

A PURDUE STUDENT GUIDE TO TUBERCULOSIS

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Earlier this year a student on the West Lafayette campus of Purdue University was diagnosed with an infection of the lungs. Although many lung infections are diagnosed each week at the Purdue University Student Hospital, this one was strangely different than the normal bronchitis and pneumonia typically seen at a college campus. The student was diagnosed with an active case of Tuberculosis in late January, and several students were tested to ensure that no one had been infected with this contagious disease. (http://www.purdueexponent.org/?module=article&story_id=3823). After the release of this information, there were many rumors floated about tuberculosis, how it can be spread, and the threat level to the general student population. This pamphlet intends to answer any questions regarding this highly infectious and deadly disease.

What is Tuberculosis?

Tuberculosis is a highly contagious disease most commonly found in the respiratory tract. It is caused by *mycobacterium tuberculosis*, a rod shaped bacteria that is most often associated with respiratory infections. This disease is common outside of the United States, but due to the fact that this condition is easily treated with proper medication and the advancements the American health system it remains relatively dormant in the American society (Iademarco). Yet, outside of the United States and especially in third world countries, tuberculosis is an epidemic, infecting 1/3 of the world's population including 9 million new cases each year. Tuberculosis presents 11,000 cases in the United States and about 750 deaths per year. Worldwide, the deaths due to tuberculosis

rise to nearly 1.6 million per year, accounting for 11% of deaths due to infectious diseases. (Madigan, Martinko) Tuberculosis is the leading killer of individuals diagnosed with HIV and it may lie latent for a period of time before becoming active. (CDC/Division of Tuberculosis Elimination)

What is the Pathway of Infection?

M. Tuberculosis is transmitted via respiratory droplets that are aerosolized by coughing, and can remain active in the air for hours. There are approximately 3000 infectious nuclei per cough. The probability of inhaling an infectious nuclei increases with the amount of time spent in close proximity with an infected person as well as the intimacy of contact between the subjects. Once the bacteria takes residence in the lung tissue, it may develop into a fully active case of tuberculosis, but there is a chance it remains in the latent form (Raviglione). Tuberculosis is classified in one of two categories, a primary infection and a post primary infection or reinfection. In a primary infection activated tuberculosis droplets are inhaled and the bacteria grow and flourish in the lungs resulting in an acute infection. This occurs when the body's natural immune response calls macrophages to the site of the activated bacteria. Tuberculosis has the ability to grow inside of the macrophages, yielding a complex called a tubercle. Inside the macrophage, the bacteria can grow and reproduce, creating more *mycobacteria tuberculosis*. More macrophages are called to the site of the infection, which creates more tubercles and a diseased large aggregate of tubercles. Because of its ability to grow in the lysosomes and phagocytes of macrophages, tuberculosis shows a strong resistance to low pH and oxidative elements found in such cellular bodies. A postprimary infection is when a subject is introduced to a *mycobacterium tuberculosis* sample but the subject does not

show signs or symptoms of the activated disease. In such a case, the bacteria are present in the body, as evidenced by a positive PPD test, (discussed later) but the bacteria lies dormant in the patient's lungs, possibly for years. Reactivation of the dormant bacteria can be caused by stress, aging, antibiotic overcrowding and hormonal changes in an individual. The reinfection will result in the same symptoms as a primary infection, the only difference being the time from initial exposure to presentation of symptoms (Madigan, Martinko).

What are the Symptoms of Tuberculosis?

One difficulty in classifying the common symptoms of tuberculosis is the similarities of the symptoms to other pulmonary disorders. This fact calls for further diagnostic imaging to definitively identify a lung disease as tuberculosis. Common symptoms of tuberculosis include a productive prolonged cough lasting longer than 3 weeks, chest pain and hemoptysis, or the coughing up of blood. Systemically, the symptoms are a fever and chills, night sweats, appetite loss, weight loss and easily fatigability. Another difficulty in diagnosing tuberculosis on symptoms alone is that 19% of tuberculosis victims have extra-pulmonary symptoms exclusively. Although more rare than pulmonary tuberculosis, the site of infection may be the spine, kidney

How is Tuberculosis Diagnosed?

Often times, the diagnosis of tuberculosis is based on the risk factors present in a patient's life. The strength of his or her immune system is important along with previous contact with an infected person. Early diagnosis is important to stem the spread and severity of the disease. The most common screening test for tuberculosis infection is called a PPD skin test. This test uses a protein factor called RT23 that can elicit a skin

reaction when injected subcutaneously in a person with tuberculosis. This test is restrictive and is not 100% accurate. False negatives occur in patients with a suppressed immune system or even in patients with an overwhelming tuberculosis infection. Although a positive test result will occur in a patient with a normal case of TB, false positives can transpire in patients with a strain of nontuberculosis mycobacterium, also known as the BCG vaccine. A more definitive, yet more expensive and less common diagnostic tool is the AFB microscopy test. A sample of tissue or sputum, excreted phlegm from a cough, is taken and smeared and stained on a microscope slide to specifically identify mycobacterium tuberculosis. This method is more accurate than a PPD skin test, but the most definitive test is an actual growing of *mycobacterium tuberculosis* on an egg or agar based medium. This will clearly show any active TB bacteria but can take 4-8 weeks. The best tool for diagnostic screening of TB is still the PPD skin test. After a positive PPD result, further diagnostic tests can be administered (Raviglione).

How is Tuberculosis treated?

In a person showing a latent form of the bacteria due to a positive PPD test but presenting no other signs or symptoms, simply treating the patient with an antibiotic may be enough. However, such a treatment is not sufficient for patients showing an active primary infection of tuberculosis. A form of chemotherapy can be used to treat an active case. The relatively cheap and almost entirely specific for tuberculosis treatment is called isoniazid. This can effectively stop the synthesis of mycolic acid, an acid essential to mycobacterium growth, and is usually given in extremely small doses. This treatment is administered over a period of 9 months to ensure complete eradication of the

mycobacterium tuberculosis bacilli. Even though this treatment is effective in eliminating the bacteria, incomplete treatment may lead to a reemergence of a drug resistant strain of tuberculosis. Two procedures have been implemented to lower the emergence of drug resistant tuberculosis. One of which is entitled direct observation treatment (DOT) or in a hospital setting, several sets of antimycobacteria drugs followed by isoniazid treatment. Observing the patient take the drug ensures that enough of drug is administered to lower the prevalence of drug resistant tuberculosis. Treating the patient with several types of antituberculosis medication can also help in lowering the emergence of drug resistant tuberculosis (Madigan, Martinko).

Is There a Tuberculosis Vaccine?

The BCG vaccine is widely recognized as being the most effective. Because of the low prevalence of TB in the United States the BCG vaccine is only used broadly in third world countries as a means to protect against tuberculosis. The BCG vaccine is an attenuated form of the mycobacterium bovis, the causative agent of tuberculosis in cattle. This is used to stimulate an immunity memory against the human strain of mycobacterium tuberculosis. (AHFS)

Conclusion:

Although mainly a disease affecting the third world, tuberculosis still demands attention of health care officials across the world. Due to the staggering number of infections and deaths per year across the globe, the pandemic of tuberculosis is a problem that needs to be dealt with by a coalition of health organizations all over the planet. Increasing availability of anti-mycobacterium drugs in less developed countries and the assurance of the control of the emergence of multi-drug resistant tuberculosis, can control the

prevalence of tuberculosis and can control the spread of the contagious disease. As far as the community of Purdue University is concerned, the disease was primarily controlled by local health care offices. Most outbreaks of the disease in the United States are controlled in a similar manner.

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