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Major Course Output 2: Medical Diagnostic ChatBot

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REPORT

I. Introduction

The machine project aims to develop a medical diagnostic expert system for a dynamic list of diseases prevalent among poor communities in the Philippines by utilizing logic and object-oriented programming languages, mainly Prolog for the expert system's back end and Java for the interface, respectively. This chatbot system includes the diagnosis of the following diseases:

- Dengue
- Hypertension
- Hepatitis B
- Influenza
- Cholera
- Measles
- Tuberculosis
- Typhoid
- Pneumonia
- Leprosy

As of the report writing, the domain of this project consists of the following disease types: respiratory, cardiovascular, gastrointestinal, dermatological, and infectious. The purpose of these disease types' inclusion is due to their prevalence in rural communities depending on different significant factors. These factors may include the rural communities' healthcare access, demographics, climate status, state of living, etc. The following figure shows the medical expert system's current diseases and their categories.

Diseases and their category:

Category
Respiratory disease: Pneumonia
Cardiovascular disease: Hypertension
Gastrointestinal disease: Cholera, Hepatitis B, Typhoid
Dermatological disease: Measles, Leprosy
Infectious disease: Dengue, Tuberculosis, Influenza

Figure 1. Medical expert system's current diseases and their respective categories

Implementing this task requires medical and programming expertise because the medical expert system's efficiency and accuracy will heavily rely on how the programmers design the algorithm and how the medical professionals make the knowledge base credible and accurate enough for medical diagnoses. This expert system will be significant to poor or rural communities because they have little access or affordability to good medical facilities. Due to that reason, this chatbot will allow people to determine what disease they could potentially have without having to go through expensive tests and how they may treat it as soon as possible.

II. Knowledge Base and Chatbot

The knowledge base is structured in a way wherein each symptom has an assigned weight (in float format) that represents its significance level (not related to the significance level concept in statistics) for each disease it is under, ranging between 0 to 1. The same symptoms that different diseases share may have different weight values depending on the significance or prevalence of their respective diseases. For example, in our knowledge base, high fever has a weight value of 0.9 for dengue and 0.8 for influenza. In this example, high fever is a main symptom for both diseases based on medical articles; however, their different weight values indicate that the significance level of high fever to Dengue prevalence is not the same as its significance level to Influenza prevalence. There are instances wherein a symptom has a low weight value to one disease (indicating that it is not entirely a significant symptom of the disease) and yet has a high weight value to another (indicating that it is a significant symptom of the disease). Furthermore, the possibility of a disease being a diagnosis is determined through its total score, which is the sum of all the weight values of the disease's symptoms present in the patient. This real-world information was translated into these formulas to make a more accurate diagnosis and minimize the chance of the patient getting multiple responses or diagnoses due to weight similarities.

After the patient states his symptoms, the chatbot will tell the patient what diseases he could potentially have based on the score (sum of the weights) of each disease in the knowledge base. Any disease with a score above an assigned minimum threshold value (1 in this project's case) will be displayed to the patient, with the disease with the highest score being the main medical diagnosis. One threshold value is used for all diseases to minimize score bias. This chatbot is flexible because a medical professional would be able to alter the weights to whatever he thinks is more appropriate or accurate. There is also an emergency feature for certain diseases with certain symptoms. This will inform the patient that his case is an emergency and that he/she would need to seek a doctor or emergency services immediately.

An example for this would be dengue, which has high fever, severe headaches, pain behind the eyes, muscle and joint pains, nausea, vomiting, swollen glands, and

rashes as its symptoms. The weight for high fever is 0.9, the weight for severe headaches is 0.6, the weight for swollen glands is 0.4, and the weight for rashes is 0.5. So if the patient had high fever and severe headaches, the score would be 1.5 (0.9 + 0.6), and it would be displayed as a possible disease, or be the main medical diagnosis if there is no disease with a higher score. If the patient had only swollen glands and rashes, the score would only be 0.9 (0.4 + 0.5), so the chatbot would not display dengue as a possible diagnosis.

The symptoms of each of the diseases and choosing the diseases themselves were rather the easier part of the knowledge base to finalize. Using various medical websites to choose the most common diseases that are prevalent in the poor communities and then the finalization of the main symptoms for the respective diseases, it did not cause much problems. While at times for the symptoms, there were minor dilemmas on whether to include certain ones or not, spending a little more time delving a bit more into it made the decision easier.

```
include(measles) :-  
    yes(high_fever);  
    yes(cough);  
    yes(runny_or_stuffy_nose);  
    yes(red_watery_eyes);  
    yes(koplik_spots_in_the_mouth);  
    yes(measles_rash).  
  
include(tuberculosis) :-  
    yes(weight_loss);  
    yes(fever);  
    yes(night_sweats);  
    yes(cough);  
    yes(chest_pain);  
    yes(coughing_blood).
```

Figure 2.1 Using Prolog to assign symptoms to diseases

While getting the information for the knowledge base was relatively easy as mentioned previously, the logic formulation to connect the backend to the frontend was the difficult part on the other hand. Our group as a whole was struggling in coming up with a definite idea in approaching the task that would also work best for the integration of Prolog and Java without relying too much on Java in dealing with program setbacks that are difficult to address in Prolog. Furthermore, assigning the weights for the particular disease along with coming up with the appropriate threshold value was also relatively difficult as we do not have sufficient expertise in the medical field to decide which values to assign; therefore, we placed weight and threshold values that are

somewhat reasonable based on our discretion for the sole reason of testing the whole medical expert system.

```
3 influenza(X) :-
4     has_symptom(fever, 0.8, X1),
5     has_symptom(feverish_or_chills, 0.7, X2),
6     has_symptom(cough, 0.9, X3),
7     has_symptom(sore_throat, 0.6, X4),
8     has_symptom(runny_or_stuffy_nose, 0.7, X5),
9     has_symptom(muscle_or_body_aches, 0.8, X6),
10    has_symptom(headaches, 0.7, X7),
11    has_symptom(fatigue, 0.8, X8),
12    has_symptom(vomiting, 0.4, X9),
13    has_symptom(diarrhea, 0.3, X10),
```

Figure 2.2 Assigning weights to symptoms of Influenza

```
Weight is (X1 + X2 + X3 + X4 + X5 + X6 + X7 + X8 + X9 + X10),
X is Weight,
(Weight > 1) -> true.
```

Figure 2.3 Threshold value of Influenza

```
switch (nMenuChoice) {
    case 0: // EXIT
        break;
    case 1:
        Query q1 = new Query("consult('src/mcokb.pl')");
        consultResult = q1.hasSolution();

        if (consultResult){
            System.out.println(x:"Medical knowledge base has successfully been consulted. Diagnosis may now commence.");
        }
}
```

Figure 2.4 Java code to connect frontend to backend

To elaborate further on our approach to the task through Prolog and Java programming languages, we have decided to utilize a chief complaint system as the start of the medical expert system. Usual chief complaints include own brief explanations of the main symptoms of the patients that forced them to seek medical diagnosis; however, interpreting them through code is a difficult task that is currently outside our scope and limitations, so we decided to make use of a list of symptoms that the patient can choose from to form the chief complaint. Although the patient can pick all of the possible symptoms that the patient currently experiences, the patient is encouraged to choose

only the main symptoms that made him seek a medical diagnosis. Once the patient has decided on his chief symptoms, the chatbot will proceed to include which diseases are possible candidates for diagnosis based on the given symptoms.

The chatbot system only includes diseases with at least one of the patient's chief symptoms. For instance, if high fever is one of the patient's chief symptoms, then the chatbot system will include diseases that have high fever as their symptom. This part adds efficiency to the system because it prevents the chatbot from implementing a brute force approach of asking all the possible questions in all diseases.

