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ORIGINAL RESEARCH PAPER

An Application Method for the use of Neutrosophic Soft Mappings in Decision-Making the Diagnosis of Covid-19 and Other Lung Diseases

Elif Karataş[1] · **Taha Yasin Ozturk**[1]

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Abstract
Covid-19 is an epidemic that has spread rapidly around the world and be direct damages the lung in recent years. Many researchers struggled for months trying to find a diagnosis and therapy for this epidemic. As a result of these studies, they have identified common of many symptoms of the epidemic disease with some lung diseases like flu, colds and even allergies. It can say that it is difficult to determine the exact disease type as lung diseases show similar symptoms. Because the elements of indeterminacy and falsehood are commonly ignored in practical assessments, it's difficult to identify precision can't anticipate the period of therapy and in the patient's progress history. In order to after eliminate this uncertainty decide on the definitive diagnosis, a mathematical model was put forward by using neutrosophic soft set theory and function properties of this theory. These concepts are necessary and sufficient to accurately diagnose diseases by connecting with mathematical modeling. This study makes easier to establish a link between patients' symptoms and therapy patterns. A table is created in fuzzy interval [0, 1] for put in order the type of disease among various lung diseases. Diagnosing the disease and finding the best therapy depends on the neutrosophic soft mapping. Finally the generalized neutrosophic soft mapping are utilized map to help predict the duration of therapy until the disease is cured.

Keywords Neutrosophic soft set · Neutrosophic soft mapping · Covid-19 · Lung diseases · Decision making

Introduction

Sometimes serious lung diseases can be a limiting cause for people because shortness of breath also visible as a symptom in other lung diseases such as Covid-19 and pneumonia. Although there are many diseases that affect the lungs, the name of Covid-19 is type of disease the most mentioned recently. Because it spread rapidly all over the world, cost the lives of many people and still this pandemic could not be prevented. Although other diseases are sometimes due to viruses, fungi, genetics and external effects, Covid-19 has a highly contagious feature and is transmitted from an infected person. Personal care and isolation are of vital importance in the transmission of this disease.

Traditional mathematical methods can are insufficient to solve uncertainty concerns in robotics, engineering, economics, medicine and the environment in the fields. Many theories such as fuzzy set theory (Zadeh 1965), intuitionistic fuzzy set theory (Atanassov 1986), soft set theory (Molodtsov 1999), neutrosophic soft set theory (Maji 2013), Spherical linear Diophantine fuzzy sets (Riaz and Hashmi 2019) have been emerged as a means of coping with these inadequacies. Zadeh fuzzy set theory (Zadeh 1965) was introduced in 1965 to eliminate this problem, and since then this theory has been a powerful tool for solving decision-making problems.

However, for many researchers, the modeling of data continued to be insufficient in solving these problems and new set theories continued to be constructed. Intuitionistic fuzzy set theory (Atanassov 1986) which is relatively more useful than fuzzy set theory, was constructed by Atanassov because only the positive membership degree of an element

✉ Elif Karataş
e.karatas7@hotmail.com

Taha Yasin Ozturk
taha36100@hotmail.com

[1] Department of Mathematic, Kafkas University, Kars, 36100, Turkey

is insufficient. In addition to fuzzy set theory, This set theory takes the negative membership degree too in the range [0,1] and defines the sum of the positive membership and negative membership degrees as less than 1 and equal.

Soft set theory (Molodtsov 1999) was defined by Molodtsov in 1999 because these theories are still insufficient in parameterization. This theory and its applications quickly found place for itself in many different fields. By using binary combination sets such as fuzzy soft set (Cagman et al. 2011) and intutionistic fuzzy soft set (Cağman and Karataş 2013), intensive studies have been made on these set structure in all sub-branches of mathematics and are still being done. Al-shami and El-Shafei (2020), Al-shami et al. (2019), El-Shafei and Al-shami (2020), Feng et al. (2010), Ozturk and Ozkan (2019), Yin et al. (2012), and Cagman et al. (2011). Soft mapping (Kharal and Ahmad 2011) and fuzzy soft mapping (Kharal and Ahmad 2009) was defined by Kharal and Ahmad and some properties were examined.

Afterwards, because no the indeterminacy membership degree of an element is evaluated in fuzzy set and intuitionistic fuzzy set theories, Neutrosophic set theory (Smarandache 2005), a generalization of these set theories, was constructed by Samarandache. Neutrosophic soft set theory (Maji 2013), which is a combination of soft set and neutrosophic set, was first constructed by Maji. Also this theory was revised and reinterpreted by Deli and Broumi (2015) in 2015. In 2017, Bera introduced neutrosophic soft topological spaces (Bera and Mahapatra 2017), however, some basic concepts such as intersection, union, 'and', 'or' on neutrosophic soft sets have been redefined (Ozturk et al. 2019) by Oztürk et al., who noticed that there are some structural deficiencies regarding the operations on this set. In addition, they had reconstructed the neutrosophic soft topological spaces by using defined the concepts in Ozturk et al. (2019) study then had redefined the concept of neutrosophic soft point and study on separation axioms in neutrosophic soft topological spaces (Gunduz et al. 2019). New studies are make on this structures and their combinations that still very popular (Ozturk and Yolcu 2021; Abu Qamar and Hassan 2018; Zulqarnain et al. 2021; Ajay and Charisma 2021; Ozturk and Yolcu 2020; Das et al. 2021).

Neutrosophic soft mapping (Alkhazaleh and Marei 2014) was defined by Alkhazaleh and Marei. However, this study may not provide some basic characteristic of the function such as $(F, A) \subseteq f^{-1}(f((F, A)))$ sometimes, so concept mapping on neutrosophic soft sets are has structural some problems. Using different definitions of concepts such as null neutrosophic soft set, neutrosophic soft union, neutrosophic soft intersection, "and", "or", are redefined the concept of neutrosophic soft mapping (Yolcu et al. 2021), by Yolcu et al. who noticed this. Later, the concept of neutrosophic soft continuity (Ozturk et al. 2021) was defined by Ozturk et al. Also in terms of application, Riaz and Hashmi (2021) introduced m-polar neutrosophic soft mappings and developed an algorithm based on m–polar neutrosophic soft mapping to accurately detect disease and determine the best therapy for each patient's matching ailment. Saeed et al. (2021) investigated the neutrosophic hypersoft mappings and they applied neutrosophic hypersoft mappings to properly diagnose the sickness and choose the optimal medicine for each patient's individual ailment.

In this study, a group of patients suffering from lung disease taken up and a scenario aimed to healing them was constructed. The diseases that the patients suffer from and some symptoms of these diseases was introduced. Diseases were diagnosed for each patient, taking into account the symptoms and medical history of these patients. As a result of the diagnosis of the disease and the doctor's observations, the best therapy method was found for each patient. The after therapy was applied to the patient, the recovery process of the patient was observed. An algorithm based entirely on neutrosophic soft mapping was used in the determination phase of diagnosis and therapy. Some features that make this algorithm more reliable than others; medical history of the patient is evaluated. Although determining the diagnosis and therapy method by neutrosophic soft mapping, patients with no healing can be restored to their pre-therapy state with neutrosophic soft inverse mapping. Thus providing an opportunity to apply a new therapy for these patients.

