AN APPLICATION OF FUZZY NEUTROSOPHIC SOFT SETS METHOD FOR PREDICTING COVID-19 SURVEILLANCE STATUS

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Abstract

Coronavirus Disease 2019 (COVID-19) is a new type of disease that has never been previously identified in humans and has been declared a pandemic. The diagnosis of the disease is complicated by the variety of symptoms and imaging findings and the severity of the disease at the time of presentation. Fuzzy Neutrosophic Soft Sets are able to handle many types of uncertainty data such as ambiguity, inaccuracy, ambiguity, and inconsistency. Therefore, Fuzzy Neutrosophic Soft Sets can be applied to overcome the uncertainty of symptoms in COVID-19 surveillance. This research was conducted by collecting and presenting the respondent's Neutrosophic value and Neutrosophic value as a knowledge base, then performed Fuzzy Neutrosophic Soft Sets operations (composition, complement, value function, and score function) to obtain the monitoring status of the predicted results. Furthermore, the monitoring status of the predicted results is compared with the actual monitoring status of the respondents to obtain the accuracy level of Fuzzy Neutrosophic Soft Sets. Based on testing of 12 respondents, with 7 respondents as training data and 5 respondents as testing data, the accuracy of the Fuzzy Neutrosophic Soft Sets method in the diagnosis of COVID-19 surveillance status was 80%.

Keywords: Diagnostic system, Coronavirus Disease 2019 (COVID-19), Fuzzy Neutrosophic Soft Sets, accuracy test

1. PRELIMINARY

Many uncertainty theories have been introduced including probability theory by Pascal and Fermat (17th century), Fuzzy Set theory by Zadeh (1965), Intuitionistic Set by Atanassov (1983), and Neutrosophic by Smarandache (1998). However, these theories have weaknesses due to the inadequacy of the parameterization tools of these theories. Molodtsov in 1999 introduced a new theory to minimize the weaknesses associated with parameterization. The theory is called the soft set theory (Abdy, 2017). Neutrosophic logic (Smarandache, 1998) is an extension of Fuzzy logic, intuitionistic logic, and three-valued logic that uses the value of uncertainty (indeterminacy) and is described by x = (t, i, f). Radwan (2016) in his research states that Neutrosophic has the advantage of Fuzzy and Fuzzy Intuitionistic, because it is able to handle many types of uncertainty data such as ambiguity, inaccuracy, ambiguity, and inconsistency. From a philosophical point of view, the Neutrosophic set is worth the subset of real-standard or non-standard]-0, 1+[. However, because this subset is difficult to implement, a Fuzzy Neutrosophic Set can be used which has a value of the subset [0,1] (Celik, 2016).

Coronavirus Disease 2019 (COVID-19) is a pandemic, and Indonesia has declared that COVID-19 is a non-natural disaster in the form of a disease outbreak that must be resolved so that there is no increase in cases. According to research on the clinical characteristics of COVID-19 in China (Guan et al, 2020), the diagnosis of the disease is complicated by the diversity of symptoms and imaging findings and the severity of the disease at the time of its appearance. Fuzzy Neutrosophic Soft Sets can be used to address the ambiguity, inaccuracy, ambiguity, and inconsistency of the diversity of symptoms and severity of COVID-19 surveillance. Therefore, the authors in this study raised the theme "An

Application of Fuzzy Neutrosophic Soft Sets Method for Predicting COVID-19 Surveillance Status".

2. LITERATURE REVIEW

2.1 Fuzzy Neutrosophic Soft Sets

Florentine Smarandache introduced the degree of indeterminacy/neutrality (i) as an independent component in 1995 (published 1998) and defined it as a Neutrosophic Set with three components (t, i, f) = (truth, indeterminacy, falsehood). Radwan (2016) describes the differences from uncertainty models, for example the information is not clear "the color of this flower is close to red", this type of uncertainty can be handled with a Fuzzy Set. For example, the incorrect information "machine temperature between 88-92 °C", this type of uncertainty can be handled with the Fuzzy Intuitionistic Set. An example of ambiguous information "votes for this candidate is around 60%" and an example of inconsistency "the chance of raining tomorrow is 70%, that doesn't mean the chance it won't rain 30%, because there may be weather factors that you may not be aware of", this type of uncertainty can be handled with the Neutrosophic Set.

Ashbacher (2002) explains that Neutrosophic logic is an extension/combination of fuzzy logic, paraconsistent logic, and three-valued logic that uses indeterminate values (uncertainty). In Neutrosophic logic, simply each variable x is logically represented by three values.

X = (t, i, f)

Where t is the degree of truth (truth), f is the degree of false (untruth), and i is the level of indeterminacy (uncertainty).

For example, the statement "Tomorrow will rain" does not mean the component structure is fixed, this statement may be 40% true, 50% not sure, and 45% incorrect at some point in time. But at other times it could turn out to be 50% correct, 49% unsure, and 30% correct. Then the next day the statement might be 100% true, 0% not sure, and 0% not true (when tomorrow it really rains), and so on.

Soft Set Theory (Molodtsov, 1999) finds a wide range of applications in the complex medical sciences, engineering, management economics and social sciences mainly because of its flexibility without limitation on approximate situation descriptions. According to Arockianani (2014), today many mathematicians have extended this theory by proposing the concepts of Fuzzy Soft Set and Intuitionistic Fuzzy Soft Set along with their properties and have obtained many applications in decision making.

