From India to Canada

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Our patient 53-year-old Robert K. immigrated from India about a year ago. Over the past month, he has had fevers, chills, night sweats and a chronic productive cough. He goes to see his family doctor who confirms a fever of 38.5°C. Upon auscultation she also finds crackles in the right lung and decreased breath sounds in the right lower lung field. She sends Robert for a chest X-ray and gives him three sterile containers with instructions to generate three deep sputum samples over three mornings. After the samples are examined in the Microbiology Laboratory the Public Health Unit notifies Robert K. to report to the local hospital for further assessment

What are the signs and symptoms of this patient?

The definition of “signs” and “symptoms” are important to tell apart as they both provide a significant and different role in narrowing down the patient’s disease. Medical signs are objective characteristics that are detected by a healthcare professional, in this case is Robert’s family doctor. Symptoms are characteristics experienced by the patient themselves and may be considered to be subjective. The main different between signs are symptoms relate to the person who is observing them. Certain signs that the doctors can detect may not be noticed by the patients themselves [8].

In Robert’s case, the symptoms he observes and experiences himself includes fevers, chills, night sweats and chronic coughs. However, the signs that his family doctor observes that Robert does not know about include crackles in the right lung and decreased breathing sounds in the right lower lung field. Other sources that she can obtain signs from are from the chest x-ray results and the sputum sample results. One symptoms that can also be considered a sign is the fever, where Robert’s family doctor was able to confirm his fever of 38.5°C.

According to the signs are symptoms presented, Robert most likely has an infection that affects his respiratory system, which includes the lungs, trachea, bronchi, bronchioles, and alveoli, to be brief. His signs and symptoms can be narrowed down to *Mycobacterium tuberculosis* due to his travel history from India, which is an area that is known to have this disease. To further confirm this infection, *M. tuberculosis* causes symptoms such as persistent coughing, chest pain, production of mucus, fevers, chills, and night sweats.

Which body system is affected, in what specific area and what is the normal physiological function of this area of the body?

M. tuberculosis is known to cause the infection called Tuberculosis, and mainly affects the respiratory system (**Figure 1**) [7]. The respiratory system contains two main components, which are broken down into smaller components. [1]

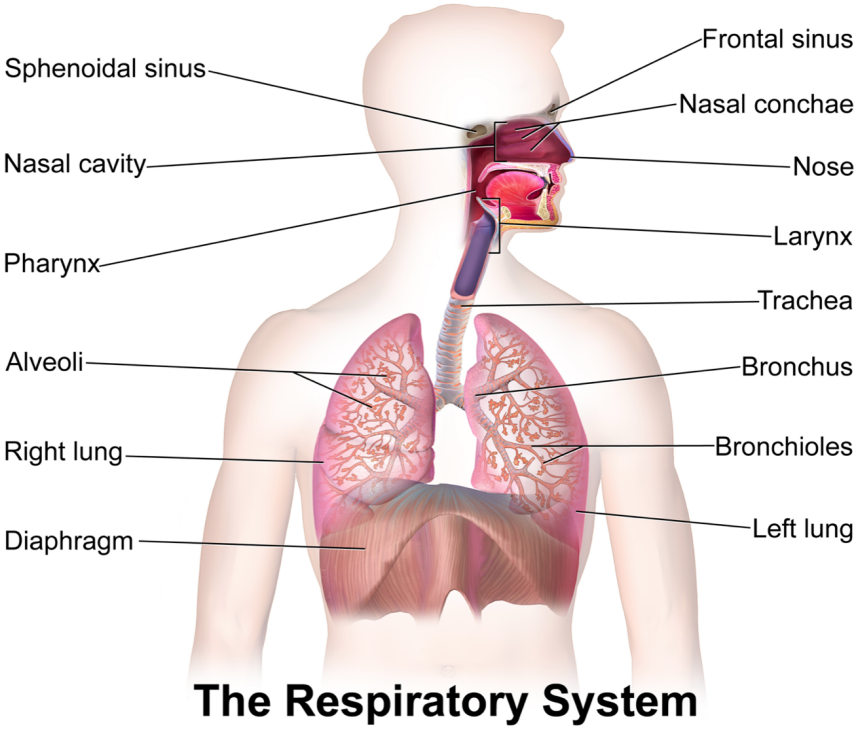

Figure 1. The respiratory system overview.

