**Computer Simulation Disease Transmission NIH** Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Per\_\_\_\_

|  |  |
| --- | --- |
| **Characteristic** | **Range** |
| virulence (likelihood of dying) | 0 (no victims die) to 0.75 (75% of victims die) |
| duration of infection | 1 day to 20 days |
| rate of transmission | 0.1 per day to 10 per day |
| initial percent immune | 0% to 100% |

**Launch Simulator** in 1 of the following 2 ways:

* <https://science.education.nih.gov/supplements/webversions/InfectiousDiseases/activities/activity4.html>
* Click on “Launch Simulator”

**Simulate the Disease Activity Done in Class**

* Run the computer simulation of disease transmission with disease characteristics close to the “One Day Disease” Activity done previously in class – both with 0% immune and 65% immune.

|  |  |  |
| --- | --- | --- |
| **Simulation Settings**  **Then select “Autorun” and read your data from the displayed 30 day graph & table.** | Initial Immunity = 0%  Virulence = 0  Duration of Infection =2 Day  Rate of Transmission = 1person/day | Initial Immunity = 65%  Virulence = 0  Duration of Infection =2 Day  Rate of Transmission = 1person/day |
| Did an epidemic occur?  (>= 10% level sick at one time) |  |  |
| Maximum Number of sick |  |  |
| Maximum % sick |  |  |
| Maximum Occurred on Day # |  |  |

* **Did the computer simulation match the classroom activity? Explain.**

**Investigating the Effect of Changing a Disease Characteristic:**

1. Test **each** of the 4 characteristics **individually** that affect the likelihood that an epidemic will occur. Document your data in the tables that follow.
2. Change only **one** of the characteristics, resetting after each simulation.
3. Click **“Autorun”** and read your data from the displayed 30 day graph.
4. **NOTE: An epidemic occurs when 10% of the population is infected**.

**1st Characteristic: Virulence**

* Virulence is the likelihood of dying if the disease is contracted. The simulation guides are 0-.75
  + 0 = No victims die, 0.75 = 75% of the victims die
* First, run a simulation with .75 virulence (75% die), but don’t fill in the chart below. What is unusual or unexpected?

**1st Characteristic: Virulence continued:**

* Now complete the chart below by running 4 simulations with virulence numbers between 0 – 0.2 which is a more typical range for virulence. (It is rare for a disease to cause death in 20% or more of the population.)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Simulation #1** | **Simulation #2** | **Simulation #3** | **Simulation #4** |
| **Virulence** Set at |  |  |  |  |
| Epidemic occur? | Y / N | Y / N | Y / N | Y / N |
| Max % Sick |  |  |  |  |
| Max Occurred on Day Number?? |  |  |  |  |
| Length (in days) of Epidemic Levels |  |  |  |  |
| Ending Endemic Level |  |  |  |  |

**Analysis of Virulence:**

* Compare the levels of less virulent vs. more virulent infectious diseases:
  + Compare the length (# of days) of those that reached epidemic levels.
  + How do the ending endemic levels compare?

**2nd Characteristic: Duration of Infection**

* Duration is how long the disease lasts in an infected person. (Range on simulation is 1 – 20 days)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Simulation #1** | **Simulation #2** | **Simulation #3** | **Simulation #4** |
| **Duration** Set at |  |  |  |  |
| Epidemic occur? | Y / N | Y / N | Y / N | Y / N |
| Max % Sick |  |  |  |  |
| Max Occurred on Day Number?? |  |  |  |  |

**Analysis of Duration:**

* Compare the speed of reaching epidemic levels based on duration of infection:
* What reasons might explain these observations?

**3rd Characteristic: Rate of Transmission**

* Rate of transmission is the number of persons infected per day.
* Simulation range = 0.1 – 10/day which is the rate expected if the infectious person makes 100 contacts/day.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Simulation #1** | **Simulation #2** | **Simulation #3** | **Simulation #4** |
| **Transmission Rate** Set at |  |  |  |  |
| Epidemic occur? | Y / N | Y / N | Y / N | Y / N |
| Max % Sick |  |  |  |  |
| Max Occurred on Day Number?? |  |  |  |  |
| Ending Endemic Level |  |  |  |  |

**Analysis of Rate of Transmission:**

* Does the rate of transmission affect whether an infectious disease becomes **endemic**? Explain.

