance programs.

- [Solution 4: Post-campaign monitoring](#)

Category: Insufficient campaign engagement and community outreach

Barrier 3: Lacking public knowledge of rabies as an important and vaccine preventable disease.

Nearly all dogs are connected to people, either as owned dogs connected to a specific household or as community dogs fed by a number of people within the community, few dogs are entirely unowned. Despite these dogs providing value to their household or community (e.g. companionship, security, herding), people may be unaware how rabies is transmitted or how to prevent it, even if they are aware of the clinical signs. Hence the engagement of the public is essential for successful vaccination campaigns as accessing a sufficient proportion of the dog population will require the public to act in support.

- [Solution 5: Use existing proven communication routes for health messaging](#)
- [Solution 6: Courses and guides in rabies communication](#)
- [Solution 7: World Rabies Day events](#)

Barrier 4: Dog owners and carers¹ do not engage with the campaign, taking minimal action to access vaccination for their dogs.

To address this barrier effectively we must first understand the reasons why people did not attend the vaccination campaign – for example they may be unaware the campaign was running that day, they cannot transport or handle their dog, they don't appreciate the importance of vaccination, they hold traditional beliefs about rabies that exclude the role of vaccination, they don't think rabies is an issue (becomes more likely as rabies cases reduce), they don't know if there will be free vaccine or at a cost, or they had a bad experience with a previous vaccination campaign.

- [Solution 8: Understand this human behaviour](#)
- [Solution 5: Use existing proven communication routes for health messaging](#)
- [Solution 6: Courses and guides in rabies communication](#)
- [Solution 9: Improve campaign logistics](#)
- [Solution 10: Change vaccination strategy](#)
- [Solution 11: Incentives for vaccination](#)
- [Solution 12: Dog vaccination champions](#)
- [Solution 13: Provide vaccination for free](#)

Barrier 5: Communities lack trust in vaccines, vaccinators or officials.

Communities may describe or display a lack of trust in vaccines, vaccinators or those officials running the campaign. Solutions to this barrier must start with an understanding of the reasons why people lack trust.

- [Solution 14: Understand the perception of vaccines, vaccinators and officials](#)
- [Solution 15: Improve disease transmission mitigation at vaccination campaigns](#)
- [Solution 16: Use high quality vaccine](#)
- [Solution 17: Investigate post-vaccination adverse events](#)
- [Solution 18: Integrated vaccination campaigns](#)
- [Solution 19: Partner with local programs, NGOs and organisations](#)
- [Solution 20: Select appropriate people for vaccinator role](#)
- [Solution 9: Improve campaign logistics](#)
- [Solution 11: Incentives for vaccination](#)

Category: Insufficient campaign capacity

Barrier 6: Less than 70% of the dogs can be accessed for vaccination, either because they can't be handled or because they are free-roaming and can't be caught.

Dogs that are free-roaming, either because they are allowed to roam by their owners or are unowned/community owned dogs, are epidemiologically relevant dogs for rabies control because they have the greatest contact rates with other dogs and therefore the greatest opportunity for viral transmission. Conversely if vaccinated, these free-roaming dogs then have the greatest ability to act as a barrier to prevent further spread if there is a rabies outbreak. Vaccination campaign approaches that target free-roaming dogs (of all ages and levels of ownership) bring vaccination coverage in line with epidemiological relevance.

- [Solution 21: Improve dog catching and handling skills of vaccination campaign staff](#)
- [Solution 22: Improve community engagement in accessing community dogs](#)
- [Solution 23: Oral rabies vaccination](#)

¹Dog 'carers' are people that feed a community dog but do not claim full ownership, they may also be termed 'guardians', 'feeders' or 'dog lovers'. Although they do not claim ownership of a dog they may be willing to help access vaccination services.

Barrier 7: Insufficient trained personnel to manage vaccination campaign and conduct the vaccinations.

Effective elimination of the rabies virus requires homogeneous vaccination coverage, which demands sufficient trained personnel to cover the area with accessible vaccination campaigns. Insufficient personnel capacity can lead to patchy and inconsistent coverage as campaigns become limited in scope and more widely spaced.

- [Solution 24: Utilise online training tools in dog vaccination](#)
- [Solution 25: Expand list of approved professionals to be engaged in vaccination](#)
- [Solution 18: Integrated vaccination campaigns](#)
- [Solution 19: Partner with local programs, NGOs and organisations](#)

Barrier 8: Insufficient vaccines of good quality.

Effective vaccination campaigns clearly need access to sufficient vaccines to vaccinate all dogs that they are able to vaccinate. This vaccine must be of sufficient quality to ensure long-lived immunity; a poor quality vaccine that provides a short period of immunity is a false economy as the costs of accessing dogs for vaccination through a campaign will be wasted. Accessing dogs for vaccination is usually more expensive than the vaccine itself, even when a high-quality vaccine is imported. Not all vaccines available on the market have the same level of potency (e.g. see the range of potency reported by [Rathnadiwakara et al 2023](#) for 7 brands of commercially available rabies vaccine in Sri Lanka, 3 of which were not compliant) so vaccination campaign managers and rabies control policy makers should ensure that vaccines selected for the campaign are of sufficient potency.