First, we have the upper respiratory tract, which contains the nose and nasal cavity, para-nasal sinuses, and pharynx [1].

Nose and nasal cavity (**Figure 2)**: the main entrance (other than the mouth) for outside air to enter into the rest of the respiratory system [2]. This part of the body contains hairs that line the inner wall and serve to filter and clean the air as it passes through the nose. The nasal cavity is also separated by the nasal septum, which forms the two sides of our nose [1].

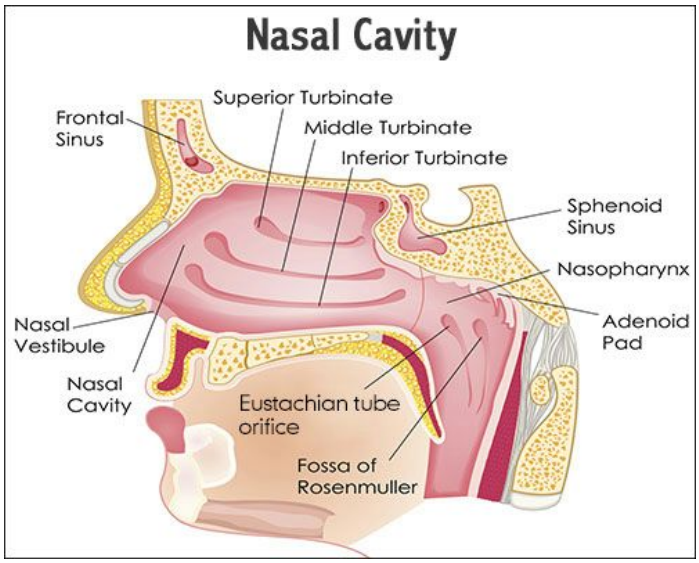

Figure 2. Nasal cavity overview.

Para-nasal sinuses (**Figure 3)**: these are hollow spaces in the bones of your skull. They contain small openings that connect to the nasal cavity and help regulate the temperature and humidity of the air that is passing through. They lighten the skull, help resonate the voice, and enhance the efficiency of respiratory mucus membrane in filtration, humidification, and thermoregulation of the air that is being inhaled [1].

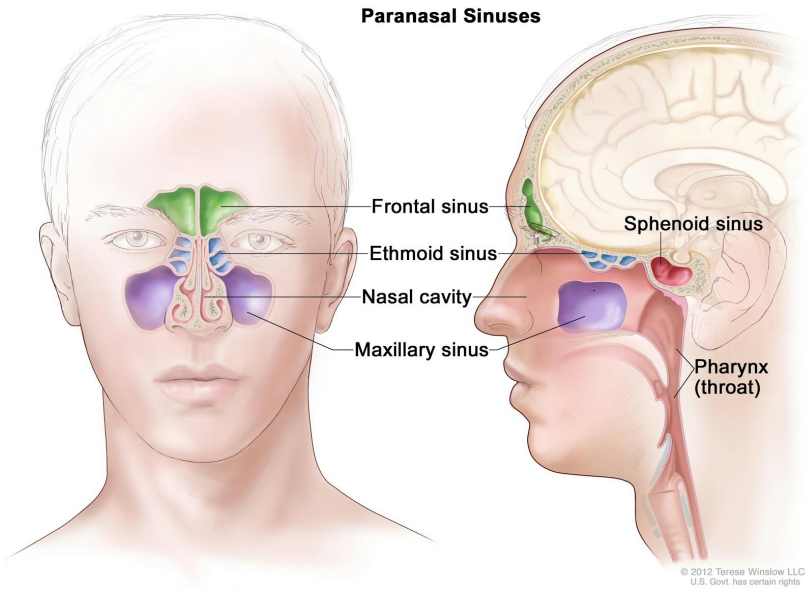

Figure 3. Paranasal sinus overview.