Afterward, the medical expert system asks the patient further questions (in a yes/otherwise format) about specific symptoms based on the possible diseases for a medical diagnosis. There are instances wherein a symptom is asked more than once due to it being present in more than one disease. Preventing this redundancy is usually one of Prolog's strengths; however, since we have integrated Java for the front end, a few modifications in both Java and Prolog files are required to prevent redundant questions so that the front end can detect if a symptom has already been asked based on back-end Prolog queries from the existing knowledge base.

After the patient has answered all the required questions, the possible diseases' scores are computed based on the present symptoms and their significance to their respective diseases. When the scores are finally computed, the chatbot system checks which diseases are possible diagnoses if their scores have surpassed their threshold values and are displayed to the patient, along with the scores and treatments for transparency. There are scenarios wherein a chatbot system may detect an emergency case. If such scenarios occur, the chatbot system displays an urgent message for emergency.

III. Results and Analysis

This section includes the summary of sample conversations (test cases) portraying the medical expert system's performance and setbacks in different situations. This section will be further divided into two parts: conversations that highlight the expert system's features and performance and conversations that showcase the expert system's setbacks and limitations.

Impressive Sample Conversations

Patient's Chief Symptoms:

- high fever (40°C/104°F)
- pain behind eyes
- severe headaches

Possible disease/s:

- Dengue
- Measles

Figure 3.1 Possible diseases after the patient completes the chief complaint

Questions for Dengue

Does the patient have muscle and joint pains? If yes, input [Y]: y
Does the patient have nausea? If yes, input [Y]: y
Does the patient have vomiting? If yes, input [Y]: y
Does the patient have swollen glands? If yes, input [Y]: y
Does the patient have rash? If yes, input [Y]: n

Questions for Measles

Does the patient have cough? If yes, input [Y]: n
Does the patient have runny nose? If yes, input [Y]: n
Does the patient have red watery eyes? If yes, input [Y]: n
Does the patient have koplik spots in the mouth? If yes, input [Y]: n
Does the patient have measles rash? If yes, input [Y]: n

Figure 3.2 List of questions based on existing patient chief and other symptoms

```

-----
Medical Record:

Patient Name: Jan Jansen
Patient Age: 24 years old
Patient Gender: Male

Patient's Symptoms:
- high fever (40°C/104°F)
- pain behind eyes
- severe headaches
- muscle and joint pains
- nausea
- vomiting
- swollen glands

Medical Diagnosis:
Patient most likely has the disease Dengue with a score of 4.6.

TREATMENT:
- Dengue does not have specific treatment, instead the pain symptoms are treated.
- Acetaminophen (paracetamol) is often used to control pain. Avoid using non-steroidal anti-inflammatory drugs like ibuprofen and aspirin as they can increase the risk of bleeding.
- For people who have already gotten dengue, to avoid getting it again there is a vaccine called Dengvaxia
- Hospitalization is needed for those with severe dengue

Patient Emergency Status: None
-----

```

Figure 3.3 Final Medical Diagnosis

Figure 3.1 - 3.3 make up the first sample conversation. In Figure 3.1, it showcases the result of the patient's chief complaint after entering high fever, pain behind eyes, and severe headaches as input for the patient's chief symptoms. This is one highlight of the conversation because after the chief symptoms are recorded, the possible diseases that the patient might have have been narrowed down from 10 total diseases to only 2 because high fever is present in both Dengue and Measles, signifying the importance of the chief complaint system and careful decisions in choosing the main symptoms.

Afterwards, the patient is then asked with a set of questions relating to the possible diseases. In Figure 3.2, the chatbot asked the patient about the set of symptoms per possible disease. In this scenario, the patient is asked one set of questions for Dengue and another for Measles. If we're going to see the full list of diseases and their symptoms, we can see that some symptoms were not asked because they were answered by the patient either during the chief complaint formation or during the question and answer part per disease. This is beneficial because it is possible that multiple diseases have the same number of symptoms and this will prevent the chatbot system from repeating the same questions more than once, making the chatbot more optimal in *average case scenarios*.

After the patient finishes the question and answer interview, he is then presented with a final medical diagnosis report. In Figure 3.3, the number of symptoms of the patient has increased because of the follow-up questions in Figure 3.2. Furthermore, we can also see that the Dengue's score has exceeded its assigned threshold value, indicating that the patient most likely has the disease. In addition, Measles has also

been disregarded because the patient's present symptoms that are related to Measles are insufficient (total weight values of symptoms relating to Measles that the patient experiences have not exceeded the minimum threshold value) to conclude that Measles is also a possible diagnosis.

```

Patient's Chief Symptoms:
- too high blood pressure (180/120 mm Hg or higher)
- fever
- weight loss
- cough
- night sweats

Possible disease/s:
- Hypertension
- Hepatitis b
- Influenza
- Measles
- Tuberculosis
- Typhoid
- Pneumonia

```

Figure 3.4 List of possible diseases in 2nd sample conversation

```

Questions for Hypertension
Does the patient have high blood? If yes, input [Y]: y
Does the patient have severe headaches? If yes, input [Y]: y
Does the patient have chest pain? If yes, input [Y]: y
Does the patient have dizziness? If yes, input [Y]: n
Does the patient have difficulty breathing? If yes, input [Y]: n
Does the patient have nausea? If yes, input [Y]: n
Does the patient have vomiting? If yes, input [Y]: n
Does the patient have vision changes? If yes, input [Y]: n
Does the patient have anxiety? If yes, input [Y]: n
Does the patient have confusion? If yes, input [Y]: n
Does the patient have buzzing in the ears? If yes, input [Y]: n
Does the patient have nosebleeds? If yes, input [Y]: n
Does the patient have abnormal heart rhythm? If yes, input [Y]: n

Questions for Hepatitis b
Does the patient have fatigue? If yes, input [Y]: n
Does the patient have loss of appetite? If yes, input [Y]: n
Does the patient have abdominal pain? If yes, input [Y]: n
Does the patient have dark urine? If yes, input [Y]: n
Does the patient have clay colored bowel movements? If yes, input [Y]: n
Does the patient have joint pain? If yes, input [Y]: n
Does the patient have jaundice? If yes, input [Y]: n

Questions for Influenza
Does the patient have feverish or chills? If yes, input [Y]: n
Does the patient have sore throat? If yes, input [Y]: n
Does the patient have runny or stuffy nose? If yes, input [Y]: n
Does the patient have muscle or body aches? If yes, input [Y]: n
Does the patient have headaches? If yes, input [Y]: n
Does the patient have diarrhea? If yes, input [Y]: n

Questions for Measles
Does the patient have high fever? If yes, input [Y]: n
Does the patient have runny nose? If yes, input [Y]: n
Does the patient have red watery eyes? If yes, input [Y]: n
Does the patient have koplik spots in the mouth? If yes, input [Y]: n
Does the patient have measles rash? If yes, input [Y]: n

Questions for Tuberculosis
Does the patient have coughing blood? If yes, input [Y]: n

Questions for Typhoid
Does the patient have weakness? If yes, input [Y]: n
Does the patient have rash? If yes, input [Y]: n

Questions for Pneumonia
Does the patient have shortness of breath? If yes, input [Y]: n
Does the patient have rapid heartbeat? If yes, input [Y]: n