Previous existing theories may target only the truth-membership of objects, not evaluate the indeterminacy-membership, falsity-membership, or ignore membership dependent on a parameter therefore, it is insufficient in terms of examining more comprehensively and in determining the most appropriate treatment.In order to overcome this problem, a neutrosophic soft cluster structure has been studied, which can handle the parametric values of diseases in more detail by taking into account the indeterminacy-membership, falsity-membership and parametric values. The study aims to characterize the diagnosis of lung disease with its associated symptoms. After investigating the different side effects of lung diseases, we find that it is difficult to distinguish the distinctiveness of the symptoms related to the disease and the type of the disease. The elements of indeterminacy and falsehood are commonly disregarded in practical diagnosis. This problem makes it difficult to accurately track the patient's progress over time and makes it impossible to predict the duration of treatment. We introduce the neutrosophic soft set, neutrosophic soft mapping, and neutrosophic soft inverse mapping to overcome these obstacles. With the use of our described neutrosophic soft set and mapping model, we are able to more thoroughly

examine the patient's disease data, consider all conceivable angles under the neutrosophic soft set definition, and identify the core symptoms of the disease using mapping. By integrating the issue with scientific modeling, these concepts can and are necessary for a thorough analysis of the problem. This study weakens the proposed study's multidimensional nature by emphasizing a link between symptoms and treatment. Firstly, the categories of lung diseases were listed in a table based on the fuzzy interval [0,1]. To accurately diagnose each patient's infection and select the optimum treatment, a calculation based on neutrosophic soft mapping was built up. Eventually, the generalized neutrosophic soft mapping is presented in order to predict patient progress reports. If the proposed treatment has an unfavorable effect on the patient, the inverse mapping is defined in order to keep the previous stage of the patient's report under consideration for the suggestion of new treatment. In this way, a specialist is encouraged that to save the patient's progress history until the infection is relieved.

Following is how the rest of the article is organized. The definitions of neutrosophic soft set, neutrosophic soft image, and neutrosophic inverse image are provided in "Preliminaries". In the "Application of Neutrosophic Soft Mapping" of the study, some lung diseases and the symptoms of these diseases are mentioned. In the "Methodology", the algorithm of a comprehensive application created to determine the type of this disease, to choose the most appropriate treatment method and to observe the progress in the treatment process is given. Moreover by adhering to this algorithm, a practical application and comparative analysis are given to demonstrate the validity of the proposed approach, and how the obtained results will be exhausted in terms of treatment is mentioned.

Preliminaries

Definition 1 Smarandache (2005) A neutrosophic set A on the universe of discourse X is defined as:

$$A = \{\langle x, T_A(x), I_A(x), F_A(x)\rangle : x \in X\},$$

where $T, I, F : X \rightarrow]^{-}0, 1^{+}[$ and $^{-}0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3^{+}$.

Firstly, neutrosophic soft set defined by Maji (2013) and later this concept has been modified by Deli and Broumi (2015) as given below:

Definition 2 Let X be an initial universe set and E be a set of parameters. Let $P(X)$ denote the set of all neutrosophic sets of X. Then, a neutrosophic soft set $\left(\widetilde{F}, E\right)$ over X is a set defined by a set valued function $\widetilde{F}$ representing a mapping $\widetilde{F} : E \rightarrow P(X)$ where $\widetilde{F}$ is called approximate function of the neutrosophic soft set $\left(\widetilde{F}, E\right)$. In other words, the neutrosophic soft set is a parameterized family of some elements of the set $P(X)$ and therefore it can be written as a set of ordered pairs,

$$\left(\widetilde{F}, E\right) = \left\{\left(e, \left\langle x, T_{\widetilde{F}(e)}(x), I_{\widetilde{F}(e)}(x), F_{\widetilde{F}(e)}(x)\right\rangle : x \in X\right) : e \in E\right\}$$

where $T_{\widetilde{F}(e)}(x),\ I_{\widetilde{F}(e)}(x),\ F_{\widetilde{F}(e)}(x) \in [0, 1]$, respectively called the truth-membership, indeterminacy-membership, falsity-membership function of $\widetilde{F}(e)$. Since supremum of each T, I, F is 1 so the inequality $0 \leq T_{\widetilde{F}(e)}(x) + I_{\widetilde{F}(e)}(x) + F_{\widetilde{F}(e)}(x) \leq 3$ is obvious.

Definition 3 Ozturk et al. (2019) Let $\left\{\left(\widetilde{F}_i, E\right) \middle| i \in I\right\}$ be a family of neutrosophic soft sets over the universe set X. Then

$$\bigcup_{i\in I}\left(\widetilde{F}_i, E\right) = \left\{\left(e, \left\langle x, \sup\left[T_{\widetilde{F}_i(e)}(x)\right]_{i\in I}, \sup\left[I_{\widetilde{F}_i(e)}(x)\right]_{i\in I}, \inf\left[F_{\widetilde{F}_i(e)}(x)\right]_{i\in I}\right\rangle : x \in X\right) : e \in E\right\},$$

$$\bigcap_{i\in I}\left(\widetilde{F}_i, E\right) = \left\{\left(e, \left\langle x, \inf\left[T_{\widetilde{F}_i(e)}(x)\right]_{i\in I}, \inf\left[I_{\widetilde{F}_i(e)}(x)\right]_{i\in I}, \sup\left[F_{\widetilde{F}_i(e)}(x)\right]_{i\in I}\right\rangle : x \in X\right) : e \in E\right\}.$$

The arbitrary union and intersection of the neutrosophic sets are given as above. To find the finite union and intersection of neutrosophic sets,we apply operations "max" instead of "sup" and "min" instead of "inf".

Definition 4 Ozturk et al. (2019)

1. A neutrosophic soft set $\left(\widetilde{F}, E\right)$ over the universe set X is said to be null neutrosophic soft set if $T_{\widetilde{F}(e)}(x) = 0$, $I_{\widetilde{F}(e)}(x) = 0$, $F_{\widetilde{F}(e)}(x) = 1$; $\forall e \in E, \forall x \in X$. It is denoted by $0_{(X,E)}$.
2. A neutrosophic soft set $\left(\widetilde{F}, E\right)$ over the universe set X is said to be absolute neutrosophic soft set if $T_{\widetilde{F}(e)}(x) = 1$, $I_{\widetilde{F}(e)}(x) = 1$, $F_{\widetilde{F}(e)}(x) = 0$; $\forall e \in E, \forall x \in X$. It is denoted by $1_{(X,E)}$.

Clearly, $0^c_{(X,E)} = 1_{(X,E)}$ and $1^c_{(X,E)} = 0_{(X,E)}$.

Definition 5 Yolcu et al. (2021) Let $NSS(X, E)$ and $NSS(Y, E')$ be two neutrosophic soft classes and $u : X \rightarrow Y$ and $v : E \rightarrow E'$ be mappings. Then a mapping $f = (u, v) : (X, E) \rightarrow (Y, E')$ is defined as follows:

For a neutrosophic soft set $\left(\widetilde{F}, A\right) \in NSS(X, E)$, $f\left(\left(\widetilde{F}, A\right)\right)$ is a neutrosophic soft set in $NSS(Y, E)$ obtained as follows:

$$T_{u(F)(e')}(y) = \begin{cases} \sup\limits_{e\in v^{-1}(e')\cap A,\ x\in u^{-1}(y)} T_{F(e)}(x), & \text{if } u^{-1}(y) \neq \emptyset \\ 0, & \text{otherwise} \end{cases}$$

$$I_{u(F)(e')}(y) = \begin{cases} \sup\limits_{e \in v^{-1}(e') \cap A,\ x \in u^{-1}(y)} I_{F(e)}(x), & \text{if } u^{-1}(y) \neq \emptyset \\ 0, & \text{otherwise} \end{cases}$$

$$F_{u(F)(e')}(y) = \begin{cases} \inf\limits_{e \in v^{-1}(e') \cap A,\ x \in u^{-1}(y)} F_{F(e)}(x), & \text{if } u^{-1}(y) \neq \emptyset \\ 1, & \text{otherwise} \end{cases}$$

for $e' \in v(A) \subseteq E'$, $y \in Y$.

