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Nano Topology and Decision Making in Medical Applications

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***Abstract*-This paper is divided into two parts: Firstly, we study the theory of The Nano Topology and investigate its relation with the work of a medical application on Random Blood Sugar Testing, and the discovery which affects the inaccuracy of measuring Blood Sugar Levels. This gives us negative results that affect the health of diagnosing the disease. In the second section, we study The Coronavirus and identifying the most important factors that confirm the positive of the disease.**

***Keywords*- Nano Topology; Random Blood Sugar Testing, Coronavirus.**

I. INTRODUCTION

Nano Topology in terms of Lower and Upper Approximations, the method of reduction of Nano Topology depends on Information Systems division of data into the collection. In which the categories are elements of the same conditions, and the reduction of effects the classification, which makes this method of the best ways to deal with (IS), which can be deleted conditions and elements are not influential in the decision, Nano Topology was introduced by Lillis Thivagar and Richard [1, 2, 3, 4, 5, 6, 7, 8]. Utilizing the theories approximate and a subset of the universe`s the boundary region of based on the equivalency relations, the theory has been proved. Additionally, considering the theory, Nanostructures, and inward Nanostructures are recognized.

II. FUNDAMENTAL OF NANO TOPOLOGY MODEL

Definition 2.1. [1] Let $\mathcal{U}$ be the universe, R be an equivalence on $\mathcal{U}$ and, $\mathcal{T}_R(Y) = \{\mathcal{U}, \emptyset, \mathrm{R}^*(Y), \mathrm{R}_*(Y), B_\mathrm{R}(Y)\}$, called A Nano Topology, where: $Y \subseteq \mathcal{U}, \mathcal{T}_\mathrm{R}(Y)$, fulfills the accompanying aphorisms. If: $\mathcal{U}$ and $\emptyset \in \mathcal{T}_\mathrm{R}(Y)$, The union of the objects of any the subcollection $\mathcal{T}_\mathrm{R}(Y)$ is in $\mathcal{T}_\mathrm{R}(Y)$, The intersections of the elements of any the subcollection $\mathcal{T}_\mathrm{R}(Y)$ is in $\mathcal{T}_\mathrm{R}(Y)$.

Remark 2.2. [1] Let $\mathcal{U}$ be the universe of objects and R be an equivalence relation on $\mathcal{U}, \forall\, Y \subseteq \mathcal{U}$,we characterize $\mathcal{T}_\mathrm{R}(Y) = \{\mathcal{U}, \emptyset, \mathrm{R}^*(Y), \mathrm{R}_*(Y), B_\mathrm{R}(Y)\}$, where: $\mathrm{R}^*(Y), \mathrm{R}_*(Y)$,and $B_\mathrm{R}(Y)$, are individually the boundary, the lower and upper approximations district of Y regarding R,we note that $\mathcal{U}$, and $\emptyset \in \mathcal{T}_\mathrm{R}(Y)$. Since: $\mathrm{R}_*(Y) \subseteq \mathrm{R}^*(Y)$, $\mathrm{R}_*(Y) \cup \mathrm{R}^*(Y) = \mathrm{R}^*(Y) \in \mathcal{T}_\mathrm{R}(Y)$, also $\mathrm{R}_*(Y) \cup B_\mathrm{R}(Y)\mathrm{R}^*(Y) \in \mathcal{T}_\mathrm{R}(Y)$, and $\mathrm{R}^*(Y) \cup B_\mathrm{R}(Y) = \mathrm{R}^*(Y) \in \mathcal{T}_\mathrm{R}(Y)$,also $\mathrm{R}_*(Y) \cap \mathrm{R}^*(Y) = \mathrm{R}_*(Y) \in \mathcal{T}_\mathrm{R}(Y)$, and $\mathrm{R}^*(Y) \cap B_\mathrm{R}(Y) = B_\mathrm{R}(Y) \in \mathcal{T}_\mathrm{R}(Y)$, and $\mathrm{R}^*(Y) \cap B_\mathrm{R}(Y) = \emptyset \in \mathcal{T}_\mathrm{R}(Y)$.