```

Figure 3.5 List of possible questions and the patient's answers for 2nd sample conversation

```

-----
Medical Record:

Patient Name: John Doe
Patient Age: 55 years old
Patient Gender: Male

Patient's Symptoms:
- too high blood pressure (180/120 mm Hg or higher)
- fever
- weight loss
- cough
- night sweats
- high blood
- severe headaches
- chest pain

Medical Diagnosis:
Patient most likely has the disease Tuberculosis with a score of 2.9.

TREATMENT:
There are various treatments from latent and active infections, to specific people with HIV, pregnant, and for children.
Thus we urge you to coordinate with your local health professionals for treatment as it takes a long time before one can be treated, as it could be fatal if not treated properly.
To assist, here is a website that show facilities throughout the Philippines that is part of the national tuberculosis control program that might assist you in finding local help: https://ntp.doh.gov.ph/resources/facilities/
In addition, please protect others through protecting yourself as well through isolation, facemasks, and proper ventilation in your environment. While taking the treatment program, please take drugs as directed with discipline
When an emergency rises, please contact medical services.

The following diseases are other possible diagnoses with their respective scores in descending order:
Disease:      Score:
- Hypertension 2.6
- Pneumonia    2.3
- Influenza    1.7

Patient Emergency Status: DECLARE EMERGENCY DUE TO HYPERTENSIVE CRISIS
-----

```

Figure 3.6 Final medical diagnosis for 2nd sample conversation

Figure 3.4 - 3.6 make up the second sample conversation. Figure 3.4 showcases the patient's chief symptoms after the chief complaint and is presented with the possible diseases the patient might have.

Figure 3.5 shows the list of all possible questions for all the possible diseases while disregarding possible redundant questions. We can see that in Figure 3.5, the patient was asked additional symptoms under hypertension. This is one feature of the chatbot system because there are certain scenarios wherein if a chief symptom is severe enough, an emergency may be called depending on other concerning symptoms related to the chief symptom. In this scenario, a patient may have hypertension (if blood pressure is 140/90 mmHg or higher) and hypertensive crisis (blood pressure 180/120 mmHg). A blood pressure of 180/120 mmHg is a main indicator of hypertensive crisis and an emergency must be called if any additional concerning symptoms (refer to the list by WHO) are experienced by the patient. Since the patient has a blood pressure of 180/120 mmHg, the chatbot asks additional questions to determine whether an emergency should be called or not.

After the patient is done with the questions, the chatbot system presents his final medical report, which showcases that he might have Tuberculosis as the main disease; However, since the patient has a too high blood pressure and other concerning symptoms, the medical report also shows that an emergency must be declared.

Although this conversation was supposed to highlight a feature, it also shows the chatbot system's setback of asking too many questions, which will be further elaborated on in the later parts of this section.

```
Patient's Chief Symptoms:
- high blood (140/90 mmHg or higher)
- vomiting
- thirst
- rapid dehydration
- rapid heart rate

Possible disease/s:
- Dengue
- Hypertension
- Hepatitis b
- Influenza
- Cholera
```

Figure 3.7 List of possible diseases in the 3rd sample conversation

```
Questions for Dengue
Does the patient have high fever? If yes, input [Y]: n
Does the patient have severe headaches? If yes, input [Y]: n
Does the patient have pain behind eyes? If yes, input [Y]: n
Does the patient have muscle and joint pains? If yes, input [Y]: n
Does the patient have nausea? If yes, input [Y]: n
Does the patient have swollen glands? If yes, input [Y]: n
Does the patient have rash? If yes, input [Y]: n

Questions for Hypertension

Questions for Hepatitis b
Does the patient have fever? If yes, input [Y]: n
Does the patient have fatigue? If yes, input [Y]: n
Does the patient have loss of appetite? If yes, input [Y]: n
Does the patient have abdominal pain? If yes, input [Y]: n
Does the patient have dark urine? If yes, input [Y]: n
Does the patient have clay colored bowel movements? If yes, input [Y]: n
Does the patient have joint pain? If yes, input [Y]: n
Does the patient have jaundice? If yes, input [Y]: n

Questions for Influenza
Does the patient have feverish or chills? If yes, input [Y]: n
Does the patient have cough? If yes, input [Y]: n
Does the patient have sore throat? If yes, input [Y]: n
Does the patient have runny or stuffy nose? If yes, input [Y]: n
Does the patient have muscle or body aches? If yes, input [Y]: n
Does the patient have headaches? If yes, input [Y]: n
Does the patient have diarrhea? If yes, input [Y]: n

Questions for Cholera
Does the patient have low blood pressure? If yes, input [Y]: n
Does the patient have loss of skin elasticity? If yes, input [Y]: n
Does the patient have muscle cramps? If yes, input [Y]: n
Does the patient have frequent painless watery stools? If yes, input [Y]: n
```

Figure 3.8 List of possible questions and the patient's answers in the 3rd sample conversation

```

-----
Medical Record:

Patient Name: Jane Doe
Patient Age: 52 years old
Patient Gender: Female

Patient's Symptoms:
- high blood (140/90 mmHg or higher)
- vomiting
- thirst
- rapid dehydration
- rapid heart rate

Medical Diagnosis:
Patient most likely has the disease Cholera with a score of 3.0.

TREATMENT:
- Rehydration: temporarily replace lost body fluid by giving Oral Rehydration Solution (ORESOL) or a homemade solution composed of 1 teaspoon of salt, 4 teaspoons of sugar mixed to 1 liter of water
- Rehydration is the most important treatment for cholera, do not provide drinks with high sugar content such as juice, soft drinks, or sports drinks, as it could worsen diarrhea.

The following diseases are other possible diagnoses with their respective scores in descending order:
Disease:      Score:
- Hypertension  1.1

Patient Emergency Status: None
-----

```

Figure 3.9 Final medical diagnosis for 3rd sample conversation

In addition to the information in Figure 3.4 - 3.6, this conversation also features a scenario wherein the patient's emergency status is not declared as true. In Figure 3.8, we can see that no further questions were asked to the patient involving hypertensive crisis because the patient only has high blood (140/90 mmHg) and does not have a blood pressure greater than 180/120 mmHg. This feature does not only take into account emergency cases, but it also further reduces the number of possible unnecessary questions asked to the patient.

In Figure 3.9, we can see that Cholera is the main diagnosed disease, along with hypertension as another diagnosed disease. Taking into account multiple diagnoses also increases the chatbot's reliability and transparency to the patient since in reality, multiple diseases and their symptoms may coexist with each other.

Poor Sample Conversations

Patient's Chief Symptoms:

- cough
- fatigue
- runny or stuffy nose
- nausea
- vomiting

Possible disease/s:

- Dengue
- Hepatitis b
- Influenza
- Cholera
- Measles
- Tuberculosis
- Typhoid
- Pneumonia
- Leprosy