[Chapter 3.1.18](#) of the WOAHA Manual of Diagnostic Tests and Vaccines for Terrestrial Animals provides the requirements and tests for validity of animal rabies vaccines.

- [Solution 26: WOAHA Vaccine bank](#)
- [Solution 27: PAHO revolving fund](#)
- [Solution 28: Utilise planning tool to estimate vaccine needs](#)

Barrier 9: Limited or perceived thermotolerance of vaccine/unreliable cold chain.

The perceived limited thermotolerance of vaccines can lead to vaccine being discarded or communities being excluded from vaccination campaigns because of insufficient cold chain capacity

- [Solution 29: Vaccines with proven thermotolerance](#)
- [Solution 30: Passive cooling devices](#)



3.0. Solutions

Solution 1: Using published human: dog ratios initially, then refine using post-campaign monitoring.

Estimates based on published human: dog ratios in a similar context (e.g. geographic, socio-economic, socio-cultural and/or religious background) can allow initial campaigns to be run. These initial campaigns, even if limited in geographical scope, offer an opportunity to compare the estimate of dog population size based on human: dog ratios to the number of vaccines used and vaccine coverage measured by post-campaign monitoring (see guidance on post-campaign monitoring under barrier 2). The result of this comparison allows for refinement of the dog population estimate and improved planning and budgeting for future campaigns all the while making an immediate impact through rabies vaccination. These dog population estimates should be refined on a regular basis to keep up with changes in dog population size resulting from changes in dog ownership and dog population dynamics.

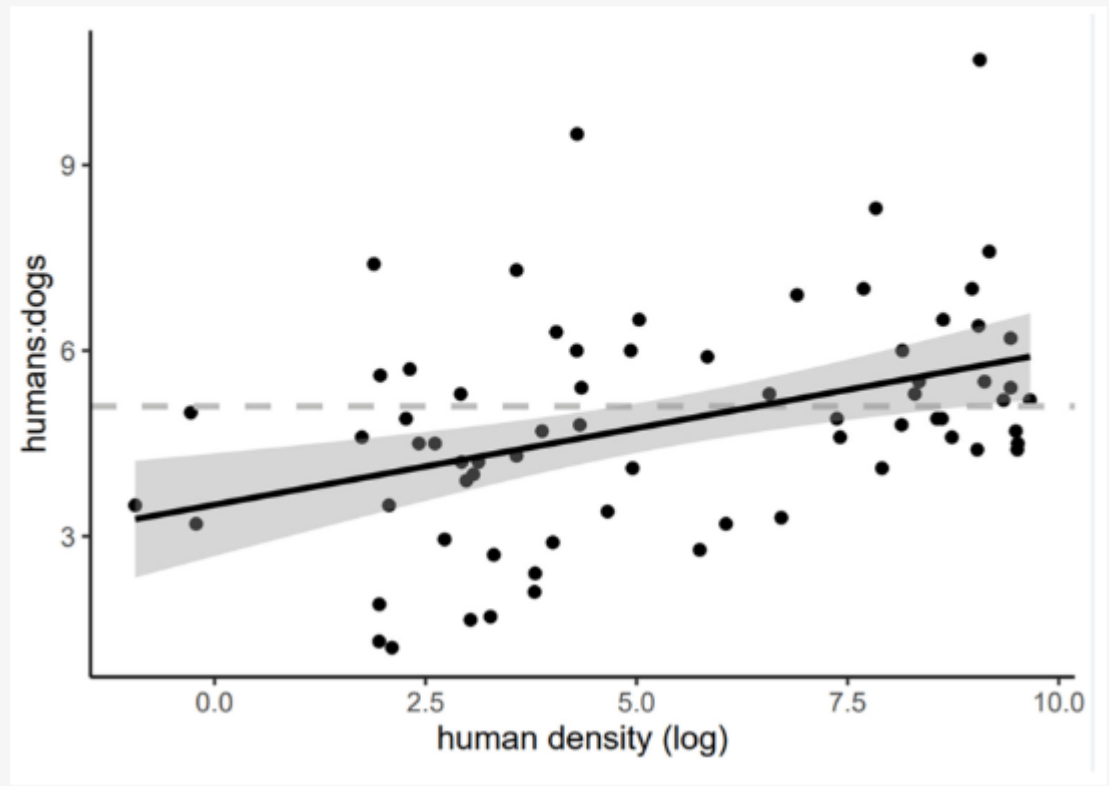
Estimates of human: dog ratios are ideally based on research within the country. However, if such studies are lacking, the following ratios can be applied to calculate an estimate for initial campaigns:

Table 1: Number of humans per dog for estimation of dog population size, data from Table 1 of Wallace et al 2017 ([Elimination of dog-mediated human rabies deaths by 2030: Needs Assessment and Alternatives for Progress Based on Dog Vaccination](#)).

