Decision Medical-Support Plan Using the Bayes Method to Diagnose the Symptoms of Digestive System Diseases

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Abstract: *According to the importance and recommendations of the health organization about individual diseases, emphasis on the updating of medical techniques and methodology has been currently obtained a special place. By combining fields related to this subject, including computer science, has proven its application in medical discussions and is very important for solving the challenges in this area. Using a variety of algorithms and techniques, a decision medical support system can be provided to diagnose many diseases in a timely manner, as well as provide solutions for them. This research introduces the importance of the digestive system and the relevant microorganisms, and for the purpose of test and obtaining data by smell sensory which is taken through mouth, will be evaluated using the Bayes method for the timely diagnosis of the disease in three organs of the mouth, esophagus & pharynx and stomach. By examining the symptoms and bacterial elements in these three organs, we will work to diagnose the disease. By an overall assessment of these elements, the probability and the percentage of the presence of symptoms that may affect the person in the future will be analyzed.*

Keywords: *Digestive Disease Diagnosis, Bacteria, Bayes Method, Data Mining, Decision Medical Support System.*

INTRODUCTION

With this famous slogan of medicine, "Prevention is better than cure". Researchers in the field of medicine are pursuing further research in this regard. The doctors have proved that there are many methods to diagnose and prevent diseases timely, but based on the results, and according to the Hakim Jorjani words, three principles are considered for diseases including: 1- Disease (illness), 2- side effect (side effects of that disease), 3- cause (the cause of the disease), that is, each disease has a cause and its complications that it may be another disease, itself. Understanding symptoms and correct diagnose the type of disease can provide an acceptable trend to determine the disease, and it's an introduction to healing and recovery. In modern medicine, the disease is characterized by observing the symptoms of the patient, these observations can be obtained from a person's physical condition or mental symptoms. The items of touching, measuring instruments and taking tests from the patient create a database of symptoms and help the doctor to diagnose the disease and its type. Doctors adapt the symptoms with previous experience and reports and documentations from other doctors, then determine the type and method of treatment of that disease. The diagnosis of many patients is complicated or, in some cases, their symptoms are close. These symptoms should be evaluated in a variety of different ways, which will make it possible to use different techniques and

methods to recognize and diagnose symptoms. This issue can cause the presence of some diseases to be widespread and unknown, and that there is no other sign of and diagnose and recognition decisively, there is no correct statement. Based on this description, the use of a decision medical support system implemented by computer science and intelligent algorithms are the best option for diagnosing diseases, as well as determining their type.

In regard to the causes of bacterial or similar diseases, any type of bacteria or germ has certain symptoms in relation to their environment and site of release, these symptoms can be the most likely changes and chemical reactions that occur at their proliferation site and provide a precondition for onset of one or more diseases (Whiteley, Diggle and Greenberg, 2017). These microorganisms are identifiable in relation to the process and reactions that they show, and these reactions can cause complications such as poisoning or inflammation in one or a part of a member. The use of FT-IR imaging can be a quick and cost and effective diagnosis of pathogenic bacteria. The proposed method in standard conditions is suitable for transferring microbial materials to IR inputs and, measurements are optimized by device learning classes with artificial neural networks using matrix methods (Lasch et al., 2018). In the meantime, the researchers divide the bacteria into two gram positive and gram negative categories, some of which are causing the disease. The bacteriologists are divided the natural bacterial species residing in the body into two temporary or transient and another persistent species, depending on the degree of prevalence. Transient species, unlike persistent species, live only for some time in the body and may be removed from the body for a while due to the lack of necessary mechanisms for life and new colonization. Pathogenic bacteria do not always cause infection and illness, that is, a healthy person may have this bacterium in his/her body and stomach, and there are no symptoms (Ramírez-Guízar et al., 2017). Based on this explanation, the present study is about human digestive system, which by considering several organs including mouth, esophagus & pharynx, and stomach, examined the their environmental and structural conditions that contain numerous microorganisms. Given the magnitude and dynamics of microorganisms in dealing with each other and the role of some harmful microorganisms in the digestive system, the total data presented in this study is introduced in a minimum and maximum range that may occur, and examine based on a series of basic rules in this area by default.

Human Digestive System

The digestive system is one of the active parts of the human body that extends from the mouth to the anus, consisting of the digestive tract and glands and is about 7 m in length. The digestive tract also includes the mouth, pharynx, esophagus, stomach, narrow intestine, and the colon[1].