2.2 Coronavirus Disease 2019 (COVID-19)

Coronaviruses are a large family of viruses that cause illness ranging from mild to severe symptoms. There are at least two types of coronavirus that are known to cause disease with severe symptoms, such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS). Based on the "Coronavirus Disease Prevention and Control Guidelines 2019 (COVID-19) 4th Revision" issued by the Indonesian Ministry of Health (2020) it is explained that the operational definition of supervision and response provided by the Indonesian government to implement prevention and control in handling cases of the COVID-19 with the following categories:

a. Pasien Dalam Pengawasan (PDP) or Patient Under Supervision.
b. Orang Dalam Pemantauan (ODP) or People In Monitoring
c. Orang Tanpa Gejala (OTG) or People Without Symptoms

Some of the symptoms along with their respective codes from the COVID-19

surveillance category include:

a. Fever or a history of fever (G01).
b. Symptoms and signs of respiratory distress (cough, runny nose, sore throat, etc.) (G02).
c. Severe Pneumonia or Acute Respiratory Infection (ARI) (G03).
d. No other cause based on convincing clinical description (G04).
e. In the last 14 days prior to the onset of symptoms, had a history of traveling or living in a country/region that reported local transmission (G05).
f. In the last 14 days before symptoms appear, have a history of travel or living in a local transmission area in Indonesia (G06).
g. Contact with a confirmed case of Coronavirus disease 2019 (COVID-19) in the last 14 days before symptoms developed (G07).

3. METODOLOGY

3.1 Problem Identification and Data Collection

This study uses the Fuzzy Neutrosophic Soft Sets method to diagnose COVID-19 surveillance status. Then, the results of the diagnosis/prediction will be compared with the actual data to find the level of accuracy of the Fuzzy Neutrosophic Soft Sets method in determining the surveillance status of COVID-19 in Indonesia. Meanwhile, the data collection process includes:

a. COVID-19 surveillance status sourced from the 2020 Revised 4th "Coronavirus Disease Prevention and Control Guidelines (COVID-19)" 2020 by the Indonesian Ministry of Health.
b. Neutrosophic data as a system knowledge base uses data from Wiguna and Riana's research (2020) which is also sourced from the 2020 Revised 4th Guidelines for Prevention and Control of Coronavirus Disease 2019 (COVID-19) by the Indonesian Ministry of Health.
c. Neutrosophic symptom data from patients/respondents with surveillance status for testing the accuracy of predictive results.

3.2 Implementation of Fuzzy Neutrosophic Soft Sets

The algorithm of the Fuzzy Neutrosophic Soft Sets method is as follows:

a. Presenting the symptoms of the respondent to get the patient-symptom relationship (Q).
b. Presenting medical knowledge that relates symptoms to diseases (R)
c. Get the composition (T) of the relations (Q) and (R) with the formula:

$$T_{R\circ A}(y) = \vee_x[T_A(x) \wedge T_A(x,y)],$$
$$I_{R\circ A}(y) = \vee_x[I_A(x) \wedge I_A(x,y)],$$
$$F_{R\circ A}(y) = \wedge_x[F_A(x) \vee F_A(x,y)]. \quad (1)$$

Where TA, IA and FA represent the value of truth, indeterminacy, and falsehood.

d. Obtain the complement of the patient–symptom relation (Q') with the formula:

$F^c(a) = < x, T_{Fc}(x) = F_F(x), I_{Fc}(x) = 1 - I_F(x), F_{Fc}(x) = TF(x) >$ (2)

For all a ∈ A , x ∈ X.

Note: T = Truth, I = Indeterminacy, F = Falsehood.

e. Obtain the complement of the patient–symptom relation (R') with the formula (2).
f. Get the complement composition (T') of the relation (Q') and (R') with the formula (1).
g. Calculates the value function for composition (T) and complement composition (T') with the formula:

$$V(F,A) = TA + (1 - IA) - FA \quad (3)$$

Where TA, IA and FA represent the value of truth, indeterminacy, and falsehood for every single (F, A).

h. Obtaining the score function from the composition value function (T) and the complement composition value function (T') with the formula:
$S1 = V(F, A) - V(G, B)$ (4)
Where S1= Score function, T = truth, I = indeterminacy, F = falsehood.

i. Finding the highest score as a result of the diagnosis/prediction.

3.3 Accuracy of Fuzzy Neutrosophic Soft Sets

The calculation of the level of accuracy is carried out by comparing the actual COVID-19 surveillance status of the respondents with the predicted COVID-19 surveillance status, then to get the percentage of method accuracy the following formula is used:

$$Accuracy = \frac{number\ of valid\ data}{total\ data}\ x\ 100\% \quad (5)$$

The research flow can be described as follows:

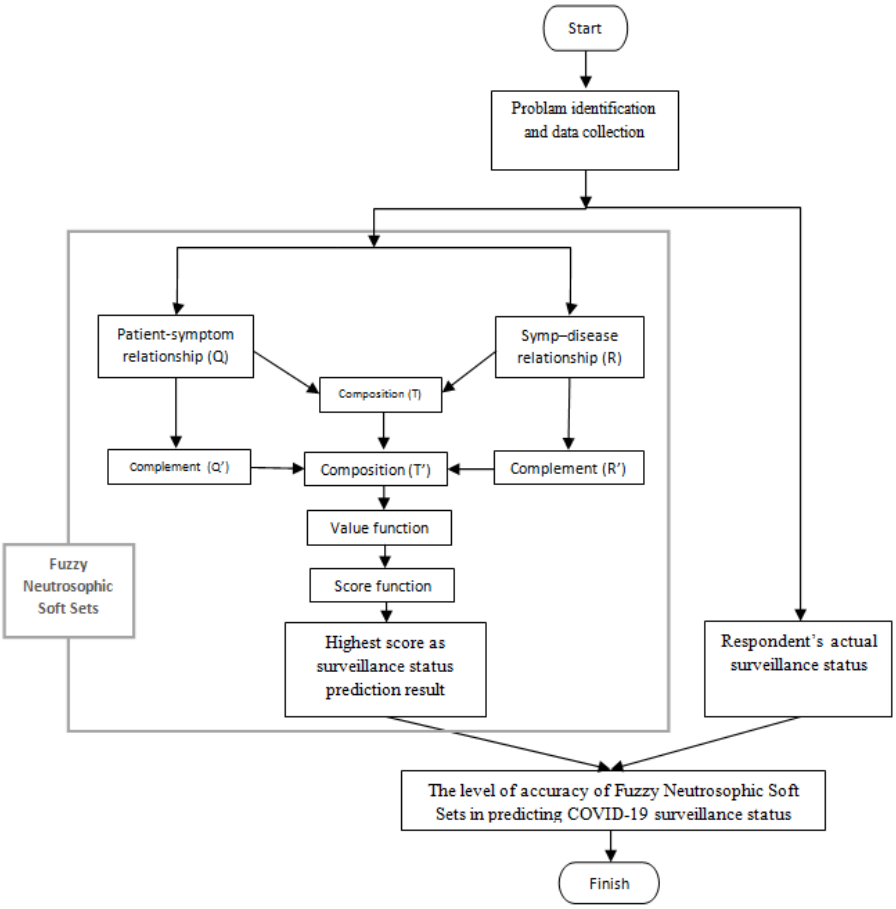


Figure 1 Research flow

4. RESULT AND DISCUSSION

4.1 Problem Identification and Data Collection

This study uses the Fuzzy Neutrosophic Soft Sets method to diagnose COVID-19 surveillance status. Then, the results of the diagnosis will be compared with actual data to find the level of accuracy of the Fuzzy Neutrosophic Soft Sets method in determining the status of COVID-19 surveillance in Indonesia. The data collection needed in this study is as

follows:

a. Data on symptoms and surveillance status of COVID-19 are sourced from the official document "Covid-19 Prevention and Control Guidelines for Coronavirus Disease 2019 (COVID-19)" 4th Revision 2020 by the Indonesian Ministry of Health as follows:

Table 1 Surveillance status of COVID-19

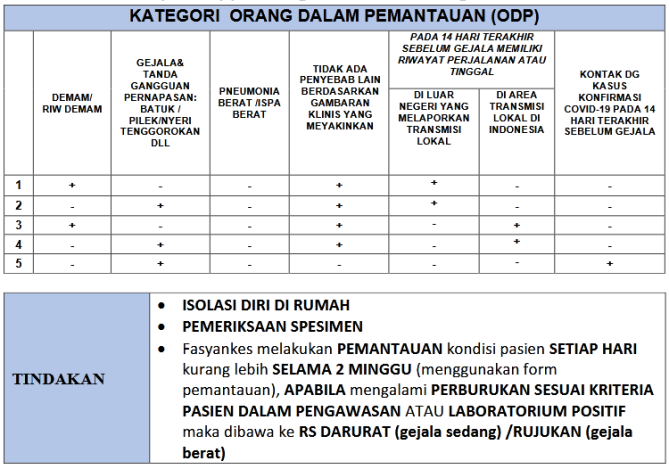
No.	Surveillance Status	Description
1	Pasien Dalam Pengawasan (PDP)	Patient under supervision
2	Orang dalam Pemantauan (ODP)	People in monitoring
3	Orang Tanpa Gejala (OTG)	People without symptoms

Table 2 Symptom of COVID-19 surveillance

No.	Code	Symptoms
1	G01	Fever or a history of fever
2	G02	Symptoms and signs of respiratory distress (cough, runny nose, sore throat, etc.)
3	G03	Severe Pneumonia or Acute Respiratory Infection (ARI)
4	G04	No other cause based on convincing clinical description
5	G05	In the last 14 days prior to the onset of symptoms, had a history of traveling or living in a country/region that reported local transmission
6	G06	In the last 14 days before symptoms appear, have a history of travel or living in a local transmission area in Indonesia
7	G07	Contact with a confirmed case of Coronavirus disease 2019 (COVID-19) in the last 14 days before symptoms developed

b. The value of Neutrosophic as a knowledge base is also sourced from the comparison value of symptoms in the category of surveillance status in the document "Guidelines for Prevention and Control of Coronavirus Disease 2019 (COVID-19)" 4th Revision 2020 by the Ministry of Health of the Republic of Indonesia as follows:

