Biology 067: Emerging Diseases

Fall 2007 Symposia

Infectious Diseases and Health in the World Today

Druckenmiller Atrium
11:30 AM-12:55 PM
Tuesday, Dec. 4

Poster 1: **African Sleeping Sickness: The Terror of the Bush**

Poster 2: **Cervical cancer: A global scare**

Poster 3: **DEN-1, DEN-2, DEN-3, DEN-4: We declare a Dengue war**

Poster 4: **Guinea Worm Disease: A Preventable Endemic?**

Poster 5: **Mist and Mesh: Malaria in the 21st Century**

Poster 6: **Bacterial Meningitis**

	Presentation time		
Poster Group	11:30-12:00	12:00-12:30	12:30-11:55
African sleeping sickness	Abby		Lee
Cervical cancer	Anna		Grace
Dengue Fever	Katie	Liz	
Guinea worm disease	Lindsay E	Noori	
Malaria		Eileen	Lindsay L
Meningitis		Davia	Lauren

Poster 1

African Sleeping Sickness: The Terror of the Bush

L. Colon and G. Comeau

Human African Trypanosomiasis (African sleeping sickness) is a parasitic disease transmitted by a vector. The protozoa are transmitted to humans by the tsetse fly. There exist two forms of the protozoa that infect humans: *Trypanosoma brucei gambiense* and *Trypanosoma brucei rhodesiense*. Hosts can be infected by the parasite through the bite of the tsetse fly, from an infected mother to child through the placenta, and by laboratory accidents. Once infected, Human African Trypanosomiasis has three phases. After the initial sign of infection, a chancre at the site of the bite, the host enters the incubation period, followed by the Haemolymphatic phase and the Neurological phase. If untreated, the Neurological phase ends in death. Treatment varies depending on the parasite causing infection and at which point in the infection's cycle the parasite is detected. *T.b. gambiense* is treated with Pentamidine, Melarsoprol, or Eflornithine while *T.b. rhodesiense* is treated with Suramin or Melarsoprol. Despite the fact that there are treatments, problems arise because of the difficulty of properly detecting the parasite, the lack of availability of certain drugs and the side effects of the drugs. Finally, measures can be taken to prevent contact with the parasite, including wearing light clothing and long pants, staying out of the brush, and using insecticides to kill the tsetse vector.

Rural populations are especially vulnerable to African sleeping sickness, because they rely heavily on agriculture, fishing, animal husbandry, and hunting putting them in the rivers, lakes, and wooded savannah where the tsetse flies are found. This disease can also spread easily in war-torn and impoverished areas, where the infrastructure has collapsed, and people live in unhygienic conditions and lack access to medical supplies. This absence of available medical care in isolated populations makes the disease hard to control. Politically, the disease competes with other pandemic diseases for funding, cutting money allocated to supplies and research. There have been three major epidemics in African thus far. In recent epidemics in the Democratic Republic of Congo, Angola and Southern Sudan, prevalence has reached 50%. Sleeping sickness was considered the first or second greatest cause of mortality, even ahead of HIV/AIDS in those communities. Africa as a whole is estimated to have between 50,000 and 70,000 cases.

The prevalence of this disease has had serious economic and social consequences. Fear of the disease has led to the abandonment of fertile lands and has stunted development in certain areas, leading to the depopulation of large areas in Africa. Further, a couple cases have been reported in India. However, some research is being undertaken to look for new drugs, as scientists in England have recently discovered that the parasite cannot survive without the use of its flagellum of protein tail. This poses possibilities for the development of a new drug.

Poster 2

Cervical cancer: a global scare

G. Lazarus and A. Noucas

Cervical cancer is a cancer caused by the virus HPV. HPV is a sexually transmitted disease, which has many different strains some of which are high risk and some of which are low risk. The low risk forms of HPV cause genital warts, and other non-lethal symptoms. However it is the high-risk strains, which can cause Cervical Cancer. Once an individual has contracted a high-risk strain of HPV they can develop two different types of cervical cancer. The first is called Squamous cell carcinoma, this accounts for 80-90% of cervical cancers. In this case the virus affects the squamous cells, which are flat thin cells that cover the surface of the endocervix. The other form is Adenocarcinomas. This accounts for 10-20% of cervical cancers, and in this case the virus affects the mucus-producing gland cells of the endocervix. The way that HPV develops into cervical cancer is by the production of two proteins E6 and E7. When these proteins are present in the body they turn off the tumor suppressor genes, and when those genes have been turned off, the result is uncontrolled growth of cells, in this case cells found in the cervix. Cervical Cancer is often detected because of an irregular pap smear, which is a test that collects cells from the cervix. Once an individual has been diagnosed with Cervical Cancer the next step includes, medications, surgery (to remove cells that are cancerous or pre cancerous) and radiation therapy. In addition to this there has been a lot of research done and a vaccine has been produced called Gardasil. This vaccine is almost 100% effective for preventing infection with HPV types 6 and 11 (low risk strains responsible for 90% of genital warts) and 16 and 18 (high risk strains responsible for 70% of all cervical cancers). HPV is the most common STD, and cervical cancer is on the rise as a more and more prevalent type of cancer. It is complicated by its relationship with sex as the mode of contraction because of the social implications that are associated with STD's. Because of this Cervical cancer has had a huge impact both nationally and internationally, especially in parts of the world where they don't have the money to test for, prevent, and treat cervical cancer.

