Neutrsophic Health Analysis in Times of COVID-19

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Abstract

The current COVID-19 pandemic represents a danger for which efforts have been joined to find an effective treatment. This pandemic has evolved so quickly that new data emerge daily on the number of sick and fatal cases. As of September 2021, more than 180 countries with positive COVID-19 cases have been notified to the World Health Organization, including 228,807,631 confirmed cases, including 4,697,099 deaths. So far, the Americas region is the most affected with a total of 88,207,746 confirmed cases, and during this period, Ecuador has reported 246 new infections on average each day, for a total of 507,003 infections and 32,661 deaths. To date, dissimilar methods and treatments have been used to mitigate its effects. However, no effective treatment option has been found against it, generating uncertainty, social panic, and impacts on the population's mental health as a result of the fear of infection and death. That is why the present work focuses on analyzing and determining the alternatives for the control of detection of the pandemic, through the processing of the neutrosophic TOPSIS method. It offers many benefits in the analysis of neutralities to the study of indeterminacies in the field of Medicine. The processing using neutrosophic methods allowed obtaining the best alternative to fight against COVID-19.

Keywords: population; neutrosophic TOPSIS; COVID-19

1. Introduction

The coronavirus pandemic has generated an unprecedented situation that has paralyzed countries and has disproportionately affected the poorest and most vulnerable. Facing the onslaught of this crisis requires leadership, vision, and collaboration from the central government and the GADs. The most important action to face COVID-19 is to contain the spread of the virus through self-isolation, quarantine, and social distancing, measured with positive health impacts by flattening the contagion curve; however, it affects economic activity as distancing generally implies the slowdown in production or even its total interruption [1], [2].

In 100 days after the official declaration of the first case in Ecuador, it has been possible to show that the forced confinement or quarantine has caused a series of problems in social, family, and affective behavior, increasing states of anxiety, anguish, and stress that are mixed with uncertainty due to the serious problems that the country faces, related to the loss of jobs, the increase in poverty and social inequalities, generating an unprecedented crisis of the civilizational model [3].

Health systems around the world face problems in providing medical care to patients. Due to the pandemic affecting the world and the country, it is necessary to take decisive and impactful actions for the benefit of citizens and the health team. Currently, there is a high rate of infections, especially among doctors and nurses who in some cases, are added to the lists of victims [4, 5].

There is no specific treatment, so symptomatic treatment is prescribed in mild and moderate cases, and support measures or treatment of complications in severe cases [6]. Therefore, educating patients through guidelines to

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reduce the risk of contagion in the population and health personnel is the only alternative to follow. In addition to continuing with the implementation of prophylactic measures, so as not to saturate the health systems such as the closure of places of agglomeration of people, measures of social isolation, and the promotion of social distancing [7], [8], [9].

The contagion of COVID-19 occurs directly, through respiratory droplets during episodes of coughing or sneezing, which enter through the respiratory and/or conjunctival mucosa or are accidentally carried by the host to their mucous membranes, through the hands, which pick it up from the contaminated environment[10]. This virus ranges from mild illnesses with nonspecific signs and symptoms of acute respiratory disease, to severe pneumonia with respiratory failure and septic shock [11]. Possibly with an overreaction of the immune system leading to an autoimmune attack of the lungs. Although the predominant symptoms are respiratory, gastrointestinal manifestations can also occur [12, 13].

The advance of COVID-19 has been devastating for the world, especially in Latin America, also leaves in public view the structural inequalities in health systems, inequity, the lack of strengthening in primary health care, and the need for investment provision of health care equipment for health personnel. In Ecuador,, at least 2,000 health workers have resigned due to the risks of the pandemic, experiencing disadvantages and working conditions that lead them to quit their jobs and put their mental health at risk [14, 15].

To face the challenges of the COVID-19 pandemic and ensure sustainable performance, national health systems must adapt to new circumstances, assess readiness for a rapid response, assess compliance with international protocols, and take decisive and supportive impact actions for the benefit of citizens and the health team [16].

Prevention is necessary from primary care because the development of primary care and first-level care services is insufficient. The selection of an appropriate strategic guide for the reorganization of health systems is made based on the infection capacity and the risk of spreading a pandemic. For the study of the current context, the objective is to analyze and determine the alternatives for the control of detection of the pandemic through the neutrosophic contribution[17].

2. Definition

This section details the main concepts and techniques that will be used in this study.

Definition 1. Let X be a universe of discourse. A Neutrosophic Set (NS) is characterized by three membership functions [18], $u_A(x), r_A(x), v_A(x): X \rightarrow]$ -0,1+ [, which satisfy the condition $-0 \leq inf\, u_A(x) + inf\, r_A(x) + inf\, v_A(x)\ sup\ u_A(x) + sup\ \ r_A(x) + \sup v_A(x) \leq 3^+$ for all $x \in X$. $u_A(x), r_A(x)\ and\ v_A(x)$ denote the membership functions of true, indeterminate, and false of x in A, respectively, and their images are standard or non-standard subsets of $]\ -0,1+[$. [19].

