

# Canine Rabies Blueprint - Dog Component

## 5.4. What are we going to do - dog component?

This section provides practical guidelines for the actual implementation of measures to control dog rabies.

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### 5.4.1. What techniques are available to estimate the number of dogs?

If information on the number of dogs present in the community is not available, it is recommended, but not required, that a dog population survey be conducted before implementing a canine rabies control programme. These surveys assist with more accurate campaign planning, assessing the needs of dog population management programmes, and evaluating the effectiveness of intervention. If the campaigns need to be implemented with some urgency, first rapid population estimates can be made, as described [here](#), and additional surveys can be implemented post-vaccination (e.g. combined with surveys for estimation of vaccination coverage, described [here](#)).

The options for estimating the number of dogs to vaccinate are as follows:

- ▶ Expert opinion based on historical data of previous campaigns or on registration records if available.

- ▶ Expert opinion based on [estimations](#) made in other geographic areas/demographic settings.
- ▶ Commonly used census techniques:
  - **Questionnaire surveys** can be used to establish the mean number of **owned dogs** per household and dog:human ratios. Since the total human population or number of households is generally known through national population censuses, an estimate of the owned dog population can then be extrapolated. These surveys can be conducted before, during or after campaigns (e.g. combined with post-vaccination surveys to estimate vaccination coverage, described [here](#)). Households for interview should be selected randomly. Additional information can be obtained on:
    - (1) Dog characteristics (e.g. sex, age, population turnover, dog handling/keeping practices, vaccination status), features of the animal that are helpful for understanding reproductive patterns, annual recruitment into the dog population (critical to determine the required frequency of campaigns) and level of supervision and accessibility.
    - (2) Household characteristics including determinants of dog ownership (e.g. socio-economic status, livestock ownership, religion and sex of the head of households), which can be used as predictors of dog population size and distribution (as shown in [this study](#)) and to gather information on accessibility for vaccination.
    - (3) Knowledge of rabies in the household, which can be useful for targeting public awareness campaigns, as described [here](#).

It should be understood that the additional information is not always necessary, and priorities should be based on resources available to carry out the surveys.

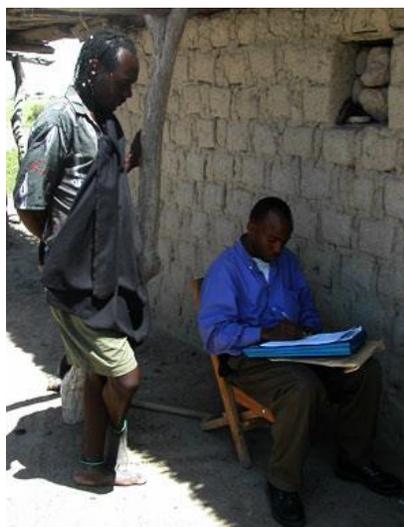


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- Methods are also available to assess the number of [roaming dogs](#) (both owned and unowned dogs, but not accompanied by an owner) such as:
- **Indicator counts** which consist of counting dogs (e.g. males, females and pups) along selected representative routes. Counts can be repeated every year (at the same time of the year) to evaluate changes in population over time (i.e. if the number of dogs has increased or decreased). Click [here](#) to learn more about this method.
- **Capture-mark-recapture methods** consist of temporarily marking dogs, e.g. with a dye or distinctive collars (click [here](#) for examples of devices to mark dogs), and then subsequently recording the proportion of marked individuals in the population during a “visual recapture” effort. From the number of dogs marked and the observed ratio of marked to unmarked dogs the total number of street dogs is calculated. Marking can conveniently be done during vaccination campaigns. However, it is important to perform marking and recapture within a time period of a few days in order to minimize mark loss, dog movement and mortality effects. Also it is better to work in a defined area of only 0.5 to 2 km<sup>2</sup> than in transects. The observations can also be combined with estimates of the number of owned dogs obtained through household questionnaires to estimate the number of unmarked dogs as shown in [these studies](#). Estimates of population densities can also be obtained from the rates of capture during a marking campaign lasting a few days. Dogs may also be given permanent marks if the intervention includes anesthesia for additional studies.



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- **Population estimates** can be obtained by extrapolating counts made in a sample (e.g. randomly selected subregions to whole cities). These surveys can also be repeated to detect changes in the number of roaming dogs. Click [here](#) to learn more about this method and how to estimate the total number of dogs from the sample.

See [here](#) for examples of dog population estimates made in various settings.

## 5.4.2. Why is epidemiological surveillance important and what can we do to enhance it?

► Rabies surveillance is the key index for the success of any intervention programme. It involves the collection of essential data to (1) determine the rabies situation at the start of the programme, (2) to monitor and evaluate the progress and impact of intervention, (3) to manage potential human exposures adequately, (4) to calculate the cost-effectiveness of control efforts and (5) to demonstrate absence and freedom of disease in a given area. (See [Section 1](#) of the Rabies Surveillance Blueprint for further details on the importance of surveillance.)