Poster 3

DEN-1, DEN-2, DEN-3, DEN-4: WE DECLARE A DENGUE WAR

L. Button and K. Wells

Dengue fever is a mosquito-borne disease caused by a virus that is most commonly transmitted by the female *Aedes aegypti* mosquito. The virus comes in one of four serotypes of the genus Flavivrus: DEN-1, DEN-2, DEN-3 and DEN-4. Dengue fever is potentially extremely virulent; complications can lead to Dengue Hemorrhagic Fever (DHF), which is then capable of progressing to Dengue Shock Syndrome.

Three to fourteen days after a person is infected with the dengue virus, they experience symptoms of fever, headache, muscle and joint pains, nausea, vomiting, rash and local hemorrhaging. If the disease goes so far as to advance to Dengue Shock Syndrome, symptoms escalate rapidly and can induce circulatory failure, shock, and potentially death within 24 hours.

The mosquito can progress from egg to adult within eight days. Their life span is only two weeks. However, during that short period, they can produce up to three generations, each consisting of one hundred eggs! Humans are most likely to get bitten by an *Aedes aegypti* at dawn and dusk.

Dengue fever is a tropical disease. It has since spread beyond the southern hemisphere to all parts of the globe due to conditions created by human behavior (poor waste management, increased air travel, etc). These factors increase the population of the vector, thus increasing the probability of virus transmission. The number of cases has been rising significantly, particularly within the last twenty years. At the moment, there is no cure for dengue. Scientists are working on a vaccine, but, currently, the best way to deal with the disease is to practice effective prevention strategies.

References:

Facts taken from C.D.C website and W.H.O website.

Poster 4

Guinea Worm Disease: A Preventable Endemic?

N. Ali and L. Enriquez

The disease known as Guinea Worm Disease is caused by a nematode parasite Dracunculus. The parasite is spread through the consumption of contaminated and unsanitary drinking water. Humans become infected by drinking this unsanitary water which contains infected copepods. Copepods are a planktonic predatory species of water fleas[1]. Once ingested, the copepods die, leaving behind the Dracunculus larvae which mature for a brief time. Following reproduction, the male worms die, leaving the female worms to grow for 10-14 months[2]. Prior to the worm's surfacing, an acidic blister becomes apparent on the skin. There is neither a treatment to prevent infection, nor a medication to kill the disease once a person becomes infected. Additionally, humans remain susceptible to infection, and cannot become immune. The most common danger of Guinea Worm Disease is the secondary bacterial infection that arises if the afflicted area is not treated with antibacterial ointment[3]. Despite the lack of medical treatment available, there are many means of preventing the spread and transmission of the disease. Water sanitation is vital to stopping the spread of Dracunculus, since the disease is spread through the intermediate host of the copepod. Increasing water sanitation by filtering or using disease killing chemicals will aid these efforts. Finally, by educating afflicted villages, eradication of the disease becomes plausible. The economic disparity that remains between the third world countries, and those already developed is the sole factor for the endemic taking place. Had these African countries been able to afford clean and filtered water, the endemic would never have happened. As of now, 98% of the disease in people has been eradicated, but Sudan, Ghana, and Nigeria remain heavily infected[4]. 2009 remains the intended worldwide eradication date, though many officials believe that Sudan's political instability and the consequences of its' never ending civil war will delay attainment of this goal[5].

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[1] Yelifari, L. "The intermediate hosts of Dracunculus." Annals of Tropical Medicine and Parasitology 91(1997): 403-409.

[2] Greenway, Chris. "Dracunculiasis (Guinea Worm Disease)." Canadian Medical Association 170.4.17 02 2004 495-500 <http://web.ebscohost.com/ehost/pdf?vid=4&hid=101&sid=39178730-49f8-4277-9780-7f232011697d%40sessionmgr103>.

