**Discussion Guide for Dynamical Fever**

**Intro**

* **Explain** to students that the objective is to make vaccination recommendations for the year 2023. Their only resource is the available case data from 2015-2022, as well as information about a veterinary vaccine introduced in 2017 and a human vaccine introduced in 2020.
* They do NOT need to identify the disease of interest, merely suggest how best to avoid it. **Ask,** *can anyone think of a public health intervention in history that effectively mitigated a disease without actually identifying the disease?*
  + Example: Taking consumptive people outside to avoid “miasma” actually just limited the damp conditions that favor TB bacterial growth, but this practice started long before TB was a known infectious agent

**Then, walk them through the year-by-year case data.**

* **Plot** cases from 2015. ***Ask*** *for one volunteer to describe the data. Use the investigative report sheet as a guide for how to describe it.*
  + **Ask,** can we learn anything about the transmission of this disease? Do we have any ideas about what causes it or why?
* **Plot** cases from 2016. ***Ask*** *for one volunteer to describe the data. Use the investigative report sheet as a guide for how to describe it.* 
  + Are there any noticeable differences in 2016 data from 2015? Does this second year of data change our inference from 2015 at all?
* **Plot** cases from 2017 and 2018. ***Ask*** *for one volunteer to describe the data for each year. Use the investigative report sheet as a guide for how to describe it.*

**Veterinary vaccine**

* **Read:** A veterinary vaccine against DF was approved for use in dogs in mid-2017, but since there was not a problem that year, the Ministry of Health did not promote its use. Following the disease's resurgence in 2018, however, information on the vaccine was sent to veterinarians and pet owners in an effort to encourage vaccine uptake. **Ask:**
  + Based on the data from 2015-2018, what have you learned about DF?
  + What factors might determine the differences in epidemic size and duration from year to year?
  + Is it possible to draw any conclusions about the natural history of the disease?
  + Why might the epidemic die out each spring?
* **Read:** By the beginning of 2019, 40 percent of the dog population in Tana had been vaccinated.
* **Plot** cases from 2019. ***Ask*** *for one volunteer to describe the data. Use the investigative report sheet as a guide for how to describe it.*
* **Read:** Results were inconclusive from this campaign, but the Minister of Health ultimately decided to continue the vaccine information campaign for another year and then reassess the situation. Veterinarians and pet owners were encouraged to vaccinate dogs and reminded that the vaccine needs to be renewed annually. The community's response to the vaccine was generally positive, with anecdotal evidence suggesting no vaccinated dogs had gotten sick in 2019, and by the beginning of 2020, 50 percent of the dog population in Tana had been vaccinated.
* **Plot** cases from 2020. ***Ask*** *for one volunteer to describe the data. Use the investigative report sheet as a guide for how to describe it.*
  + In the first 17 weeks of 2020, 109 dogs and 213 people contracted DF.
  + ***Ask,*** What arguments might the groups on each side of the debate make about these data? What additional information (other than more years of data) would be useful to help determine to what extent the vaccine is responsible for the differences in the outbreaks observed before and after its introduction?

**Human vaccine**

* ***Read,*** Luckily for the Minister of Health, the approval of a human vaccine against DF in mid-2020 meant that he did not have to take a strong stance on the debate over dog vaccination. Instead, he simply redirected funds from the earlier information campaign on dog vaccination to promote human vaccination. By the beginning of 2021, 50 percent of the people in Tana had been vaccinated, though dog vaccine uptake fell to 20 percent.
* **Plot** cases from 2021. ***Ask,*** *for one volunteer to describe the data. Use the investigative report sheet as a guide for how to describe it.*
* **Read:**By mid-June, the Minister had had enough and decided step down in order to spend more time with his family and their dogs. His former Deputy was quickly appointed to be the Ministry of Health's Acting Minister, and she worked doggedly over the next few months to ensure that as many people in the community were vaccinated in time for the 2022 season as possible. By the beginning of the year, 80 percent of the people in Tana had been vaccinated. In the meantime, a contamination scare temporarily disrupted the availability of the dog vaccine. The Acting Minister had never been convinced that the dog vaccine had caused the reduction in dog or human DF cases following its introduction, believing instead that a new, less transmissible strain had probably been introduced around the same time as the canine vaccine. She was therefore surprised to see so many canine cases in Antananarivo in 2022.
* **Plot** cases from 2022. ***Ask,*** *for one volunteer to describe the data. Use the investigative report sheet as a guide for how to describe it.*
  + In fact, there were more cases of DF in dogs in 2022 than in any year on record, with 812 canine cases, though there were only 149 human cases. As a dog lover, the Acting Minister is distraught, and it is at this point that she decides she needs outside expertise and brings you in as a consultant.
  + ***Ask,*** Having reviewed all of the data available to you, what potential DF transmission patterns could explain all of the observed data? What would you advise the Acting Minister to do in order to prepare for the 2023 DF season?

**Planning ahead**

* **Now** have students break into small teams to decide the optimal levels to vaccinate for 2023. Give them 5-10 minutes to test various possibilities and plot the associated histograms.
* **Close** with 5-10 minutes of whole classroom discussion. Make sure that students understand the histograms, as well as the final vaccination plots.
  + Why does vaccinating 50 percent of dogs appear to eliminate cases in dogs when vaccinating 50 percent of people only reduces the number of human cases by about 50 percent?
  + What do you think vaccinating 50 percent of dogs would do to the number of human cases, on average? What about the effect of vaccinating 50 percent of people on the number of dog cases?
  + Can review concepts like ‘stochasticity’, R0, spillover, as well as public health information about rabies
  + Pv = 1-1/R0. Can they figure out R0?
  + R0 = 2; stochastic model resets every year with one infectious dog that immigrates into the population. Immunity is not maintained from one year to the next.