Figure 3a List of possible diseases in the 4th sample conversation

```
Questions for Dengue
Does the patient have high fever? If yes, input [Y]: n
Does the patient have severe headaches? If yes, input [Y]: n
Does the patient have pain behind eyes? If yes, input [Y]: n
Does the patient have muscle and joint pains? If yes, input [Y]: n
Does the patient have swollen glands? If yes, input [Y]: n
Does the patient have rash? If yes, input [Y]: n

Questions for Hepatitis b
Does the patient have fever? If yes, input [Y]: n
Does the patient have loss of appetite? If yes, input [Y]: n
Does the patient have abdominal pain? If yes, input [Y]: n
Does the patient have dark urine? If yes, input [Y]: n
Does the patient have clay colored bowel movements? If yes, input [Y]: n
Does the patient have joint pain? If yes, input [Y]: n
Does the patient have jaundice? If yes, input [Y]: n

Questions for Influenza
Does the patient have feverish or chills? If yes, input [Y]: n
Does the patient have sore throat? If yes, input [Y]: n
Does the patient have muscle or body aches? If yes, input [Y]: n
Does the patient have headaches? If yes, input [Y]: n
Does the patient have diarrhea? If yes, input [Y]: n

Questions for Cholera
Does the patient have rapid dehydration? If yes, input [Y]: n
Does the patient have rapid heart rate? If yes, input [Y]: n
Does the patient have low blood pressure? If yes, input [Y]: n
Does the patient have loss of skin elasticity? If yes, input [Y]: n
Does the patient have muscle cramps? If yes, input [Y]: n
Does the patient have thirst? If yes, input [Y]: n
Does the patient have frequent painless watery stools? If yes, input [Y]: n

Questions for Measles
Does the patient have runny nose? If yes, input [Y]: n
Does the patient have red watery eyes? If yes, input [Y]: n
Does the patient have koplik spots in the mouth? If yes, input [Y]: n
Does the patient have measles rash? If yes, input [Y]: n

Questions for Tuberculosis
Does the patient have weight loss? If yes, input [Y]: n
Does the patient have night sweats? If yes, input [Y]: n
Does the patient have chest pain? If yes, input [Y]: n
Does the patient have coughing blood? If yes, input [Y]: n

Questions for Typhoid
Does the patient have weakness? If yes, input [Y]: n

Questions for Pneumonia
Does the patient have shortness of breath? If yes, input [Y]: n
Does the patient have rapid heartbeat? If yes, input [Y]: n

Questions for Leprosy
Does the patient have discolored patches of skin? If yes, input [Y]: n
Does the patient have growths on the skin? If yes, input [Y]: n
Does the patient have stiff or dry skin? If yes, input [Y]: n
Does the patient have painless ulcers on feet soles? If yes, input [Y]: n
Does the patient have painless lumps on face or earlobes? If yes, input [Y]: n
Does the patient have loss of eyebrows or eyelashes? If yes, input [Y]: n
Does the patient have numbness of affected skin areas? If yes, input [Y]: n
Does the patient have muscle weakness? If yes, input [Y]: n
Does the patient have enlarged nerves? If yes, input [Y]: n
```

Figure 3b List of possible questions and the patient's answers in the 4th sample conversation

```

-----
Medical Record:

Patient Name: Juan Dela Cruz
Patient Age: 28 years old
Patient Gender: Male

Patient's Symptoms:
- cough
- fatigue
- runny or stuffy nose
- nausea
- vomiting

Medical Diagnosis:
Patient most likely has the disease Influenza with a score of 2.8.

TREATMENT:
- Antiviral drugs are an effective treatment option, most effective when taken one to two days after the symptoms begin.
- Contact your doctor immediately if you are a young child, 65 years of age and older, pregnant, or have certain medical conditions
such as asthma, diabetes and heart disease.

The following diseases are other possible diagnoses with their respective scores in descending order:
Disease:          Score:
- Hepatitis b      1.8
- Cholera          1.4
- Dengue          1.2
- Measles          1.2

Patient Emergency Status: None
-----

```

Figure 3c Final medical diagnosis for 4th sample conversation

Figure 3a - 3c make up the fourth sample conversation. One of the clear setbacks of the chatbot system (as mentioned above) is its poor performance in terms of its efficiency in including diseases and asking questions. Our group may have utilized specific rules (such as the use of the chief complaint system and the inclusion of diseases based on the existing chief symptoms) to make the chatbot system more optimal; however, in terms of worst case scenarios, only little improvements are perceivable. This issue will exacerbate when more diseases and symptoms are added to the knowledge base. For instance, in Figure 3a, 9/10 of the diseases were included as possible candidates for diagnosis, making the chatbot system nonoptimal in this scenario. This is due to the fact that even if a few symptoms were chosen by the patient during the chief complaint formation, a lot of diseases in real life share the same symptoms, leading to multiple diseases being included for the follow-up question and answer phase because of a mere symptom.

In Figure 3b, roughly 45 out of 60 symptoms (excluding chief symptoms) were asked by the chatbot system. Even if some redundant questions weren't asked repeatedly, the overall performance of the chatbot isn't optimal. In the worst case scenario, if all the diseases have unique symptoms and all the diseases share at least a single symptom, the number of questions that the chatbot system will ask will just be as close as the total number of symptoms in the knowledge base. For example, if 9 diseases have 10 symptoms each and all of them share the same symptom and the rest

of their symptoms are all unique, assuming that symptom was already asked by the chatbot, roughly 81 follow-up questions will be asked (because the same symptom would never be asked more than once), which is inefficient in terms of *worst case scenarios*.

In Figure 3c, multiple diagnoses were shown to the patient because the weight values assigned to the symptoms are close to the diseases' threshold values. Though it is important to note that the weight values of the symptoms in the knowledge base as of this report's writing are solely *placeholders with intuition* to somewhat try and make the weight values more reliable while also focusing on the expert system's overall algorithm; however, slight errors on weight and threshold value assignments can greatly affect the overall accuracy of the chatbot system (as displayed above) since the threshold values of all the diseases are the same (for eligibility in score comparison) and the number of symptoms of each disease varies. In the end, the people who will assign weight and threshold values must have an expertise in the medical field.

To summarize, the strengths of the chatbot have tradeoffs that pave the way to its weaknesses. The core strengths of the chatbot include the utilization of symptom weight values and disease score threshold values for more reliability and flexibility, implementation of a chief complaint system that narrows down the possible diseases to make the chatbot's efficiency more optimal, an algorithm that reduces redundant or unnecessary questions based on existing patient symptoms in the knowledge base, implementation of the possibility of diagnosing multiple diseases for more transparency and reliability, and taking into account emergency cases for specific severe scenarios.

On the other hand, the main weaknesses of the chatbot include the high possibility of non optimal performance of the chatbot in average to worst case scenarios due to the possibility of including too many diseases as candidates for possible diagnoses and asking too many unnecessary questions to the patients. In addition, the disease scores interpretation and possible diagnoses can be inaccurate due to the effect of possible overestimation or underestimation of weight and threshold values, which is why more analytical efforts must be made by medical professionals for them to be able to optimize the symptom weight values and disease threshold values and retain accuracy and objectivity.

IV. Recommendations

One of the flaws we found about the chatbot's performance is that it asks the user unnecessary questions related to diseases that they likely do not have based on their answers to the questions related to their symptoms. For example, if a user were to say no to most of the symptoms to a disease and the weights of the remaining symptoms do not exceed the threshold, the chatbot would continue to ask the user about them anyway.

To solve this problem, an algorithm can be implemented where the questions for symptoms are asked in order of their given weights in descending order so that it can identify if the patient does not have the disease and can stop asking questions related to the disease. If the disease shares a symptom with another disease that the user could have, the chatbot can simply ask about the symptom while asking questions related to the other disease. The implementation of an algorithm like this will save the user from being asked any unnecessary questions.

Another solution that would help minimize the number of unnecessary symptom questions is implementing an algorithm that keeps track of a disease's total possible score given the existing symptoms. For instance, this can be done by creating a variable with an initial value (let's call the variable 'temp') equal to the sum of all the weights of the symptoms plus the weight values of the symptoms in the disease that are present in the patient. Whenever a symptom has been asked to the patient and the patient does not have that symptom, the chatbot deducts the symptom's weight value from the temp variable. If the temp variable's value becomes less than the disease's threshold value and there are more symptoms to ask, the chatbot will disregard the next symptoms that are not yet asked because even if those symptoms are present to the patient, it is impossible for them to make the disease's score surpass the threshold value. The following figure is an example for a more clear interpretation.


```

sampleddisease(X) :-
    has_symptom(symptom_one, 0.9, X1),
    has_symptom(symptom_two, 0.7, X2),
    has_symptom(symptom_three, 0.7, X3),
    has_symptom(symptom_four, 0.5, X4),
    has_symptom(symptom_five, 0.4, X5),
    has_symptom(symptom_six, 0.4, X6),
    has_symptom(symptom_seven, 0.2, X7),
    has_symptom(symptom_eight, 0.1, X8),

    Weight is (X1 + X2 + X3 + X4 + X5 + X6 + X7 + X8),
    X is Weight,
    (Weight > 1) -> true.