If surveillance measures are not in place at the start, they must be implemented quickly and strategically. It is important to stress that efficient reporting of data is as important as its collection, so that timely analyses can be conducted. Such analyses may reveal changes in the rabies situation, such as outbreaks which require immediate intervention. An example list of basic indicators that can be used to assess the burden of canine rabies and the impact of control measures can be found [here](#)

► Rabies in animals can be suspected based on bite history and [clinical signs](#), but **laboratory confirmation** is the only definitive means of diagnosis. Countries embarking in a rabies control programme must have the minimum infrastructure for laboratory-based diagnosis, as described [here](#), using the gold standard, the [direct fluorescent antibody test](#), at least at the central level (national rabies laboratories). Click [here](#) for a list of basic supplies you need to run this test. If alternative validated techniques are used, as described [here](#), prior thorough validation and comparison to standard rabies diagnostic test is essential and confirmation of results at central laboratories using the fluorescent antibody test may only be required for negative samples. For an overview of the minimum requirements needed for an effective surveillance system, read [Section 3](#) of the Rabies Surveillance Blueprint.

► [Simple sample collection techniques](#) for implementation by a range of operators, including veterinary, livestock/extension officers, and game wardens, may be introduced to facilitate field collection and transport of samples in remote rural locations and to improve sample submission rates. Click [here](#) for the list of supplies that rabies surveillance personnel need in the field. It is essential that transport of specimens to rabies diagnostic facilities is organized in an efficient way to ensure timely and safe delivery. See the Rabies Surveillance Blueprint [Section 3.3](#) for further information on personnel and infrastructure needed for sample collection.



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► Recognition of rabies cases by communities living in rabies-endemic areas can be relatively accurate. Under these circumstances, information on (unconfirmed) cases of human and animal rabies and animal-bite injuries can be obtained from **questionnaire surveys** or may be part of syndromic surveillance. However, this is generally of most use for rapid assessments rather than determining incidence, unless all reports can be followed up for further investigation. Questionnaire surveys may also be of value in understanding local knowledge, attitudes and behaviors and this information can be used for more targeted communication and education programmes.



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► **Animal-bite injury data** from hospitals are an easily accessible source of data and can be used as indicators of animal rabies cases in an area and rabies exposures, and to assess the impact of dog vaccination on human rabies exposures. Surveillance systems that take animal bite patient data and

then follow up in the patients' communities can lead to better data on cases of rabid animals and also reveal additional victims bitten by those dogs. If biting dogs are located and remain healthy after 10 days of observation, the patient can stop the course of PEP, leading to cost savings. This form of surveillance has been very effectively applied in Haiti (see CASE STUDY HAITI).

- ▶ Hospitals can also provide information on **post-exposure prophylaxis doses** administered which can be used to evaluate the cost-effectiveness of canine rabies control programmes through reduction in public health expenditure on costly human rabies vaccines (resulting from reduction in dog rabies).

- ▶ It is also vital that accurate records of all **expenditures on rabies control efforts** are kept so that cost-benefit analyses can be completed at a later date. For the types of data needed to conduct economic and cost-benefit analyses see [these examples](#).

- ▶ **Geo-referenced data** on human and animal rabies cases (including clinical, laboratory-confirmed and animal-bite injury data) are useful to identify regions most affected by rabies and to ensure targeted actions.

- ▶ **Mobile phone technology** could also enhance rabies surveillance by allowing real-time reporting/detection of cases and animal-bite injuries as well as providing timely information on availability of anti-rabies biologicals. For more information, see [here](#).

For further details on what types of data should be collected and how to establish a database for conducting epidemiological analysis is available in the Rabies Surveillance Blueprint, [Section 5](#).



### 5.4.3. Are there specific signs in an animal that we can watch to confirm that it is rabid?

Clinical signs of rabies are rarely definitive, therefore if a likely exposure occurs humane euthanasia should be carried out and the brain tissue of the animal should be tested by fluorescent antibody test in a reliable diagnostic laboratory. However, if facilities for caging are available, the animal can be caught and observed daily for [clinical signs of rabies](#).

Dogs can be confined in appropriate holding facilities or on the owner's property (provided that there are no risks of accidental exposure of the owner or other people). If the animal stays healthy for more than 10 days, rabies can be ruled out and the dogs should be vaccinated and returned to their owner. Dogs showing signs consistent with rabies should be euthanised immediately using humane techniques, available [here](#).

