Yakshma Samara—an Expert System for Clinical Diagnosis of Tuberculosis

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Abstract: We hear about different kinds of diseases every day. Few of them curable and few incurable. There are also cases where people die suffering from such diseases and few people have to struggle for lifetime due to such diseases. There are many such deadliest diseases, one among them is TB.

Millions of deaths occur annually due to TB and many cases will be relapsed due to incomplete treatment. Patients will need all time assistance from the doctors and health care centers which is practically not possible most of the times, and at times patients forget to have their medicines and attend health checkups. In this paper, we are proposing an automated tool called “Yakshma Samara”, which is an android application that enables the users to query about symptoms, diagnosis & treatment of TB and it also sends reminders for health checkups or medications, store the Reports during the complete course of TB treatment. The tool allows the users to interact with their physician and discuss about their treatment. The proposed tool is developed based on the concept Expert System which uses Artificial Intelligence and helps the user to diagnose whether He/She has TB based on the input such as patient’s details, symptoms, and Tuberculin Skin Test details.

Keywords:
Expert system, Diagnosis, TB, Relapse TB case, Tuberculin skin test (TST), Underweight.

1. INTRODUCTION:
Tuberculosis, or TB, is an infectious bacterial disease caused by Mycobacterium tuberculosis [1].

TB most commonly affects the lungs, and it can be transmitted from one person to other via droplets from the throat and lungs of people with the active respiratory disease. In healthy people, infection with Mycobacterium tuberculosis often causes no symptoms, since the person's immune system acts to “wall off” the bacteria. The symptoms of active TB of the lung are coughing, sometimes with sputum or blood, chest pains, weakness, weight loss, fever and night sweats. Tuberculosis is treatable with a six-month course of antibiotics. [2]

Over 1.4-1.7 million deaths occur annually due to tuberculosis. Doctors face a lot of challenges to provide good health-care with unassisted automation in hospitals where there are several patients who need the doctor's attention. According to the survey made, many cases have a relapse of TB due to improper/incomplete treatment of TB. Many patients also miss out the regular health checkups and medications. Thus, we have come up with an idea of developing an automated tool called “Yakshma Samara” that would help to overcome such problems of missing out the medications and health checkups, and also guide the patient by providing a detailed information about TB, its symptoms, tests, and treatment.

1.1 Literature Survey

The author in [1] discusses about basic research works to improve the understanding of how TB “works” in the human host, how the human immune system responds to infection with Mycobacterium Tuberculosis. The author also discusses about effective diagnostics, pharmaceuticals, and vaccines.

The author in [3] describes the facts about TB, like what TB is, its types, mode of infection, prevention of TB and also about the bacteria that causes TB. The author also discusses about the symptoms of TB, different tests available to diagnose TB. The author also discusses about TB tests to find out whether someone has TB bacteria that are susceptible to TB drug treatment or are drug resistant. Then further in [3,4], the authors discuss about the treatment plan for curing TB. The authors also discuss about the drugs used to cure TB.

In [5], the author describes about the food habits that a TB patient should adopt and foods that...
he/she should avoid. Author also speaks about the food that may lead to other complicated health issues that can worsen the condition of the TB patients.

The author(s) of [6] discuss about the idea of an Expert system which is an architecture for translating patient’s information from the web for using it in diagnosis of tuberculosis. The author(s) have discussed about automating the pre-laboratory screening process against tuberculosis infection to aid diagnosis and make it fast and accessible to the public via the Internet.

The author of [7] has described about the major hurdles in TB control and elimination.

In our proposed idea, we are trying to build an android application that can help the TB patients during the entire course of their treatment by providing all necessary information related to TB, it also helps in the successful completion of the treatment by providing assistance of the medical professional anytime and also reminds the patient about their medications and regular health checkups, thus decreasing the probability of a relapse TB infection.

2. TERMINOLOGY

2.1 Expert System:

Expert system is an automated tool that uses knowledge based or conditional based approach to process the given inputs and generate a valid output.

2.2 Diagnosis:

Diagnosis means, to identify if the person is infected with some disease by examining something or someone.