Proposition 2.3. [1] If $\mathcal{T}_\mathrm{R}(Y)$ is A Nano Topology on $\mathcal{U}$ concerning Y, then the set $\beta\,(\mathcal{T}_\mathrm{R}(Y)) = \{\mathcal{U}, \mathrm{R}_*(Y), B_\mathrm{R}(Y)\}$, is the basis for $\mathcal{T}_\mathrm{R}(Y)$.

III. Nano Topology in Random Blood Glucose Test

The random sugar analysis is one of the types of analyses used to check blood glucose, to help a diagnose diabetes, or to monitor treatment and the blood sugar levels in the people with diabetes. Typically, one pricks the finger to accomplish a small drop of blood and wiping it with a special digital chip to obtain the result of the blood sugar within a few moments. It is a worth noting that no preparations or procedures are needed before the analysis is performed, in addition to analysing the people with diabetes to check the level of blood sugar, the doctor may perform a random sugar analysis in a case of suspicion that the person has diabetes, and it should be noted that the incidence of type 2 diabetes may occur a slowly which may lead to delayed onset symptoms of the disease.

A. Some of The Symptoms of Diabetes that may Require Following Analysis

If your blood sugar level is higher than 200 milligrams per decilitre, this means that you have diabetes.

The percentage of random sugar in the blood varies according to the timing and the amount of food the patient consumed.

Sugar is between 80 milligrams per decilitre to 120 milligrams per decilitre upon waking up or before eating. The sugar level is between 100 milligrams per decilitre to 140 milligrams per decilitre after meals or just before bed.

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B. Some Other Factors that Influence Outcome of Analysis

In the case of drinking alcohol directly before the examination or several days before it is taken. Severe disease increases the level of sugar in the blood. Smoking is one of the factors that increase of sugar in the blood. Eating large quantities of caffeine, such as coffee and tea, during the day will increase the level of sugar.

C. The Rate of Normal Random Sugar

The normal percentage of blood sugar level in healthy people is related to the time they were examined or eaten; the results of this examination are divided into 3 sections according to the time of taking the blood:

The normal sugar level for a person fasting 8 hours or more is less or equal to 100 mg / dL.

In the case of eating food from a time that may reach two hours, and if the person is under the age of fifty years, they will have a sugar level of less than 140 mg / dL.

people over 50 years, their natural sugar level is 150 mg / dL, and for people older than 60, their sugar level is less than 160 mg /dL.

The natural percentage of sugar when undergoing a random examination depends on the quantity and quality of food that a person consumed before the examination, but often the proportion of sugar is normal when waking up from the morning.

In this application, we will analyze the data of a group of patients. A random blood test was tested for the appearance of some symptoms similar to diabetes. Their data was in the following Table 1:

Table 1: Random blood glucose test

Patients (P)	Take Cortisone(C)	Syncope (S)	Physical stress(P)	RBG
P_1	Yes	Yes	No	High
P_2	Yes	No	Yes	High
P_3	Yes	No	No	High
P_4	No	Yes	Yes	Normal
P_5	No	Yes	No	Normal
P_6	No	No	Yes	Normal

Based on the information system of the random blood glucose testing, and the corresponding Nano Topology, we will discover and predict disease-causing factors, disease detection using a new algorithm caused by Nano Topology.

Start implementing steps:

Algorithm of The Nano Topology to detect The Random Blood Glucose Test

Step 1: If universe $\mathcal{U}$, $\mathbb{A}$ is a set of attributes, $C$is a condition of attributes, and $D$is a choice of attributes, the elements labeled the low, and the attributes labeled by the columns.

Step 2: We determine the boundary region, the upper approximation, and the lower approximation of Y.

Step 3: Form Nano Topology $\mathcal{T}_{R}(Y)$ on $\mathcal{U}$, and its basis β ($\mathcal{T}_{R}(Y)$).

Step4: Delete an attribute(xi) from C, and calculate the boundary region, the upper approximation, and the lower approximation of Y.

Step 5: Form Nano Topology $\mathcal{T}_{R-(x_I)}(Y)$ on $\mathcal{U}$, and its basis β ($\mathcal{T}_{R-(x_I)}(Y)$).

Step 6: Renew Step 3, and,4.∀ attributes in C.

Step 7: The resulting attributes in C which β ($\mathcal{T}_{R}(Y)$)≠ β ($\mathcal{T}_{R-(x_I)}(Y)$) generate The Core.