Rabid animals of all species usually exhibit typical signs of CNS disturbance, with minor variations among species. The most reliable signs, regardless of species, are acute behavioural changes and unexplained progressive paralysis. The clinical course may be divided into 3 general phases—prodromal, acute excitative, and paralytic/end stage. However, this division is of limited practical value because of the variability of signs and the irregular lengths of the phases. During the prodromal period, which lasts ~1-3 days, animals show only vague nonspecific signs, which intensify rapidly. The disease progresses rapidly after the onset of paralysis, and death is virtually certain a few days thereafter. Some animals die rapidly without marked clinical signs.

The term “furious rabies” refers to animals in which aggression (the acute neural excitative phase) is pronounced. “Dumb or paralytic rabies” refers to animals in which the behavioural changes are minimal, and the disease is manifest principally by paralysis.

#### The "six step" method for a presumptive diagnosis of rabies in living dogs

The six clinical criteria for a diagnosis of rabies are:

1) Age of the dog?

a) Less than 1 month \_\_\_\_\_ not rabies

b) One month or more or not known \_\_\_\_\_ go to 2

2) State of health of the dog?

a) Normal (not sick) or sick more than 10 days \_\_\_\_\_ not rabies

b) Sick less than 10 days or not known \_\_\_\_\_ go to 3

3) How did the illness evolve?

a) Acute onset from normal health \_\_\_\_\_ not rabies

b) Gradual onset or not known \_\_\_\_\_ go to 4

4) How was the condition during the clinical course in last 3-5 days?

a) Stable or improving (with no treatment) \_\_\_\_\_ not rabies

b) Symptoms and signs progressing or not known \_\_\_\_\_ go to 5

5) Does the dog show the sign of “circling”?

(It stumbles or walks in a circle and hits its head against the wall as if blind.)

a) Yes \_\_\_\_\_ not rabies

b) No or not known \_\_\_\_\_ go to 6

6) Does this dog show at least 2 of the 17 following signs or symptoms during the last week of life?

a) Yes \_\_\_\_\_ rabies

b) No or showing only 1 sign \_\_\_\_\_ not rabies

1. Drooping jaw
2. Abnormal sound in barking
3. Dry drooping tongue
4. Licking its own urine
5. Abnormal licking of water
6. Regurgitation
7. Altered behaviour
8. Biting and eating abnormal objects
9. Aggression
10. Biting with no provocation
11. Running without apparent reason
12. Stiffness upon running or walking
13. Restlessness
14. Bites during quarantine
15. Appearing sleepy
16. Imbalance of gait
17. Frequent demonstration of the "dog sitting" position

Summarized from “Six Criteria for Rabies Diagnosis in Living Dogs.” V. Tepsumethanon, H. Wilde, F. X. Meslin; *J Med Assoc Thai.* 2005; 88(3)

#### 5.4.4. How do we dispose of animals that have died of rabies?

If possible remove the brain or parts of the brain or decapitate the animal first and send the samples/head to the laboratory for examination as soon as you can. Laboratory confirmation of cases is critical for accurate surveillance and has implications for disease control responses. Click [here](#) to access the protocol for sample collection. The rest of the body should be incinerated or buried.

## 5.4.5. What methods and strategies are available for dog vaccination?

The choice of vaccination method and strategy is critical to ensure enough dogs will be vaccinated to break the cycle of rabies transmission.

Characterising the dog population (see [here](#)) can help decide which vaccination methods and strategies will lead to the most successful campaign outcome.

Current **methods** include parenteral vaccination and oral vaccination (ORV), and each can be delivered by a variety of different **strategies**. A single strategy or a combination of strategies should be selected on the basis of the setting or known socio-cultural factors and the accessibility of the dog population. Different vaccination methods may also be combined within a campaign in order to achieve sufficient vaccination coverage.



Central point vaccination in Payatas, Manila, Philippines. Photo: Gelay Conception/GARC

Vaccination **strategies** available for parenteral dog vaccination are as follows:

- ▶ **Continual vaccination at fixed vaccination posts.** Dog owners take their dogs/cats at any time to well-recognized sites (such as private or government veterinary clinics). Although this technique requires little government effort, it may fail to reach many owned and all unowned dogs resulting in poor population coverage or coverage that is difficult to measure.
- ▶ **Central-point vaccination strategy.** Mobile teams set up temporary vaccination points at a central location within villages or cities conveniently located for dog owners. This strategy is relatively inexpensive and can achieve the recommended level of coverage (See [CASE STUDY TANZANIA](#) and other examples [here](#) ) Additionally, a mobile team can travel around city streets or other public areas in search of roaming animals. There may be a need to estimate the size of catchment areas of temporary

clinics and decide on their spacing accordingly.

► **House-to-house campaigns.** Vaccination teams travel to individual houses to vaccinate dogs. This strategy may be required in remote areas or where owners cannot leash their dogs. It usually results in a sufficient percentage of dogs being vaccinated, and it causes only minimal disruption of the normal community functions, but it is costly and logistically difficult ([CASE STUDY TANZANIA](#)).