Definition 6 Yolcu et al. (2021) Let $NSS(X, E)$ and $NSS(Y, E')$ be neutrosophic soft classes and $u : X \to Y$ and $v : E \to E'$ be mappings. Then a mapping $f^{-1} : NSS(Y, E') \to NSS(X, E)$ is defined as follows: For a neutrosophic soft set $(\widetilde{G}, B)$ in $NSS(Y, E')$, $f^{-1}((\widetilde{G}, B))$ is a neutrosophic soft set in $NSS(X, E)$ obtained as follows:

$$T_{u^{-1}(G)(e)}(y) = \begin{cases} T_{G(v(e))}(u(x)), & \text{if } v^{-1}(e) \in B \\ 0, & \text{otherwise} \end{cases}$$

$$I_{u^{-1}(G)(e)}(y) = \begin{cases} I_{G(v(e))}(u(x)), & \text{if } v^{-1}(e) \in B \\ 0, & \text{otherwise} \end{cases}$$

$$F_{u^{-1}(G)(e)}(y) = \begin{cases} F_{G(v(e))}(u(x)), & \text{if } v^{-1}(e) \in B \\ 1, & \text{otherwise} \end{cases}$$

For $e \in v^{-1}(B) \subseteq E$ and $x \in X$, $f^{-1}((\widetilde{G}, B))$ is called a neutrosophic soft inverse image of the neutrosophic soft set $(\widetilde{G}, B)$.

Definition 7 (Dong et al. 2019; Liu and Luo 2016) Let $A = \{T_A(x), I_A(x), F_A(x)\}$ be a neutrosophic set. The score function, accuracy function, and certainty function, respectively, are defined as follows,

$$s(A) = \frac{2 + T_A(x) - I_A(x) - F_A(x)}{3}$$
$$a(A) = T_A(x) - F_A(x)$$
$$c(A) = T_A(x)$$

The truth membership $T_A(x)$ is positively connected with the scoring function, while the indeterminacy-membership $I_A(x)$ and false-membership $F_A(x)$ are negatively correlated on this calculation.

The comparison procedure between two neutrosophic sets is represented as follows, based on (Definition 7).

Definition 8 Dong et al. (2019) and Liu and Luo (2016) Let A_1 and A_2 be two neutrosophic set, the comparison relationships between A_1 and A_2 are as follows:

1. A_1 is superior to A_2 if $s(A_1) > s(A_2)$, and it can be denoted by $A_1 \succ A_2$;
2. A_1 is superior to A_2 If $s(A_1) = s(A_2), a(A_1) > a(A_2)$, and it can be denoted by $A_1 \succ A_2$;
3. A_1 is superior to A_2 if $s(A_1) = s(A_2), a(A_1) = a(A_1)$ and $c(A_1) > c(A_2)$, and it can be denoted by $A_1 \succ A_2$;
4. A_1 is equal to A_2 if $s(A_1) = s(A_2), a(A_1) = a(A_1), c(A_1) = c(A_2)$, and it can be denoted by $A_1 \succ A_2$

Application of Neutrosophic Soft Mapping

This section will go over some lung disorders and symptoms and diagnoses will examine for who suffer from this diseases. We determine the relationship with the therapies, diseases and symptoms of these patients by mapping, inverse mapping and some compositions. In addition, this algorithm shows how mathematical structures can be used for lung patients.

On Lung Diseases and Their Characteristic

After the recent covid-19 epidemic, diagnosis and therapies of lung diseases have become even more important. So all studies on this subject have an important place in the field of medicine. In this section, we examine lung diseases and their characteristics. Although there are many lung diseases in medical science, we consider some of these diseases.

1. Covid-19
2. Pneumonia
3. Chronic Obstructive Pulmonary Disease (COPD)
4. Bronchitis

1. Covid-19

The SARS-CoV-2 virus causes Coronavirus Disease (COVID-19), an infectious disease. The majority of those infected with the virus will have mild to moderate respiratory symptoms and will recover without the need for medical attention. Some patients, on the other hand, will become critically sick and require medical assistance. Likelihood of serious symptoms is more likely the elderly and those with underlying medical disorders such as cardiovascular disease, diabetes, chronic respiratory disease, or cancer. COVID-19 is patients of all ages can make to get very ill or even to die. Being thoroughly informed on the disease and how it spreads is the best strategy to avoid and slow down transmission. Stay at least one meter away from people, wear a well fitted mask, and wash your hands or use an alcohol-based detersive periodically to protect yourself and others from infection. When it's your turn, get vaccinated and follow local advice. When an infected person coughs, sneezes, speaks, sings, or breathes, the virus can spreads in microscopic liquid particles from their mouth or nose. Larger respiratory droplets to smaller aerosols are included in these particles. If you are sick, it is critical to adopt etiquette, such as coughing or sneeze into a flexed elbow, and to stay at home and

even to self-isolate until you heal. (https://www.who.int/health-topics/coronavirus#tab=tab_1)

2. **Pneumonia**

Pneumonia is a lung illness caused by an acute respiratory infection. When a healthy person breathes, tiny sacs called alveoli in the lungs fill up with air. If a person has pneumonia then the alveoli get blocked with pus and fluid, making breathing difficult and restricting oxygen intake. Pneumonia is the most common infectious cause of death in children around the world. In 2019, this disease claimed the lives of 740 180 children under the age of five, corresponds to 14% of all death among children under the age of five, but 22% of all deaths among children aged one to five. Children and families are affected by pneumonia all over the world, but mortality are highest in South Asia and Sub-Saharan Africa. Pneumonia can be prevented in children with basic treatments, and it can be treated with low-cost, low-tech medication and care. (https://www.who.int/news-room/fact-sheets/detail/pneumonia)

3. **Chronic Obstructive Pulmonary Disease (COPD)**

COPD which is a curable and evadable disease is a chronic lung disease that affects both men and women around the world. Airflow into and out of the lungs is restricted because to abnormalities in the tiny airways of the lungs. The airways narrow as a result of a variety of factors. Parts of the lung may be destroyed, mucus may obstruct the airways, and the airway lining may be inflamed and swollen. COPD can also be referred to as "emphysema" or "chronic bronchitis". Emphysema is a condition in which the little air sacs at the end of the airways in the lungs are destroyed. https://www.who.int/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-(copd)

4. **Bronchitis**

Coughing and sputum production for at least three months of the year for two years is a symptom of the condition. Without a doubt, this cough should be explored to see if it is caused by another illness, such as tuberculosis or slow-progressing lung cancer. Turkey Republic of Health Minister (2021)

(Information about Covid-19, Pneumonia and Chronic Obstructive Pulmonary Disease (COPD) was taken from the official website of the World Health Organization. In addition, information about Bronchitis has been taken from the official website of the Ministry of Health of the Republic of Turkey.)

Lung diseases have some common symptoms seen in every patient. We have listed some of this symptoms.

Fever
Cough
Tiredness
Loss of taste or smell
Aches and pains
Rash on skin, or fingers
Difficulty breathing or shortness of breath
Chest pain
Phlegm
Nausea
Vomiting
Diarrhea

The cause of these diseases can be sometimes genetic and usually environmental factors or sometimes being in contact with people infected by the disease etc. There are various diagnosis and therapy methods for these diseases, and the therapy are usually drug therapy.