Anything that enters the stomach is mixed with the enzymes inside it to decompose into more simple components. The mixture then goes out of the stomach and goes to the intestines to get the decomposed food for the blood flow (Derakhshan, 2017). The decomposed food passes through the blood flow throughout the body and is placed on the cells of the body to be consumed or stored. Food components that are not absorbed are repelled from the body.

Microorganisms

Ibn Sina, an Iranian scientist of the tenth and eleventh century AD, had realized that microorganisms caused the disease[2]. However, he may not be regarded as the discoverer of germs. But this was done by Antonie van Leeuwenhoek. Leeuwenhoek, with his primary microscope, observed the water of the pond and found out that there are microorganisms in it. Among other important people in this field, Robert Koch noted that discovered the bacterium of tuberculosis[3]. Microorganisms are microscopic organisms that are not seen with the armed eye. In spite of their simple structure, these microorganisms are capable of physiological activities that

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[1] human digestive system (2016), http://elmnama.com.
[2] https://fa.wikipedia.org.
[3] biology (2018), http://daneshnameh.roshd.ir.

organic organisms carry out with multi-cellular structures. Microorganisms in other living creatures, such as humans, animals and plants, have a significant and important role in the life cycle. But their importance is not limited to the environment, and they have also shown their applications in technology and industry.

Bacteria

Bacteria are mono-cellular microorganisms that have lived on Earth for millions of years ago and very much before the creation of humans. The bacteria take their nutrients directly from their environment. Humans also need some bacteria to get the nutrients they need. These bacteria typically live in the intestines (Hill, 2018). The proliferation of bacteria and other microorganisms requires proper environmental conditions and the presence of nutrients. These conditions vary according to the type of organisms. These requirements include moisture, energy, and carbon sources and basic elements. If the above conditions are not met, the growth rate is declining and we will see a growth curve consisting of four stages of lag, logarithmic, and a record (static) and death (relative). But the problem here is that bacteria are negligible in comparison to human body cells[4]. Therefore, it is difficult and challenging to observe and confront them during a prevalence.

Partitioning Problem Statement

To give a detailed explanation of the implementation of the research, the visual paradigm software was used to analyze each section of the digestive system with the factors related to each of them, including temperature, pH and moisture, which percentages of each are specified. Then, by separating them, we will work out the problem. In Fig. 1, three parts of the digestive system, including the mouth, esophagus & pharynx, are the stomach, each of which is considered as an agent here.
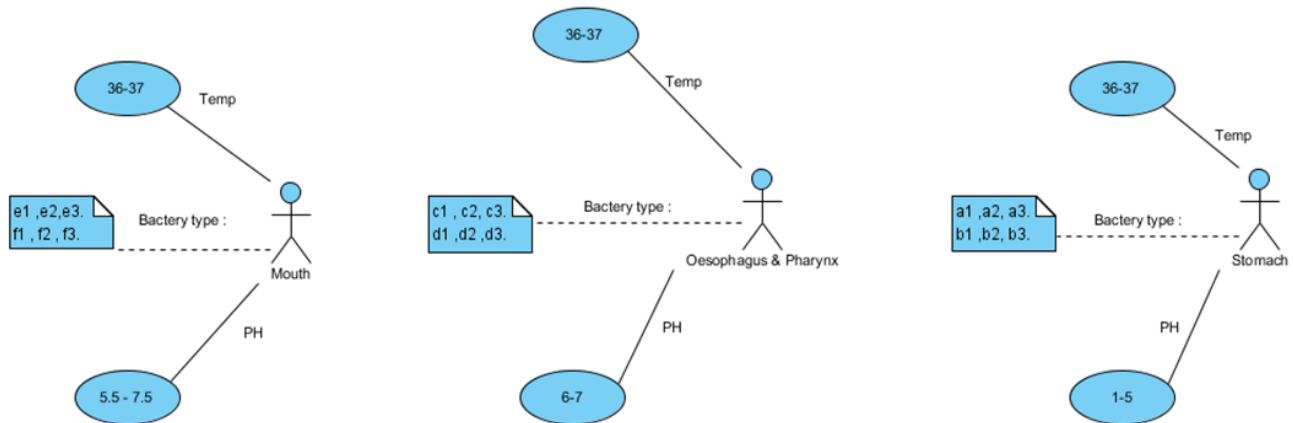

Fig.1: Digestive system separation by features

Here we consider two types of bacterial species for each agent (mouth, esophagus & pharynx stomach), each of which has a subset of bacteria in that species. In Fig. 2, we classify some mineral elements of the body (inorganic, organic materials), which play a fundamental role in the structure of microorganisms. That is, some elements are exacerbated the microorganisms, and in the other category, materials that destroy or disrupt the growth of bacteria are observed. In general, these three distinct parts are useful elements that are needed by the human body and are fed into body by the daily food, and the effect and relationships between them are determined in Fig. 2.