► **Capture/vaccinate/release.** Where large populations of fractious, or ownerless dogs exist, mobile vaccination teams may need to travel through the streets accompanied by dog catchers. Dogs are captured (usually in a net), vaccinated and then released immediately (see the study in India [here](#) ).



Vaccination strategies available for oral dog vaccination are as follows:

► **House-to-house handout.** This can easily be incorporated into a house-to-house parenteral vaccination campaign and all dogs not accessible for parenteral vaccination (used as a first choice) are considered for oral vaccination. Bait is distributed to individual dogs and they are observed as they consume the bait and waste is removed immediately. This method is generally preferable as it avoids unnecessary exposure to the vaccine by people, or animals other than dogs.

► **Distribution of baits to dog owners.** This involves relying on dog owners giving the bait to their dogs. As the vaccination is generally not observed, its success may be difficult to assess.

► **Wildlife immunization model.** ORV baits are distributed in the environment. This is only generally applicable in very specific cases such as with true feral dogs.

Further guidance on oral vaccination is available [here](#). Any time the use of ORV in a campaign is being considered, the safety profile of the vaccine must be evaluated prior to its widespread use. WHO recommends that a risk assessment is conducted prior to distributing baits to ensure that human risk of exposure or adverse events are mitigated (see [here](#) ).

Parenteral vaccination of dogs remains the cornerstone of dog rabies control and can be used for passive vaccination strategies, such as vaccination at fixed points. However, in many areas not all dogs can be restrained and are therefore inaccessible for vaccination. Some dogs are aggressive when handled and these as well as unowned dogs will likely require the implementation of more active vaccination methods (such as CVR). Click here to learn about [restraining](#) and [inoculation techniques](#) for parenteral immunization.

However, in some cases trying to catch and restrain dogs may not be feasible or may be very time and labour intensive. Here, oral vaccination could be used as a supplementary tool: all dogs not accessible for parenteral vaccination could be offered a bait containing a vaccine-loaded blister. Oral vaccination using baits has been used to vaccinate dogs in field trials (see these [studies](#)). In some areas, programmes have combined delivery of oral vaccination baits with parenteral vaccination ([CASE STUDY PHILIPPINES](#)) ([CASE STUDY TURKEY](#)) ([CASE STUDY KWA-ZULU NATAL](#)). However, the use of oral vaccine baits is still experimental and further field studies are needed to evaluate its' effectiveness. Depending on the region, dogs may prefer locally made baits instead of those provided by the supplier.

Independently of the methods and strategy adopted, synchronized campaigns (e.g. one-day or one-week campaigns covering whole municipalities or states) may be very effective in mobilizing many sectors and the public, in view of the short duration of their involvement and higher media and public profile. See the examples here. If dog owners must pay for vaccination, their participation in campaigns may be reduced. Offering free vaccinations is generally recommended, but other models of recovering costs from owners may be possible (see [section 3.3.5](#)). Sometimes incentives, such as dog collars, are offered as a way to increase participation in vaccination campaigns (see [here](#) for an example), but care must be taken to not raise the cost of the programme, or reduce participation if these are not provided in the future.



Photo courtesy of the Serengeti Carnivore Disease Project

Measuring the vaccination coverage level achieved by any method (at least after initial campaigns, and maybe after every campaign) is very important if the success of the campaign is to be assessed, and improvements are to be made. Investments in assessing the coverage level achieved can be well worth it if adjustments are made to enable sufficiently high coverage to be achieved and rabies is eliminated in a shorter timeframe. See [here](#) for an example of where low coverage in some areas allowed rabies to persist. In many cases, errors in the initial dog population size or composition estimates can be corrected by assessing the proportion of all dogs that have been reached by a campaign. A more effective campaign can then be designed from these findings if necessary. See [section 5.6.2](#) for more information.

## 5.4.6. How do we plan the vaccination campaign on the ground?

**What are the vaccination goals?** Prior to planning your vaccination campaign it is important to define the goals of the vaccination program. Rabies control programs (focused on reducing human burden, but not elimination) are often carried out in response to a rabies outbreak or reported human case. Rabies elimination programs (focused on sustained vaccination over multiple years at high levels) are carried out in more advanced programs to eliminate the disease from an area.

Achieving a vaccination coverage of greater than 70%, annually, for multiple successive years will halt transmission of rabies in 95% of situations (see [this study](#)). For this reason a target of 70% vaccination is recommended for recurrent annual vaccination campaigns to ensure elimination is reached (See the [WHO Expert report](#)). However, the coverage required may be lower than 70% in zones where there is a low risk of rabies transmission, for example where most dogs are restricted in their movements. An important factor is that vaccination coverage should reach 70% in all zones where there is a high risk of transmission, and not just on average across a large area. Pockets of low vaccination coverage in high risk zones can allow rabies transmission to persist.