Step1: $\mathcal{U} = \{P1, P2, P3, P4, P5, P6\}$, Take Cortisone($C$), Syncope ($S$) ,and Physical Stress($P$) form the attributes, and Random Blood Glucose Tests (RBG) the set of decisions.

$Y = \{P1, P2, P3\}$, the set of patients having high random blood glucose.

$$\mathcal{U}/R = \{\{P1\},\{P2\},\{P3\},\{P4\},\{P5\},\{P6\}\}$$

Step 2: The lower and upper approximation of Y denoted by $R_*(Y) = \{P1, P2, P3\}$, and $R^*(Y) = \{P1, P2, P3\}$.

Therefore $B_R(Y) = \phi$.

Step 3: The Nano topology: $\mathcal{T}_R(Y) = \{\mathcal{U}, \phi, \{P1, P2, P3\}\}$, and its basis $\beta\ (\mathcal{T}_R(Y)) = \{\mathcal{U}, \phi, \{P1, P2, P3\}\}$.

Step 4: Case (1): If the attribute "Take Cortisone" is removed then: $\mathcal{U}/(R-\{c\}) = \{\{P1, P5\}, \{P3\}, \{P2, P6\}, \{P4\}\}$,

$(R-\{c\})_*(Y) = \{P3\}$,

$(R-\{c\})^*(Y) = \{\{P1\}, \{P2\}, \{P3\}, \{P5\}, \{P6\}\}$.

Step 5: $\mathcal{T}_{R-(c)}(Y) = \{\mathcal{U}, \phi, \{P3\}, \{P1, P2, P3, P5, P6\}, \{P1, P2, P5, P6\}\}$,

$\beta\ (\mathcal{T}_{R-(c)}(Y)) = \{\mathcal{U}, \{P3\}, \{P1, P2, P5, P6\}\} \neq \beta\ (\mathcal{T}_R(Y))$.

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Step 6: Case (2): If the attribute "Syncope" is removed then:
$\mathcal{U}/(\mathrm{R}-\{s\}) = \{\{P1, P3\}, \{P2\}, \{P5\}, \{P6\}, \{P4\}\}$,
$(\mathrm{R}-\{s\})_*(Y) = \{P1, P2, P3\}$,
$(\mathrm{R}-\{s\})^*(Y) = \{P1, P2, P3\}$,
$\mathcal{T}_{\mathrm{R}-(s)}(Y) = \{\mathcal{U}, \phi, \{P1, P2, P3\}\}$,
$\beta\ (\mathcal{T}_{\mathrm{R}-(s)}(Y)) = \{\mathcal{U}, \phi, \{P1, P2, P3\}\} = \beta\ (\mathcal{T}_{\mathrm{R}}(Y))$.
Case (3): If the attribute "Physical Stress" is removed then:
$\mathcal{U}/(\mathrm{R}-\{P\}) = \{\{P1\}, \{P2, P3\}, \{P4, P5\}, \{P6\}\}$,
$(\mathrm{R}-\{P\})_*(Y) = \{P1, P2, P3\}$,
$(\mathrm{R}-\{P\})^*(Y) = \{P1, P2, P3\}$,
$\mathcal{T}_{\mathrm{R}-(P)}(Y) = \{\mathcal{U}, \phi, \{P1, P2, P3\}\}$,
$\beta\ (\mathcal{T}_{\mathrm{R}-(P)}(Y)) = \{\mathcal{U}, \phi, \{P1, P2, P3\}\} = \beta\ (\mathcal{T}_{\mathrm{R}}(Y))$.
Step 7: Therefore, The Core (R) = {C}. Likewise, if Y is considered the patients' set with normal blood glucose, then again, The Core (R) = {C}.

Remark 3.1. We conclude from this application that it is not accurate to judge a patient with diabetes despite the presence of apparent symptoms of the disease, it may lead to eating cortisone is the reason for the high blood sugar levels. For this reason, it is not desirable to judge the rate of blood sugar in patients while eating substance cortisone.