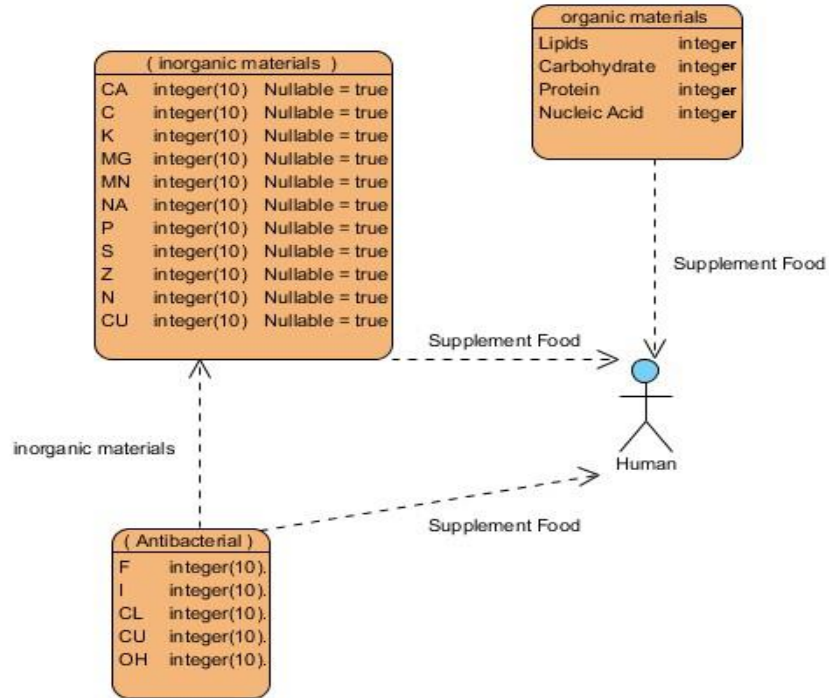[4] biology (2018), http://daneshnameh.roshd.ir.

Fig. 2: Inorganic materials separation in the human body

Then some of the elements from the total organic and inorganic materials for bacteria are described as follows.
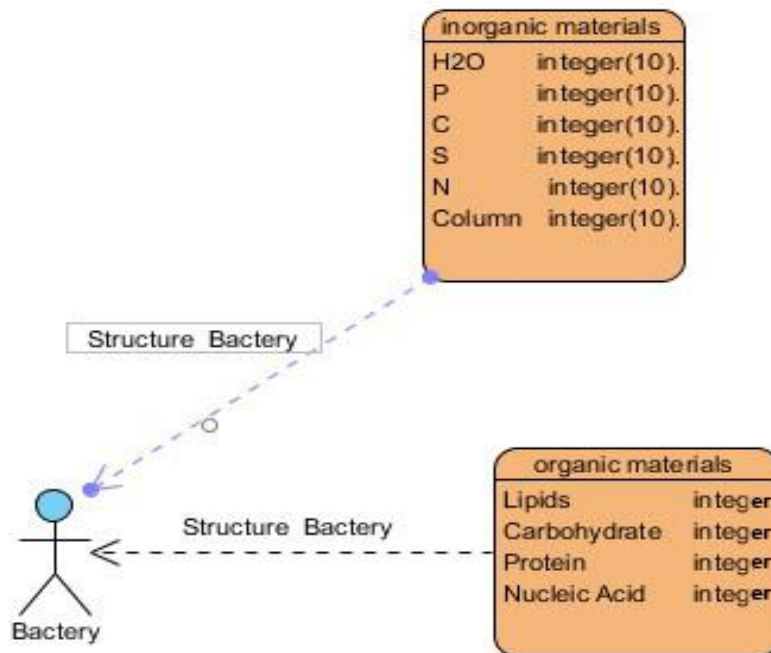

