**Research Proposal: Rabies in Kazakhstan**

Rabies is a viral and zoonotic disease, meaning that it is an infectious disease that is transmitted between animal and human species. Rabies is present on all continents; however, primarily targets poor communities living in remote locations. Kazakhstan, a landlocked country in Central Asia, was chosen as the geographical location of this research project. Kazakhstan is known as the ninth largest country in the world. Kazakhstan’s abundance of natural mineral resources and arable land has historically been exploited by the corrupt Kazakhstani government as well as envious outside countries. A little over half of the population lives in urban cities, while others are scattered throughout various regions of the country living in very segregated and poor conditions. The rates of infant and maternal mortality, life expectancy, and healthcare standards in Kazakhstan are much lower than those in the Western hemisphere. Healthcare is provided free of charge for all people; however, medical facilities are centralized in urban towns leaving many provincial regions with insufficient health resources. Rabies, specifically, is a deadly disease if left untreated. The post-exposure prophylaxis is the primary and only way treatment that currently exists against rabies. Dogs are identified as the main source of transmission cases to humans. The most common method of transmission is saliva, which occurs during bite and scratch incidents. The incubation period of rabies is around three months, yet the time may vary depending on the location of virus entry. The rabies virus causes inflammation of the central nervous system, specifically fatally targeting the brain and the spinal cord. The two forms of diseases are furious and paralytic rabies. Furious rabies cause hyperactivity, hydrophobia, and aerophobia and result in proximal death due to cardio-respiratory arrest. Paralytic rabies, which is the less common form of the disease, cause muscle paralysis and development of a coma, which causes misdiagnosis and under-reporting of the d­isease.

Animal vaccination is a preventative method against rabies transmission; however, the current vaccination protocols have not been proven to be effective. The current protocol imposes mandatory vaccination policies for all susceptible livestock in high risk areas and monitoring practices in all other areas. Though most vaccinations occur orally, some animals get vaccinated through consuming baits placed throughout the woods. The current measures imposed by the Kazakhstani government against rabies are oral vaccinations of animals in areas with an active outbreak as well as adjacent territories, forced preventative vaccination of animal species prone to rabies, control of stray animals, and various awareness raising campaigns (3). Kazakhstan eradicated foot and mouth disease, another zoonotic type of infection, by 2013 through the strategy of animal vaccination. The government tried to replicate the same vaccine approach for rabies; however, the method did not prove to be efficient. One group of researchers finds no discrepancy between the suggested vaccination standards and the actual vaccination percentages amongst farm and wild animals, indicating the ineffectiveness of the oral vaccination process. Sultanov et al. introduce the idea of stopping livestock vaccination in order to use funds for vaccination of dogs and foxes (1). The researchers suspect that this might indirectly protect the livestock and create funding that can be used towards better needs (1). Whether or not vaccination of foxes and dogs reduces cattle rabies cases is the open question of my research. Gaining knowledge of the effectiveness of this vaccination method can lead to a change of vaccination protocol which not only would reduce the number of rabies cases but also decrease costs.

The idea is to identify two regions of similar geographical, geological, and epidemiological composition from the zoned map of Kazakhstan that Abdrakhmanov et al. created through their maximum entropy model (2). Each region would have a farm with cattle of similar composition to act as the control variable in this research experiment. One farm would stop vaccination of cattle and only vaccinate the stray dogs and foxes in the area. One of the vaccination methods utilized would be the catch-vaccinate-release program, similar to the currently employed catch-sterilize-release campaigns for stray animals. Another vaccination strategy would be bait vaccination distributions throughout the woods. Animals would consume baits that contain the vaccine and get immunized against rabies. The second farm would follow the current vaccination protocol. Farm officials from both locations will be recording the status of their cattle regarding rabies throughout the span of the experiment. The experiment will span two and a half years to give time for new population of cattle as well as dogs and foxes to be born and see the effect of vaccination approaches. After the two and a half year mark, results from the two farms would be compared. A hypothesis of the experiment can be that vaccinating foxes and dogs seen near a farm leads to protection of the livestock.

The objective of the inquiry is to identify if funds can be saved through stopping vaccinations of cattle and relying on indirect protection through fox and dog vaccinations. The gains of answering the question is the discovery of a new effective method of vaccination that leads to fewer rabies outbreaks and saves funds that can be used for other causes. The current vaccination protocol has been identified as ineffective by many groups of researches yet it still is the primary combat tactic against rabies. Reducing the number of rabies cases is beneficial for the overall health of Kazakhstan’s population that may be at risk of getting rabies from animals. Farmers, too, may find this new method to be time and resource saving. Better health of the livestock translates into profit for them, which ultimately would benefit the greater agricultural community in Kazakhstan as farming is a big sector of the economy. Money that is saved from the stopping of livestock vaccines can be then used towards better implementation of rabies diagnostic tests into medical centers around Kazakhstan. On the other hand, however, the investigation can face various obstacles in the form of finding two similar enough farms and surrounding areas to eliminate geographical bias from the experiment. Though the zoned map takes into account information on the geological factors of the region, it might still be difficult to find identical conditions. Another obstacle revolves around the catch-vaccinate-release method in the sense that it can be hard to vaccinate the same number of wild dogs and foxes to establish the same environment for cattle on the farms.