Region	Humans per dog; Urban	Humans per dog; Rural
Global mean	10.8	10.8
Asia and Oceania	7.5	14.3
China	48.3	48.3
Africa	21.2	7.4
The Americas	7.5	7.5
Europe	6.5	6.5

Within a country, the human to dog ratio can vary greatly between communities. Human density has been identified as a predictor of human to dog ratios; as human density increases so the number of humans per dog increases, hence there are fewer dogs than you would expect from the national human: dog ratio in dense urban areas and more dogs than you would expect in low density rural areas (Table 1 indicates different human:dog ratios for urban high human density and rural low human density, where such data was available). This relationship is often exponential rather than linear; where this relationship has been explored using dog and human population estimates from different communities, the log of human density is used to predict human to dog ratios. For example, [Moran et al 2022](#) in Guatemala and [Garde et al 2022](#) in Chile found highest human density urban areas had a 3-fold increase in the number of people per dog, hence a 1/3 of expected dog population, whilst the least dense rural areas had only 20% the number of people per dog as compared to the national mean, hence a 5-fold increase in the expected number of dogs. See the following graph of human:dog ratios recorded in different communities in Chile, and the relationship with human density (log) of those communities from [Garde et al 2022](#):

Figure 2. Linear regression (black line) between the ratio of the number of humans to dogs per municipality as a function of human density in that municipality ($n = 71$). Gray area depicts the 95% confidence interval. Grey dashed line refers to the 5.1 human-to-dog ratio commonly used as a baseline in the national program.



Religion may also be a significant predictor of human:dog ratios within a country. Mixed religion communities are expected to have the average human:dog ratio, but for communities that are composed of majority Christian citizens the ratio of people to dogs will be lower and hence there will be more dogs than expected when applying the average human: dog ratio, whilst in majority Muslim communities the ratio is expected to be higher and hence fewer dogs than predicted by the average ratio. The following table provides a summary of the ranges of human: dog ratios from several published estimates in Asia and Africa, combining the predictors of human density and religion into one estimate:

Setting	Human: dog ratio
Rural Christian	4-10
Rural Muslim	25-50
Urban Christian	10-30
Urban Muslim	>70

Solution 2: Including dog ownership in census questions.

National and local government censuses of either people and/or livestock are an opportunity to include questions about dog ownership. This would result in data on the number of dogs owned at a particular point in time and potential household characteristics related to dog ownership which could be used to predict dog ownership in areas not covered by the census. If the most recent census did not include information on dogs, this can be advocated for ahead of the next census. If this method is intended to produce a human to dog ratio, then it is critical that the census be conducted amongst a representative population, including both dog owning and non-dog owning households, and capture the human population within surveyed households. Where additional questions about owned dogs are possible to include, their current vaccination status and level of confinement would be useful to establish current vaccination needs - owned dogs that are unvaccinated and are allowed to roam unsupervised are a priority target for vaccination campaigns.

Solution 3: Including dog ownership questions in household surveys initiated for other purposes.

Household surveys conducted for other public or animal health purposes can also include a question on dog ownership. For example: UNICEF included such a question on dog ownership during a polio related household survey, and some countries use formal community health systems such as Community Health Volunteers that are responsible for 100 households each, for which they can report dog ownership. As mentioned for Solution 2, the survey methodology must be appropriate to interpret dog population ownership, such as including a representative sample and establishing the number of people living in the sampled households to allow the calculation of human to dog ratios.

Solution 4: Post-campaign monitoring

Post-campaign monitoring using street surveys/transects measures vaccination coverage of free-roaming dogs, whilst household surveys assess vaccination coverage of owned dogs (some of which may also be seen on transects, as in many countries owned dogs are allowed to roam outside the home). Post-campaign monitoring of free-roaming dogs requires vaccinated dogs to be marked as vaccinated, this is usually done using collars or non-toxic paint spray/stick. This is essential for post-vaccination monitoring of free-roaming dogs using transects through campaign areas but is also useful for household surveys of vaccination status of owned dogs, in addition to certificates of vaccination given to owners.