Fig. 3: useful and constructive elements for bacteria

But a small percentage of organic material is involved in the structure of bacteria, and its constructive parts include inorganic material such as carbon, nitrogen, sulfur, phosphorus and water. But with the studies

conducted, it is observed that a productive rotation will provide the necessary materials for the growth of microorganisms or their elimination, all of which are related to each other, and also affect the growth and development of bacteria. Subsequently, decision medical support systems are designed to provide timely guidance to healthcare professionals (Shilaskar, Ghatol and Chatur, 2017) and are an alternative strategy for increasing the accuracy of testing and diagnosis and treatment of developing disease. The ability to generalize these systems is examined based on the characteristics of the data set used during its development. In the research (Maseleno and Hidayati, 2017) and in Fig. 4, diagnose and presence of 6 bacteria with the default names, (a, b) for mouth, (c, d) related to the esophagus & pharynx, and (e, f) for the stomach, and the chart of each bacterium in each test, is shown a value relative to a disease in each member.
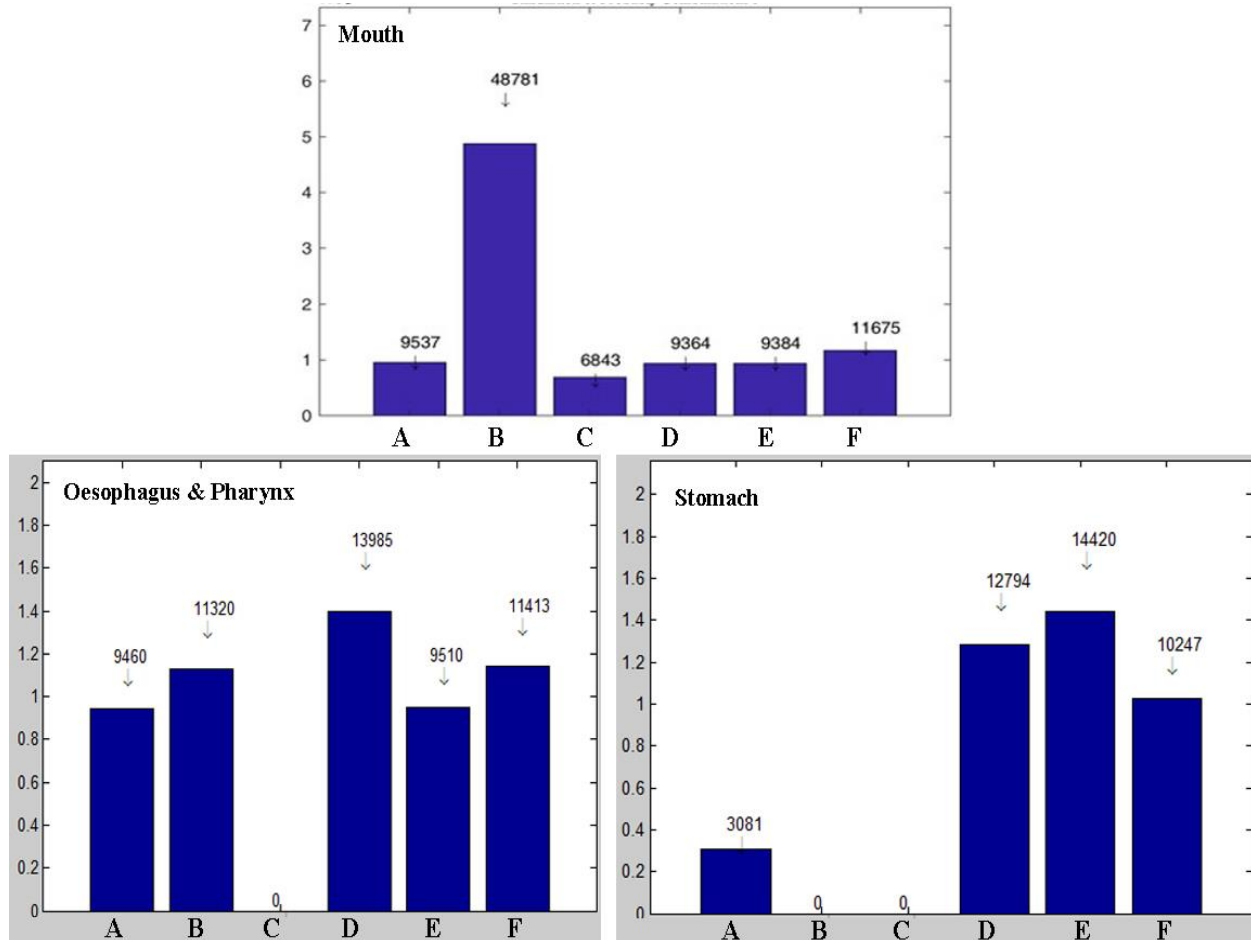
Fig. 4: Diagnostic charts of disease of three organs in the digestive system (Maseleno and Hidayati, 2017)

This test was performed on the basis of sampling and simulation by smell sensors by mouth and the diagnosis of disease was based on the highest number of bacteria associated with that member. The present study is also done in the following of the research (Maseleno and Hidayati, 2017).