1) Orang Dalam Pemantauan (ODP)/ People Under Supervision



KATEGORI ORANG DALAM PEMANTAUAN (ODP)							
	DEMAM/ RIW DEMAM	GEJALA& TANDA GANGGUAN PERNAPASAN: BATUK / PILEKNYERI TENGGOROKAN DLL	PNEUMONIA BERAT /ISPA BERAT	TIDAK ADA PENYEBAB LAIN BERDASARKAN GAMBARAN KLINIS YANG MEYAKINKAN	PADA 14 HARI TERAKHIR SEBELUM GEJALA MEMILIKI RIWAYAT PERJALANAN ATAU TINGGAL		KONTAK DG KASUS KONFIRMASI COVID-19 PADA 14 HARI TERAKHIR SEBELUM GEJALA
					DI LUAR NEGERI YANG MELAPORKAN TRANSMISI LOKAL	DI AREA TRANSMISI LOKAL DI INDONESIA	
1	+	-	-	+	+	-	-
2	-	+	-	+	+	-	-
3	+	-	-	+	-	+	-
4	-	+	-	+	-	+	-
5	-	+	-	-	-	-	+

TINDAKAN	• **ISOLASI DIRI DI RUMAH** • **PEMERIKSAAN SPESIMEN** • Fasyankes melakukan **PEMANTAUAN** kondisi pasien **SETIAP HARI** kurang lebih **SELAMA 2 MINGGU** (menggunakan form pemantauan), **APABILA** mengalami **PERBURUKAN SESUAI KRITERIA PASIEN DALAM PENGAWASAN** ATAU **LABORATORIUM POSITIF** maka dibawa ke **RS DARURAT (gejala sedang) /RUJUKAN (gejala berat)**

Figure 2 ODP category details

a) Fever or a history of fever (G01)

T (+) = 2/5 = 0.4 I = 0 F (-) = 3/5 = 0.6

b) Symptoms and signs of respiratory distress (cough, runny nose, sore throat, etc.) (G02)

T (+) = 3/5 = 0.6 I = 0 F (-) = 2/5 = 0.4

c) Severe Pneumonia or Acute Respiratory Infection (ARI) (G03)

T (+) = 0/5 = 0 I = 0 F (-) = 5/5 = 1

d) No other cause based on convincing clinical description (G04)
T (+) = 4/5 = 0.8 I = 0 F (-) = 1/5 = 0.2

e) In the last 14 days prior to the onset of symptoms, had a history of traveling or living in a country/region that reported local transmission (G05)
T (+) = 2/5 = 0.4 I = 0 F (-) = 3/5 = 0.6

f) In the last 14 days before symptoms appear, have a history of travel or living in a local transmission area in Indonesia (G06)
T (+) = 2/5 = 0.4 I = 0 F (-) = 3/5 = 0.6

g) Contact with a confirmed case of Coronavirus disease 2019 (COVID-19) in the last 14 days before symptoms developed (G07)
T (+) = 1/5 = 0.2 I = 0 F (-) = 4/5 = 0.8

2) Orang Tanpa Gejala (OTG)/ People In Monitoring

KATEGORI ORANG TANPA GEJALA (OTG)							
	DEMAM/ RIW DEMAM	GEJALA& TANDA GANGGUAN PERNAPASAN: BATUK / PILEK/NYERI TENGGOROKAN DLL	PNEUMONIA BERAT /ISPA BERAT	TIDAK ADA PENYEBAB LAIN BERDASARKAN GAMBARAN KLINIS YANG MEYAKINKAN	*PADA 14 HARI TERAKHIR SEBELUM GEJALA MEMILIKI RIWAYAT PERJALANAN ATAU TINGGAL*		KONTAK DG KASUS KONFIRMASI COVID-19 PADA 14 HARI TERAKHIR SEBELUM GEJALA
					DI LUAR NEGERI YANG MELAPORKAN TRANSMISI LOKAL	DI AREA TRANSMISI LOKAL DI INDONESIA	
1	-	-	-	-	-	-	+

TINDAKAN	• **DILAKUKAN KARANTINA MANDIRI** • **PEMERIKSAAN SPESIMEN** • Puskesmas melakukan **PEMANTAUAN** kondisi pasien **SETIAP HARI** kurang lebih **SELAMA 2 MINGGU** (menggunakan form pemantauan), **APABILA** mengalami MUNCUL **GEJALA/TANDA** maka - Ringan: Isolasi diri di rumah - Sedang: Rawat di RS Darurat - Berat: Rawat di RS Rujukan

Figure 3 OTG category details

a) Fever or a history of fever (G01)
T (+) = 0/1 = 0 I = 0 F (-) = 1/1 = 1

b) Symptoms and signs of respiratory distress (cough, runny nose, sore throat, etc.) (G02)
T (+) = 0/1 = 0 I = 0 F (-) = 1/1 = 1

c) Severe Pneumonia or Acute Respiratory Infection (ARI) (G03)
T (+) = 0/1 = 0 I = 0 F (-) = 1/1 = 1

d) No other cause based on convincing clinical description (G04)
T (+) = 0/1 = 0 I = 0 F (-) = 1/1 = 1

e) In the last 14 days prior to the onset of symptoms, had a history of traveling or living in a country/region that reported local transmission (G05)
T (+) = 0/1 = 0 I = 0 F (-) = 1/1 = 1

f) In the last 14 days before symptoms appear, have a history of travel or living in a local transmission area in Indonesia (G06)
T (+) = 0/1 = 0 I = 0 F (-) = 1/1 = 1

g) Contact with a confirmed case of Coronavirus disease 2019 (COVID-19) in the last 14 days before symptoms developed (G07)
T (+) = 1/1 = 1 I = 0 F (-) = 0/1 = 0

