Food and Agriculture Organization
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FAO Animal Health

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Vaccinate to eliminate – insights into rabies control

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WORLD ANIMAL PROTECTION

USAID

Epidemiological foundation of disease control

- To control an infectious disease, must decrease the rate of new infections
- R_0 = basic reproductive number = the expected number of secondary infections resulting from one single infection in a completely susceptible population
  - Example: 1 person with measles spreads the disease to 10 other people → R_0 = 10

- **$R_0 > 1$** → number of new infections will **increase** over time
- **$R_0 = 1$** → number of new infections will **remain stable** over time
- **$R_0 < 1$** → number of new infections will **decrease** over time

- *The closer **R** is to zero, the faster the time to elimination*

Vaccination for elimination vs vaccination for control

- Vaccination for control:
  - Goal: reduce disease burden (reduce the *R*)
  - Utilized when resources are limited ($$) or disease elimination is not possible
  - Cost-efficiency measured by cost necessary per unit of disease burden reduction in the species of interest (e.g. humans in the case rabies)
  - Dog vaccination target for rabies: typically 70% of the dog vaccination to achieve progressive control

- Vaccination for elimination:
  - Goal: eliminate the disease from the population (reduce the *R* to zero)
  - Utilized when sufficient resources are available to disease elimination if feasible (e.g. efficacious vaccine possible in reservoir species)
  - Cost-benefit measured by the overall cost of achieving elimination of disease divided by costs saved as a result of elimination, therefore the intention is **long-term cost savings** as a result of no longer needed to control the disease
    - **Return on investment (ROI)**: How much money will we save if we eliminate this disease? → the faster elimination can be achieved the longer our investment in elimination will be earning "interest"
  - Dog vaccination target: ???

So how should we vaccinate if our goal is to achieve rabies elimination?

To maximize the value of elimination, the focus should be on achieving elimination as cheaply and quickly as possible.

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To maximize the value of elimination, the focus should be on achieving elimination as **cheaply** and quickly as possible.

Which dogs are the most valuable to vaccinate in order to have the greatest impact on spread of the rabies (R_0)?

Dogs with the highest likelihood of encountering the rabies virus.

Dogs that are not kept in enclosed areas.

- **Roaming owned dogs**
- **Unowned dogs**

Alternatively, which vaccination activity has the lowest likelihood of stopping spread of the rabies virus?

Revaccination of dogs which are already immune and have a low probability of encountering the rabies virus

Annual vaccination of dogs that are kept in enclosed areas.

And currently where is most of our dog vaccination money spent?

Annual vaccination of owned dogs

Rabies vaccination for elimination

1. Cheaply:
   - vaccinate roaming dogs efficiently
   - Avoid revaccinating indoor animals which are already immune
2. Quickly:

And what can our friend in epidemiology, the R_0 tell us about speed?

The closer ***R*** is to zero, the faster the time to elimination.

And what is the relationship between vaccination and *R*?

The higher the vaccination coverage, the lower the R.

Therefore our basic goal in elimination becomes to increase vaccination coverage in the population until the virus is eliminated

Shifting to elimination

1. Greater focus on street dogs
   → think like a rabies virus!
2. Emphasis on adding news dogs to the immune population rather than annual vaccination
   1. Puppy vaccination drives
   2. Use of long-term collars to identify vaccinated street dogs so unvaccinated dogs can be more efficiently targeted
3. Keep vaccinating until the virus is gone!


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To Eliminate Rabies!

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A place we can go to work together, helping each other to learn how to best eliminate rabies as efficiently as possible.

What we learned about street dogs

1. Vaccinating them is difficult, but **not impossible**

2. Vaccination teams perform remarkably better when they **compete** against each other

3. We can get large areas vaccinated in short periods of time when many teams **work together** in the same place at the same time


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