In addition to providing a measure of vaccination coverage of owned dogs, post-campaign household surveys also provide an opportunity to calculate the local human:dog ratio by asking for the number of people and dogs living within a household. This is particularly valuable where national averages had previously been applied in the absence of locally available data. Using data collected from post-campaign monitoring of free-roaming dogs to refine population estimates requires accurate recording of how many and where vaccinations were conducted. The number of dogs that were vaccinated and marked within a specific area is compared to the estimated vaccination coverage *across that same area* to estimate the dog population *of that same area*.

$$\frac{\text{Number of vaccinated and marked dogs} \times \text{total number of dogs seen on survey}}{\text{Number of marked dogs seen on survey}}$$

This is a Lincoln–Petersen estimator and makes a number of assumptions that may not hold true for dogs: No mark loss, no immigration or emigration between vaccination and post-campaign monitoring, and all dogs have an equal chance of being vaccinated and then re-sighted (this is violated if dogs that are hard to access for vaccination are also hard to spot during post-campaign monitoring). Even if the estimate is imperfect because these assumptions do not hold true, this approach is a resource efficient method for refining a population estimate which can then be used to improve the planning of future vaccination campaigns. More detailed guidance is provided in the following guidelines:

- ❖ [ICAM \(2015\) 'Are we making a difference? A guide to monitoring and evaluation of dog population management interventions'](#) includes a chapter (page 83-86) on post-vaccination campaign monitoring using street surveys and/or household questionnaires, suitable either for free-roaming and/or confined dog populations.
- ❖ [World Animal Protection \(2014\) 'Guidelines for Mass Dog Vaccination'](#) includes a section (section 7, page 46-49) on post-vaccination campaign monitoring using street surveys, suitable for free-roaming dog populations.

Monitoring tools:

In addition to allowing campaign managers to plan and track the implementation of mass vaccination campaigns, the following tool also allows you to measure vaccination coverage after a campaign has been completed.

➤ [World Veterinary Service \(WVS\) app](#)

The following tool is available to track survey data during a street survey:

➤ [ICAM Talea survey tool](#)

Solution 5: Use existing proven communication routes for health messaging.

Rabies is a One Health disease; it requires the actions of both human and animal health for effective control. Hence, awareness raising of the disease and its prevention through dog vaccination is the role of several sectors including public health educators and community animal health workers.

Identify established awareness raising and education routes that have been culturally appropriate and effective in your community for other human or animal diseases - explore the potential to utilise these same routes for rabies messages both on the importance of rabies vaccination for dogs and also for the specific logistics of the campaign; how, when and where people can access vaccination through your campaign - ensure communication activities are run before and during the campaign. These may include traditional media, social media, radio shows, public service SMSs through mobile phone networks (e.g. [vaccination reminders using SMS in Haiti](#)), loudspeakers, posters, engaging local community leaders and street theatre.

UAR provides a [Public Information Toolkit](#) designed for human and animal health authorities to inform the public about rabies and encourage responsible dog ownership, health-seeking behaviour, dog vaccination and reporting of suspected rabies cases.

The GARC website provides [social media toolkits](#) on rabies awareness and prevention. They also provide [education courses](#) and [downloadable resources for teaching children](#) including modifiable awareness posters, videos and resources for professionals.

Wherever possible, a participatory approach should be used to design the Information, Education and Communication (IEC) materials and strategy for dissemination; this means including non-academic stakeholders from the community in the design process to ensure the IEC materials are understandable and are presented to community members in an appropriate way.

Solution 6: Courses and guides in rabies communication

UAR provides a [Public Information Toolkit](#) designed for human and animal health authorities to inform the public about rabies and encourage responsible dog ownership, health-seeking behaviour, dog vaccination and reporting of suspected rabies cases.

The World Health Organization (WHO) provides a free online course '[Rabies & One Health: From basics to cross-sectoral action to stop human rabies deaths](#)' through their OpenWHO.org website. This includes module 4: 'Preventing rabies in dogs' which covers the steps needed for successful mass dog vaccination and module 5: 'Awareness and community empowerment'.

The Global Alliance for Rabies Control (GARC) has an [Education Platform](#) on which 2 public awareness related courses are hosted: the foundational Rabies Educator Certificate and the subsequent Community Coordinator Certificate that builds additional skills for non-professional community members to assist in the organisation and effective implementation of a vaccination campaign in their community.

[World Animal Protection \(2014\) 'Guidelines for Mass Dog Vaccination'](#) includes section 3 (pages 14-19) on education and messaging.

Solution 7: World Rabies Day events

World Rabies Day falls on September 28th; the anniversary of the death of Louis Pasteur who developed the first rabies vaccine. However, events related to World Rabies Day are run in the weeks before and after this date. This is an opportunity to raise public awareness of rabies as an important and preventable disease and can be used as occasion to hold vaccination campaigns. There are many resources for running a public awareness event linked to World Rabies Day available to download from the [GARC website](#).

Solution 8: Understand this human behaviour

Frameworks for understanding and changing human behaviour may be applied to dog vaccination, including [the COM-B model of human behaviour](#) that describes how the combination of capability, opportunity and motivation drives behaviour. There are publications on socio-economic and cultural barriers to accessing dog vaccination from various countries that may be a source of information: e.g., Peru, [Castillo-Neyra et al \(2017\)](#); Chad, [Mbaipago et al 2022](#); Tanzania, [Bardosh et al 2014](#); Taiwan, [Ku-Yuan et al \(2014\)](#).