3) Pasien Dalam Pengawasan (PDP)/ People Without Symptoms

KATEGORI PASIEN DALAM PENGAWASAN (PDP)							
	DEMAM/ RIW DEMAM	GEJALA& TANDA GANGGUAN PERNAPASAN: BATUK / PILEK/NYERI TENGGOROKAN DLL	PNEUMONIA BERAT /ISPA BERAT	TIDAK ADA PENYEBAB LAIN BERDASARKAN GAMBARAN KLINIS YANG MEYAKINKAN	*PADA 14 HARI TERAKHIR SEBELUM GEJALA MEMILIKI RIWAYAT PERJALANAN ATAU TINGGAL*		KONTAK DG KASUS KONFIRMASI COVID-19 PADA 14 HARI TERAKHIR SEBELUM GEJALA
					DI LUAR NEGERI YANG MELAPORKAN TRANSMISI LOKAL	DI AREA TRANSMISI LOKAL DI INDONESIA	
1	+	+	+	+	+	-	-
2	+	+	-	+	+	-	-
3	+	+	+	+	-	+	-
4	+	+	-	+	-	+	-
5	+	-	-	-	-	-	+
6	+	+	+	-	-	-	+
7	+	+	-	-	-	-	+
8	+	+	+	+	-	-	-
TINDAKAN	• **PERAWATAN (Ringan: Isolasi diri di rumah, Sedang: Rawat di RS Darurat, Berat: Rawat di RS Rujukan)** • **PEMERIKSAAN SPESIMEN**						

Figure 4 PDP category details

a) Fever or a history of fever (G01)
T (+) = 8/8 = 1 I = 0 F (-) = 0/8 = 0
b) Symptoms and signs of respiratory distress (cough, runny nose, sore throat, etc.) (G02)
T (+) = 7/8 = 0.875 I = 0 F (-) = 1/8 = 0.125
c) Severe Pneumonia or Acute Respiratory Infection (ARI) (G03)
T (+) = 4/8 = 0.5 I = 0 F (-) = 4/8 = 0.5
d) No other cause based on convincing clinical description (G04)
T (+) = 5/8 = 0.625 I = 0 F (-) = 3/8 = 0.375
e) In the last 14 days prior to the onset of symptoms, had a history of traveling or living in a country/region that reported local transmission (G05)
T (+) = 2/8 = 0.25 I = 0 F (-) = 6/8 = 0.75
f) In the last 14 days before symptoms appear, have a history of travel or living in a local transmission area in Indonesia (G06)
T (+) = 2/8 = 0.25 I = 0 F (-) = 6/8 = 0.75
g) Contact with a confirmed case of Coronavirus disease 2019 (COVID-19) in the last 14 days before symptoms developed (G07)
T (+) = 3/8 = 0.375 I = 0 F (-) = 5/8 = 0.625

The neutrosophic values are presented in the form of a symptom-disease relation table (R) as follows:

Table 3 Neutrosophic values as a knowledge base

R	ODP	OTG	PDP
G01	(0.4,0,0.6)	(0,0,1)	(1,0,0)
G02	(0.6,0,0.4)	(0,0,1)	(0.875,0,0.125)
G03	(0,0,1)	(0,0,1)	(0.5,0,0.5)
G04	(0.8,0,0.2)	(0,0,1)	(0.625,0,0.375)
G05	(0.4,0,0.6)	(0,0,1)	(0.25,0,0.75)
G06	(0.4,0,0.6)	(0,0,1)	(0.25,0,0.75)
G07	(0.2,0,0.8)	(1,0,0)	(0.375,0,0.625)

c. The Neutrosophic value of respondents was obtained through questionnaires/interviews with 12 respondents with surveillance status (6 PDP respondents, 2 ODP respondents, 4 OTG respondents) presented in the following table.

Table 4 Neutrosophic values and status surveillance from respondent

Respondent	G01 (t, i, f)	G02 (t, i, f)	G03 (t, i, f)	G04 (t, i, f)	G05 (t, i, f)	G06 (t, i, f)	G07 (t, i, f)	Surveillance Status
P1	(0,0,0)	(0,0,0)	(0,0,0)	(0,0,0)	(0,0,0)	(1,0,0)	(1,0,0)	OTG
P2	(0.5,0.7,0.2)	(0,0.7,0.5)	(0.2,0.1,1)	(0.6,0.8,0.3)	(0.8,0,0.1)	(0,0.4,1)	(0.9,0,0.3)	OTG
P3	(0,0,1)	(0,0,1)	(0,0,1)	(0.9,0.7,0)	(0,0,1)	(0.7,0.7,0)	(0,0,0)	OTG
P4	(0.6,0.4,0.3)	(0.4,0.2,0.5)	(0,0,1)	(0.8,0,0.2)	(0,0,1)	(0.4,0.3,0.5)	(0.3,0.3,0.4)	PDP
P5	(0.2,0.4,0.8)	(0.5,0.4,0.5)	(0.1,0.2,0.8)	(0.8,0.4,0.2)	(0.2,0.4,0.8)	(0.5,0.4,0.5)	(0.4,0.4,0.6)	ODP
P6	(0.025,0.25,0.75)	(0.08,0.4,0.2)	(0.02,0.3,0.9)	(0.2,0.5,0.8)	(0,0,1)	(0,0.5,1)	(1,0.5,0)	OTG
P7	(0,0,1)	(1,0,0)	(0,0,1)	(0,0,1)	(1,0,0)	(1,0,0)	(0,1,0)	PDP
P8	(0,0,1)	(0.5,0.5,0)	(0,0.5,0.5)	(0,0.5,0.5)	(0,0,1)	(0,0,1)	(0,0.5,0.5)	PDP
P9	(0,0,1)	(0,1,0)	(0,0.5,0.5)	(0,0,1)	(0,0,1)	(0,0,1)	(0,0.5,0.5)	PDP
P10	(1,0,0)	(0.3,0,0)	(0.1,0,0)	(0,0,0)	(0.9,0,0)	(0.8,0,0)	(1,0,0)	ODP
P11	(1,0,0)	(1,0,0)	(0,0.5,0)	(0,0.5,0)	(0.9,0,0)	(0,0.5,0)	(0,0.5,0)	PDP
P12	(0.8,0.3,0.2)	(0.5,0.2,0.5)	(0,0.2,0.9)	(0.8,0.2,0.2)	(0,0.2,0.9)	(0.6,0.3,0.3)	(0.7,0.3,0.2)	PDP