**4th Characteristic: Level of Immunity**

* Simulation range is 0-100%

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Simulation #1** | **Simulation #2** | **Simulation #3** | **Simulation #4** |
| **Immunity Level** Set at |  |  |  |  |
| Epidemic occur? | Y / N | Y / N | Y / N | Y / N |
| Max % Sick |  |  |  |  |
| Max Occurred on Day Number?? |  |  |  |  |
| Length (in days) of Epidemic Levels |  |  |  |  |

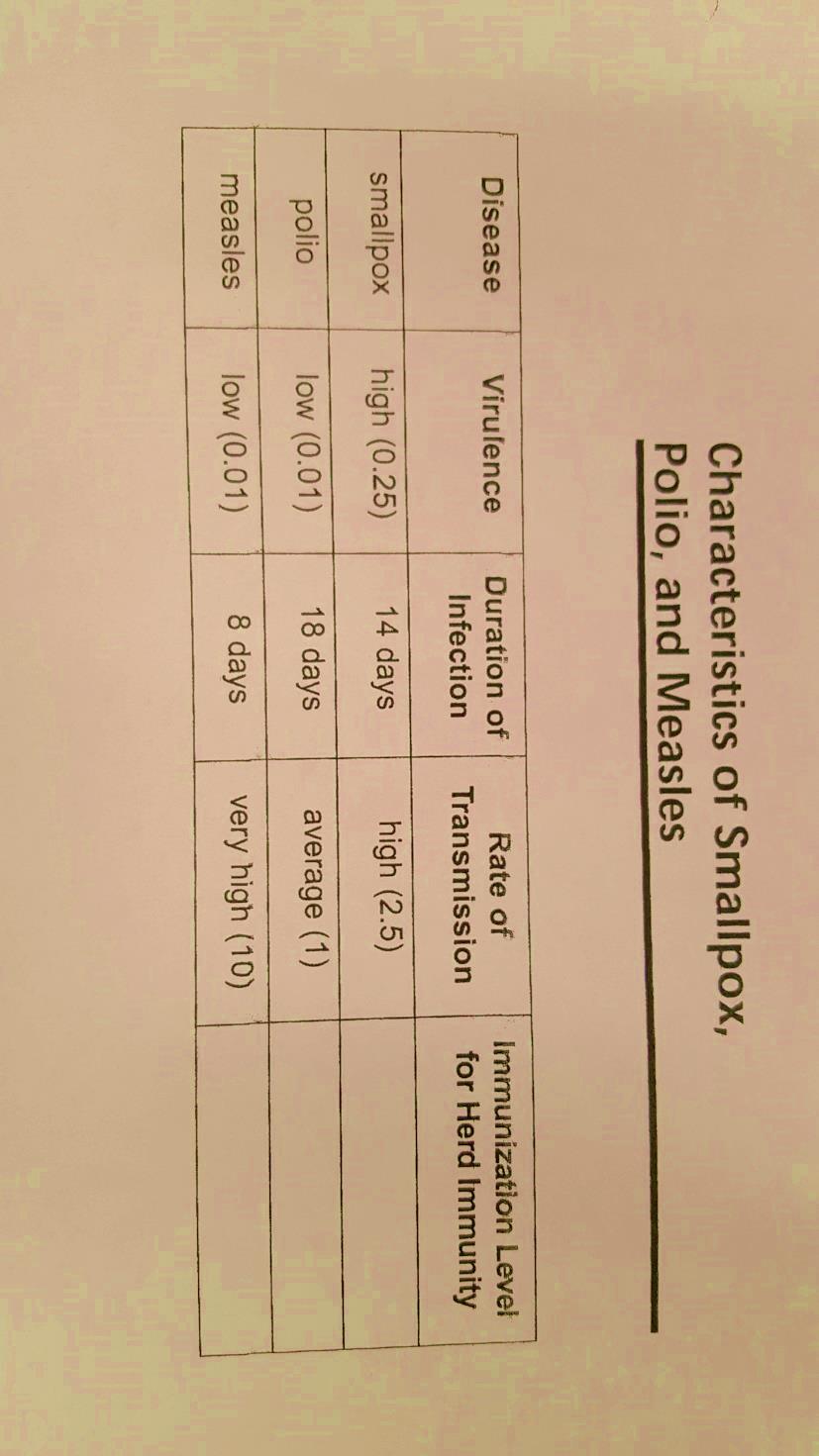
**Analysis of Level of Immunity:**

* Discuss how level of immunity affects speed, duration and likelihood of epidemic levels being reached.