Definition 2. Let X be a universe of discourse. A Single-Valued Neutrosophic Set (SVNS) A over X is an object of the form:

$$A = \{\langle x, u_A(x), r_A(x), v_A(x)\rangle : x \in X\} \tag{1}$$

Where $u_A, r_A, v_A: X \rightarrow [0,1]$ satisfy the condition $0 \leq u_A(x), r_A(x), v_A(x) \leq 3$ for all $x \in X$. $u_A(x), r_A(x)\ y\ v_A(x)$ denote the membership functions of true, indeterminate, and false of x in A, respectively. For convenience, a Single Value Neutrosophic Number (SVNN) will be expressed as A = (a, b, c), where a, b, c [0,1] and satisfies $0 \leq a + b + c \leq 3$.

SVNSs came up with the idea of applying neutrosophic sets for practical purposes. As a result, some operations between SVNN are expressed below:

1. Given A1 = (a1, b1, c1) and A_2 = (a2, b2, c2) 2 SVNN, the addition between A_1 and A_2 is defined as:

$$A_1\ \ A_2 = (a_1 + a_2 - a_1 a_2, b_1 b_2, c_1 c_2) \tag{2}$$

2. Given A_1 = (a1, b1, c1) and A_2 = (a2, b2, c2) 2 SVNN we have that the multiplication between A_1 and A_2 is defined as:

$$A_1\ \ A_2 = (a_1 a_2, b_1 + b_2 - b_1 b_2, c_1 + c_2 - c_1 c_2) \tag{3}$$

3. The product by a positive scalar with a SVNN, A = (a, b, c) is defined by:

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$$A = (1 - (1 - a), b, c) \tag{4}$$

4. Let $\{A_1, A_2, \dots, A_n\}$ be a set of n SVNN, where $A_j = (a_j, b_j, c_j)$ (j = 1, 2, …, n), then the Neutrosophic Weighted Average Single Value Operator (WASVO) on the set is calculated by the following Equation:

$$\sum_{j=1}^{n} \lambda_j A_j = \left(1 - \prod_{j=1}^{n} (1 - a_j)^{\lambda_j}, \prod_{j=1}^{n} b_j{}^{\lambda_j}, \prod_{j=1}^{n} c_j{}^{\lambda_j},\right) \tag{5}$$

Where λ_j is the weight of Aj, λ_j ∈[0, 1] and $\sum_{j=1}^{n} = 1$.

Definition 3. Let $A^* = (A_1^*, A_2^*, \dots, A_n^*)$ be a vector of n SVNN such that $A_j^* = (a_1^*, b_2^*, c_j^*)(j = 1,2, \dots, n)$ and $B_i = (B_{i1}, B_{i2}, \dots, B_{im})(i = 1,2, \dots, m)$ and are m vectors of SVNN such that $B_{ij} = (a_{ij}, b_{ij}, c_{ij})$ (i = 1, 2,…, m) (j = 1, 2,…, n). Then the Measure of Separation between Bi and A * is calculated by the following Equation:

$$s_i = \left(\frac{1}{3}\sum_{j=1}^{n}\left\{(a_{ij} - a_j^*)^2 + (b_{ij} - b_j^*)^2 + (c_{ij} - c_j^*)^2\right\}\right)^{\frac{1}{2}} \tag{6}$$

Where i = (1,2, ..., m)

Definition 4. Let A = (a, b, c) be a SVNN, the scoring function S of a SVNN, based on the true membership degree, the indeterminate membership degree, and the false membership degree are defined by the following Equation :

$$S(A) = \frac{1 + a - 2b - c}{2} \tag{7}$$

Where S (A) [- 1, 1]∈

In this article, linguistic terms will be associated with SVNN, so experts can carry out their assessments in linguistic terms, which is more natural. Therefore, the scales shown in Tables 1 and 2 will be considered.[20].

Table 1. Linguistic terms used

Linguistic term	**SVNN**
Extremely good (EG)	(1,0,0)
Very very good (VVG)	(0.9, 0.1, 0.1)
Very good (VG)	(0.8,0,15,0.20)
Good (G)	(0.70,0.25,0.30)
Medium good (MDG)	(0.60,0.35,0.40)
Medium (M)	(0.50,0.50,0.50)
Moderately bad (MDB)	(0.40,0.65,0.60)
Bad (B)	(0.30,0.75,0.70)
Very bad (VB)	(0.20,0.85,0.80)
Very very bad (VVB)	(0.10,0.90,0.90)
Extremely bad (EB)	(0,1,1)

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Table 2. Linguistic terms representing the weight of the importance of the alternatives.