Pharynx (**Figure 4)**: the throat. it is a 12 to 15 cm muscular tube that acts as a conduit for air between the nasal cavities and larynx. it also conducts the path for food between the oral cavity and the esophagus. Due to its involvement in breathing and eating, it is considered as a part of the respiratory system and the digestive system. The pharynx starts from the base of the skull and ends to the esophagus and is divided into three parts. The Nasopharynx is located behind the nasal cavities and above the soft palate. The roof of this section has a collection of lymphoid tissue known as pharyngeal tonsils. The auditory tube opens on the lateral walls of the nasopharynx and connects to the middle ear. This helps to equalize air pressure between the middle ear and pharynx. The oropharynx lies behind the oral cavity, while the laryngopharynx lies behind the larynx. [1]

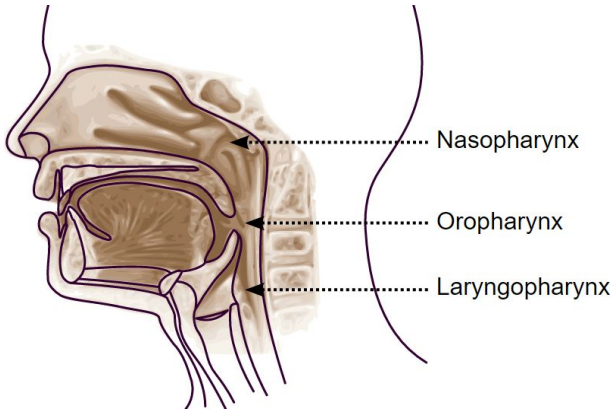

Figure 4. The 3 components of the pharynx.

In the lower respiratory tract, where the bacteria is most likely going to infect, we have the larynx, trachea, bronchi, and lungs [1].

Larynx **(Figure 5)**: organ of phonation that contains cartilaginous skeleton. The cartilages are groups as unpaired (thyroid, cricoid, and epiglottis) and paired (arytenoid, corniculate, and cuneiform). The thyroid cartilage is the biggest cartilage that is formed by two laminae which protrudes out to form the Adam's apple in front of the neck. The cricoid cartilage is the most inferior cartilage and resembles a right with its lamina [2]. The epiglottis is a leaf shaped cartilage that is attached to the interior side of the larynx. It is located behind the tongue and acts as a lid to close the entrance of the larynx during swallowing. The arytenoid cartilages are two pyramidal shaped cartilages that articulate with the cricoid cartilage. The corniculate and cuneiform cartilages are two small cartilages on each side of the aryepiglottic fold and extends between the arytenoid cartilage and the epiglottis [1].

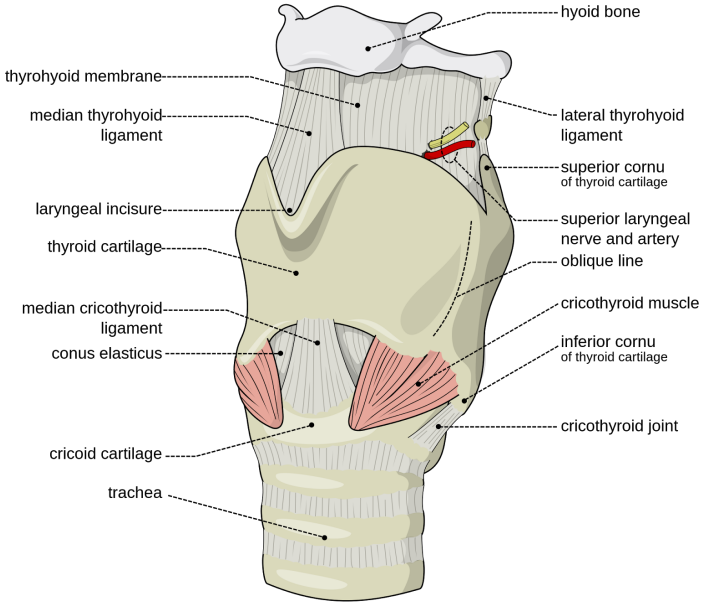

Figure 5. Components of the larynx.