In the next section, The proposed method will be semantically compared to a few existing structures in Table 1 and the algorithm to be used to analyze the disease, find the best treatment method and monitor the progress of the suggested therapy method in neutrosophic soft mapping will be introduced.

Methodology

Pre-step

A doctor may encounter some complications when diagnosing the disease because lung disease can shows similar symptoms. Sometimes in this situation can be difficult to decide. As these difficulties arise from uncertainties, neutrosophic soft sets is suitable for processing and evaluating this information. Firstly, is generated set the fuzzy interval [0, 1] for different types of lung diseases in order to translate verbal information into numerical language. A table is created which to determine the type of disease among various lung diseases, given as Table 2.

Since progress period of each disease has its concentration. Every doctor gather info about the medical history of patiens and performs various tests and examinations in order to apply the best therapy to the patients.

Table 3 shows the day to day examination results according to the severity of patients suffer from lung diseases. There are three different stages for each type of disease; seen of severe, mid, and lightweight pain. The diagram of

Table 1 Comparison of present theories

Theories	Disadvantage
fuzzy sets (Zadeh 1965)	lacks information regarding the indeterminacy and non-membership
intuitionistic fuzzy sets (Atanassov 1986)	lacks information regarding the indeterminacy
soft sets (Molodtsov 1999)	lacks information regarding the membership indeterminacy and non-membership
fuzzy soft sets (Cagman et al. 2011)	lacks information regarding the indeterminacy and non-membership
neutrosophic sets (Smarandache 2005)	lacks information regarding the indeterminacy non-membership values of an element of the set is given

certain intervals created for these stages is given in Table 3 below.

For example, severe chronic obstructive pulmonary disease (S-C) the fuzzy value are the interval [0.40, 0.43) for second day. This values are the interval [0.43,0.46) for 3-5 days and [0.46, 0.50) for more than 5 days. Similarly, we can make all the observations using the same table.

Algorithm

Step 1- Different lung diseases are identified. Now, Let $X = \{x_1, x_2, ..., x_r\}$ is the set of patients of suffer from lung diseases and $E = A = \{e_1, e_2, ..., e_t\}$ is the parameter set which represented are noted patients' symptoms. A doctor, with the help of a mathematician, converts the daily diagnostic chart expressed in verbal linguistic terms into form neutrosophic soft set. this set will help us to relate patients to symptoms and to diagnose the disease.

The set created by the doctor after the examination at "αth times" can be given as follows,

$$F_\alpha(e_s) = \left\{\left(e_s, \left\langle x_p, T^\alpha_{\widetilde{F}(e_s)}(x_p), I^\alpha_{\widetilde{F}(e_s)}(x_p), F^\alpha_{\widetilde{F}(e_s)}(x_p)\right\rangle : x_p \in X\right) : e_s \in E, \alpha = 1, 2, 3...n\right\}$$

where $T^\alpha_{\widetilde{F}(e_s)}(x), I^\alpha_{\widetilde{F}(e_s)}(x), F^\alpha_{\widetilde{F}(e_s)} \in [0, 1]$ are truth membership, indeterminacy membership and falsity membership of Covid-19, Pneumonia, COPD, Bronchitis for sth symptoms and pth patients, respectively, ($p = 1, 2, ..., r$ and $s = 1, 2, ..., t$).

Neutrosophic soft union of all diagnostic charts is taken to obtain the most accurate information about patients.

Table 2 Fuzzy intervals corresponding to diseases

Diseases	Different range of [0,1]
Covid-19	[0.7, 1]
Pneumonia	[0.5, 0.7)
COPD	[0.3, 0.5)
Bronchitis	[0.1, 0.3)
None of these four diseases	[0, 0.1)

Step 2- Suppose that $E' = B = \{e'_1, e'_2, ..., e_{t'}\}$ are diseases that correspond to the diseases that occur of patients. The doctor creates a set based on patients' medical history and symptoms in other words she is introduces set of weights corresponding to symptoms for every patient.

Step 3- We description a mapping $f = (u, v) : NSS(X, E) \to NSS(X, E')$ given as $u : X \to X$ and $v : E \to E'$, where $u(x_p) = x_p, v(e_s) = e_{s'}, (p = 1, 2, ..., r, , s = 1, 2, ..., t$ and $s\prime = 1, 2, ..., y)$ depends on the diseases corresponding to the symptoms.

Let neutrosophic soft mapping $f = (u, v) : NSS(X, E) \to NSS(X, E')$ describe as

$$T_{u(F)(e')}(x) = \left|T_{e'_{s'}}\right| \begin{cases} \sup\limits_{e \in v^{-1}(e') \cap A,\, x \in u^{-1}(x)} T_{F(e)}(x) & if\ u^{-1}(x) \neq \phi, v^{-1}(e') \cap A \neq \phi \\ 0_{(X,E)} & otherwise \end{cases}$$

$$I_{u(F)(e')}(x) = \left|I_{e'_{s'}}\right| \begin{cases} \sup\limits_{e \in v^{-1}(e') \cap A,\, x \in u^{-1}(x)} I_{F(e)}(x) & if\ u^{-1}(x) \neq \phi, v^{-1}(e') \cap A \neq \phi \\ 0_{(X,E)} & otherwise \end{cases}$$

$$F_{u(F)(e')}(x) = \left|F_{e'_{s'}}\right| \begin{cases} \inf\limits_{e \in v^{-1}(e') \cap A,\, x \in u^{-1}(x)} F_{F(e)}(x) & if\ u^{-1}(x) \neq \phi, v^{-1}(e') \cap A \neq \phi \\ 1_{(X,E)} & otherwise \end{cases}$$

where $T_{e'_{s'}}, I_{e'_{s'}}$ and $F_{e'_{s'}}$ are connected weights from (F_1, E'). Get the image of $(F_1, E) \cup (F_2, E) = (F_3, E)$ under mapping characterized by f and its express as $f((F_3, E))$.

Step 4- In this step, by comparing the results of the obtained set with the values in Table 3, a diagnostic chart is created where we can observe the accuracy of the results.

Step 5- The score value of the set obtained in the Step-3 is calculated using

$$\frac{2 + T - I - F}{3}$$

and the arithmetic average of the score values corresponding to the symptoms is taken. In this way, the type of disease is determined for every patient.

Step 6- Imagine that $E' = \{e'_1, e'_2, e'_3, e'_4\}$ be a diseases set and $E'' = \{e''_1, e''_2, e''_3, e''_4\}$ be representation of proper therapies proposed by the doctor. From this, we can construct a table describing the positive effects and adverse effects of therapy methods on each disease.

Step 7- It is finded neutrosophic soft max-min composition between set obtained in step-4 with set obtained in step-6 and denoted by $X^1_{E''}.((X^1, E'')$ briefly shown with $X^1_{E''})$.

Step 8- The skore value of the table obtained in the previous step is calculated and the therapy method(s) corresponding to the highest score value is selected.

