Homework 4

Question 1.

a. Name 2 examples of each: bacterial and viral pathogens which are of public health relevance. State the disease they cause, and 1-5 country/countries affected by them. Please cite the source used to inform your choice, eg. Scientific papers or reputable websites (eg: http://www.who.int/countries/en/ or http://www.cdc.gov/mmwr/).

b. Check to indicate the pathogen types for which each statement applies.

Trait	Bacteria	Virus
Obligate intracellular pathogen: uses host cellular machinery to reproduce		
Can be killed or inhibited by antibiotics		
Short pathogen peptide sequences are displayed in the MHC surface receptors		
Living cells, usually have both a membrane and a cell wall		
Protein capsid houses nucleic acid core		
Can reproduce without a host		
Size in micrometers		

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Question 2.

Based on the information provided below, explain how the immune system would act against each of the following pathogens. Write a short paragraph for each. Address which type(s) of immune response would be involved (or bypassed), and the specific immune components most relevant for fighting the disease.

a. **Herpes virus.** Enters through mucosal epithelium or abraded skin. Infects epithelial cells causing painful blisters in lips and genital area. Virus migrates to nerve cells that innervate the tissue, hiding inside of them until next herpes flare. Disease is characterized by recurring episodes, despite the presence of existing antibodies against the virus.

b. ***Vibrio cholera*****.** Transmitted by fecal oral route. Bacteria colonize and multiply outside the epithelial cells of the small bowel. Cholera enterotoxin binds intestinal epithelial cells resulting in a massive secretion of electrolytes and water into intestinal lumen. Causes severe watery diarrhea.

c. ***Mycobacterium tuberculosis*****.** Infects lung alveoli by airborne transmission. Bacteria resist destruction by alveolar macrophages and can even multiply inside them (an unusual feat for a bacterium!). Lung tissue destruction results from cell-mediated immune reactions.

d. **Polioviruses.** Transmitted mostly by fecal oral route. Viral particles resist acidity of stomach and establish infection in the cells of the small bowel and neighboring lymph nodes, which rapidly spreads to other lymph nodes, bone marrow and spleen. The immune system usually controls infection before virus appears in the blood, so most infections are asymptomatic. However, in few patients the virus does accumulate in the blood, and can then migrate to the central nervous system causing paralysis.

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Question 3.

Please read the article 'Polio: an end in sight?' by Toby Reynolds, and answer the following questions. Chapter 8 in your textbook can also help in answering some of them.

POLIO: AN END IN SIGHT?

Eradication of polio is proving more difficult than WHO expected, as the recent outbreak in Nigeria shows. **Toby Reynolds** takes a look at the current global situation

By the end of 2001 a massive immunisation campaign had driven poliomyelitis out of all but a few isolated pockets of resistance, and the world looked set to rid itself of one of the most feared diseases of the 20th century. Cases of paralytic polio had fallen from more than 350 000 in 125 infected countries in 1988 to under 500 in 10 endemic countries in 2001: India, Pakistan, Nigeria, Afghanistan, Niger, Somalia, Egypt, Angola, Ethiopia, and Sudan.[1] Optimists hoped that the next three years would be entirely free of infection, meaning that by 2005 the virus could be consigned to history books alongside smallpox—the only disease to be eradicated by a vaccination programme.

Those hopes were dashed as the disease flared up first in 2002 in northern India, where vaccination efforts had been scaled back, and then in northern Nigeria a year later, after rumours that the vaccine caused infertility led to a sharp fall in coverage. These outbreaks meant the 2005 goal for a polio-free world was not met, even though it had already been put back five years. By 2006, at least 20 countries had become reinfected and the number of cases worldwide had risen to almost 2000 (figure).[1]

Signs of hope

However, things may be looking up. So far this year there have been 545 cases of polio, most of them in countries with endemic disease, compared with 1353 for the same period last year.[1] Eight countries (Nepal, Cameroon, Bangladesh, Kenya, Ethiopia, Namibia, Indonesia, and Yemen) that had polio cases in 2006 have not yet had a case this year, although they must have no cases for three years before they can be said to be polio free.

Dr Bruce Aylward, a Canadian epidemiologist and director of the World Health Organization's polio eradication initiative, says the programme has shifted its focus to the more virulent type 1 poliovirus and is now back on track.

"After our big setback in northern Nigeria and after problems with the efficacy of the vaccine in the northern part of India and the security issues in Afghanistan and Pakistan, we shifted our tactics enormously in late 2006," he said.

Previously the eradication effort had mostly used the trivalent oral vaccine, which protects against all three wild poliovirus

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types, he said. "We decided to go preferentially after the eradication of type 1 polio using a monovalent vaccine. Part of the problem with the trivalent oral vaccine is that the viral strains compete with each other. Type 2 tends to be the strain that you get the best serological response to, and that compromises the response to type 1 and type 3.

"Now in most places we do monovalent type 1 rounds and intersperse them with rounds of trivalent vaccine or monovalent type 3 vaccine just to keep type 3 under control while we try to get type 1 finished.

"As of mid-2007 there have been some major developments. Not only is type 1 way down around the world, but we are seeing hardly any international spread, and the key reservoir area of western Uttar Pradesh in India has now gone nearly 11 months without a type 1 virus.

"If this continues, we will soon be able to say definitively from a technical perspective that polio can be eradicated with the tools we now have available and the tactics countries are using to deliver them."

But with the major setbacks experienced, Dr Aylward is careful not to overstate progress: "It can turn around overnight, with a news story in northern Nigeria, with an outbreak of violence in Pakistan or Afghanistan, with the monsoons in India—whatever. It is fragile: that is the nature of an eradication programme." Dr Aylward said. "All those caveats aside, the programme is actually in very good shape and I think very few people would have ever expected that we would be where we are today given the setbacks of the last couple of years," he added.

The main requirements now are cash, mostly from rich countries that are free of polio, and political determination from those poorer countries that still have the disease. The programme has cost at least

a. Name 2 other intestinal pathogens that infect children in developing countries. Why would existing infection with these organisms prevent development of vaccine-induced immunity?

b. Name 3 potential problems that could compromise the success of the polio vaccination campaign in eradicating the virus.

c. In addition to the financial cost, name one other major cost of implementing disease-specific initiatives, such as polio eradication

d. In one single paragraph propose 2 intervention strategies that could help address these problems.

e. In rare cases, the Sabin (oral) vaccine can cause disease in the vaccinated person or spread to unvaccinated contacts of immunized children. Explain why this might occur.

f. There has been much interest in eliminating poliovirus worldwide. What is the only infectious disease that has been eradicated to date?

g. What does GAVI stand for? Which polio vaccine would you recommend GAVI to adopt? Name 2 reasons why.