**Who is responsible for canine rabies vaccination?** Once the goal of vaccination has been developed it is important to identify who will be responsible for carrying out the campaign. Responsibility is likely to vary between countries, but is likely to belong to a Ministry of Agriculture, Ministry of Health, or perhaps a Non-Governmental Organization. Identifying the responsible authority will have a great influence on obtaining permission, and on the personnel, logistics and equipment available. Further guidance on Roles and Responsibilities is provided in [Section 2](#).

**Where and when will you vaccinate?** The vaccination campaign may cover an entire country or perhaps just a portion of the country. Campaigns should always consider the risk of re-introduction of rabies from surrounding communities. Geographic barriers such as rivers or mountains may help prevent movement of dogs into a rabies vaccination zone. However, if borders are porous then rabies imported through dog movement should be considered when selecting vaccination zones.

Campaigns should be conducted in a short period of time (<3 months) to ensure that the vaccination rate in dogs does not drop below critical numbers. The time of the year, day of the week and time of the day for vaccinations should be considered to maximise participation.

**What method(s) and strategies of vaccination are appropriate?** Choosing the most appropriate vaccination strategy to stop rabies transmission needs careful consideration of the local situation. What is the dog population structure, and will the method of vaccination reach dogs involved in the enzootic transmission cycle? Will enough dogs be accessed if owners are required to bring dogs for vaccination or is a door-to-door approach more suitable? Who is expected to bring dogs for vaccination?

**Will dog catching teams be needed?** These questions should be addressed by people with local knowledge such as the village leaders, village animal health workers or others with an interest in supporting rabies control efforts. See [section 5.4.5](#) for more information on choosing the best methods and strategies for vaccination campaigns.

Once the best method and strategy has been decided on, vaccination team members, accompanied by village leaders, should then visit the selected area in order to plan the campaigns on the ground. The proposed area should be carefully mapped and broken into daily work blocks and further into sub-team blocks, allocating teams to certain areas. It might be useful to conduct smaller-scale campaigns first (e.g. pilot projects) to gain experience and subsequently expand to cover larger areas. Logistics should be planned carefully and time allowed for purchase of equipment and preparation.

The Community Coordinator Certificate (CCC) course of the [GARC education platform](#) has been designed to enable interested people to become actively involved in the protection of their community against rabies, and support the planning and execution of vaccination campaigns.

Further practical information related to Infrastructure, legislative framework, costs and funding relevant to planning larger scale vaccination campaigns are provided in [Sections 3.1 to 3.3](#) Information on who may need to be trained is provided in [Section 5.3](#) and on what may need to be bought is provided in [Section 5.2](#)

### **5.4.7. How do we make sure that the community and dog owners know about the vaccination campaign?**

Advertising of campaigns locally can be carried out a week before the chosen vaccination day by distributing leaflets, posters and letters to community leaders (who will inform community members in formal and informal meetings). The information should be posted at all popular places including schools (children are an important target group), political party offices, shopping centres/markets and government offices. More intensified efforts can be made by using specialized advertisement teams that will deliver information about the vaccination day across a village using a megaphone (using vehicles, bikes or motorbikes). Appropriate adoption of local tools for reaching a wide audience is critical. At local, regional and national levels a range of media and materials such as leaflets, newspaper advertisements, radio, TV programmes, and social media (e.g. Twitter, Facebook, YouTube) can be used. The involvement of religious leaders (e.g. in Islamic countries, the imam) is also highly effective. The announcement of *dog vaccination weeks* to be conducted once a year at fixed time points should also be considered. See [Section 4.2](#) of the Canine Rabies Blueprint for more information on how to develop a communications plan for a vaccination campaign.



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### 5.4.8. Which dogs should be vaccinated?

In practice, mass vaccination campaigns usually attempt to vaccinate every dog, so that even when dogs die and others are born between campaigns, the vaccination coverage remains as high as possible.

Vaccine manufacturers recommend that pups should be vaccinated only after 3 months of age, particularly if a nursing pup's mother is known to be recently vaccinated against rabies. However, it is important that dogs of all ages, including young pups, are vaccinated during a mass vaccination campaign. If pups are not included in campaigns, it is likely that the overall population vaccination coverage will not be high enough to prevent rabies transmission in the interval between campaigns.

There is good evidence from African campaigns that pups younger than 3 months mount a solid (protective) immune response to the modern cell culture rabies vaccines and that these commercially-available, inactivated vaccines are entirely safe in healthy pups (see Morters reference [here](#)). Although circulating maternal antibodies in puppies may reduce the effectiveness of rabies vaccination, the studies have shown that modern cell culture vaccines are still safe to use in puppies from two weeks old. A high vaccine efficacy may still be demonstrated in such young puppies (see [here](#)).