Step 9- We description a new generalized mapping, $f'(u', v') : (X^{d-1}, E'') \to (X^d, E'')$ where $u' : X^{d-1} \to X^d$ and $v' : (E'')^{d-1} \to (E'')^d$ given as

$$u'(x_1) = x_1,\ u'(x_2) = x_2,\ ...,\ u'(x_r) = x_r$$
$$v'(e''_1) = e''_1,\ v'(e''_2) = e''_2,\ ...,\ v'(e''_{t'}) = e''_{t'}$$

and can be calculated as

$$X^d_{E''} = f'(X^{d-1}_{E''})(e'')(x) = \frac{1}{d}\left\{\begin{array}{ll} \bigcup\limits_{\xi\in(u')^{-1}(x)}\left(\bigcup\limits_{\psi\in(v')^{-1}(e'')\cap E''} X^{d-1}_{e''}\right)(x) & \text{if } (u')^{-1}(x)\neq\phi,\ (v')^{-1}(e'')\cap E''\neq\phi \\ O_{(X,E)} & \text{otherwise}\end{array}\right\}$$

where $d = 2, 3...$ is the number of therapy episodes and $e'' \in v(e') \subseteq E''$, $x \in X^d$, $\xi \in X^{d-1}$, $\psi \in (E'')^{d-1}$.

Step 10- Step-9 is repeated until sufficient result is achieved.

Numerical Example on Lung Diseases and Covid-19

In this section, the algorithm created is adapted to a medical scenario. The input information as verbally expressed by the doctor who check up of patients is converted into mathematical language. In the next step, set of the patient suffering from lung disease is determined and symptoms are noted. Then, indicative tables are created under the supervision of the doctor to examine different types lung diseases and the daily situations related to the diagnosis (Tables 2 and 3). By aid of this tables, symptoms and the intensity of the lung diseases can be examined. The most attractive aspect of this model is consider of the patient's medical history and input info thus the type of disease can be determined more accurately. In addition, this algorithm will allow to choose the most useful therapy method for the diagnosed diseases. Then it provides the opportunity to observe the recuperation level of the patients in the treatment process.

Now we suppose that patients visits to the doctor and doctor want to determine every patient suffers from which

Table 3 Daily concentrations for identifying diseases

Diseases	1-2 day	3-5 day	> 5 day
S-Covid-19 (S-C19)	$0.89 \le x < 0.93$	$0.93 \le x < 0.95$	$0.95 \le x \le 1.00$
M-Covid-19 (M-C19)	$0.76 \le x < 0.79$	$0.79 \le x < 0.84$	$0.84 \le x < 0.89$
L-Covid-19 (L-C19)	$0.70 \le x < 0.72$	$0.72 \le x < 0.74$	$0.74 \le x < 0.76$
S-Pneumonia (S-P)	$0.61 \le x < 0.63$	$0.63 \le x < 0.66$	$0.66 \le x < 0.70$
M-Pneumonia (M-P)	$0.54 \le x < 0.56$	$0.56 \le x < 0.58$	$0.58 \le x < 0.61$
L-Pneumonia (L-P)	$0.50 \le x < 0.51$	$0.51 \le x < 0.53$	$0.53 \le x < 0.54$
S-COPD (S-C)	$0.40 \le x < 0.43$	$0.43 \le x < 0.46$	$0.46 \le x < 0.50$
M-COPD (M-C)	$0.35 \le x < 0.36$	$0.36 \le x < 0.38$	$0.38 \le x < 0.40$
L-COPD (L-C)	$0.30 \le x < 0.31$	$0.31 \le x < 0.33$	$0.33 \le x < 0.35$
S-Bronchitis (S-B)	$0.24 \le x < 0.26$	$0.26 \le x < 0.28$	$0.28 \le x < 0.30$
M-Bronchitis (M-B)	$0.15 \le x < 0.18$	$0.18 \le x < 0.21$	$0.21 \le x < 0.24$
L-Bronchitis (L-B)	$0.10 \le x < 0.11$	$0.11 \le x < 0.13$	$0.13 \le x < 0.15$
None of these four diseases (NFD)	$0.00 \le x < 0.10$	$0.00 \le x < 0.10$	$0.00 \le x < 0.10$

lung disease. Sometimes the symptoms of different lung diseases can be similar, so it can be difficult to diagnose the disease and its phases, intensity. After the doctor examined the patient several times, ignores to some effects based on the patient's health, patient's medical history and input info, environmental and genetic factors, etc. Then, using the data, a therapy is chosen and a therapy plan is created by the doctor.

Step 1- Suppose that $X = \{x_1, x_2, x_3, x_4\}$ is the set of four patients and $E = \{e_1, e_2, e_3, e_4\}$ is the parameter set which represented are noted patients' symptoms by doctor while checkup. The qualities of E parameters set can be description as: e_1 = loss smell and tatse e_2 = fever e_3 = cough e_4 = phlegm.

As remark by the basic inlet info of patients with above the described symptoms, we can structure a table of two day ($d = 2$) with the knowledge gathered by the doctor given as $(F_d, E) \in NSS(X, E)$.We give grades of truth membership, indeterminacy membership, and falsity membership corresponding to the symptoms occurring for each patient. First and second day's grades in form NSSs given as (F_1, E) and (F_2, E), respectively.

$$(F_1, E) = \left\{ \begin{array}{l} e_1 = \{\langle x_1, 0.93, 0.73, 0.62\rangle, \langle x_2, 0.60, 0.67, 0.70\rangle, \langle x_3, 0.86, 0.78, 0.53\rangle, \langle x_4, 0.62, 0.55, 0.62\rangle\} \\ e_2 = \{\langle x_1, 0.89, 0.76, 0.70\rangle, \langle x_2, 0.65, 0.65, 0.70\rangle, \langle x_3, 0.78, 0.72, 0.56\rangle, \langle x_4, 0.55, 0.52, 0.25\rangle\} \\ e_3 = \{\langle x_1, 0.90, 0.63, 0.68\rangle, \langle x_2, 0.64, 0.61, 0.68\rangle, \langle x_3, 0.76, 0.70, 0.61\rangle, \langle x_4, 0.64, 0.57, 0.45\rangle\} \\ e_4 = \{\langle x_1, 0.95, 0.83, 0.72\rangle, \langle x_2, 0.80, 0.65, 0.75\rangle, \langle x_3, 0.70, 0.71, 0.63\rangle, \langle x_4, 0.60, 0.58, 0.55\rangle\} \end{array} \right\} \quad (1)$$

$$(F_2, E) = \left\{ \begin{array}{l} e_1 = \{\langle x_1, 0.95, 0.75, 0.45\rangle, \langle x_2, 0.57, 0.67, 0.70\rangle, \langle x_3, 0.66, 0.80, 0.42\rangle, \langle x_4, 0.82, 0.75, 0.52\rangle\} \\ e_2 = \{\langle x_1, 0.80, 0.66, 0.60\rangle, \langle x_2, 0.55, 0.65, 0.70\rangle, \langle x_3, 0.70, 0.73, 0.52\rangle, \langle x_4, 0.45, 0.57, 0.42\rangle\} \\ e_3 = \{\langle x_1, 0.87, 0.65, 0.70\rangle, \langle x_2, 0.67, 0.61, 0.61\rangle, \langle x_3, 0.66, 0.67, 0.45\rangle, \langle x_4, 0.58, 0.45, 0.40\rangle\} \\ e_4 = \{\langle x_1, 0.72, 0.73, 0.52\rangle, \langle x_2, 0.70, 0.65, 0.70\rangle, \langle x_3, 0.71, 0.78, 0.67\rangle, \langle x_4, 0.73, 0.50, 0.65\rangle\} \end{array} \right\} \quad (2)$$