IV. COVID-19 in Terms of Nano Topology

Coronaviruses are a wide scope of infections that may cause malady in creatures and the people. It is realized that various coronaviruses cause human respiratory sicknesses in seriousness running from the basic virus to progressively extreme ailments, for instance, the Middle East Respiratory disease. The newfound Coronavirus causes Covid-19 sickness.

A. The Side Effects of COVID-19 Infection

The most widely recognized manifestations of the Covid-19 malady are fever, exhaustion, and dry hack. Other, less normal side effects that a few patients may have include: torment and throbs, headache, conjunctivitis, the runs, sore throat, loss of taste or smell, rash or discoloration of the fingers or toes and nasal blockage. These manifestations are generally mellow and start bit by bit. A few people become contaminated without feeling mellow manifestations. A large number of patients up to 80% recover from illness without needing special care. However, about one in five patients with Covid-19 disease who have side effects also experience increasingly severe side effect. The danger of creating serious difficulties increments among the older and individuals with other medical issues, for example, hypertension, heart and lung malady, diabetes, or malignant growth. All individuals, of all ages, should look for clinical consideration promptly on the off chance that they build up a fever as well as hack joined by trouble breathing/windedness, chest agony or weight, or loss of discourse or development. At whatever point conceivable, it is suggested that you contact your doctor or medicinal services office ahead of time, with the goal that the patient can be coordinated to the suitable center. In this application, we will analyze the data of a group of patients. They showed a group of different symptoms. Their data was in the following Table: 2:

Based on the information system of Covid-19, and the corresponding Nano Topology, we will discover and predict disease-causing factors, disease detection using a new algorithm caused by Nano Topology. Where: High temperature, Breathing Difficulty, Sore Throat, Physical Strain, and Loss of Taste and Smell are represented by symbols: *A1*, *A2*, *A3*, *A4*, and *A5* respectively. Assume that :"Yes","No"represent by symbols: "1", "0"

Algorithm of The COVID -19 virus`s adverse effects:
Step 1: If universe $\mathcal{U}$, $\not{A}$ is a set of attributes, $C$is a condition of attributes, and $D$is a choice of attributes, the elements labeled the low, and the attributes labeled by the columns.
Step 2: We determine the boundary region, the upper approximation, and the lower approximation of *Y*.
Step 3: Form Nano Topology $\mathcal{T}_{\mathrm{R}}(Y)$ on $\mathcal{U}$, and its basis β ($\mathcal{T}_{\mathrm{R}}(Y)$).
Step4: Delete an attribute(xi) from C, and calculate the boundary region, the upper approximation, and the lower approximation of Y.
Step 5: Form Nano Topology $\mathcal{T}_{\mathrm{R}-(x_I)}(Y)$ on $\mathcal{U}$, and its basis β ($\mathcal{T}_{\mathrm{R}-(x_I)}(Y)$).
Step 6: Renew Step 3, and,4.∀ attributes in C.
Step 7: The resulting attributes in C which β ($\mathcal{T}_{\mathrm{R}}(Y)$)≠ β ($\mathcal{T}_{\mathrm{R}-(x_I)}(Y)$) generate The Core.