Using participatory approaches at the campaign planning stage can help to identify and understand dog vaccination seeking behaviours, providing an opportunity to design the campaign and associated Information, Education and Community (IEC) material to navigate potential obstacles in advance. However, post-campaign monitoring using household questionnaires is another opportunity to ask owners of unvaccinated dogs why they did not attend the campaign; such an inquiry should be done sensitively to avoid inferring blame or alienating those non-participating community members. However, if this opportunity does not allow sufficient time to explore the barriers to engaging in the vaccination campaign, owners can be invited to attend follow-up focus groups or they can be provided with feedback channels such as toll-free numbers or suggestion boxes through which they can explain the barriers to their engagement with vaccination campaigns. Achieving participatory approaches for all communities when scaling up to national programmes may be unfeasible, hence this approach may be used in a sample of communities and extrapolated to similar communities.

Solution 9: Improve campaign logistics.

The opportunity to engage in the vaccination campaign may be low due to inappropriate timing or placement of the vaccination services (particularly important if using central point vaccination strategy). Consult local leaders, public and animal health professionals to establish timings and locations that are appropriate for dog owners and carers, and any occasions that should be avoided (e.g. elections, market days, religious festivals, seasonal activities such as harvest or rainy seasons). Explore placement of vaccination points and consider both the distance between locations and that they are well positioned and attended for other purposes such as schools, churches, football fields and local government offices. Review the success or failure of previous vaccination campaigns and learn what timing and placements are most successful for each community.

The World Health Organization (WHO) provides a free online course '[Rabies & One Health: From basics to cross-sectoral action to stop human rabies deaths](#)' through their OpenWHO.org website. This includes module 4: 'Preventing rabies in dogs' which covers the steps needed for successful mass dog vaccination.

The Global Alliance for Rabies Control (GARC) has an [Education Platform](#) on which the online course [Community Coordinator for Rabies Certificate](#) is hosted, this course includes skills in building relationships with community leaders, and links between animal and human health sectors, to assist in planning and implementing mass vaccination events at the community-level.

[World Animal Protection \(2014\) 'Guidelines for Mass Dog Vaccination'](#) includes a section (section 2, page 6-13) on preparing for vaccination campaigns which includes guidance on community preparation and the resources you need to gather for successful implementation.

Engaging school children in rabies awareness creation can increase engagement with vaccination campaigns, if the campaigns are held at appropriate times for their involvement. This is because they may have a primary role in taking care of dogs and can also be agents of change within the household, taking what they learn in school about rabies and dog vaccination back to share with the household.

Solution 10: Change vaccination strategy.

There are several strategies for vaccination campaigns:

- ❖ Central point: a fixed place in a community where vaccines are made available for everyone that brings their dog.
- ❖ Mobile vaccination points: Similar to central point in that vaccines are made available to dogs that are brought, but the point is moved on frequently to minimise the distance required for people to travel.
- ❖ Free-roaming dog catching, vaccinate and release: The vaccination team travels through the community asking local people to catch dogs they know they can handle, or using expert catcher/handlers in the team to catch the dogs, usually using nets so vaccines can be administered and dogs marked whilst still in the net. The vaccinated and marked dogs are then released.
- ❖ Door-to-door: The vaccination team travels along (all) streets stopping at each household to locate dogs and provide vaccines to all dogs that are held by owners or handlers in the team.
- ❖ Oral rabies vaccine: delivered by hand to individual dogs to maximise the chance that every dog receives a bait and minimise dogs eating more than one bait each (See UAR's '[Oral vaccination of dogs against rabies: Recommendations for field applications and integration into dog rabies control programmes](#)').
- ❖ Community-based continuous vaccination: Dog rabies vaccine is stored locally and made available outside of annual campaigns, providing an opportunity to access dogs that were missed by the campaign, or were imported/born after the campaign (e.g., [Duamor et al 2022](#) trailed community-based continuous mass dog vaccination delivery strategies in Tanzania).

Table 1 in [Undurraga et al 2020](#) provides a list of the characteristics and advantages versus limitations of the above 1-5 strategies, note that central point and mobile vaccination points are combined into one category of "Mobile Static Point (MSP) vaccination". An assessment of community-based continuous vaccination is not included in this summary:

Table 1
Summary and definition of alternative methods for mass dog vaccination, Haiti 2016.