Step 2- Suppose that $E' = \{e'_1, e'_2, e'_3, e'_4\}$ be a diseases is associated with E semptoms set and where e'_1 = Covid-19 e'_2 = Pneumonia e'_3 = COPD e'_4 = Bronchitis. Then $NSS(X, E')$ be the collection of all neutrosophicsoft sets in X. Doctor appoint the weight to the diseases corresponding to the medical history of patients and this the form neutrosophic soft set given as (F_1, E')

$$(F_1, E') = \left\{ \begin{array}{l} e'_1 = \{\langle x_1, 0.90, 0.47, 0.11\rangle, \langle x_2, 0.55, 0.50, 0.71\rangle, \langle x_3, 0.85, 0.50, 0.22\rangle, \langle x_4, 0.40, 0.42, 0.53\rangle\} \\ e'_2 = \{\langle x_1, 0.85, 0.73, 0.48\rangle, \langle x_2, 0.50, 0.55, 0.69\rangle, \langle x_3, 0.80, 0.61, 0.31\rangle, \langle x_4, 0.50, 0.32, 0.65\rangle\} \\ e'_3 = \{\langle x_1, 0.89, 0.63, 0.61\rangle, \langle x_2, 0.67, 0.56, 0.72\rangle, \langle x_3, 0.83, 0.60, 0.55\rangle, \langle x_4, 0.60, 0.42, 0.57\rangle\} \\ e'_4 = \{\langle x_1, 0.72, 0.65, 0.70\rangle, \langle x_2, 0.78, 0.58, 0.53\rangle, \langle x_3, 0.77, 0.68, 0.63\rangle, \langle x_4, 0.48, 0.32, 0.71\rangle\} \end{array} \right\} \quad (3)$$

Step 3- We description two mappings $u : X \to X$ and $v : E \to E'$ given as

$u : X \to X$	$v : E \to E'$	
$u(x_1) = x_1$	$v(e_1) = e'_1$	$v(e_3) = e'_2$
$u(x_2) = x_2$	$v(e_2) = e'_1$	$v(e_3) = e'_3$
$u(x_3) = x_3$	$v(e_2) = e'_2$	$v(e_4) = e'_2$
$u(x_4) = x_4$	$v(e_2) = e'_4$	$v(e_4) = e'_3$
$u(x_5) = x_5$	$v(e_3) = e'_1$	$v(e_4) = e'_4$

Then neutrosophic soft mapping can be define as $f = (u, v) : NSS(X, E) \to NSS(Y, E')$. We calculate the image of $(F_1, E) \cup (F_2, E) = (F_3, E)$ using given mapping in the step-3 of the algorithm.

$$f((F_3, E)) = \left\{ \begin{array}{l} e'_1 = \{\langle x_1, 0.86, 0.36, 0.05\rangle, \langle x_2, 0.64, 0.34, 0.13\rangle, \langle x_3, 0.73, 0.10, 0.01\rangle, \langle x_4, 0.66, 0.08, 0.04\rangle\} \\ e'_2 = \{\langle x_1, 0.64, 0.61, 0.21\rangle, \langle x_2, 0.40, 0.36, 0.42\rangle, \langle x_3, 0.56, 0.48, 0.33\rangle, \langle x_4, 0.37, 0.19, 0.16\rangle\} \\ e'_3 = \{\langle x_1, 0.85, 0.52, 0.32\rangle, \langle x_2, 0.54, 0.36, 0.44\rangle, \langle x_3, 0.63, 0.47, 0.25\rangle, \langle x_4, 0.44, 0.24, 0.23\rangle\} \\ e'_4 = \{\langle x_1, 0.30, 0.76, 0.36\rangle, \langle x_2, 0.18, 0.42, 0.62\rangle, \langle x_3, 0.70, 0.63, 0.48\rangle, \langle x_4, 0.26, 0.46, 0.24\rangle\} \end{array} \right\} \quad (4)$$

Step 4- We collation $f((F_3, E))$ with TABLO-3 and we get the initial diagnosis.

diseases/patient	x_1	x_2	x_3	x_4
e'_1	(M-C19, M-C, NFD)	(S-P, L-C, L-B)	(L-C19, L-B, NFD)	(S-P, NFD, NFD)
e'_2	(S-P, M-P, M-B)	(M-P, S-C, L-C)	(M-P, S-C, L-C)	(M-C, M-B, M-B)
e'_3	(M-C19, L-P, L-C)	(S-P, S-C, S-B)	(M-P, S-C, S-B)	(S-C, S-B, M-B)
e'_4	(S-B, L-C19, M-C)	(S-P, S-P, S-C)	(L-C19, S-P, S-C)	(S-B, S-C, S-B)

(5)

We will benefit this table later to control correctness of our conclucions.

Step 5- Calculating the score values of $f((F_3, E))$ benefiting

$$\frac{2 + T - I - F}{3}$$

for every patient related to their diseases. Later get average score of all values for every patient. For instance the average score for patient x_1 be able to calculate as

$$= \frac{0.82 + 0.72 + 0.88 + 0.85}{4} = 0.82$$

Similarly we can calculate score values for every patient;

diseases/patient	x_1	x_2	x_3	x_4
e'_1	0.82	0.61	0.67	0.39
e'_2	0.72	0.54	0.58	0.38
e'_3	0.88	0.58	0.64	0.53
e'_4	0.85	0.67	0.66	0.52
average score	0.82	0.60	0.63	0.45

(6)

Now, we can comparison the score values with Table 2 and we can diasnosed of diseases for every patient. The result of this comparison expose that patient x_1 is suffer from Covid-19, patients x_2 and x_3 are suffer from Pneumonia and x_4 is suffer from COPD.

Step 6- After the doctor diagnosed the diseases, suggested a personalized some medications or therapy methods for each patient. We developed the according to the doctor's suggest with the proper therapy corresponding to the diseases. Suppose that $E'' = \{e''_1, e''_2, e''_3, e''_4, e''_5\}$ be representation of proper therapies proposed by the doctor, where

$e''_1 =$ İntramuscular therapy
$e''_2 =$ İntravenous therapy
$e''_3 =$ Oral suspension therapy
$e''_4 =$ Oxygen therapy
$e''_5 =$ Surgery therapy.

Now, we establish set which can given grades doctor's suggest with the proper therapy corresponding to the diseases.

therapy/symptoms	e'_1	e'_2	e'_3	e'_4
e''_1	(0.68, 0.23, 0.36)	(0.78, 0.58, 0.62)	(0.98, 0.23, 0.25)	(0.67, 0.24, 0.31)
e''_2	(0.94, 0.48, 0.23)	(0.64, 0.25, 0.41)	(0.75, 0.15, 0.32)	(0.35, 0.24, 0.31)
e''_3	(0.88, 0.22, 0.42)	(0.62, 0.81, 0.43)	(0.66, 0.12, 0.21)	(0.69, 0.11, 0.11)
e''_4	(0.72, 0.50, 0.13)	(0.81, 0.51, 0.31)	(0.97, 0.12, 0.03)	(0.91, 0.41, 0.37)
e''_5	(0.87, 0.17, 0.45)	(0.77, 0.73, 0.65)	(0.85, 0.49, 0.26)	(0.87, 0.58, 0.25)

(7)

The set of grades create taking into account inlet info, onset and process of the patient and the history of each patient. This values can tell the positive effects and negative effects of therapy methods on each disease. So, we can say that positive membership degree signify positive effects, indeterminacy membership degree signify inactive effects and falsity membership degree signify adverse effects of therapy method.

Step 7- We find neutrosophic soft max-min composition between (7) and (4).