4.2 Implementation of Fuzzy Neutrosophic Soft Sets

Fuzzy Neutrosophic Soft Sets are implemented in this study with the following algorithm:

a. Presenting the patient-symptom relationship (Q) as follows:

Table 5 Patient-symptom relationship (Q)

Q	G01 (t, i, f)	G02 (t, i, f)	G03 (t, i, f)	G04 (t, i, f)	G05 (t, i, f)	G06 (t, i, f)	G07 (t, i, f)
P1	(0,0,0)	(0,0,0)	(0,0,0)	(0,0,0)	(0,0,0)	(1,0,0)	(1,0,0)
P2	(0.5,0.7,0.2)	(0,0.7,0.5)	(0.2,0.1,1)	(0.6,0.8,0.3)	(0.8,0,0.1)	(0,0.4,1)	(0.9,0,0.3)
P3	(0,0,1)	(0,0,1)	(0,0,1)	(0.9,0.7,0)	(0,0,1)	(0.7,0.7,0)	(0,0,0)
P4	(0.6,0.4,0.3)	(0.4,0.2,0.5)	(0,0,1)	(0.8,0,0.2)	(0,0,1)	(0.4,0.3,0.5)	(0.3,0.3,0.4)
P5	(0.2,0.4,0.8)	(0.5,0.4,0.5)	(0.1,0.2,0.8)	(0.8,0.4,0.2)	(0.2,0.4,0.8)	(0.5,0.4,0.5)	(0.4,0.4,0.6)
P6	(0.025,0.25,0.75)	(0.08,0.4,0.2)	(0.02,0.3,0.9)	(0.2,0.5,0.8)	(0,0,1)	(0,0.5,1)	(1,0.5,0)
P7	(0,0,1)	(1,0,0)	(0,0,1)	(0,0,1)	(1,0,0)	(1,0,0)	(0,1,0)
P8	(0,0,1)	(0.5,0.5,0)	(0,0.5,0.5)	(0,0.5,0.5)	(0,0,1)	(0,0,1)	(0,0.5,0.5)
P9	(0,0,1)	(0,1,0)	(0,0.5,0.5)	(0,0,1)	(0,0,1)	(0,0,1)	(0,0.5,0.5)
P10	(1,0,0)	(0.3,0,0)	(0.1,0,0)	(0,0,0)	(0.9,0,0)	(0.8,0,0)	(1,0,0)
P11	(1,0,0)	(1,0,0)	(0,0.5,0)	(0,0.5,0)	(0.9,0,0)	(0,0.5,0)	(0,0.5,0)
P12	(0.8,0.3,0.2)	(0.5,0.2,0.5)	(0,0.2,0.9)	(0.8,0.2,0.2)	(0,0.2,0.9)	(0.6,0.3,0.3)	(0.7,0.3,0.2)

b. Presenting medical knowledge that relates symptoms to diseases (R) as follows.

Table 6 Symptom-diseases relationship (R)

R	ODP	OTG	PDP
G01	(0.4,0,0.6)	(0,0,1)	(1,0,0)
G02	(0.6,0,0.4)	(0,0,1)	(0.875,0,0.125)
G03	(0,0,1)	(0,0,1)	(0.5,0,0.5)
G04	(0.8,0,0.2)	(0,0,1)	(0.625,0,0.375)
G05	(0.4,0,0.6)	(0,0,1)	(0.25,0,0.75)
G06	(0.4,0,0.6)	(0,0,1)	(0.25,0,0.75)
G07	(0.2,0,0.8)	(1,0,0)	(0.375,0,0.625)

c. Get the composition (T) of the relations (Q) and (R) using formula (1).
Table 7 Composition (T)

