# Tracking the elimination of rabies from Pemba Island, Tanzania

Kennedy Lushasi1-3, Kirstyn Brunker2, Elaine Ferguson2, Rachel Steenson2, Ally Z Mohamed4, Chanasa Ngeleja5, Daniel T Haydon2, Eberhard Mbunda6†, Emmanuel Mpolya3, Francois-Xavier Meslinx, Geoffrey Mchau7, Gurdeep Jaswant1,13, Hesron Nonga6, Joel Changalucha1, Khasim Omar4, Kija Ng’abhi8, Kristyna Rysava9, Lwitiko Sikana1, Maganga Sambo1, Malavika Rajeev10, Mathew Maziku6, Msanif Masoud11, Nicodemus Govella1, Paul Johnson2, Roman Biek2, Rudovick Kazwala12, Sarah Cleaveland2, Tiziana Lembo2, Zacharia Mtema1 & Katie Hampson1,2


Rabies has circulated on Pemba Island, off the Tanzanian mainland, since the late 1990s. In 2010, a rabies elimination program was initiated in southeast Tanzania including Pemba. We investigated transmission dynamics in response to dog vaccinations as rabies was eliminated from Pemba.

We used active contact tracing building upon routine surveillance of animal bite injuries to identify rabid animals, human rabies exposures and deaths, as well as government census data and post-vaccination transects to estimate the dog population size and vaccination coverage over time. We combined these data to construct transmission trees and infer the effective reproduction number (Re).

Rabies incidence declined from 42 probable dog cases in 2010 prior to mass dog vaccinations to just two in 2014 when dog vaccination lapsed. Over the same period rabies exposures declined from 32 in 2010 to two in 2014 and rabies was not detected from May 2014 until June 2016. Whole genome sequencing indicated that viral introductions from the Tanzanian mainland in both 2016 and 2017 caused the outbreak, involving 28 dog rabies cases in late 2016 and 66 cases in 2017, corresponding to 35 and 126 human exposures respectively. Between 2010 and 2017, six human rabies deaths were recorded. Emergency dog vaccination was undertaken in response, with campaigns completed every year since late 2016. In 2018 only 8 rabid dogs were detected and 19 rabies exposures, with no transmission recorded since October 2018.

We found that improved vaccination coverage over consecutive campaigns, led to declines in Re, with four campaigns sufficient to repeatedly eliminate rabies from this small population (<4,000 dogs). However, lapsed vaccinations together with movement of incubating animals from the mainland allowed rabies to re-establish. Continued surveillance and investigations of biting incidents are critical to ensure that any new incursions are controlled and freedom from rabies is maintained.

### 1. What is your pathogen? Multiple options possible (e.g. if working on coinfections)

**Other viruses**: Rabies

### 2. On a scale of 1-5 is your work mostly eco/epidemiological or evolutionary? 1 (100% eco/epidemiological)

### 3. On a scale of 1-5 is your work mostly theoretical or experimental/empirical?

5 (100% empirical)