Data Categorization Methods:

Categorical goals are to use a model to predict a class of objects that are labeled with unknown titles. Data mining is a heterogeneous group of different sciences, and any technique that can specify a new insight of data can be considered as data mining. This topic is the field of communication between statistics science,

computer science and artificial intelligence, data modeling. Categorization is a kind of learning done with the help of initial samples, and categorization is based on sets of predefined data.

Implementing Bayes Method

This method is referred to as part of a simple categorization based on a series of probabilities in machine learning topics. In general, this method is used to categorize states based on the probability of occurrence of a mode. For example, in the diagnosis of hepatitis B disease using the Bayes method, which is a good way to recognize and prevent disease (Maseleno and Hidayati, 2017) can be very practical. Bayes methods consist of initial knowledge and probabilities with a series of additional information that possible performance can be obtained from new data. Independent random variables are used in different states based on the Bayes Theorem. Despite the issues and assumptions that exist in the Bayes approach, it will be appropriate to categorize further issues.

The structure of bacteria that contains a range of inorganic materials such as carbon (5% to 11%), nitrogen (2 to 40%), sulfur (5%), water (20 to 65%), phosphorus (1 to 7%), which these structures has been achieved on the basis of scientists research. Our analysis for diagnosis of bacterial disease is examined accordingly. In the following, we consider a series of senses based on diagnose of inorganic materials in a person by the smell sensor in (Akraminia, 2018) and based on the inorganic materials in the structure of bacteria and inorganic materials sensed from a person's mouth, the analysis were done basis based on Bayes method. For example, if the database of esophagus & pharynx disease is considered, one of the parameters of this database is the bacteria and its values. So we can take into account that the structure of bacteria is analyzed after diagnose, and each of its mineral and chemical elements is also observed. All of these elements are determined to a certain value, which accordingly, and Bayes model:

$$p(x_1, \dots x_n \mid c) = p(x_1 \mid c) * p(x_2 \mid c) * p(x_3 \mid c) * \dots * p(x_n \mid c) \qquad (1)$$

$$C = \operatorname*{argmax}_{c_j \in C} P(C_J) \prod_{i=1}^{n} p(x_3 \mid c_i) \qquad (2)$$

Based on constant percentages, the bacterial structure is adapted. In each section of the mouth, esophagus & pharynx, and stomach, there are elements with a specified value, as shown in Fig. 4. For example, the bacteria e and f has been reported with 8.7% and 5% related to the mouth, respectively, which each of these elements separately were placed in both minimum and maximum range to achieve the average probability of that element. We consider the minimum and maximum value for each element in the structure of the bacterium in relation to other elements, as specified in Table 1.

Table 1: Minimum/maximum elements in each member

MAT-ORGN	Stomach				Esophagus & Pharynx				Mouth			
	a		B		C		d		E		F	
	min	max	min	max	min	Max	min	max	min	max	Min	Max
C	2	0.1	10	0.5	22	1	4	0.2	17.4	0.8	10	0.5
P	2	0.3	1.5	0.2	5	0.7	2	0.3	3	0.4	2	0.3
S	1	1	1	1	1	1	1	1	1	1	1	1
N	20	1	12.5	0.6	7	0.4	6	0.3	16	0.8	18	0.9
h2O	1.5	0.4	2	0.6	3	0.9	2.2	0.7	2.5	0.8	2.2	0.7

MIN-MAX	Stomach		Esophagus & Pharynx		Mouth	
	min	Max	Min	max	Min	Max
C	7	0.318	24	1.09	22.4	1.018
P	2.8	0.392	6	0.857	4	0.571
S	1.5	1.5	1.5	1.5	1.5	1.5
N	26.3	1.3125	10	0.5	25	1.25

h2O	2.4	0.746	4	1.238	3.525	1.084

For example, the amount of carbon in the structure of a bacteria, according to scientists, is from a minimum of 5% and a maximum of 11%, which is derived from two detected carbon at minimum and maximum in mouth bacteria, e with 8.7%, and f with a 5% value. According to estimates from Table 1, the minimum carbon of bacteria related to the mouth is 22.4%, which is the lowest probability of getting this element in the mouth. Also, the maximum bacterial carbon of the mouth is achieved with value of 1.018%, which is the lowest probability of getting this element in the mouth. Therefore, an averaging is obtained for the correctness of the samples from two minimum and maximum intervals of detected elements with minimum and maximum standard states of the elements forming bacteria here.