$X^1_{E''} =$

therapy/patient	x_1	x_2	x_3	x_4
e''_1	(0.85, 0.58, 0.32)	(0.64, 0.36, 0.36)	(0.68, 0.48, 0.25)	(0.66, 0.24, 0.25)
e''_2	(0.86, 0.36, 0.23)	(0.64, 0.34, 0.23)	(0.73, 0.25, 0.23)	(0.66, 0.24, 0.23)
e''_3	(0.86, 0.61, 0.32)	(0.64, 0.36, 0.42)	(0.73, 0.48, 0.25)	(0.66, 0.19, 0.23)
e''_4	(0.85, 0.51, 0.13)	(0.64, 0.41, 0.13)	(0.72, 0.48, 0.13)	(0.66, 0.41, 0.13)
e''_5	(0.86, 0.61, 0.32)	(0.64, 0.42, 0.44)	(0.73, 0.58, 0.26)	(0.66, 0.46, 0.25)

(8)

$X^1_{E''}$ show that connection among suggested therapy methods and patients in form of neutrosophic soft set.

Step 8- The most appropriate therapy method for every patient is with high positive effect grade and low adverse effect grade. For this reason we calculate score values of connection among suggested therapy methods and patients.

therapy/patient	x_1	x_2	x_3	x_4
e''_1	0.65	0.64	0.65	0.72
e''_2	0.76	0.69	0.75	0.73
e''_3	0.64	0.62	0.67	0.75
e''_4	0.74	0.70	0.70	0.71
e''_5	0.64	0.59	0.63	0.65
Suggested therapy	e''_2	e''_4	e''_2	e''_3

(9)

In the terms of this chart, the most beneficial therapy method is e''_2 for patients x_1 and x_3 whereas other therapies can be detrimental for this patients. Similarly the most beneficial therapy is e''_4 for patient x_2 and e''_3 for patient x_4 as it has a higher score than other therapy methods. Since the suggested therapy methods is determined according to the medical history of patients, the choice of therapy methods may differ for other patients and other conditions.

Step 9- Every patient's procedure of therapy and response to therapy can vary according to the patient's story. The procedures may be repeated until the disease is completely cured. Using neutrosophic soft mappings, we can follow healing process of every patient. For this We description two mappings $u' : X^{d-1} \to X^d$ and $v' : (E'')^{d-1} \to (E'')^d$, whrere

$$u : X \to X \qquad v : E \to E'$$
$$u'(x_1) = x_1 \qquad v'(e''_1) = e''_1$$
$$u'(x_2) = x_2 \qquad v'(e''_2) = e''_2$$
$$u'(x_3) = x_3 \qquad v'(e''_3) = e''_3$$
$$u'(x_4) = x_4 \qquad v'(e''_4) = e''_4$$
$$v'(e''_5) = e''_5$$

The neutrosophic soft mapping is as follow,

$$X^d_{E''} = f'(X^{d-1}_{E''})(e'')(x)$$
$$= \frac{1}{d}\left\{\begin{array}{ll} \bigcup\limits_{\xi\in(u')^{-1}(x)}\left(\bigcup\limits_{\psi\in(v')^{-1}(e'')\cap E''} X^{d-1}_{e''}\right)(x) & if\,(u')^{-1}(x)\neq\phi, (v')^{-1}(e'')\cap E''\neq\phi \\ O_{(X,E)} & \text{otherwise}\end{array}\right\}$$

where, $d = 2, 3, ...$ signify episodes of therapy and $e'' \in v(e') \subseteq E''$, $x \in X^d, \xi \in X^{d-1}, \psi \in (E'')^{d-1}$.

Step 10- After report of first episode is $X^1_{E''}$ given as Eq. 8, report of second episode is calculated for $d = 2$