Linguistic term	SVNN
Very Important (VI)	(0.9, 0.1, 0.1)
Important (I)	(0.75,0.25,0.20)
Average (A)	(0.50,0.50,0.50)
Not Important (NI)	(0.35,0.75,0.80)
Not Very Important (NVI)	(0.10,0.90,0.90)

The TOPSIS method for SVNN consists of the following: assuming $A = \{\rho_1, \rho_2, \dots, \rho_m\}$ is a set of alternatives and $G = \{\beta_1, \beta_2, \dots, \beta_m\}$ is a set of criteria, the following steps will be carried out:

Step 1: Determine the weight of the experts. For this, the specialists evaluate according to the linguistic scale that appears in Table 1, and the calculations are made with its associated SVNN, let's call $A_t = (a_t, b_t, c_t)$ the SVNN corresponding to the t-th decision-maker (t = 1, 2, ..., k). The following formula calculates the weight:

$$\lambda_t = \frac{a_t + b_t\left(\frac{a_t}{a_t + c_t}\right)}{\sum_{t=1}^{k} a_t + b_t\left(\frac{a_t}{a_t + c_t}\right)} \tag{8}$$

$\lambda_t \geq 0$ and $\sum_{t=1}^{k} \lambda_t$

Step 2: Construction of the neutrosophic decision matrix of aggregated single values. This matrix is defined by $D = \sum_{t=1}^{k} \lambda_t D^t$ $D_{ij} = (u_{ij}, r_{ij}, v_{ij})$ and is used to aggregate all individual evaluations. d_{ij} is calculated as the aggregation of the evaluations given by each expert $(u_{ij}^t, r_{ij}^t, v_{ij}^t)$, using the weights λ_t of each one with the help of Equation 5. In this way, a matrix $D = (d_{ij})_{ij}$, is obtained, where each d_{ij} is a SVNN (i = 1,2, .., m; j = 1,2,…, n).

Step 3: Determination of the Weight of the Criteria. Suppose that the weight of each criterion is given by $W = (w_1, w_2, \dots, w_n)$, where w_j denotes the relative importance of the criterion $\lambda_t w_j^t = (a_j^t, b_j^t, c_j^t)$. If it is the evaluation of the criterion λ_t by the t-th expert. Then Equation 5 is used to aggregate w_j^t those with the weights λ_t.

Step 4: Construction of the neutrosophic decision matrix of the Single Value Weighted Average concerning the criteria. $D^* = D * W, where\ d_{ij} = (a_{ij}, b_{ij}, c_{ij})$

Step 5: Calculation of the ideal positive and negative SVNN solutions. The criteria can be classified as cost type or benefit type [18]. Let G1 be the set of benefit-type criteria and G2 the cost-type criteria. The ideal alternatives will be defined as follows:

$$\rho^+ = a_{\rho+w}(\beta_j), b_{\rho+w}(\beta_j), ac_{\rho+w}(\beta_j) \tag{9}$$

Denote the positive ideal solution, corresponding to G1.

$$\rho^- = (a_{\rho-w}(\beta_j), b_{\rho-w}(\beta_j), ac_{\rho-w}(\beta_j)) \tag{10}$$

Denote the negative ideal solution, corresponding to G2. Where:

$$a_{\rho+w}(\beta_j) = \begin{cases} max_i a_{\rho iw}(\beta_j), si\ j\epsilon G_1 \\ min_i a_{\rho iw}(\beta_j), si\ j\epsilon G_2, \end{cases} \qquad a_{\rho-w}(\beta_j) = \begin{cases} min_i a_{\rho iw}(\beta_j), si\ j\epsilon G_1 \\ max_i a_{\rho iw}(\beta_j), si\ j\epsilon G_2, \end{cases}$$

$$b_{\rho+w}(\beta_j) = \begin{cases} max_i b_{\rho iw}(\beta_j), si\ j\epsilon G_1 \\ min_i b_{\rho iw}(\beta_j), si\ j\epsilon G_2, \end{cases} \qquad b_{\rho-w}(\beta_j) = \begin{cases} min_i b_{\rho iw}(\beta_j), si\ j\epsilon G_1 \\ max_i b_{\rho iw}(\beta_j), si\ j\epsilon G_2, \end{cases}$$

$$c_{\rho+w}(\beta_j) = \begin{cases} max_i c_{\rho iw}(\beta_j), si\ j\epsilon G_1 \\ min_i c_{\rho iw}(\beta_j), si\ j\epsilon G_2, \end{cases} \qquad c_{\rho-w}(\beta_j) = \begin{cases} min_i c_{\rho iw}(\beta_j), si\ j\epsilon G_1 \\ max_i c_{\rho iw}(\beta_j), si\ j\epsilon G_2, \end{cases}$$