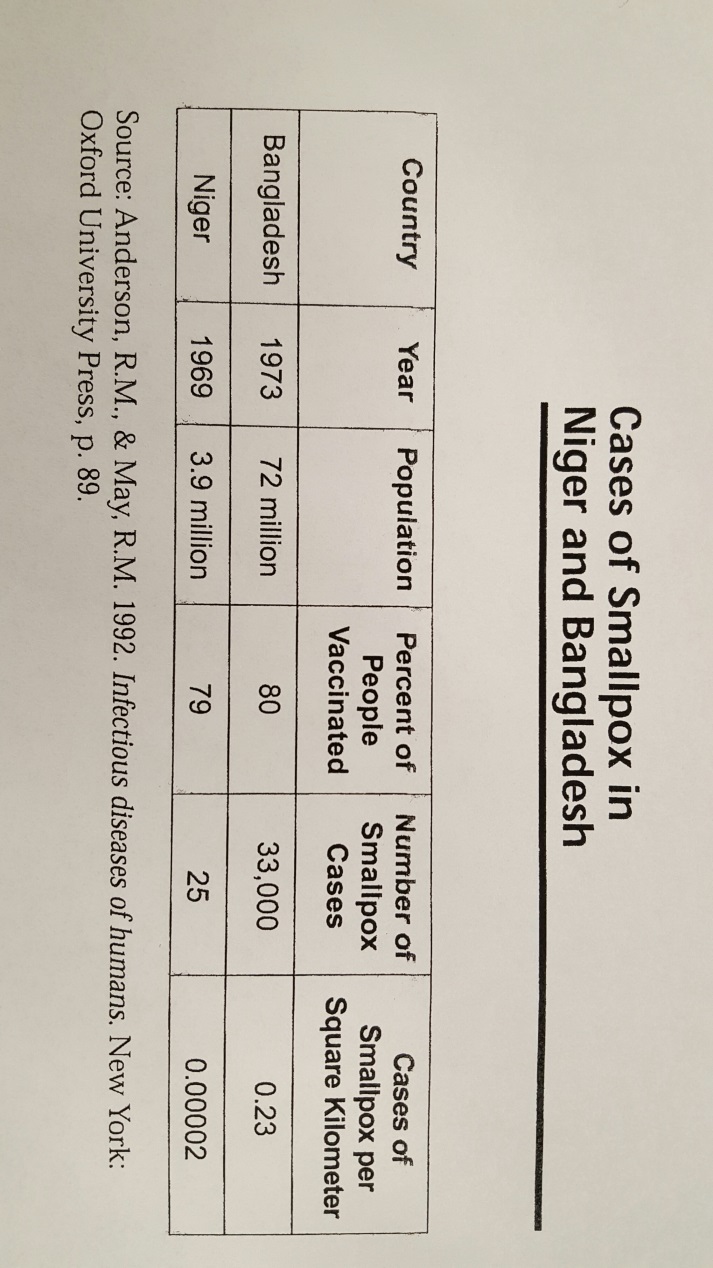
**What About Immunity Levels Needed for Real Disease?**

Use the simulator to determine the minimum Immunization Level needed for the following diseases.

* Use the Virulence, Duration of Infection and Rate of Transmission numbers given in the table.
* Adjust the Immunity levels to prevent a 10% epidemic level.



Even when immunity levels are high, epidemics may occur. Additional factors, not accounted for by a model, may have an impact on the spread of a disease. Examples of such unexpected outbreaks are listed below.



* How does the level of immunity in these 2 countries compare to the **Immunization Level for Herd Immunity** you determined in the computer simulation?
* Neither country reached epidemic levels. Each country had some infected persons.

* + What percent was infected in Bangladesh? Show your calculation.
  + What percent was infected in Niger? Show your calculation.
  + Neither reached an epidemic level of 10%, but Bangladesh had an outbreak with a significant number of persons. What other factors, beyond the four you have been testing, might have contributed to the unexpected outbreak?