Vaccination method	Characteristics and advantages	Limitations
Mobile Static Point vaccination (MSP)*	Community members are encouraged, through community engagement activities, to bring dogs to a centralized location where vaccinators have established a temporary vaccination clinic Owned dogs and dogs which are always or partially confined to an owner's control are typically favored by this vaccination strategy	Free roaming dogs† may not be readily handled by dog owners, thus are less likely to be reached. Potential risk of disease transmission between dogs. Community owned and stray dogs typically have no person or family which feels responsibility to bring these dogs to a MSP clinic Parenteral rabies vaccine, requires dog restraint with potential risk of bites Aggressive or overly shy dogs less likely to be brought to a MSP Depend on owner awareness of MSP clinic, and geographical accessibility
Capture vaccinate release vaccination (CVR)*‡	Vaccinators are required to capture the dog before vaccination Strategy is aimed at reaching free roaming dogs‡	Requires a skilled workforce to capture and vaccinate dogs in a safe manner for the animal and vaccinator, may decrease effectiveness in time due to dogs running away from vaccinators. Parenteral rabies vaccine, requires dog restraint with potential risk of bites
Door-to-door vaccination (DDV)*	Vaccinators visit each household to offer dog vaccination Do not require owner to bring dog to a MSP clinic Aggressive or overly shy dogs can be more easily reached	More labor-intensive than MSP Free-roaming dogs and/or owner may not be at home when the vaccinators arrive Parenteral rabies vaccine, requires dog restraint with potential risk of bites
Oral rabies vaccination (ORV)§	Baits are handed to a dog or placed in the community for dogs to ingest Do not require dog restraint May more readily reach aggressive and shy dogs May reach free roaming‡, community owned and stray dogs	Unlikely to reach community owned and stray dogs Technology still under development, limited field data on implementation Vaccines are more costly than parental vaccines Oral rabies vaccines are based on live replication competent viruses

Exploring the reasons for why people do not engage in the vaccination campaign may reveal that the strategies used for the campaign are not suitable. Consider asking communities about the appropriateness of alternative vaccination strategies, test alternatives with the community to see if this increases engagement, or combine strategies; e.g. start with central point and follow with door-to-door to reach unvaccinated dogs that have not been brought to the central point.

The [VaxPLAN](#) allows users to design vaccination campaigns and immediately see the expected cost and coverage in the dog population. The tool helps vaccination campaign managers determine the appropriate amount of vaccine, the most effective methods for vaccine distribution, and the cost to operationalize the designed plan. This tool is most appropriate for early-stage vaccination programs, programs that have not achieved desired coverage levels, and programs that may benefit from a mixed-methods vaccination approach. [Wallace et al \(2019\)](#) is a supplementary publication that explains the development of this tool.

Solution 11: Incentives for vaccination.

We would like people to engage with vaccination campaigns because rabies matters. But we may need to include other incentives to build motivation for the behaviour of accessing rabies vaccination for dogs. Integrated vaccination campaigns (see barrier 5, solution 2 for more information) may be perceived as an incentive as they offer an efficient opportunity to address more than one disease at one event. Or consider dog vaccination specific incentives such as a dog collar (e.g., collars acting as incentives in Zanzibar [Omar et al 2023](#), and collars and/or wristbands for owners in Tanzania [Minyoo et al 2015](#)), dog food or basic veterinary services (e.g., vaccination against other canine diseases, parasite control and basic wound treatment), a folder with IEC materials about rabies control or lottery entries with each vaccination certificate. In the long-term, responsible dog ownership including regular rabies vaccination should become a social norm, hence consider incentives as a short-term method to increase motivation but engage additional behaviour change methods to ensure maintenance of vaccination seeking behaviour. Providing additional incentives will require additional resources, and even minor incremental cost increases may have negative impacts on dog vaccination budgets; incentives should balance an increase in participation while not jeopardising the ability to procure sufficient vaccine resources. As these incentives may address issues in addition to rabies (such as animal welfare or other canine diseases) there may be an opportunity to seek those resources from other donors.

Solution 12: Dog vaccination champions.

There is a social dimension to human behaviours that can be utilised, by encouraging dog owners that do engage with vaccination to be 'champions' for this behaviour within their community. This may be particularly effective when the champion is already an influential person within the community.

Solution 13: Provide vaccination for free.

Owners that can afford to pay for vaccination should seek private veterinary services; governments should encourage local veterinarians to offer rabies vaccination, and require them (and support with accessible systems) to track and report vaccination to ensure these vaccines are counted in national rabies control programmes. Charging people for vaccination when attending vaccination campaigns is an attempt to create income to support sustainability of campaign services. However, where people are unwilling to pay for vaccination, charging will drive down vaccination uptake until coverage is insufficient for effective rabies control, negating any potential economic benefits of bites, PEP and deaths averted. Providing vaccination for free increases costs of the vaccination campaign but, where this increases coverage, this increases economic benefits and hence is a better return on investment.

Solution 14: Understand the perception of vaccines, vaccinators and officials.

Listen to community concerns about vaccines, vaccinators and officials and have meaningful conversations responding to their concerns - these may be best conducted by an independent party, not a vaccinator or official. There may be general vaccine hesitancy, a specific distrust of dog rabies vaccines due to a prior negative experience (such as contracting an unrelated infectious disease shortly after rabies vaccination) or another reason. Listen to community concerns and have meaningful conversations responding to their concerns.