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Start implementing steps:
Step1: Assume
$U =$ $\{P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16, P17, P18, P19, P20, P21, P22, P23, P24, P25, P27, P28, P29, P30, P31, P32\}$, *be the set of patients,*
$Y = \{P1, P2, P17, P18\}$,
Y the patients` set who showed positive outcomes.
$\mathcal{U}/R =$ $\{\{P1\}, \{P2\}, \{P3\}, \{P4\}, \{P5\}, \{P6\}, \{P7\}, \{P8\}, \{P9\}, \{P10\}, \{P11\}, \{P12\}, \{P13\}, \{P14\}, \{P15\}, \{P16\}, \{P17\}, \{P18\}, \{P19\}, \{P20\}, \{P21\}, \{P22\}, \{P23\}, \{P24\}, \{P25\}, \{P26\}, \{P27\}, \{P28\}, \{P29\}, \{P30\}, \{P31\}, \{P32\}$.
Step 2: The lower and upper approximation of Y denoted by:
$R_*(Y) = \{P1, P2, P17, P18\}$, *and* $R^*(Y) = \{P1, P2, P17, P18\}$, Therefore $B_R(Y) = \phi$.
Step 3: The Nano Topology:
$\mathcal{T}_R(Y) = \{\mathcal{U}, \phi, \{P1, P2, P17, P18\}\}$, *and its basis*
$\beta(\mathcal{T}_R(Y)) = \{\mathcal{U}, \phi, \{P1, P2, P17, P18\}\}$.
Step 4: Case (1): If the attribute "A1" is removed then:
$\mathcal{U}/(R - \{A1\}) = \{\{P1, P17\}, \{P2, P18\}, \{P3, P19\}, \{P4, P20\}, \{P5, P21\}, \{P6, P22\}, \{P7, P23\}, \{P8, P24\}, \{P9, P25\}, \{P10, P26\}, \{P11, P27\}, \{P12, P28\}, \{P13, P29\}, \{P14, P30\}, \{P15, P31\}, \{P16, P32\}\}$,
$(R - \{A1\})_*(Y) = \phi$,
$(R - \{A1\})^*(Y) = \{P1, P2, P17, P18\}$,
Step 5: $\mathcal{T}_{R-(A_1)}(Y) = \{\mathcal{U}, \phi, \{P1, P2, P17, P18\}\}$,
$\beta(\mathcal{T}_{R-(A_1)}(Y)) = \{\mathcal{U}, \phi, \{\{P1, P2, P17, P18\}\} = \beta(\mathcal{T}_R(Y))$.
Step 6: Case (2): If the attribute "*A2*" is removed then*:*
$\mathcal{U}/(R - \{A2\}) = \{\{P1, P9\}, \{P2, P10\}, \{P3, P11\}, \{P4, P12\}, \{P5, P13\}, \{P6, P14\}, \{P7, P15\}, \{P8, P16\}, \{P17, P25\}, \{P18, P26\}, \{P19, P27\}, \{P20, P28\}, \{P21, P29\}, \{P22, P30\}, \{P23, P31\}, \{P24, P32\}\}$,
$(R - \{A2\})_*(Y) = \phi$,
$(R - \{A_2\})^*(Y) = \{P1, P2, P9, P10, P17, P18, P25, P26\}$,
$\mathcal{T}_{R-(A_2)}(Y) = \{\mathcal{U}, \phi, \{P1, P2, P9, P10, P17, P18, P25, P26\}\}$,
$\beta(\mathcal{T}_{R-(A_2)}(Y)) = \{\mathcal{U}, \phi, \{P1, P2, P9, P10, P17, P18, P25, P26\}\} \neq \beta(\mathcal{T}_R(Y))$.
Case (3): If the attribute "*A3*" is removed then:
$\mathcal{U}/(R - \{A3\}) = \{\{P1, P5\}, \{P2, P6\}, \{P3, P7\}, \{P4, P8\}, \{P9, P13\}, \{P10, P14\}, \{P11, P15\}, \{P12, P16\}, \{P17, P21\}, \{P18, P22\}, \{P19, P23\}, \{P20, P24\}, \{P25, P29\}, \{P26, P30\}, \{P27, P31\}, \{P28, P32\}\}$,
$(R - \{A3\})_*(Y) = \phi$,

Table 2. The COVID -19 virus`s adverse effects

patients	A_1	A_2	A_3	A_4	A_5	Decision
P_1	1	1	1	1	1	Positive
P_2	1	1	1	1	0	Positive
P_3	1	1	1	0	1	Negative
P_4	1	1	1	0	0	Negative
P_5	1	1	0	1	1	Negative
P_6	1	1	0	1	0	Negative
P_7	1	1	0	0	1	Negative
P_8	1	1	0	0	0	Negative
P_9	1	0	1	1	1	Negative
P_{10}	1	0	1	1	0	Negative
P_{11}	1	0	1	0	1	Negative
P_{12}	1	0	1	0	0	Negative
P_{13}	1	0	0	1	1	Negative
P_{14}	1	0	0	1	0	Negative
P_{15}	1	0	0	0	1	Negative
P_{16}	1	0	0	0	0	Negative
P_{17}	0	1	1	1	1	Positive
P_{18}	0	1	1	1	0	Positive
P_{19}	0	1	1	0	1	Negative
P_{20}	0	1	1	0	0	Negative
P_{21}	0	1	0	1	1	Negative
P_{22}	0	1	0	1	0	Negative
P_{23}	0	1	0	0	1	Negative
P_{24}	0	1	0	0	0	Negative
P_{25}	0	0	1	1	1	Negative
P_{26}	0	0	1	1	0	Negative
P_{27}	0	0	1	0	1	Negative
P_{28}	0	0	1	0	0	*Negative*
P_{29}	0	0	0	1	1	*Negative*
P_{30}	0	0	0	1	0	*Negative*
P_{31}	0	0	0	0	1	*Negative*
P_{32}	0	0	0	0	0	*Negative*