```

Assuming the patient has symptom_seven, initialize temp variable's value where

$$\text{tempVar} = (0.9 + 0.7 + 0.7 + 0.5 + 0.4 + 0.4 + 0.2 + 0.1) + (0.2)$$

$$\text{tempVar} = 3.9 + 0.2 = 4.1$$

The first parenthesis is the sum of all the symptom weights and the second parenthesis is the sum of all the patient's present symptom weights (0.2 in this case because patient has symptom_seven).

Let's say the patient doesn't have symptoms one to five, then tempVar will be deducted by the sum of symptom one to five's weight values.

$$\text{tempVar} = 4.1 - (0.9 + 0.7 + 0.7 + 0.5 + 0.4)$$

$$\text{tempVar} = 0.9$$

Since symptom seven has already been asked during the chief complaint formation, it will not be asked again.

Furthermore, symptom six and eight will not be asked by the chatbot because even if they are present (along with symptom seven), they wouldn't pass the threshold value of 1 because $0.4 + 0.2 + 0.1 = 0.7 < 1$

It would be deemed unnecessary to ask symptoms six and eight.

Figure 4.1 Variable tracking approach to reduce unnecessary questions

In Figure 4.1, symptoms six and eight were not asked anymore because they are deemed as unnecessary. In addition, it is important to note that the symptoms must all be sorted in descending order based on their weight values. This approach may be done through Prolog or Java and this can help reduce the total number of questions that the chatbot system may ask based on the chief symptoms. Due to our limitations in our knowledge in integrating Java and Prolog, we have decided not to include this for the meantime, but this is one idea that we may possibly recommend for future use.

Another recommendation, though not related to the structure of the knowledge base, would be to get medical professionals to assign the weight values in order to improve the accuracy of the chatbot. One of the strengths of this chatbot is its flexibility, with the weights and thresholds being adjustable. The influence of local medical professionals in the weights of the knowledge base will greatly increase the accuracy and effectiveness of the chatbot. Further suggestions on how the patient can treat the

disease on his own (if possible) can also be added by the medical professional into the diagnosis.

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VI. Contributions of Each Members

Cabinbin, Pierre - Research, report writing
Coo, Hans - Research, report writing
Naman - Research, coding(Backend), report writing
Samson, Wesly - Research, front end and back end coding, and report writing.

VII. Appendix

1) Dengue - *“Dengue is a viral infection caused by the dengue virus (DENV), transmitted to humans through the bite of infected mosquitoes.”*

1. Prevalence in Rural Communities RRLs:

- *“Dengue is a major public health problem in the Philippines and is endemic in all regions of the country.” (Undurraga et al., 2017)*
- *“Although once confined to urban and semi-urban areas, dengue is now widespread in rural areas of the Philippine Archipelago” (Espino, et al., 2012)*

2. Symptoms:

- high fever (40°C/104°F)
- severe headache
- pain behind the eyes
- muscle and joint pains
- nausea
- vomiting
- swollen glands
- rash

3. Illness Info Reference:

- World Health Organization (2023, March 17). *Dengue and severe dengue*.
<https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue>
- Undurraga, E.A., Edillo, F.E., Erasmo, J.N.V., Alera, M.T.P., Yoon, I., Largo, F.M., & Shepard, D.S. (2017). Disease Burden of Dengue in the Philippines: Adjusting for Underreporting by Comparing Active and Passive Dengue Surveillance in Punta Princesa, Cebu City. *Am J Trop Med Hyg*, 96(4), 887-898. <https://doi.org/10.4269/ajtmh.16-0488>
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4. Treatment

- Dengue does not have specific treatment, instead the pain symptoms are treated.
- Acetaminophen (paracetamol) is often used to control pain. Avoid using non-steroidal anti-inflammatory drugs like ibuprofen and aspirin as they can increase the risk of bleeding.
- For people who have already gotten dengue, to avoid getting it again there is a vaccine called Dengvaxia
- Hospitalization is needed for those with severe dengue

2) Hypertension - *“High blood pressure, also called hypertension, is blood pressure that is higher than normal. Your blood pressure changes throughout the day based on your activities. Having blood pressure measures consistently above normal may result in a diagnosis of high blood pressure (or hypertension).”*

1. Prevalence in Rural Communities RRLs:

- *“...hypertensive disease was fifth among top causes of death in the Philippines, with 2,565 deaths or 5.9 percent of total deaths that occurred from January to February 2022” (Mapa, 2022; Baclig, 2022)*

2. Symptoms:

- High blood pressure (140/90 mmHg or higher).
- Declare emergency if blood pressure is (180/120 mmHg or higher) and any of the following symptoms are felt:
 - severe headaches
 - chest pain
 - dizziness
 - difficulty breathing
 - nausea
 - vomiting
 - blurred vision or other vision changes
 - anxiety
 - confusion

- buzzing in the ears
- nosebleeds
- abnormal heart rhythm

3. Illness Info Reference:

- World Health Organization (2023, March 16). *Hypertension*. <https://www.who.int/news-room/fact-sheets/detail/hypertension>
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4. Treatment

- Lower blood pressure by implementing lifestyle changes
 - Eat food with less salt
 - Lose weight
 - Be physically active
 - Stay away from tobacco
- There are several common blood pressure medicines:
 - ACE inhibitors relax blood vessels and prevent kidney damage. Examples: enalapril, lisinopril
 - Angiotensin-2 receptor blockers (ARBs) relax blood vessels and prevent kidney damage. Examples: losartan and telmisartan
 - Calcium channel blockers relax blood vessels. Examples: amlodipine, felodipine
 - Diuretics eliminate extra water from the body, lowering blood pressure. Examples: hydrochlorothiazide, chlorthalidone
- Blood pressure goal is less than 140/90 (less than 130/80 if you have cardiovascular disease, diabetes, or a kidney disease)

3) Hepatitis B (Liver Illness) - *"Hepatitis B is a potentially life-threatening liver infection caused by the hepatitis B virus (HBV). It is a major global health problem. It can cause chronic infection and puts people at high risk of death from cirrhosis and liver cancer."*

1. Prevalence in Rural Communities RRLs:

- *"In the Philippines, around one in 10 people have chronic hepatitis B, and six in 1,000 have chronic hepatitis C. Hepatitis is a huge public health concern in the Philippines, but due to lack of awareness, many of those who have this viral disease may not even know they have it until it's too late."* (Weiler, 2019)

2. Symptoms:

- Fever
- Fatigue
- Loss of appetite
- Nausea
- Vomiting
- Abdominal pain
- Dark urine
- Clay-colored bowel movements
- Joint pain
- Jaundice (yellow color in the skin or the eyes)

3. Illness Information Reference:

- Centers for Disease Control and Prevention (2023, March 9). *Viral Hepatitis*. <https://www.cdc.gov/hepatitis/hbv/bfaq.htm>
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4. Treatment

- For short-term hepatitis B, get a good amount of rest, nutrition, and fluids
- Those with severe symptoms need to be hospitalized
- For chronic hepatitis B, there are several drugs and medications that can be taken, but due to their side effects, it is better to consult a doctor.
- Get vaccinated for hepatitis A and get tested for hepatitis C
- Avoid drinking alcohol

4) Influenza - *"Influenza (flu) is a contagious respiratory illness caused by influenza viruses that infect the nose, throat, and lungs."*

1. Prevalence:

- *"We have a trend of illnesses or a season of illness. We experience this whenever the weather changes in the Philippines, like dry then it becomes rainy or hot then cold like this month of December," DOH officer-in-charge Maria Rosario Vergeire said (Villanueva, 2022).*

2. Symptoms

- fever* or feeling feverish/chills
- cough
- sore throat
- runny or stuffy nose
- muscle or body aches
- headaches

- fatigue (tiredness)
- some people may have vomiting and diarrhea, though this is more common in children than adults.