T	ODP	OTG	PDP
P1	(0.4,0,0.2)	(1,0,0)	(0.375,0,0)
P2	(0.6,0,0.3)	(0.9,0,0.3)	(0.6,0,0.2)
P3	(0.8,0,0.2)	(0,0,0)	(0.625,0,0.375)
P4	(0.8,0,0.2)	(0.3,0,0.4)	(0.625,0,0.3)
P5	(0.8,0,0.2)	(0.4,0,0.6)	(0.625,0,0.375)
P6	(0.2,0,0.4)	(1,0,0)	(0375,0,0.2)
P7	(0.6,0,0.4)	(0,0,0)	(0.875,0,0.125)
P8	(0.5,0,0.4)	(0,0,0.5)	(0.5,0,0.125)
P9	(0,0,0.4)	(0,0,0.5)	(0,0,0.125)
P10	(0.4,0,0.2)	(1,0,0)	(1,0,0)
P11	(0.6,0,0.2)	(0,0,0)	(1,0,0)
P12	(0.8,0,0.2)	(0.7,0,0.2)	(0.8,0,0.2)

d. Obtain the complement of the patient–symptom relation (Q') using formula (2).
Table 8 Complement of patient-symptom relationship (Q')

Q'	G01 (t, i, f)	G02 (t, i, f)	G03 (t, i, f)	G04 (t, i, f)	G05 (t, i, f)	G06 (t, i, f)	G07 (t, i, f)
P1	(0,1,0)	(0,1,0)	(0,1,0)	(0,1,0)	(0,1,0)	(0,1,1)	(0,1,1)
P2	(0.2,0.3,0.5)	(0.5,0.3,0)	(1,0.9,0.2)	(0.3,0.2,0.6)	(0.1,1,0.8)	(1,0.6,0)	(0.3,1,0.9)
P3	(1,1,0)	(1,1,0)	(1,1,0)	(0,0.3,0.9)	(1,1,0)	(0,0.3,0.7)	(0,1,0)
P4	(0.3,0.6,0.6)	(0.5,0.8,0.4)	(1,1,0)	(0.2,1,0.8)	(1,1,0)	(0.5,0.7,0.4)	(0.4,0.7,0.3)
P5	(0.8,0.6,0.2)	(0.5,0.6,0.5)	(0.8,0.8,0.1)	(0.2,0.6,0.8)	(0.8,0.6,0.2)	(0.5,0.6,0.5)	(0.6,0.6,0.4)
P6	(0.75,0.75,0.025)	(0.2,0.6,0.08)	(0.9,0.7,0.02)	(0.8,0.5,0.2)	(1,1,0)	(1,0.5,0)	(0,0.5,1)
P7	(1,1,0)	(0,1,1)	(1,1,0)	(1,1,0)	(0,1,1)	(0,1,1)	(0,0,0)
P8	(1,1,0)	(0,0.5,0.5)	(0.5,0.5,0)	(0.5,0.5,0)	(1,1,0)	(1,1,0)	(0.5,0.5,0)
P9	(1,1,0)	(0,0,0)	(0.5,0.5,0)	(1,1,0)	(1,1,0)	(1,1,0)	(0.5,0.5,0)
P10	(0,1,1)	(0,1,0.3)	(0,1,0.1)	(0,1,0)	(0,1,0.9)	(0,1,0.8)	(0,1,1)
P11	(0,1,1)	(0,1,1)	(0,0.5,0)	(0,0.5,0)	(0,1,0.9)	(0,0.5,0)	(0,0.5,0)
P12	(0.2,0.7,0.8)	(0.5,0.8,0.5)	(0.9,0.8,0)	(0.2,0.8,0.8)	(0.9,0.8,0)	(0.3,0.7,0.6)	(0.2,0.7,0.7)

e. Obtain the complement of the patient–symptom relation (R') using formula (2).
Table 9 Complement of symptom-disease relationship (R')

R'	ODP	OTG	PDP
G01	(0.6,1,0.4)	(1,1,0)	(0,1,1)
G02	(0.4,1,0.6)	(1,1,0)	(0.125,1,0.875)
G03	(1,1,0)	(1,1,0)	(0.5,1,0.5)
G04	(0.2,1,0.8)	(1,1,0)	(0.375,1,0.625)
G05	(0.6,1,0.4)	(1,1,0)	(0.75,1,0.25)
G06	(0.6,1,0.4)	(1,1,0)	(0.75,1,0.25)
G07	(0.8,1,0.2)	(0,1,1)	(0.625,1,0.375)

f. Get the complement composition (T') of the relation (Q') and (R') using formula (1).
Table 10 Complement composition (T')

T'	ODP	OTG	PDP
P1	(0,1,0)	(0,1,0)	(0,1,0.25)
P2	(1,1,0.2)	(1,1,0)	(0.75,1,0.25)
P3	(1,1,0)	(1,1,0)	(0.75,1,0.25)
P4	(1,1,0)	(1,1,0)	(0.75,1,0.25)
P5	(0.8,0.8,0.1)	(0.8,0.8,0.1)	(0.75,0.8,0.25)
P6	(0.9,1,0.02)	(1,1,0)	(0.75,1,0.25)
P7	(1,1,0)	(1,1,0)	(0.5,1,0.375)
P8	(0.6,1,0)	(1,1,0)	(0.75,1,0.25)
P9	(0.6,1,0)	(1,1,0)	(0.75,1,0.25)
P10	(0,1,0.1)	(0,1,0)	(0,1,0.5)
P11	(0,1,0)	(0,1,0)	(0,1,0.25)
P12	(0.9,0.8,0)	(0.9,0.8,0)	(0.75,0.8,0.25)

g. Calculates value function T and value function T' using formula (3).
Table 11 Value function T