If the research provides positive results, then the vaccination protocol against rabies could be changed in Kazakhstan. This in turn may lead to emergence of new vaccines. The investigation could also provide a starting point for subsequent research on animal vaccinations. Researchers could compare the effectiveness of the bait vaccination approach versus the catch-vaccinate-release approach.

The reason why the founders should consider this research proposal surrounds the lack of first-hand experiment data on rabies in Kazakhstan. Most of the studies and papers written on the topic of rabies use secondary data from the Ministry of Agriculture, Veterinary Committees, national data, and online databases. While the information provided is trustworthy, it is important to recognize the lack of technology in rural parts of Kazakhstan which may lead to biased and underreported data. The economic situation is not prosperous enough to be able to afford to test most of the proposed rabies solutions because zoonotic diseases are relatively low-damage causing in the grand scheme of issues in Kazakhstan. The government is very poorly organized and lacks cohesion amongst the different departments. This makes it difficult to efficiently address a problem: especially one that requires combined efforts of various institutions. Zoonotic diseases carry a significant threat to both animals and humans, but the uncontrollable and difficult-to-trace transmission of such diseases takes a toll on the economy. Combating rabies is a complex task, specifically in Kazakhstan, because of the large number of stray animals that are left unaccounted for in statistics. Animal disease control centers are not focused on catching and fostering the animals, which causes more complications. First, the stray animals are able to go wherever they choose, which increases their points of interaction with other animals, which in turn translates into increased risks of rabies transmission. Secondly, most stray animals have no shelter or food, which can cause them to behave aggressively and bite. Each bite can potentially transmit rabies, but it also depletes the economy of the post exposure prophylaxis resources, which are valued at $147 per treatment (4). Though rabies is an important issue in Kazakhstan, there are more prominent concerns that the government allocates resources to, leaving rabies up to independent researchers to investigate. Conducting an experiment would provide first-hand data on rabies, which is valuable for a better understanding of the disease. Sultanov et al. have examined the currently used vaccines and concluded that one of the two administered vaccines, the Indian Raksharab, was found to be highly ineffective in antibody production against rabies (1). Therefore, it is important to continue research in the area of rabies vaccines to further explore and better understand the topic.

There are some anticipated objects that may arise in response to the research inquiry. One of them being the ethical component of leaving the lives of unvaccinated cattle up to chance. Whether or not vaccinating foxes and dogs will be sufficient enough to protect the cattle is undetermined, meaning that in the case of the hypothesis not getting confirmed, some cattle may die from rabies. This would also increase the chance of rabies transmission to farmers who are taking care of the animals and may lead to loss of human lives. However, it is important to recognize that the chance of rabies transmission is rather low, and in the case of a human bite incident, the post-exposure prophylaxis treatment will be available on standby to prevent the transmission. Another possible objection may revolve around the varying levels of vaccination of wild animal in the area surrounding the two farms. While it is true that it is difficult to provide ideal conditions for the experiment where the wild animals would be identical alongside their vaccination status, it is important to recognize the appropriately accommodated design of the experiment. The number of bait vaccines that get distributed in the surrounding area will be the same for both farms alongside the placement of such baits in relation to the proximity of the farm. Similarly, there will be a daily goal of providing five vaccinations to wild animals set in place to equalize the vaccination processes near the two farms. Specifically, a researcher at each farm will be tasked with catching- vaccinating- releasing five animals every day.  
 The approximate budget of the research inquiry for the full 3 year period is $257,341. The monthly salary of each researcher will be 400,000 tenge, which equates to $936/month. Therefore, the total cost for one researcher personnel over the 3-year period will be $33,723. Having six researchers involved in the investigation will equate to $202,341 for the full length of the research process. Equipment, materials, and supplies are estimated to be around $25,000. With the relatively low cost of $0.35/dose of the rabies vaccine, $10,000 should be sufficient to cover the animal vaccine costs. Travel and lodging costs are expected to be $20,000. As explained above, the brief budget of the research plan is $257,341 for the three-year experiment.

Overall, the research proposal provides a first-hand data experiment investigating the effectiveness of the protection of cattle from the vaccinations of foxes and dogs in the surrounding area. The results may influence the current vaccination protocol in Kazakhstan, protect the lives of animals as well as humans, and allow for a reallocation of funds for another rabies-related cause, such as diagnostic testing. This research proposal satisfies my central research question’s focus on what could be done to prevent a rabies outbreak in Kazakhstan.

**Works Cited**

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