Solution 15: Improve disease transmission mitigation at vaccination campaigns.

Communities may lose trust in vaccinators and officials if their dogs are infected with other diseases, such as distemper, after attending the rabies vaccination campaign. This may have just been unfortunate timing, and not connected to the rabies vaccination campaign, but explore potential ways to limit infection at campaigns sites to minimise this risk. This includes using a new needle for every dog, organising queues to minimise contact between dogs, and the use of alternative strategies such as mobile vaccination points or door-to-door to minimise mixing between unfamiliar dogs.

Solution 16: Use high quality vaccine.

Review the quality of the current (and past) vaccine, if quality is low and hence there have been vaccine failures, this gives credibility to the lack of trust in vaccines. Use only high-quality vaccines to build trust in vaccines and to ensure a good return on campaign cost investment. See solution 26 WOAHP Vaccine bank for opportunities to access high-quality vaccine.

Solution 17: Investigate post-vaccination adverse events.

Invest in investigation of adverse events following vaccination, to both establish whether there is a genuine problem with vaccines that needs to be addressed and to rebuild community trust in vaccines by taking any adverse events seriously and communicating the results and any subsequent actions promptly.

Solution 18: Integrated vaccination campaigns.

Rabies can be addressed alongside other human and animal health diseases; using integrated vaccination campaigns can build on existing trust and engagement with human and livestock vaccination. Integrating campaigns can also reduce costs of implementation by sharing campaign capacity between disease control budgets.

Solution 19: Partner with local programs, NGOs and organisations.

It is beneficial to explore the stakeholder and partnership landscape in a given country or area to identify other programs, NGOs and organisations working with the target communities to build on the trust they have established in these communities and the synergies of actions. [Communities Against Rabies](#) is an example of an initiative that aims to bring non-governmental partners together to work in a coordinated manner and then engage constructively with local and national governments to align with national strategies. The coordination of multiple partners includes formal data flows from field activities to government to enhance national efforts and recognition of control activities across space and time. These programmes, NGOs and organisations may be engaged in other issues of human and animal health, hence this solution may be linked to the previous solution of integrated vaccination campaigns. For example, the Guinea Worm Eradication Program (GWEP) is conducting routine dog surveillance in some African countries, requiring regular access to owners and their dogs and the opportunity to promote the need for rabies vaccination.

Solution 20: Select appropriate people for vaccinator role.

Evidence has shown that local animal health service providers are more likely to be trusted and solicited by their communities when selected through a participatory process involving community members. Therefore, involving communities in the selection process of vaccinators is key; they are the best positioned to indicate which individuals would fit best the role. In areas where community animal health workers (CAHWs) operate, and if national regulations allow, it might be advisable to make use of this existing workforce as vaccinators rather than training vaccinators coming from outside the communities. CAHWs are known to community members, providing basic animal health care and advice to their communities and are a stable presence in the area. They already benefit from their community's trust and especially in the animal health field. This builds trust in your vaccination campaign but also strengthens the skills of local animal health service providers that could play an ongoing role in community awareness raising, rabies surveillance and reporting, and future rabies vaccination campaigns.

Providing vaccinators with uniforms, badges and/or certificates has also been reported as a way to legitimise their activity and strengthen community's trust.

Solution 21: Improve dog catching and handling skills of vaccination campaign staff.

The Global Alliance for Rabies Control (GARC) has an online course on [Animal Handling and Vaccination Certificate](#) on their [Education Platform](#).

[World Animal Protection \(2014\) 'Guidelines for Mass Dog Vaccination'](#) includes a section (section 4, page 20-33) on dog capture and handling which includes guidance on how to capture by either hand or using equipment and how to handle a dog once caught.

FAO developed a series of catching training videos providing practical guidance on humane capture and handling of dogs for rabies vaccination, these are available on their FAO YouTube channel:

- ❖ [Part 1: Roaming Dogs, Net Catching](#) explains how to interpret roaming dog behaviour and to capture roaming dogs using nets.
- ❖ [Part 2: Catching Dogs by Hand](#) describes how to safely catch dogs by hand.
- ❖ [Part 3: Vaccination, Collars, Safety](#) describes how to vaccinate and how to apply long-lasting collars to dogs restrained in nets and held by hand. Key aspects of dog and vaccination team safety are also covered.

Solution 22: Improve community engagement in accessing community dogs.

Some free-roaming dogs are unowned, in that they do not have a single referral household but are cared for by a number of households and are hence termed community dogs with one or more carers. These carers can support mass vaccination campaigns by locating and handling community dogs for vaccination. Vaccination teams will need to be working door-to-door to make use of this opportunity as the carers are unlikely to be able to move the community dogs any distance. There will also need to be pre-campaign communication with these carers to establish their willingness to help and prepare them for being present and able to help on the campaign day.

Solution 23: Oral rabies vaccination.