[3] Cairncross, Sandy, Muller, Ralph, Zagaria, Nevio "Dracunculiasis (Guinea Worm Disease) and the Eradication Initiative" Clinical Microbiology Reviews, April 2002, p. 223-246, Vol. 15, No.2 http://cmr.asm.org/cgi/content/full/15/2/223#Treatment

[4] Greenway.

[5] Voelker, Rebecca. "Persistance Pays Off in Guinea Worm Fight" *Medical News & Perspectives*. 24/31 Oct. 2007, Vol 298: 16 (Reprinted).

Poster 5

Mist and Mesh: Malaria in the 21st Century

L. Luke and E. Palmer

According to the World Health Organization, "More than one million people die of malaria every year." Malaria is a vector-borne disease most commonly caused by the parasite *Plasmodium falciparum*. The parasite invades the liver, where it replicates. It then enters the bloodstream, where it exploits the hemoglobin, which carried oxygen to the vital human cells. Common symptoms include fever, headache, and vomiting, and the incubation period is typically around two weeks. Although the parasite is most commonly transmitted through the vector female Anopheles mosquitoes, transmission can also occur through blood transfusions, dirty needles, and childbirth.

The prevention, detection, and treatment of malaria are quite controversial. DDT, the most effective insecticide against mosquitoes, has created a controversy because of its adverse effects on humans and wildlife. Mosquito nets sprayed with insecticides, a widely-used prevention technique, have shown to reduce mortality by 20% in Africa. Detecting malaria can be quite difficult overall, but the most common methods of detection are microscopy and antibody tests. Although there is a highly effective treatment for malaria called ACT, there is a significant problem with drug-resistance mainly due to treatment before diagnosis.

Many factors contribute to the spread of malaria. The main situation that would put a potential host at risk is traveling. When moving from an area with little or no malaria incidence to a malaria endemic area, a host is much more likely to develop the disease due to lack of immunity. Environmental factors that affect malaria include rainfall and changing weather patters, which may cause mosquitoes to increase breeding.

Although malaria has been eradicated in the US, it is still a constant threat in Africa, Asia, and South America. The disease has not only affect people's lives, but forced many countries into debt because of the cost of medical supplies and the money lost from potential tourism. The future for the fight against malaria looks like a long journey ahead, but with recent breakthroughs in vaccine development, there is a light at the end of the tunnel.

Poster 6

Bacterial Meningitis

D. Steeley and L. Wilwerding

Bacterial meningitis results when bacterial meningococci is able to cross the blood brain barrier causing the non-specific immune response of inflammation of the meninges. There are multiple types of bacteria that cause meningitis; some of the most prevalent in older children are *Streptococcus pnuemonae* (Pnuemococcal), *Neisseria meningitides* (Meningococcal), and *H. influenzae* Type b. Symptoms include fever, irritability, loss of appetite, stiff-neck, vomiting, sensitivity to light, and lethargy. The infection can cause neurological defects, coma, hearing loss, visual impairments, seizures, learning disabilities, damage to kidneys, heart, and adrenal glands. The bacteria are spread through close contact resulting in transfer of oral and nasal fluids. It has an incubation period of about three of seven days. For example: sharing food, drinking glasses, and utensils; coughing, sneezing, or kissing. These vectors of transmission make college students, children, smokers, refugees, and military recruits particularly susceptible. The first vaccines for bacterial meningitis were available in the 1960s. Children are not able to metabolize these older vaccines with polysaccharide capsules as well as adults. Newly developed conjugate vaccines convert *H. influenzae* type B into antigen for T-cells to recognize. Some antibiotics that are effective against meningitis are ceftotaxime and penicillin. Penicillin resistant strains are becoming more prevalent and researchers are investigating the effectiveness of carbapenems, namely Meropenem that is delivered directly to the cerebrospinal fluid, where drugs are most effective against bacterial meningitis. The epicenter of bacterial meningitis is in developing countries, especially the African Meningitis Belt, this is the region of Africa ranging coast to coast from Senegal to Ethiopia where the mortality rate ranges between 50 and 80 percent. There are also notable cases in countries such as Guatemala and Cuba. Such an impact is due to the lack of vaccine in childhood immunizations. On the national level, there is not as high a rate of infection, however outbreaks do occur in sub-populations including college campuses and daycare centers. Here college campuses face about 113 cases annually. Overall, the nations mortality rate is less than 15 percent. In the future we face improving detection, providing vaccines to all populations and rapid diagnosis. These three elements are the remedy to eradicating Bacterial Meningitis altogether.