Trachea: fibro-cartilaginous tube that is around 12 cm long that conducts the air from the nasal cavity into the lungs. It splits into two carina, where it breaks off to go into the left and right lungs [1].

Lung: the main organ of the respiratory system [2]. The two lungs are located on either side of the upper chest and are separated by the heart and its large vessels. Each lung has an apex, three surfaces and three boarders. The inferior surface of each lung sits on the diaphragm, muscle for breathing. The medial surface of the lung carries the hilum through which the bronchi, vessels, and nerves enter or leave the lung. After passing through the hilum, the primary bronchi divides into secondary and tertiary bronchi. The tertiary bronchi continues to divide and produce several branches of bronchioles, terminal bronchioles, and respiratory bronchioles [2]. This is the level where gas exchange occurs **(Figure 6)**. The bronchioles terminate at the alveoli where venous blood drainage exchanges carbon dioxide with oxygen. The lungs are also surrounded by serous layers known as the pleura. The space between the pleura has pleural fluid that lubricates the surface of the lung and help facilitate breathing and the air pressure [1].

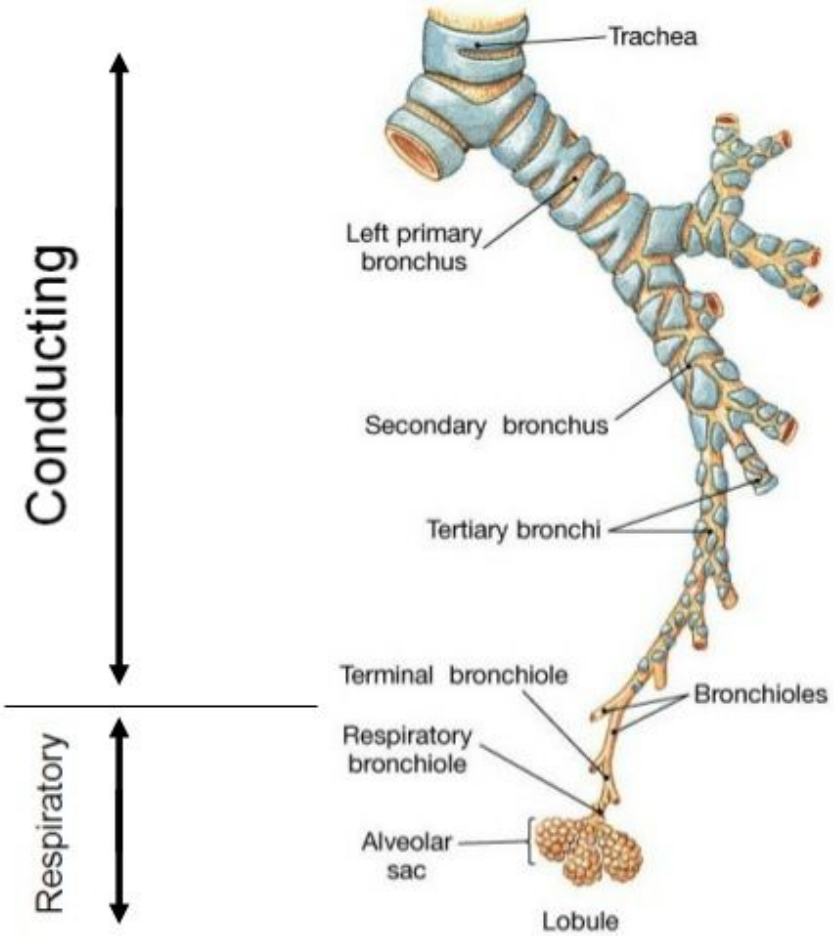

Figure 6. From the functional point of view, the respiratory system contains the conducting zone (passageway) and a respiratory zone (gas exchange).