Vaccination should also be given to pregnant and lactating dogs if possible. Vaccination is safe, and even if immunity is not optimal, there will be some level of protection from rabies which otherwise the dog may not have.



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### 5.4.9. How often should dogs be vaccinated?

For most commercially-available inactivated vaccines, a single dose of vaccine should provide protection for at least one year. (Some vaccines are effective up to 3 years when used according to the manufacturer’s recommendations.) If campaigns are carried out annually, it is recommended that vaccinated dogs receive yearly booster vaccines to ensure protection. This allows a simple message to be conveyed to the community of “Bring all dogs for vaccination at every campaign,” and it is likely to increase coverage rates.



Photo courtesy of the Society of Animal Well-Being of Lusaka and by the Department of Veterinary Medicine of the University of Lusaka

### 5.4.10. How often should campaigns be conducted?

► The traditional approach to rabies campaigns has been annual campaigns, and there is evidence that in many populations, an annual frequency of campaigns is effective.

- ▶ While this is a reasonable starting point for planning purposes, it is important to be aware that in populations with high birth and death rates, the vaccination coverage may drop off very rapidly after a single campaign. In these populations, more frequent campaigns are likely to be needed. (For example in Mexico, campaigns are carried out every 6 months.)
- ▶ Campaigns can also be timed just after breeding seasons to cover the maximum number of dogs including pups. The situation should be monitored through surveillance and planning of campaigns could be refined with more detailed information on dog population dynamics, as described [here](#).



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- ▶ After an outbreak or at the start of a new regional/national campaign, it may be advisable to plan for two campaigns in the first year, particularly as turnout may be low during the first campaign due to lack of awareness. In the event of an outbreak, a rapid response is required, and a campaign should be conducted immediately to vaccinate/re-vaccinate dogs in the area.

## 5.4.11. Should cats be vaccinated?

Although cats are not the target species for vaccination in terms of controlling or eliminating canine rabies, they are an important source of infection for humans in many areas, and vaccination of cats is recommended for reducing the human rabies risk. It is suggested that during campaigns that owners be advised to bring cats for vaccination, but limited resources should not be used for house-to-house or stray cat vaccination. Once rabies is controlled in the dog population, the canine rabies virus will also disappear in cats.



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## 5.4.12. How many people are needed on an average vaccination day?

It depends on the size of the village and accessibility of households by road. A team of four people/village at a central-point vaccination station should be sufficient to complete the tasks of dog registration, certificate writing, and vaccine administration for between 100 and 1000 dogs/day. However, if numbers of people with their dogs are low (less than 100), two people can easily carry out the tasks. For mobile vaccinations on motorbikes and house-to-house campaigns, 2-4 people are needed for dog capture and handling, 1-2 people are needed to inject the vaccination, and 1-2 people are needed for record keeping and communicating with the community. Therefore, the make-up of teams should be flexible based on estimated numbers and may need to be adjusted based on turnouts during initial campaigns. The vaccination station and personnel should be under the supervision or responsibility of a veterinarian.

## 5.4.13. How can the level of vaccination coverage achieved be estimated?

Vaccination coverage can be estimated using several methods:

► **Post-vaccination questionnaire surveys** can estimate the proportion of vaccinated to unvaccinated dogs in households. During these surveys dog owners should be asked to produce vaccination certificates in order to identify dogs vaccinated in current vaccination campaigns. This method can also be used to investigate the reasons why people did not vaccinate their dogs. This method may not include community or ownerless dogs and can therefore overestimate the vaccination coverage in free-roaming dogs; the dogs most critical to vaccinate to end enzootic transmission. See [here](#) for examples.

► **From direct observation of marked and unmarked dogs**, Vaccinated dogs can be easily identified shortly after the campaign if they are marked using a temporary paint or collar (see [here](#)), or later if they are permanently marked, for example during capture-neuter-vaccinate-release (CNVR) campaigns. Examples of Capture-mark-recapture methods are [here](#). This method can be applied very soon after the campaign has been completed, and can quickly identify areas where further vaccination efforts are required, before the vaccination team moves away.

Consideration of the duration of marks should be made when designing an evaluation. Collars may be lost quickly, or removed and paint marks may wash off after several days. Permanent marking techniques are not appropriate in all settings, particularly in areas where a permanent mark will leave exposed wounds that can become infected or parasitized. Marking dogs that have been vaccinated orally can be a challenge as the dogs are being not handled, but programmes have successfully used 50-100ml syringes filled with dyed water to mark dogs.

Restricted vaccinated dogs that are kept inside the house or backyard are often not observed. Hence, this method is less suitable for the overall dog population but can be used to determine the vaccination coverage of the free-roaming dog population.