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$(\mathrm{R}-\{A_3\})^*(Y)$ = *{P1, P2, P5, P6, P17, P18, P21, P22}*,
$\mathcal{T}_{\mathrm{R}-(A_3)}(Y)$ = *{$\mathcal{U}$, ϕ, {P1, P2, P5, P6, P17, P18, P21, P22}}*,
β *($\mathcal{T}_{\mathrm{R}-(A_3)}(Y)$) = {$\mathcal{U}$, ϕ,{P1, P2, P5, P6, P17, P18, P21, P22}} ≠ β ($\mathcal{T}_{\mathrm{R}}(Y)$).*
Case (4): If the attribute "*A4*" is removed then:
$\mathcal{U}/(\mathrm{R}-\{A3\})=$ *{{P1, P3}, {P2, P4}, {P5, P7},{P6, P8}, {P9, P11}, {P10, P12}, {P13, P15}, {P14, P16}, {P17, P19}, {P18, P20}, {P21, P23}, {P22, P24}, {P25, P27}, {P26, P28}, {P29, P31}, {P30, P32}},*
$(\mathrm{R}-\{A4\})_*(Y) = \phi$,
$(\mathrm{R}-\{A_4\})^*(Y)$= *{P1, P3, P2, P4, P17, P19, P18, P20}*,
$\mathcal{T}_{\mathrm{R}-(A_4)}(Y)$ = *{$\mathcal{U}$, ϕ, {P1, P3, P2, P4, P17, P19, P18, P20}}, and its basis:*
β *($\mathcal{T}_{\mathrm{R}-(A_4)}(Y)$) = {$\mathcal{U}$, {P1, P3, P2, P4, P17, P19, P18, P20}} ≠β ($\mathcal{T}_{\mathrm{R}}(Y)$).*
Case (5): If the attribute "*A5*" is removed then:
$(\mathrm{R}-\{A5\})_*(Y)$ = *{P1, P2, P17, P18}*,
$(\mathrm{R}-\{A_5\})^*(Y)$ = *{P1, P2, P17, P18}*,
therefore $B_{\mathrm{R}-(A_5)}(Y) = \phi$,
$\mathcal{T}_{\mathrm{R}-(A_5)}(Y)$= *{$\mathcal{U}$, ϕ, {P1, P2, P17, P18}}, and its basis:*
β *($\mathcal{T}_{\mathrm{R}-(A_5)}(Y)$) = {$\mathcal{U}$, ϕ, {P1, P2, P17, P18}} =β ($\mathcal{T}_{\mathrm{R}}(Y)$).*
Step 7: Therefore,
The Core (R) = {A2, A3, A4}.
Likewise, if Y is taken as the patients` set who negative outcomes. However, once again:
The Core *(R)* = *{A2, A3, A4}.*

Remark 4.1. Based on the prior application, we deduce that just the symptoms constituting the core confirm the presence of the disease, therefore preventive actions that are appropriate must be taken, given the presence of a positive situation.

V. CONCLUSION AND FUTURE WORK

In the first part, using Nano topology properties based on samples of patients in one of the hospitals, it was discovered that the diagnosis of Diabetes is not accurate if the patient has taken the substance Quartzon, which leads to a wrong diagnosis of high blood sugar levels, contrary to the truth, and it is recommended not to conduct this test until a sufficient period has passed to ensure that the effect of Quartzon has disappeared from the blood. In the second part, by taking a sample of 32 patients in one of Tanta University hospitals, an accurate determination was made of the confirming factors that clearly show that the patient is infected with the Corona virus, which are high temperature, difficulty breathing, sore throat, muscle pain, and loss of the sense of smell and taste.

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