3. Illness Info Reference

- Centers for Disease Control and Prevention (2023, March 31). *Influenza (flu)*. Retrieved from: <https://www.cdc.gov/flu/index.htm>
- Villanueva, R. (2022, December 25). *DOH: Flu-like illness cases increase*. Philstar. Retrieved from: <https://www.philstar.com/nation/2022/12/25/2233168/doh-flu-illness-cases-increase>

4. Treatment

- Antiviral drugs are an effective treatment option, most effective when taken one to two days after the symptoms begin.
- Contact your doctor immediately if you are a young child, 65 years of age and older, pregnant, or have certain medical conditions such as asthma, diabetes and heart disease.

5) Cholera - *“Cholera is an acute diarrheal illness caused by infection of the intestine with Vibrio cholerae bacteria.”*

1. Prevalence:

- *“DOH records showed a total of 3,729 cholera cases have been recorded across the country since last January, and the figure was 282 percent higher compared to the same period last year (2021)...” DOH officer-in-charge, Maria Rosario Vergerie, said in 2021 during a press conference.*

“..Cumulatively, most of the cholera cases were reported by Eastern Visayas, Davao Region, and Caraga...” (Casas, 2022; Mendoza, 2022)

- *“...As stated by the DOH regional office in Eastern Visayas, the cholera outbreak in Tacloban City, which has 426 cases, already resulted in five deaths. It said the 426 infections is higher compared to 192 cases on Oct. 26...” (Peña, 2022)*

2. Symptoms

- Vomiting
- Rapid dehydration (e.g. sunken eyeballs, wrinkled and dry skin)
- Rapid heart rate (consequence from dehydration)
- Low blood pressure (dehydration)
- Loss of skin elasticity (dehydration)
- Muscle cramps (consequence from fluid loss)
- Thirst (fluid loss)
- Fatigue

- Sudden onset of frequent painless watery stools*

**Diarrhea due to cholera often has a pale, milky appearance that resembles water in which rice has been rinsed. Also dangerous fluid loss that can lead to electrolyte imbalance, in severe cases, give the afflicted muscle cramps and shock; To expound on shock, if left untreated, can cause severe hypovolemic shock that can cause death within minutes as blood pressure and oxygen drops when there is low blood volume.*

Essentially, if diarrhea has a pale, milky appearance- and a person has been experiencing muscle cramps and/or shock- likely Cholera.

3. Illness Info Reference

- Casas, W. (2022, October 11). *Cholera rising, but not alarming—DOH.* manilastandard .
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- Centers for Disease Control and Prevention (2022, November 14). *Cholera - Vibrio cholerae infection: Illness and Symptoms.* Retrieved from: <https://www.cdc.gov/cholera/illness.html>

4. Treatment

Rehydration - Main form of treatment

- Can temporarily replace lost body fluid by giving *Oral Rehydration Solution* (ORESOL) or a homemade solution composed of 1 teaspoon of salt, 4 teaspoons of sugar mixed to 1 liter of water. If diarrhea persists, consult health workers or bring the patient to the nearest hospital.
- To emphasize, rehydration is the most important treatment for cholera, do not provide drinks with high sugar content such as juice, soft drinks, or sports drinks, as it could worsen diarrhea. Offer the ORESOL frequently

and measure the amount drunk and fluid loss and coordinate with your health workers. Make sure the water to make ORESOL is safe.

Antibiotics - Supplementary for severe cases

- In addition to rehydration, antibiotic treatment is also recommended, mainly for severely ill patients, from severe dehydration, pregnant women, and patients with comorbidities. This should be given as soon as the patient can tolerate oral medication, take note as well that there are multiple forms of antibiotics that could be used as the patient may be resistant to certain antibiotics, alternatives must be sought after if possible. Do note that you must not do this treatment at the expense of rehydration as rehydration is the primary treatment of cholera. Do not give this to patients with some or no diarrhea and/or dehydration. This form of treatment may cause nausea and vomiting, alongside gastrointestinal side effects, the patient must be carefully monitored as such.

6) Measles - *“Measles is a viral respiratory illness caused by a single-stranded, enveloped RNA virus with 1 serotype. It is a highly contagious disease that can lead to serious complications.”*

1. Prevalence:

- *“A total of 589 measles cases were recorded across the country in 2022, data from the Department of Health (DOH) showed. This figure posted a 186 percent increase as compared to the year 2021 where only 206 cases were logged, the DOH report showed.” (Vera, 2023)*

2. Symptoms

- High fever
- Cough
- Runny nose
- Red, watery eyes
- Koplik spots in the mouth (after 2-3 days) (Clustered, white lesions inside mouth)
- Measles rash (after 3-5 days)

3. Illness Info Reference

- Centers for Disease Control and Prevention. (2020, November 5). *Measles (Rubeola)*. Retrieved from: <https://www.cdc.gov/measles/index.html>
- Vera, A.D. (2023, January 25). *Over 580 measles cases recorded in 2022–DOH*. Manila Bulletin. Retrieved from: <https://mb.com.ph/2023/01/24/over-580-measles-cases-recorded-in-2022-doh/>

4. Treatment

- Drink plenty of water and get a lot of rest to let the virus run its course

- No specific antiviral treatment exists for measles virus. Get the vaccine to prevent getting it in the future
- Severe complications from measles can be reduced through supportive care that ensures good nutrition, adequate fluid intake and treatment of dehydration with WHO-recommended oral rehydration solution.

7) Tuberculosis- *a disease caused by germs that are spread from person to person through the air. TB usually affects the lungs, but it can also affect other parts of the body, such as the brain, the kidneys, or the spine. A person with TB can die if they do not get treatment.*

1. Prevalence

- *In the country, the DOH reported 311,000 tuberculosis cases in 2021 compared to 263,000 cases in 2020 based on the national TB registry. (Montemayor, 2023)*
- *“The good news is ... figures are catching up. In 2022, we saw that more TB cases are finally being identified. Hopefully, [numbers] improve even more until we find the [more than] 700,000 cases,” Fabella, TB advisor of the DOH disease prevention and control bureau, told reporters. (Villa, 2023)*
- *One of the major challenges in decreasing TB burden in the country is that the disease is highly prevalent in urban poor communities with little access to health care, according to an article on TB detection and patient care in Payatas and Tondo published in the journal Public Health Action in 2017. (Gonzales, 2019)*

2. Symptoms

Primary TB Infection - 1st stage, the immune system searches and destroys the germs.

– Initial stage, people may get flu-like symptoms

- Low fever
- Tiredness
- Cough

Latent TB infection

– Dormant stage, no symptoms

Active TB infection - 2nd stage, when the immune system can't control the infection. Germs may spread throughout lungs or other parts of the body.