2.3 TB:

TB is a bacterial disease usually caused by an organism called Mycobacterium tuberculosis. TB is an abbreviation of the word Tuberculosis and is how people often refer to the disease. [2]

2.4 Relapse TB Case:

A patient is said to relapse if they become and remain culture negative whilst TB treatment, but become culture positive again after finishing their TB treatment. [3]

2.5 Tuberculin skin test (TST):

The TB skin test involves injecting a small amount of fluid (called tuberculin) into the skin in the lower part of the arm. Then the person must return after 48 to 72 hours to have a trained health care worker look at their arm. The health care worker will look for a raised hard area or swelling, and if there is one then they will measure its size. They will not include any general area of redness. [3]

The TB skin test result depends on the size of the raised hard area or swelling. The larger the size of the affected area the greater the likelihood that the person has been infected with TB bacteria. But interpreting the TB skin test result, that is whether it is a positive result, may also involve considering the lifestyle factors of the person being tested for TB. [3]

2.6 Underweight:

A person is said to be underweight, if his/her BMI is less than 18.5 or weight is 15%-20% less than that of normal weight (according to BMI).

3. PROPOSED METHODOLOGY

In this paper, we are proposing a methodology for an expert system for clinical diagnosis of TB. Our whole idea is to help the TB patients by providing them all necessary information related to TB and also provide a 24/7 assistance related to health care, medication, checkup and support of the medical professionals. This idea can become a reality with our android application “Yaksha Samara”. Yaksha Samara is more or less a data store that has all the necessary information related to TB viz. TB symptoms, tests, treatment plan, and a healthy diet.

Yaksha Samara can also be used to diagnose if the person has been infected by TB bacteria. This is made possible with the aid of expert system in the application that takes a range of inputs from the user viz. health condition of the user, symptoms that the user is showing and the details about the tuberculin skin test. Before testing for TB, the patient needs to meet a health care worker who can inject tuberculin into the skin in the lower part of patient’s hand. After about 60 hours, the patient will have to measure the size of the swollen area where tuberculin was injected. The patient/user can then input the size of the infected area, and the symptoms that he/she currently has. The expert system then generates the output based on the provided inputs. The system uses a set of rules and parses through if and else conditions to compute the results.

In most of the cases, the patient skips the medications and health checkups that might lead to a relapse TB case. To overcome this problem, we are proposing the idea of having a reminder built within the App that
would remind its user about medications and health checkups. Further to this, there is also a storage for medical reports in the form of pdf or an image. This would help the users to secure their important reports throughout the course of treatment.

TB patients need assistance of their physician to query about their health related issues. Hence, integrating a chat module would help the users/patients to directly communicate with the physician.

4. CASE STUDY

The main aim of proposing this paper is to deduce a method for diagnosis of TB using an Expert system.

Input:

i. Enter the width(in mm) of swelling of TST:
   tst_width = 9

ii. Select symptoms that you have:

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coughing that lasts three or more weeks.</td>
<td>Yes</td>
</tr>
<tr>
<td>Coughing up blood.</td>
<td>No</td>
</tr>
<tr>
<td>Chest pain, or pain with breathing or coughing</td>
<td>Yes</td>
</tr>
<tr>
<td>Unintentional weight loss.</td>
<td>Yes</td>
</tr>
<tr>
<td>Fatigue.</td>
<td>Yes</td>
</tr>
<tr>
<td>Fever.</td>
<td>Yes</td>
</tr>
<tr>
<td>Night sweats.</td>
<td>No</td>
</tr>
<tr>
<td>Chills/shivering.</td>
<td>No</td>
</tr>
<tr>
<td>Loss of appetite.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

iii. Enter Height (in cm) and Weight (in kg):
   height = 167.64
   weight = 45

Processing:

Step 1: Check if (tst_width >= 6mm)
Step 2: Check if patient shows more than 5 symptoms of TB.
Step 3: Compute BMI based on the height and weight given as input.
Check if (weight < (BMI_Idealweight-(0.2*BMI_Idealweight)))
Step 4: if ((Step1 == True) && (Step2 == True) && (Step3 == True))
   Result = True
else
   Result = False

Output: Display a result message:
“TB is Positive”

5. CONCLUSION

In this paper, we have proposed a methodology for an expert system for clinical diagnosis of Tuberculosis. The proposed methodology provides information about TB to the users and the Expert system within, uses a step by step and conditional based approach to test whether or if the user has TB based on the provided inputs.

6. REFERENCES