In the research (He et al., 2018), a new method for diagnose of bacteria is presented, which can improve the bacterial diagnose accuracy by 98% using the machine learning algorithm. It is also best to learn more about the basic protocols for diagnose of bacteria to optimize labeling strategies and machine learning algorithms. The machine learning to teach the initial samples of microorganisms can be used. We can also examine whether the diagnosis of elements that are in mouth disease are related to the stomach.

This state is similar to the independence of the events (s, o, m) which is abbreviation for the three organs in the digestive system. Because all the elements are in some way dependent or independent of each other, or are subordinated to each other, so these three events are independent if:

P (SOM) = P(S)P(O)P(M)   (3)

P(SO) = P(S)P(O)   (4)

P(SM)= P(S)P(M)   (5)

P(OM) = P(O)P(M)   (6)

Given the minimum and the maximum of the elements in the members, this amount may be the same in the other two members. That is, the s element in all members is the same as seen. Or the amount of c in the mouth, and esophagus & pharynx is close together. Therefore, it is possible that the bacterial structure of the disease in each member also related to the other members or is similar with it, which this effect will be very significant. According to the above results, we can illustrate with an example the probabilities of the effects of the elements of a bacterium in each member. Here, C_1, C_2 and C_3 are related to the stomach, esophagus & pharynx and the mouth, respectively. Each of the six relevant elements is also specified to determine the probabilities as follows. We evaluated the values based on the minimum and maximum bacteria in each member and Table 5-1, based on the bacterial averaging in each member, according to the Bayes probabilities. In two cases, the data for diagnosis of the bacterium in each member were aligned in the same direction, and both specify the more probability for the mouth.

$$P(C_1 \mid X) = p(C_1)\, p(c_1 \mid c_1) p(p_2 \mid c_1)\, p(n_3 \mid c_1)\, p(s_4 \mid c_1)\, p(h_5 \mid c_1) \approx 42.13 - 3.84$$

$$p(C_2 \mid X) = p(C_2)\, p(c_2 \mid c_2) p(p_2 \mid c_2)\, p(n_3 \mid c_2)\, p(s_4 \mid c_2)\, p(h_5 \mid c_2) \approx 48.09 - 29.88$$

$$p(C_3 \mid X) = p(C_3)\, p(c_3 \mid c_3) p(p_2 \mid c_3)\, p(n_3 \mid c_3)\, p(s_4 \mid c_3)\, p(h_5 \mid c_3) \approx 59.13 - 31.29$$

According to the default diagnosis, the probability of bacterial disease of mouth is more than the other two members. So, based on a smaller sign, greater this probability is equal to C3> C2> C1.

Considering the importance and recognition of diseases, this method can be used in many medical fields and is also effective in helping the doctor in the therapeutic phase. In (Sharma and Virmani, 2017), a decision medical support system for the diagnosis of coronary disease is considered by a kind of categorization that is of importance and application of this discussion.

Conclusions

Due to the importance and sensitivity of the digestive system, the human body contains a variety of microorganisms. The human digestive system, due to its central position in the body, the existence of any disease in this part of the body has effect on other members. Due to the proper environmental conditions of the digestive system, microorganisms can continue to grow and proliferate in this area and cause disease or infections. In the past, various methods have been used to diagnose these symptoms of disease, which are usually time consuming and costly. But the most important thing is the time and type of diagnosis that is important to be acted timely to treat and prevent further damage. The use of statistical methods and computer science in this field can be very practical. Based on this, we examined and diagnosed bacteria in three organs of the mouth, esophagus & pharynx and stomach using the Bayes method. Of the probabilities, the incidence of disease symptoms of mouth is 59.13% and the probability of symptoms in the esophagus & pharynx is 48.09%, which this estimation for the stomach is 42.13%. This development and diagnosis process of disease can be effective in using a medical decision medical support system. That is, given the input of the data necessary for people, it is possible to diagnose the percentages of the symptoms of the disease that are present in the individual, but still not causing the disease to be diagnosed in a timely manner, and to proceed in the important prevention discussion.

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