Inside of Lungs

- Cough
- Coughing up blood or mucus
- Chest pain
- Pain with breathing or coughing
- Fever
- Chills
- Night sweats
- Weight loss
- Loss of appetite
- Tiredness
- Not feeling well in general

Outside of Lungs

- Fever
- Chills
- Night sweats
- Weight loss
- Loss of appetite
- Not feeling well in general
- Pain near the site of infection

Common sites of disease to look out for when outside the lungs

- Kidneys
- Liver
- Fluid surrounding the brain and spinal cord
- Heart muscles
- Genitals
- Lymph nodes
- Bones and joints
- Skin
- Walls of blood vessels
- Voice box, larynx

In children

- **Teenagers**, symptoms similar to adults
- **1-12 years old**, a fever that won't go away and weight loss
- **Infants**, they don't grow or gain weight as expected, in addition to swelling in the fluid around the brain or spinal cord, including:
 - Sluggishness and inactivity
 - Unusually fussy
 - Vomiting
 - Poor feeding
 - Bulging soft spot on head
 - Poor reflexes

Contact a doctor when:

- You cough up blood or have blood in your urine or stool.

3. Illness Info Reference

- Querri, A., Ohkado, A., Yoshimatsu, S., Coprada, L., Lopez, E., Medina, A., Garfin, A., Bermejo, J., Tang, F., & Shimouchi, A. (2017). *Enhancing tuberculosis patient detection and care through community volunteers in the urban poor, The Philippines*. *Public Health Action*, 7(4). 268-274. doi: [10.5588/pha.17.0036](https://doi.org/10.5588/pha.17.0036)
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- Mayo Clinic Staff (2023, March 22). *Tuberculosis*. Mayo Clinic. Retrieved from: <https://www.mayoclinic.org/diseases-conditions/tuberculosis/symptoms-causes/syc-20351250>

4. Treatment

- There are various treatments from latent and active infections, to specific people with HIV, pregnant, and for children. Thus we urge you to coordinate with your local health professionals for treatment as it takes a long time before one can be treated, as it could be fatal if not treated properly.
- To assist, here is a website that show facilities throughout the Philippines that is part of the national tuberculosis control program that might assist you in finding local help: <https://ntp.doh.gov.ph/resources/facilities/>
- In addition, please protect others through protecting yourself as well through isolation, facemasks, and proper ventilation in your environment. While taking the treatment program, please take drugs as directed with discipline, as it could take from four to six or nine months to recover. When an emergency rises, please contact medical services.

8) Typhoid -*typhoid fever is a bacterial infection caused by the bacterium Salmonella Typhi. It is typically spread through contaminated food and water, and is more common in areas with poor sanitation and hygiene*

1. Prevalence

- *The number of typhoid fever cases in Negros Oriental province is still rising with the latest figures showing a 131 percent increase compared to last year, a health official said on Friday. (Partlow, 2022)*
- *...Meanwhile, the country logged 7,681 typhoid cases from January to August this year. This is 109 percent higher compared to the same time period last year, Vergeire [DOH officer-in-charge] said... (Maru, 2022)*
- *The tally is 150 percent or 7,280 cases higher than the 4,844 infections reported last year for the same period...Batangas, Bohol, Bukidnon, Cagayan City, Catanduanes, Cebu, Davao City, Guimaras, Misamis Occidental, Mountain Province, Negros Occidental, Nueva Ecija, Rizal, Sarangani, and Santiago City had positive growth rates of typhoid fever cases in the past three to four weeks. (Montemayor, 2022)*

2. Symptoms

Early Illness – 1 to 3 weeks of exposure

- High Fever
- Chills
- Headache
- Diarrhea or constipation
- Weakness and fatigue
- Rash
- Stomach pain
- Muscle aches
- Cough
- Loss of appetite

Later Illness

- Stomach pain
- Very swollen stomach
- An infection caused by gut bacteria spreading throughout the body, called sepsis

Serious cases

- Confusion
- Unable to pay attention to anything around them
- Unable to react to the world around them

In some people, symptoms may return to a few weeks after the fever has gone away.

3. Illness Info Reference

- Partlow, M.J. (2022, November 18). *Typhoid fever cases on the rise in NegOr.* Philippines News Agency. Retrieved from: <https://www.pna.gov.ph/articles/1188895>

- Maru, D. (2022, August 26). *Cholera, typhoid cases in Philippines up in 2022: DOH.* ABS-CBN News. Retrieved from: <https://news.abs-cbn.com/news/08/26/22/ph-cholera-typhoid-cases-up-in-2022>
- Montemayor, M.T. (2022, November 2). *Typhoid fever cases rise by 150%.* Philippines News Agency. Retrieved from: <https://www.pna.gov.ph/articles/1187603>
- Mayo Clinic (2023, January 28). *Typhoid fever.* Retrieved from: <https://www.mayoclinic.org/diseases-conditions/typhoid-fever/symptoms-causes/syc-20378661>
- Dayco, L.D., Garcia, E.B., & Ventura, M.C.H. (n.d.). *What Is Typhoid Fever?* UNILAB. Retrieved from: <https://www.unilab.com.ph/articles/what-is-typhoid-fever>
- Centers for Disease Control and Prevention (2022, December 12). *Typhoid Fever and Paratyphoid Fever.* Retrieved from: <https://www.cdc.gov/typhoid-fever/symptoms.html>

4. Treatment

- Antibiotic therapy is the only effective treatment for typhoid fever (Mayo Clinic, 2023).
- If you start to develop symptoms for typhoid fever, immediately see your doctor for proper diagnosis and treatment. Doctors often prescribe antibiotics for the treatment of typhoid fever. Hospitalization is recommended for those who develop severe symptoms, such as severe diarrhea, a swollen stomach, or persistent vomiting, as well as for children who develop the sickness. (Dayco et al., n.d.)

9) Pneumonia - *pneumonia is an infection that causes inflammation in one or both lungs, typically caused by bacteria, viruses, or fungi. The infection causes air sacs in the lungs to fill with pus or other fluids, making it difficult to breathe.*

1. Prevalence

- *In the Philippines, pneumonia remains to be among the top causes of death.*

Based on preliminary data from the Philippine Statistics Authority (PSA), as of August 2022, pneumonia ranked sixth as the top 10 causes of mortality in the country, causing the deaths of 13,536 people. (Baclig, 2022)

- *In the new normal, pneumonia remains a leading cause of hospitalization and death among the elderly and people living with chronic disease. While the severity of pneumonia can range from mild to life-threatening, it is most severe and fatal for infants and children, adults over 65 years old,*

immunocompromised individuals, and people living with chronic health problems.

And despite the looming threat of Covid-19, pneumonia remained the seventh leading cause of death in the Philippines in 2021. (Manila Bulletin, 2023)

2. Symptoms

Bacterial Pneumonia

- Cough, which may produce yellow, green or bloody phlegm or mucus
- High Fever
- Sweating or chills
- Shortness of breath
- Chest and/or Abdominal pain, which may worsen with coughing or breathing deeply
- Rapid heart rate
- Fatigue
- Bluish skin, lips or nails
- Confusion

Viral Pneumonia – symptoms similar to bacterial or additionally:

- Dry cough
- Headache
- Muscle Pain
- Extreme tiredness or weakness

Symptoms in young children

- Fever, chills, general discomfort, sweating/flushed skin
- Cough
- Difficulty breathing or rapid breathing
- Loss of appetite
- Vomiting
- Lack of energy
- Restlessness

Signs in young children

- Grunting sound with breathing or noisy breathing
- Pale skin
- Limpness
- Crying more than usual
- Difficulty feeding
- Decreased amount of pee or less wet diapers

3. Illness Info Reference

- Baclig, C.E. (2022, November 14). *Fighting for breath: Pneumonia continues to kill children worldwide*. Inquirer. Retrieved from:

<https://newsinfo.inquirer.net/1693038/fighting-for-breath-pneumonia-continues-to-kill-children-worldwide>