► **From doses of vaccine used in relation to the estimated dog population**. This method requires calculations using good estimates of the overall dog population as the denominator value. Many programmes have found that initial dog estimates based on dog registration data or extrapolated from assumed human:dog ratios have turned out to be very inaccurate. The level of vaccination coverage calculated using this data is generally overestimated, sometimes several-fold. In these settings campaigns relying on unstable estimates should make a concerted effort to ensure that more dogs are vaccinated in each area after each successive campaign.

## 5.4.14. Is it important to include dog population management in rabies control programmes?

Including dog population management programmes will depend on whether the number of unwanted dogs in the specific location is considered a problem by the community, which may not always be the case. Given the wide differences in composition and size of dog populations between and within countries, dog population management needs must be assessed before planning and implementing any intervention. Planned interventions should follow published guidelines with monitoring and evaluation being a critical component of the programme, as explained in [this document](#). Currently recommended tools for dog population management are described [here](#).

## 5.4.15. Should dogs be removed as part of rabies vaccination campaigns?

Dog culling (i.e. removal) alone has never been effective in controlling or eliminating dog rabies and can often be counterproductive. It is therefore not recommended as a rabies control strategy on its own. Euthanasia may be required when dealing with sick (e.g. rabid), injured or aggressive dogs. Removal of dogs must be carried out humanely, and any campaigns that include removal or euthanasia of dogs should follow [published guidelines](#). Click [here](#) for practical guidelines for euthanasia. If culling is considered, it is important to ensure that previously vaccinated dogs are not removed. Euthanasia may be required for dogs that are not suitable for rehoming or release back into the community due to health or behavioural reasons. Euthanasia only deals with the symptom of a population management problem and not the cause, so removal of dogs must always be used in conjunction with other approaches and never in isolation.

## 5.4.16. What dog population management tools are currently recommended?

**Dog population management (DPM)** is a multifaceted concept which aims to improve the health and wellbeing of free-roaming dogs and reduce problems they may present, within which permanently reducing the size or turnover rate of a dog population may be a goal.

A combination of approaches is usually required for a successful dog population management programme. Here we consider interventions that could be added to a dog rabies vaccination programme to support and enhance rabies control. Planning of such additional DPM interventions should follow an initial assessment phase and analysis of the local dog population to ensure the approaches are both desired by the community and appropriate.



Photo courtesy of Serengeti Carnivore Disease Project

Currently advocated components in addition to rabies vaccination include:

- ▶ Promotion of **Responsible Dog Ownership (RDO)** through educational initiatives. The aim is to improve the guardianship of dogs and their offspring, ultimately leading to healthier, longer lived and safer (vaccinated) dogs that are not abandoned. RDO involves owners accepting their duties to: (1) provide the resources (e.g. food, water, shelter, health care, social interaction, exercise and opportunity for natural behaviours) necessary for dogs to maintain an acceptable level of health and well-being in their environments; (2) act in accordance with the legislation in place (related to registration, identification or vaccination); (3) minimise any risks (aggression, disease transmission, nuisance or injuries) that dogs may pose to communities, other animals or the environment.
- ▶ **Registration and identification** of dogs is also used to formally and physically establish ownership. Read [here](#) about laws and recommendations available for dog identification and registry. Commonly used methods for dog identification can be permanent (e.g. microchips and tattoos) or temporary (e.g. collars and tags), and they are described [here](#) and [here](#).
- ▶ **Legislative measures** (e.g. tie-up orders, abandonment legislation, mandatory registration, identification and regular rabies vaccination), which can be found in the [legislation section](#).
- ▶ Interventions aiming at **controlling dog reproduction**. The currently recommended technique for reproductive control is **surgical sterilization**, which requires trained personnel, infrastructure, equipment (listed [here](#)), appropriate anaesthesia and pain management. It should be noted that sterilization of female dogs will be much more effective at reducing dog population size and turnover than the sterilization of males.

Surgical sterilization programmes are enacted either by owners bringing their dogs to a fixed point, or using teams that capture dogs on the streets. The latter involves bring dogs to temporary facility for sterilization and vaccination and then releasing the dogs after recovery in the location where they were captured (often called Capture-Neuter-Vaccinate-Release, CNVR) programmes. [See here](#) for some examples. Both methods involves a long term strategy and considerable resources. Where throughput of combined programmes (sterilization and rabies vaccination) is low, additional vaccination (alone) efforts will be needed to reach the required number of dogs to prevent rabies transmission.

Research is currently being carried out to develop safe and effective methods for **chemical sterilisation or contraception**. Click [here](#) for information on non-surgical methods for controlling the reproduction of dogs and cats and [here](#) for specific advice on chemical castration. A non-invasive and inexpensive method is the **isolation of females in oestrus**, which could be implemented by dog owners through education. Additional vaccinations and parasite control are often provided alongside sterilisation to improve the health of individual dogs, hence enhancing owner interest in engaging with the intervention, increasing the value of individual dogs to reduce abandonment and reducing population turnover by improving survival.