Value Func. T	ODP	OTG	PDP
P1	1.2	2	1.375
P2	1.3	1.6	1.4
P3	1.6	1	1.25
P4	1.6	0.9	1.325
P5	1.6	0.8	1.25
P6	0.8	2	1.175
P7	1.2	1	1.75
P8	1.1	0.5	1.375
P9	0.6	0.5	0.875
P10	1.2	2	2
P11	1.4	1	2
P12	1.6	1.5	1.6

Table 12 Value function T'

Value Func. T'	ODP	OTG	PDP
P1	0	0	-0.25
P2	0.8	1	0.5
P3	1	1	0.5
P4	1	1	0.5
P5	0.9	0.9	0.7
P6	0.88	1	0.5
P7	1	1	0.125
P8	0.6	1	0.5
P9	0.6	1	0.5
P10	-0.1	0	-0.5
P11	0	10	-0.25
P12	1.1	1.1	0.7

h. Obtaining the score function using formula (4).
Table 13 Score function

Score Func.	ODP	OTG	PDP
P1	1.2	2	1.625
P2	0.5	0.6	0.9
P3	0.6	0	0.75
P4	0.6	-0.1	0.825
P5	0.7	-0.1	0.55
P6	-0.08	1	0.675
P7	0.2	0	1.625
P8	0.5	-0.5	0.875
P9	0	-0.5	0.375
P10	1.3	2	2.5
P11	1.4	1	2.25
P12	0.5	0.4	0.9

i. Finding the highest score as a predictive result of surveillance status.
Table 14 Highest score on score function

Score Function	ODP	OTG	PDP
P1	1.2	**2**	1.625
P2	0.5	0.6	**0.9**
P3	0.6	0	**0.75**
P4	0.6	-0.1	**0.825**
P5	**0.7**	-0.1	0.55
P6	-0.08	**1**	0.675
P7	0.2	0	**1.625**
P8	0.5	-0.5	**0.875**
P9	0	-0.5	**0.375**
P10	1.3	2	**2.5**
P11	1.4	1	**2.25**
P12	0.5	0.4	**0.9**

From the table, it is obtained that the prediction results of supervision status for each respondent are for P1 with OTG status, P2 with PDP status, P3 with PDP status, P4 with PDP status, P5 with ODP status, P6 with OTG status, P7 with PDP status, P8 with PDP status, P9 with status PDP, P10 with PDP status, P11 with PDP status, and P12 with PDP status. The comparison of the predicted patient surveillance status with the actual patient supervision status can be seen in the following table:
Table 15 Comparison of predicted and actual surveillance status

Respondent	Predicted Surveillance Status	Actual Surveillance Status	Suitability
P1	OTG	OTG	√
P2	PDP	OTG	X
P3	PDP	OTG	X
P4	PDP	PDP	√
P5	ODP	ODP	√
P6	OTG	OTG	√
P7	PDP	PDP	√
P8	PDP	PDP	√
P9	PDP	PDP	√
P10	PDP	ODP	X
P11	PDP	PDP	√
P12	PDP	PDP	√

From the table above, it is known that there were three respondents/patients who were predicted incorrectly (P2, P3, and P10). This is because the three respondents filled in symptom data that is closer to the symptoms of the PDP surveillance status, so the results of the calculation of the Fuzzy Neutrosophic Soft Sets method show the prediction results of PDP status for the three respondents.

4.3 Accuracy Testing

The accuracy test is carried out by comparing the actual COVID-19 surveillance status of the respondents with the predicted COVID-19 surveillance status, then to get the percentage of accuracy the method is carried out by dividing the number of correct predictions by the amount of data then multiplied by 100. Data sourced from 12

respondents will be divided into training and testing data. Data that has more optimal T, I, F component values will be used as testing data to test the accuracy of the Fuzzy Neutrosophic Soft Sets method, while other data will be used as training data. The following are 5 testing data that will be used to test the accuracy of the method:

Table 16 Predicted and actual surveillance status for datatesting

No	Respondent	Predicted Surveillance Status	Actual Surveillance Status	Suitability
1	**P2**	PDP	OTG	X
2	**P4**	PDP	PDP	√
3	**P5**	ODP	ODP	√
4	**P6**	OTG	OTG	√
5	**P12**	PDP	PDP	√

Based on the testing data table above, there are 4 respondents who were diagnosed correctly and 1 respondent who was diagnosed incorrectly, so that the calculation of the level of accuracy can be done as follows:

$$\text{Accuracy} = \frac{\text{number of valid data}}{\text{Total data}} \text{x } 100\%$$

$$\text{Accuracy} = \frac{4}{5} \text{x } 100\%$$

$$\text{Accuracy} = 80\%$$

From the calculation above, it is known that the accuracy of the Fuzzy Neutrosophic Soft Sets method in diagnosing the COVID-19 surveillance status in Indonesia is 80%.

5. CONCLUSION

The conclusion obtained from the implementation of the Fuzzy Neutrosophic Soft Sets method for diagnosing the COVID-19 surveillance status in Indonesia is the application of the Fuzzy Neutrosophic Soft Sets method to predict the surveillance status of 12 patients (respondents) with 7 data as training and 5 data as testing. Of the 5 testing data, 4 data were predicted correctly, and 1 data was predicted incorrectly, so the accuracy calculation shows the level of accuracy of the Fuzzy Neutrosophic Soft Sets method in diagnosing COVID-19 surveillance status in Indonesia, which is 80%.

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