- Manila Bulletin (2023, February 14). *You don't know enough about pneumonia*. Retrieved from: <https://mb.com.ph/2023/2/13/you-dont-know-enough-about-pneumonia>
- National Heart, Lung, and Blood Institute (2022, March 24). *Pneumonia - Symptoms*. Retrieved from: <https://www.nhlbi.nih.gov/health/pneumonia/symptoms>
- Mayo Clinic Staff (2020, June 13). *Pneumonia*. Mayo Clinic. Retrieved from: <https://www.mayoclinic.org/diseases-conditions/pneumonia/symptoms-causes/syc-20354204>
- Cleveland Clinic (2022, November 15). *Pneumonia*. Retrieved from: <https://my.clevelandclinic.org/health/diseases/4471-pneumonia>

4. Treatment

- Treatment will depend on the cause for the pneumonia
 - Bacterial - Antibiotics
 - Fungal - Antifungal medication
 - Viral - A doctor would prescribe medication, but it can go away on its own. Alternatively, a provider can prescribe antivirals to reduce the severity of the virus and its duration.
- Over-the-counter medicines may be recommended to treat fever and muscle pain or help you breathe easier. Talk to your provider before taking cough or cold medicines. (National Heart, Lung, and Blood Institute, 2022)

10) Leprosy - *Leprosy is an infection caused by bacteria called Mycobacterium leprae. These bacteria grow very slowly and it may take up to 20 years to develop signs of the infection.* - CDC, 2017

1. Prevalence:

- “...An average of 1,500 to 2,000 new leprosy cases have been registered each year from 2014 to 2018, according to the DOH. Gaps in healthcare, particularly in remote rural areas, hinder prompt diagnosis and treatment of leprosy...” (Novartis, 2021)
- “...However, the Philippines still has the highest number of new cases in the Western Pacific region, with 1,660 new cases in 2017. Most of the cases are in poor, marginalized rural areas...” (Ramos, n.d; Kritz, 2019)
- “...According to the World Health Organisation, around 2,000 Filipinos are diagnosed with leprosy each year, which is officially recognised as a neglected tropical disease...” (Kumar, 2018)

2. Symptoms

Skin Symptoms

- Discolored patches of skin, usually flat (may be numb and look faded)
- Growths (nodules) on the skin
- Thick, stiff or dry skin
- Painless ulcers on the soles of feet
- Painless swelling or lumps on the face or earlobes
- Loss of eyebrows or eyelashes

Nerve Damage

- Numbness of affected areas of skin
- Muscle weakness or paralysis (especially in hands and feet)
- Enlarged nerves (especially around elbows, knees, and sides of neck)
- Eye problems that may lead to blindness (when facial nerves are affected)

Consequence to mucous membranes

- Stuffy nose
- Nosebleeds

3. Illness Info Reference

- Centers for Disease Control and Prevention (2017, February 10). *Hansen's Disease (Leprosy) - Signs and Symptoms*. CDC. Retrieved from: <https://www.cdc.gov/leprosy/symptoms/index.html>
- Ramos, A. J. O. (n.d.). *Leprosy in the Philippines: History, Disease, and Challenges*. The Filipino Doctor. Retrieved, April 1, 2023, from: <https://thefilipinodoctor.com/article/leprosy-in-the-philippines-history-disease-and-challenges>
- Kritz, B. (2019, March 2). *Leprosy Remains a Stubborn, Unseen Problem in the Philippines*. Inter Press Service. Retrieved from: <https://www.ipsnews.net/2019/03/leprosy-remains-stubborn-unseen-problem-philippines/>
- Novartis (2021, January 28). *Novartis renews commitment to support DOH goal of leprosy-free Philippines*. Novartis. Retrieved from: <https://www.novartis.com/ph-en/news/media-releases/novartis-renews-commitment-support-doh-goal-leprosy-free-philippines>
- Kumar, A. (2018, January 26). *Tackling leprosy in the Philippines - in pictures*. The Guardian. Retrieved from: <https://www.theguardian.com/healthcare-network/gallery/2018/jan/26/tackling-leprosy-in-the-philippines-in-pictures>

4. Treatment

- Treatment lasts usually for one to two years, it can be cured if treatment is completed as prescribed. Coordinate with your local health professionals for treatment, usually it is treated with a combination of antibiotics to prevent antibiotic resistance development of the bacteria.

- Make sure to communicate with your doctor to share information on your situation from experiencing numbness or loss of feeling in certain parts of your body, as this may be caused by nerve damage from the infection. As well as from skin patches becoming red and painful, nerves as well, and a fever, as these may be of consequence from Leprosy and more treatment with medicine must be prescribed to reduce inflammation.
- Stick with the antibiotics and don't stop until your doctor concludes that your treatment is complete. Stopping early may make the bacteria start growing again.
- To clarify, the antibiotics will kill the bacteria that cause leprosy and prevent it from getting worse but does not reverse nerve damage or physical disfiguration that may have occurred before the diagnosis. As such, the sooner you get treated, the less permanent nerve damage occurs.

Table for Ease of Comparing with Common Symptoms

[illegible]

	Dengue	Hyper...	Hepa..B	Influenz a	Cholera	Measles	Tuber..	Typhoid	Pneum..	Leprosy
Nausea	x	x	x							
Fatigue/ Tiredne ss			x	x	x		x	x	x, viral if extreme	
Cough				x		x	x (especial ly with blood or mucus)	x	x (yellow, green, or bloody phlegm/ mucus)	
Diarrhe a				x, more common in children	x, especiall y if its milky			x		
Loss of appetite			x				x	x	x, children	
Rash	x							x		
Confusi on		x						x, severe case	x	
Nose bleedin g		x								x
Stuffy nose				x						x
Runny				x		x				

	Dengue	Hyper...	Hepa..B	Influenz a	Cholera	Measles	Tuber..	Typhoid	Pneum..	Leprosy
nose										

Unique Symptoms

Disclaimer: These symptoms are not limited to only one sickness, severe cases may catch more diseases and complications, and in consequence experience more symptoms. Still, when symptoms are sparse, these will be able to tell better.

Dengue

Pain behind the eyes, and swollen glands.

Hypertension

High blood pressure, dizziness, blurred vision or other vision changes, anxiety, buzzing in the ears, and abnormal heart rhythm.

Hepatitis B

Dark urine, clay-colored bowel movements, and Jaundice.

Influenza

Sore throat.

Cholera

Rapid dehydration, rapid heart rate, low blood pressure, loss of skin elasticity, muscle cramps, and thirst.

Measles

Red-watery eyes, Koplik spots, Measles rash (do not confuse with others, blood test)

Tuberculosis

Pain with breathing or coughing, Night sweats, Weight loss, Not feeling well in general - Active stage inside of lungs

Night sweats, Weight loss, Not feeling well in general, Pain near site of infection - Outside of lungs, similar inside but with pain near site of infection

Sluggishness and inactivity, Unusually fussy, Poor feeding, Bulging soft spot on head, Poor reflexes, Swelling fluid around brain or spinal cord - Infants

Blood in urine or stool

Typhoid

Stomach pain, very swollen stomach, Sepsis, unable to pay attention to anything around them, and unable to react to the world around them.

Pneumonia

Shortness of breath, rapid heart rate, bluish skin lips or nails - Bacterial

Similar to bacterial + extreme tiredness or weakness -Viral

general discomfort, sweating/flushed skin, lack of energy, restlessness - young children

Leprosy

Discolored patches of skin, Growths (nodules) on skin, Thick, stiff or dry skin, painless ulcers on soles of feet, painless swelling or lumps on face or earlobes, loss of eyebrows or eyelashes, numbness of affected areas of skin, muscle weakness or paralysis, enlarged nerves, eye problems that lead to blindness

