The SIRD model is a mathematical means for tracking/simulating how a disease spreads through a population. For each timepoint, a calculation is performed to determine the Susceptible, Infected, Recovered, and Dead populations, based on the previous timepoint’s information. A typical SIRD model starts with a disease being introduced to a completely healthy population. There are then infection, fatality, and recovery rates, which are used to transfer appropriate portions of each population into each other population. The sum of the populations is always equal to 1, or 100% of the population, and each individual population is equal to its initial size(from previous timepoint), minus the portions going to the other three populations, plus the portions coming in from the other three populations. Infected go to recovered or dead, recovered go to susceptible, susceptible go to infected, and dead remain where they are.

In our work, we constructed a basic SIRD model that reflected typical COVID-19 infection/recovery/mortality rates, and another with an added condition that recovered people have a chance to become susceptible again. In our testing of both models, the single-infection case only ran for about fifty iterations before most of the population recovered and became immune to the simulated disease, while the modified case ran over three-hundred iterations until nearly all the population was deceased. In the “immunity” case, the number of infected individuals reached a peak early on, and gradually decreased until hitting less than 1% of the population by the end of the simulation. Our susceptible population saw a decrease over time, with its rate of loss slowing as it decreased. Our recovered and dead populations experienced similar trends, showing highest volatility early on before finding steady states when the susceptible population had been almost completely transferred to either the recovered or dead groups. This matches traditional, short-term pathogenic models for flu-like illnesses; a large majority of individuals contract the illness, a small percentage of the sick pass away, and a large percentage recover and develop immunity from the disease. At a certain point, almost all possible hosts have been sick, and everyone is either immune or dead.

In our modified case, we once again see stabilization over time, but the end result is an almost entirely deceased population. Immunity is removed, so essentially the entire population is run through an endless cycle of being sick and healthy, where each repetition carries the same death risk, and a corresponding percentage of the population perishes. The cycle runs until majority of the population has reached the only dead-end state available, death. The other three become very small over time.