Oral rabies vaccines are baits containing a blister or sachet filled with liquid vaccine. When a dog chews on the bait, the blister or sachet filled with the liquid vaccine will be perforated and the vaccine released into the oral cavity where vaccine uptake takes place. While a parenteral vaccine has to be injected into the muscle or under the skin using a syringe and needle, oral vaccines are easier to administer to dogs that are difficult to catch or restrain for vaccination. As part of the UAR, FAO, WHO and WOAHA have produced the following publication: '[Oral vaccination of dogs against rabies: Recommendations for field application and integration into dog rabies control programmes](#)' and [UAR webinar where you can learn more about oral rabies vaccination](#).

Solution 24: Utilise online training tools in dog vaccination.

The below online training tools can provide foundational training in the skills required to vaccinate dogs safely and humanely. Online training alone is insufficient, vaccinators will also require in-person training and veterinary supervision to achieve competence.

The Global Alliance for Rabies Control (GARC) has an [Education Platform](#) on which the online course [Animal Handling and Vaccination Certificate \(AVC\)](#) is hosted, this course is a profession-specific course that focuses specifically on empowering animal health and welfare professionals that interact with dogs. It includes skills in understanding animal behaviour, effective ways to approach dogs, equipment needed to catch and handle dogs and effective vaccine administration techniques.

[World Animal Protection \(2014\) 'Guidelines for Mass Dog Vaccination'](#) includes a section (section 4, page 20-33) on dog capture and handling which includes guidance on how to capture by either hand or using equipment and how to handle a dog once caught.

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Solution 25: Expand list of approved professionals to be engaged in vaccination.

Some countries have limitations on who can vaccinate a dog. Although all vaccinators require sufficient training before engaging in vaccination, they do not have to be qualified veterinarians. Veterinary paraprofessionals, community animal health workers, veterinary/human health students and professionals trained in human vaccination delivery can also be trained in the skills required for dog vaccination. See solution 20: Select appropriate people for vaccinator role for more information on using community animal health workers.

Solution 26: WOAH Vaccine bank.

Vaccine banks enable economies of scale and contribute to the harmonisation of global and regional control programmes. As of January 2023, two [WOAH vaccine banks](#) are active and focus on rabies and peste des petits ruminants (PPR). The WOAH vaccine bank facilitates access to high quality dog rabies vaccines (as defined by the [WOAH Terrestrial Manual chapter 3.1.18 Rabies](#)), for a fixed, low-cost price. The vaccine bank is not intended to replace national vaccine procurement processes but is instead a complementary tool to provide catalytic support for implementation of a national control programme. Three modalities are available for purchasing the vaccines: purchasing by WOAH with funding support from WOAH resource partners in the framework of specific grants; purchase by an international organisation or implementing partner; or purchase directly by the WOAH Member. Regardless of how vaccines are purchased, requests must be submitted to WOAH by the respective Delegate. Ideally, this step should be taken well in advance of the planned campaign, to ensure the mechanism can be activated in time.

Solution 27: PAHO revolving fund.

Only for countries in Latin America, PAHO provides the Revolving Fund (RFV) that delivers technical cooperation to national immunisation programs to improve their vaccine demand planning and forecasting capacities, strengthen supply chain management, and ensure their financing and sustainability; this includes rabies vaccine for dogs.

Solution 28: Utilise planning tool to estimate vaccine needs.

Purchasing vaccines at scale can reduce the per vaccine costs, this requires an estimate of the total number of vaccines required. The [VaxPLAN](#) allows users to design vaccination campaigns and immediately see the expected cost and coverage in the dog population. The tool helps vaccination campaign managers determine the appropriate amount of vaccine, the most effective methods for vaccine distribution, and the cost to operationalize the designed plan. This tool is most appropriate for early-stage vaccination programs, programs that have not achieved desired coverage levels, and programs that may benefit from a mixed-methods vaccination approach. [Wallace et al \(2019\)](#) is a supplementary publication that explains the development of this tool.

Solution 29: Vaccines with proven thermotolerance.

Research has shown that some vaccines are thermotolerant under relatively normal field conditions. For example, [Lancaster et al 2016](#) found vaccination with Nobivac Rabies vaccine (an inactivated rabies vaccine) stored at 30 °C for 3 months still produced a sufficient neutralising antibody response.

Solution 30: Passive cooling devices

Unreliable cold chain storage facilities, prevalent in rural areas where there is no/limited electricity have been perceived as a challenge for rabies vaccine distribution. However, the recognition that some canine rabies vaccines are thermotolerant and retain potency after storage outside of cold chain conditions in [passive cooling devices](#) can address this perceived challenge. For example, [Lugelo et al \(2021\)](#) utilised a passive cooling device (“Zeepot”) for storage of the same Nobivac Rabies vaccine under fluctuating temperature conditions and found no difference in the resulting seroconversion as compared to the same vaccine stored using traditional cold-chain.