**Infectious Diseases HWK – Jan. 24, 1013**

**Protecting the Herd:**

**Computer simulations such as the one you have explored are useful tools for epidemiologists, who use them to make predictions about the likelihood of an epidemic occurring in a particular population or to estimate the level of vaccination coverage they must achieve to prevent epidemics in the population.**

**I. a. Use the online simulation to estimate the level of immunization required to prevent epidemics of three real diseases: smallpox, polio, and measles.**

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| --- | --- | --- | --- | --- |
| Disease | Virulences | Duration of Infection | Rate of Transmission | Immunization Level for Herd Immunity |
| SMALLPOX | High (0.25) | 14 days | High (2.5) |  |
| MEASLES | Low (0.01) | 18 days | Average (1) |  |
| POLIO | Low (0.01) |  8 days | Very high (10) |  |

Smallpox was declared eradicated from the world in 1980. Because epidemiologists knew it would not be possible to vaccinate everyone in the world, they used mathematical models of the spread of disease to estimate the level of vaccination coverage they needed to achieve and maintain to establish herd immunity in a population. (The computer simulation in this activity is based on a similar mathematical model.) Epidemiologists knew smallpox would eventually be eliminated because there would not be enough susceptible people to transmit the smallpox virus. Polio and measles are among the next targets for global eradication.

 **b. Based on the computer simulation, suggest the percentages be vaccinated to avoid an epidemic for each disease:**

**smallpox— no epidemic if \_\_\_\_\_\_\_percent or more of the population is immune**

**polio—no epidemic if \_\_\_\_\_\_\_\_percent or more of the population is immune;**

**measles—no epidemic if \_\_\_\_\_\_\_\_ percent or more of the population is immune.**

**II. Predictions made by models are sometimes inaccurate: A predicted epidemic may or may not occur in a real population. These comparisons between actual disease epidemics and epidemics predicted by models reveal the limitations of a model. For example, additional factors, not accounted for by a model, may have an impact on the spread of a disease.**

**a. Look at the table below: Make an observation about how accurate your prediction for smallpox (Part I) was for each of the two countries.**

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**Cases of Smallpox in Niger and Bangladesh**

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| --- | --- | --- | --- | --- | --- |
| Country | Year | Population | Percent of People Vaccinated | Number of Smallpox Cases | Cases of Smallpox per Square kilometer |
| Bangladesh | 1973 | 72 million | 80 | 33,000 | 0.23 |
| Niger | 1969 | 3.9 million | 79 | 25 | 0.00002 |

1. **Suggest factors your initial model did not take into account that may explain discrepancies between your prediction and the actual result in Bangladesh. (3 if possible)**

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1. **Given the following information - In 1969, Niger had 310 people per square kilometer, while in 1973, Bangladesh had 50,000 people per square kilometer. - What factor, not taken into account in the simulation, may explain the outbreaks of smallpox in Bangladesh even though the recommended levels of vaccinations had been achieved.**

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**III. Describe one thing you learned from this activity.**

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