TBMH5054 Final exam [2015]:

Pathogen transmission/Epidemiology [16pts]

Over the weekend, 15 people across the New River Valley are hospitalized with a serious condition being referred to as "hokieitis". Symptoms are varied, but include fever, cough, hallucinations, and a strange discoloration of the skin to either maroon or orange. You are the public health epidemiologist assigned to investigate. Who do you talk to? What do you ask? List at least five categories of individuals (e.g., patients, physicians, etc...) you need to talk do and describe the questions you would ask along with your motivation for asking the chosen questions. Who do you report to? What do they do with the information you collect? Who else needs the information you collect? Now describe the answers you receive to your questions. How do you use this information to stop the epidemic? Once the epidemic is over (good work!), what policy changes might you recommend to prevent future outbreaks. [Your answer should be between 1500-2000 words].

Pathogen diversity and evolution [16 pts]

Please answer the following 3-part question [1000-1500 words total for all three parts].

A. Describe the two basic mechanisms employed by influenza A viruses to increase their population-level genetic diversity?

B. Describe the selection pressure(s) that have allowed for the global emergence of pandemic influenza A strains in the human population.

C. How might you engineer a "universal" influenza A virus vaccine that would confer life-long protection in humans against diverse strains? Describe the basic features of the vaccine, how you would manufacture the vaccine, and how you would test its efficacy.

Vector-Borne Pathogens [16 pts]

The black death is one of the most well-known epidemics in history; the causative agent, *Yersinia pestis*, is also a vector-borne pathogen. Describe the transmission cycle for this pathogen. What is the vector? What kind of biological replication occurs in the vector and where does this occur within the vector? What hosts are normally associated with it? How is it transmitted to vertebrates? How long is the incubation period? Describe the disease itself and the treatment options currently used. Plague still occurs all over the world, including the United States. Why have we not had another catastrophic outbreak? What is the potential for such an outbreak to occur in the future? [1000 words]

Describe the transmission cycle for malaria. What are the most important species of human malaria parasites? Where did human malaria parasites evolve from? Describe the range of organisms that Plasmodium parasites have been identified in? What are the vectors of human malaria parasites? Describe the evolutionary history of the vectors-do they match that of the parasites? If not, what does that mean? [500 words]

Zoonotic Pathogens/Disease Ecology [16 pts]

1. Define R_0- Discuss and integrate considerations of threshold theory and critical community size – give examples (600-800 words)

2. What is host population regulation? Give examples. How can we demonstrate this phenomena? (600-800 words)

Oncolytic/Oncogenic viruses [16 pts]

1. Describe T cell exhaustion and viral carcinogenesis (1000 words +1 figures).

2. Characterize the physical and immunological barriers for oncolytic virotherapy (1000 words +1 figures).

Vaccines [16 pts]

1. You work for the board of directors of a medium-sized pharmaceutical company. The firm is considering buying patents from a series of academic scientists who have all come up with different vaccines to prevent AIDS. Of the six, the company can afford to buy only two of the patents; all six look equally promising in pre-clinical studies. Amongst the six patents are: enoughofHIV, based on a novel attenuated HIV-1 strain; StopHIV, a VSV strain pseudotyped with the HIV-1 glycoprotein; DeathtoHIV, a killed vaccine; DNAtonoAIDS, a DNA vaccine; HIVpieces, a subunit vaccine based on purified Env; and HIV3D, another subunit vaccine based on the discovery of a critical three dimensional epitope that appears only on the viral surface but is not present in the primary protein sequence. The members of the board have been arguing for two days, and each of the patents has the support of some of the members. Your job is not just to recommend which two patents should be purchased, but present convincing arguments as to why the two you have selected are indeed the best for this particular application, and why the other four are not as likely to succeed commercially. [1000-1500 words]

2. You have had enough of the controversy surrounding vaccinations and have decided to start your own blog on the topic. Write your inaugural 500 word post that summarizes succinctly why you are right and someone else is wrong (can be on either side of the argument). Avoid technical jargon-your audience is not just fellow scientists but the whole world. Use allegory, humor, etc... as necessary but be sincere and professional.

Regulation/Commercialization [4pts +10 Bonus]

Write a letter addressed to your local congressman describing in very concise terms one aspect of the regulatory system responsible for approving new drugs/therapies/vaccines/etc... that if changed would have a profound impact on biomedical productivity, job creation and/or public health outcomes. [*You will be awarded +10 bonus points if you bring in the letter along with a stamped, addressed envelope for me to mail to your representative on your behalf.*]