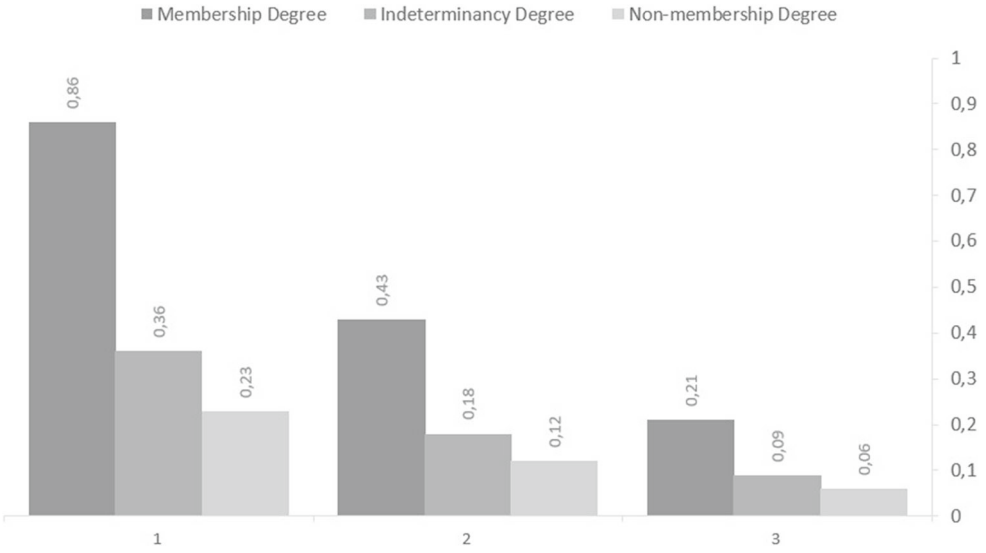


Fig. 1 Progress chart of patients x_1

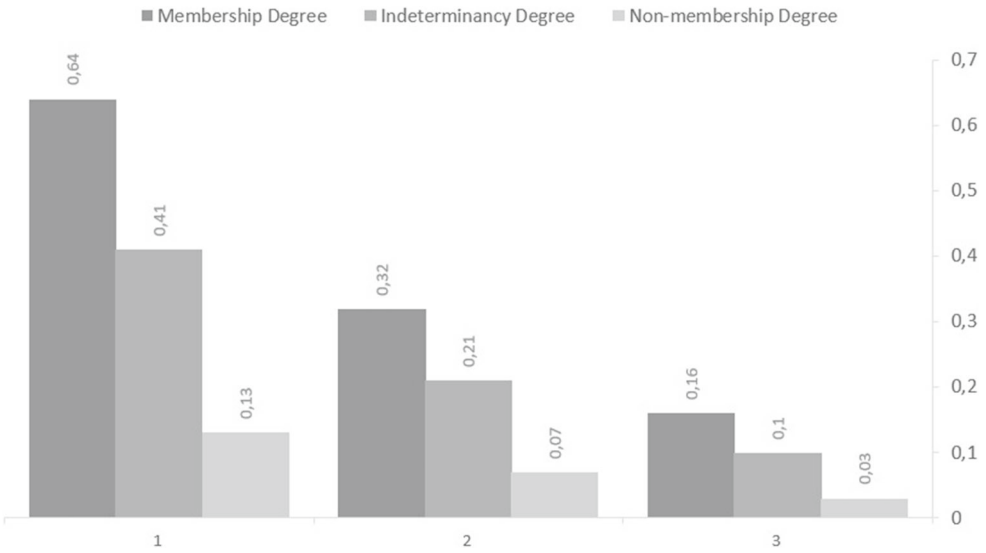


Fig. 2 Progress chart of patients x_2

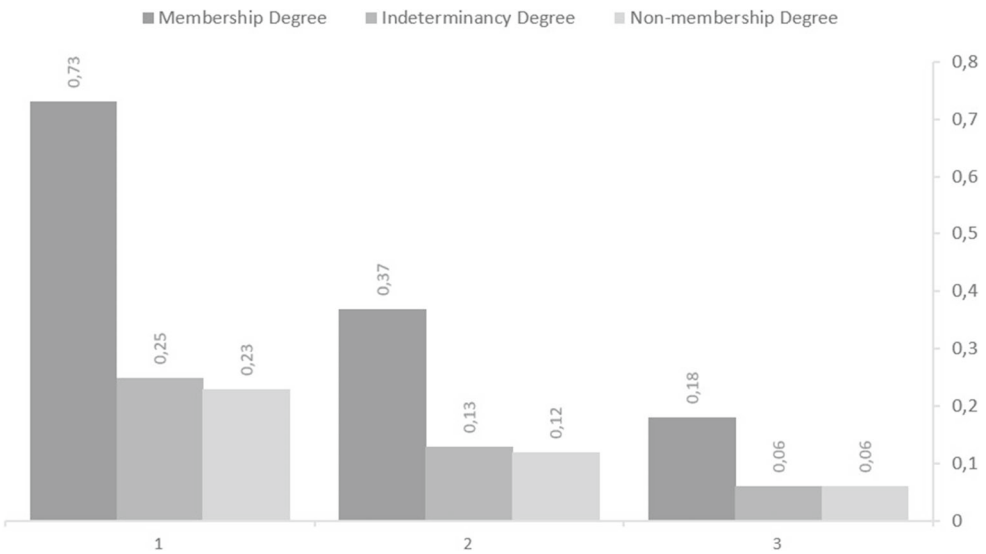


Fig. 3 Progress chart of patients x_3

and signify as $X^2_{E''}$. Step-9 is repeated until we achieve the desired results for the patients. Figures 1, 2, 3 and 4 show of each patient's progress is charts.

$X^2_{E''} =$

therapy/patient	x_1	x_2	x_3	x_4
e''_1	(0.42, 0.29, 0.16)	(0.32, 0.18, 0.18)	(0.34, 0.24, 0.13)	(0.33, 0.12, 0.13)
e''_2	(0.43, 0.18, 0.12)	(0.32, 0.17, 0.12)	(0.37, 0.13, 0.12)	(0.33, 0.12, 0.12)
e''_3	(0.43, 0.30, 0.16)	(0.32, 0.18, 0.21)	(0.37, 0.24, 0.12)	(0.33, 0.09, 0.11)
e''_4	(0.42, 0.26, 0.07)	(0.32, 0.21, 0.07)	(0.36, 0.24, 0.07)	(0.33, 0.21, 0.07)
e''_5	(0.43, 0.30, 0.16)	(0.32, 0.21, 0.22)	(0.37, 0.29, 0.13)	(0.33, 0.23, 0.13)

(10)

Similarly, report of third episode for $d = 3$ as follow,

$X^3_{E''} =$

therapy/patient	x_1	x_2	x_3	x_4
e''_1	(0.21, 0.15, 0.08)	(0.16, 0.09, 0.09)	(0.17, 0.12, 0.06)	(0.16, 0.06, 0.06)
e''_2	(0.21, 0.09, 0.06)	(0.16, 0.08, 0.06)	(0.18, 0.06, 0.06)	(0.16, 0.06, 0.06)
e''_3	(0.21, 0.15, 0.08)	(0.16, 0.09, 0.11)	(0.18, 0.12, 0.06)	(0.16, 0.05, 0.06)
e''_4	(0.21, 0.13, 0.03)	(0.16, 0.10, 0.03)	(0.18, 0.12, 0.03)	(0.16, 0.10, 0.03)
e''_5	(0.21, 0.15, 0.08)	(0.16, 0.11, 0.11)	(0.18, 0.15, 0.07)	(0.16, 0.12, 0.06)

(11)

Anymore we can understand that the therapies give positive results, as the membership degrees for every patient approaches zero as the episode of therapy increases. Because adverse and inactive effects (degree of indeterminacy and falsity for every patient) of the therapy are reduce, we can conclude that the suggested therapy is a beneficial method method and can return to normal health of patients as the therapy continues. If we continue the therapy in this way, we can say that the patients will get better.

Conclusion

Despite the limitations of existing theories, these problems are so extensive that they cannot be solved using these theories. The gathering of the patient's initial info is not likely due to these flaws. The proposed neutrosophic soft mapping is generally useful and appropriate for such diseases. Because this structure converts the patient's medical history into digital language, processes every data about the patient, and then selects the diagnosis and treatment method.

In this study, we examined Covid-19 and some lung diseases. After analyzing the patient's symptoms taking into account the her(his) medical history ,we used an algorithm to diagnose the disease. Here we used an algorithm that utilizes the neutrosophic soft mapping to diagnose the disease and select the best therapy modality. The algorithm we use has three steps. In the first stage, we diagnosed the real disease of the patients. In the second stage, we choose the best treatment method, according to disease and the severity of the disease through neutrosophic soft mapping. In the third step, we used generalized neutrosophic soft mapping to observe cure process of the patient throughout the therapy, and in this way, we were able to estimate the duration of the treatment. this algorithm, If the patient is resistant to the chosen treatment method and does not improve, it gives the opportunity to return to the previous section with the help of inverse neutrosophiic soft mapping and start another drug. The algorithm used is very powerful,

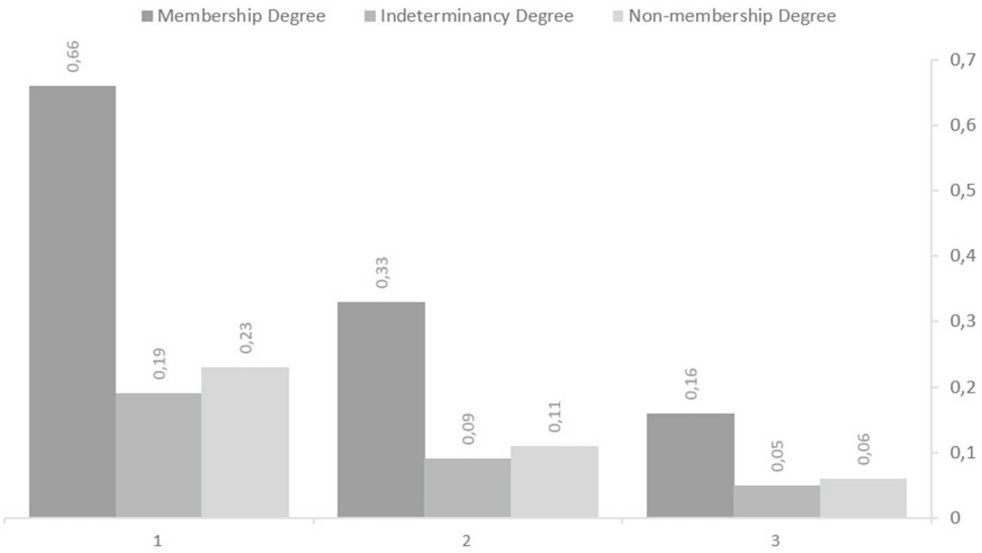


Fig. 4 Progress chart of patients x_4

valid and flexible in diagnosis and treatment of the disease. It can also be easily applied in other hybrid structures.

Data Availability The datasets generated during and/or analysed during the current study are not publicly available due to due to confdentiality agreements but are available from the corresponding author on reasonable request.

Declarations

Competing interests The authors have no relevant fnancial or nonfnancial interests to disclose.

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