In what way has the normal physiological functioning of this area of the body been disturbed by the infection?

Patients usually contract the disease by a means of aerosol particles [3]. Once the bacteria enters the respiratory pathway, it activates the host immune response which in turn activates lymphocytes leukocytes and other cytokines [4]. usually this occurs in the upper respiratory tract as the respiratory mucosal defense system would prevent the bacteria from going any further down the trachea. The production of lymphocytes and leukocytes induces damage of the epithelial cell walls and in turn can create a persistent cough in order to remove the mucus [3].

However, if the bacteria escapes the mucosal defense system, it can make its way down to the alveoli in the lungs. Inside the alveoli, macrophages will surround and engulf the bacteria if possible[3] . This can cause either latent tuberculosis or active tuberculosis. If active tuberculosis is present, the bacteria will be collected at the middle lung, which causes the lack of breathing sound in Robert. From here, breathing can be impaired and the host immune system activation will create responses that can induce fever, chest pains, and the production of sputum [3].

Secondary Infections

Tuberculosis can affect areas outside the lungs such as lymph nodes, pleura, gastrointestinal tract, liver, skin, joints, and bones. This depends on the physiological environment that the bacteria reaches, and whether or not they can strive in that environment [4].

There are times when *M. tuberculosis* creates enough damage for it to leak into the blood vessels to travel to other places. When it reaches the membranes and fluid surrounding the brain and spinal cord, it is capable of causing Tuberculosis Meningitis [5] [6]. If it disseminates into the bloodstream and circulates the entire body, it is capable of affecting the spleen, liver and the kidneys, which is known as Miliary Tuberculosis. When it reaches the kidneys, it can cause genitourinary tuberculosis where it mainly ureter, bladder, reproductive systems and its genitals. If it reaches joint and bones, it can cause Bone and Joint Tuberculosis [5]. This area is the most common for secondary infection. It can also reach the liver where it causes hepatic tuberculosis that can evolve into HPC-like symptoms. Most of the infections are facilitated by the travelling of the bacterium through the bloodstream, into the lymph nodes and then distributed to the entire body.

References

1) Alimohammadi, M., & Doroudi, M. *M & M Essential anatomy*. 223 - 233

2) Lung.ca,. (2016). *Respiratory system | The Lung Association*. Retrieved 26 February 2016, from https://www.lung.ca/lung-health/lung-info/respiratory-system

3) Emedicine.medscape.com,. (2016). *Tuberculosis: Practice Essentials, Background, Pathophysiology*. Retrieved 26 February 2016, from http://emedicine.medscape.com/article/230802-overview#a4

4) Intellectualventureslab.com,. (2016). *Overview of Tuberculosis Pathogenesis | Intellectual Ventures Laboratory*. Retrieved 26 February 2016, from http://www.intellectualventureslab.com/invent/overview-of-tuberculosis-pathogenesis

5) Pathologyatlas.ro,. (2016). *Secondary pulmonary tuberculosis*. Retrieved 26 February 2016, from http://www.pathologyatlas.ro/secondary-pulmonary-tuberculosis-pathology.php

6) Meningitis.org,. (2016). *TB meningitis*. Retrieved 26 February 2016, from http://www.meningitis.org/disease-info/types-causes/tb-meningitis

7) Textbookofbacteriology.net,. (2016). *Tuberculosis*. Retrieved 26 February 2016, from http://textbookofbacteriology.net/tuberculosis.html

8) Niamh K & Lowe C. (2016). In Signs and Symptoms. Retrieved from https://connect.ubc.ca/webapps/blackboard/execute/content/blankPage?cmd=view &content_id=_3233187_1&course_id=_68245_1&mode=reset