► **Removal of unwanted dogs for re-homing.** Re-homing is only appropriate when there is a reasonable chance that a rescued dog will be adopted by a responsible family. Sheltering dogs that have no prospects for adoption will lead to overpopulation in rehoming centers and compound health and welfare issues. Needs for opening re-homing centres must be carefully evaluated and when a re-homing centre is required in a given area building and managing it must follow published guidelines, provided [here](#) and [here](#). As an alternative to re-homing centres, networks of foster homes involving dedicated volunteers have been successfully created in some parts of Asia, as described [here](#).

If animals removed from the streets cannot be re-homed, and can no longer be sheltered, they will need to be humanely euthanized (see [here](#)).

► **Habitat control.** Areas without adequate garbage disposal are especially prone to attracting large

populations of roaming dogs. In specific areas where dogs are not tolerated (e.g. schools and hospitals) access to these resources should be restricted using measures such as animal proof bins and regular removal of garbage and education to prevent purposeful feeding and careless food disposal. Any new sites that could provide high value resources such as slaughter houses or must include regulations to control disposal of waste. Any significant alteration in access to resources must be done with care to ensure that dogs are not left without food leading to greater movement of dogs, potentially higher levels of competition and aggression over food and ultimately starvation.



DPM may be desirable to reduce the risks of dog bite injuries and other nuisance factors. However, if rabies control is the only, or primary objective, of a programme, then there is currently insufficient evidence of the benefits of DPM to justify the considerable additional expense. It is very important that programmes including DPM have clear objectives and that they are assessed to see if they are producing the desired results. A Guide to Monitoring and Evaluating Dog Population Management Interventions can be found [here](#) .

### **5.4.17. Our programme has been successful and we have eliminated dog rabies from an area - how do we keep this area rabies-free?**

Once the first objective of the dog rabies control project has been achieved (i.e. elimination of dog rabies from a given area), efforts should be made to keep this area free from rabies (**maintenance phase**).

It is recommended that the OIE and WHO guidelines be consulted for definitions of rabies-free countries and regions, available [here](#) and [here](#). Please note that the OIE definition of rabies free areas

is valid only for import regulations and is not intended to guide post-exposure prophylaxis and other public health decisions.

A region or country is recognized as free from dog rabies only if adequate epidemiological vigilance and surveillance do not detect any animals or people infected with dog rabies viruses for a period of two years. Adequate surveillance includes, but is not limited to, submitting all suspect animals to laboratory diagnosis, as described [here](#). The minimum requirements for adequate rabies surveillance are detailed in the Rabies Surveillance Blueprint, [Section 3](#).

The maintenance of an area free from dog rabies requires effective import and quarantine regulations as they are defined by international bodies, as explained [here](#).

A risk assessment taking into account the presence of wildlife rabies (including bat rabies), the prevalence of dog rabies in neighbouring areas, the effectiveness of import regulations and the quality of surveillance will inform decisions on the necessity of maintaining high vaccination coverage in dogs once the region is dog rabies free. For example, continued dog vaccination in transport hubs and border areas to ensure buffer zones may be necessary in the initial stages of the maintenance phase, while maintaining intensive surveillance and implementing prompt response strategies (i.e. containment vaccination) following new introductions.



The export of dog rabies control efforts to neighbouring jurisdictions should be attempted through increased cross-border collaborations involving relevant ministries and agencies and may be supported with resources as they become available. For example in KwaZulu-Natal, a rabies across borders group, comprising representatives from neighbouring territories (Mozambique, Swaziland and Mpumalanga), has been formed as part of a national canine rabies control programme.

## 5.4.18. How can we monitor dog movements?

Control of dog movements is important in maintaining freedom from rabies following control of dog rabies and to prevent reintroductions. Zoo-sanitary controls at border crossings and ports of entry (e.g. zoo-sanitary inspection points, police check-points, ranger posts, harbours and airports) and road checks, including checks on dogs and cats, need to be established. Regulations should be put in place

regarding restrictions on dog movements and the zoo-sanitary requirements to move dogs. Laws and recommendations available for dog importation can be found [here](#).

## 5.4.19. How can we prevent a rabies outbreak?

Outbreaks can be prevented via effective surveillance and case-reporting systems, and rabies control measures. The consequences of not having such follow-up programmes in place can be very severe. Rabies can re-enter a community if no follow-up actions are taken to prevent future outbreaks. Having a rapid response to any rabies alerts, an effective annual rabies vaccination program and effective surveillance will ensure that rabies outbreaks are prevented.

### Footnotes

WHO = World Health Organization

OIE = World Organisation for Animal Health

WSPA = World Society for the Protection of Animals, now World Animal Protection

DPM = Dog Population Management

RDO = Responsible Dog Ownership