Step 6: Calculate the distances to the ideal positive and negative SVNN solutions. With the help of Equation 6, the following Equations are calculated:

$$s_i^+ = \left(\frac{1}{3}\sum_{j=1}^{n}\left\{\left(a_{ij} - a_j^+\right)^2 + \left(b_{ij} - b_j^+\right)^2 + \left(c_{ij} - c_j^+\right)^2\right\}\right)^{\frac{1}{2}} \tag{11}$$

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$$s_i^- = \left(\frac{1}{3}\sum_{j=1}^{n}\left\{\left(a_{ij}-a_j^-\right)^2+\left(b_{ij}-b_j^-\right)^2+\left(c_{ij}-c_j^-\right)^2\right\}\right)^{\frac{1}{2}} \quad (12)$$

Step 7: Calculation of the Coefficient of Proximity (CP). The CP of each alternative is calculated with respect to the positive and negative ideal solutions.

$$\widetilde{\rho_J} = \frac{s^-}{s^+ + s^-} \quad (13)$$

Where $0 \leq \widetilde{\rho_J} \leq 1$

Step 8: Determine the order of the alternatives.
They are ordered according to what was achieved by $\widetilde{\rho_J}$. The alternatives are ordered from highest to lowest, under the condition that $\widetilde{\rho_J} \rightarrow 1$ is the optimal solution.
Additionally, the following formula was used to calculate the sample size for statistical processing.

$$n = \frac{ZNpq}{E^2(N-1)+Z^2pq} \quad (14)$$

Where, n: Sample size, Z: is the value of the normal distribution with the assigned confidence level, E: Desired sampling error, N: Population size.

3. Results

Although the situation is not of the magnitude and severity of the initial months of the pandemic, the world population continues to be a victim of COVID-19. To carry out this discussion, the circumstances that allowed the poor response to the pandemic in Ecuador were analyzed and alternatives that would lead to the curb of infections and the collapse of health systems were sought.

Considering the aforementioned, it was decided to diagnose the alternatives that have been taken in different institutions and health centers. For them, neutrosophic TOPSIS modeling was applied.

For the study, the sample size of respondents is decided using equation 14, which is taken as 50% or 0.05 the probabilities, the results being as follows:

- Maximum margin of error allowed = 10.0%
- Population size = 160
- Size for 95% confidence level: 55

It is decided to work with 95% confidence, so surveys will be applied to determine the potential success factors, measurement criteria, and their vector of weights and then apply the TOPSIS technique in its neutrosophic version to 55 respondents divided into five groups of 11 people each. Questionaries were developed based on Covid-19 management success factors[21]. The results were as follows:

Alternatives:

- Alternative 1 (A1): Training and development of health personnel and services, which have been declining, observing an inverse relationship between the increase in population and the number of urban and rural health posts and sub-centers.
- Alternative 2 (A2): Creation of a National Health System from the base, the family, and the community, with the clear goal of universalizing primary care and the implementing of epidemiological surveillance systems.

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• Alternative 3 (A3): Promote a technical and political strategy whose fundamental objective is to obtain political power for the health area and thus have the possibility of materializing the necessary changes.
• Alternative 4 (A4): Availability of resources to reduce the risk of contagion in the population and health personnel.
• Alternative 5 (A5): Implementation of new public health measures to detect and control cases to reduce the transmission of the virus.

Strategic evaluation criteria of success: 3

1. Evaluation of the alternative that provides the best results in preventing the spread of the pandemic in the country [22];
2. Evaluation of the quality of primary care and epidemiological surveillance systems.
3. Cost-benefit assessment

Expert groups: 5 groups of 11 (total 55)

1. Group of health experts from clinical centers
2. Group of private university health experts
3. Public University Health Expert Group
4. Primary Health Care Expert Group
5. Group of specialists in contagious diseases

Table 3: Calculation of the importance vector (λ_t)

Groups	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 5**
Importance vector	(0.25; 0.6; 0.8)	(0.95; 0.1; 0.1)	(0.75; 0.3; 0.4)	(0.25; 0.6; 0.8)	(0.1; 0.75; 0.85
$\boldsymbol{\lambda_t}$	0.157779687	0.285151874	0.263401159	0.157779687	0.135887592

Table 4: Matrix of criteria of single values for Criterion 1 Evaluation of the alternative that provides the best results in preventing the spread of the pandemic in the country

Alternative	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 5**
A 1	(0.25; 0.6; 0.8)	(0.95; 0.1; 0.1)	(0.25; 0.6; 0.8)	(0.1; 0.75; 0.85)	(0.75; 0.3; 0.4)
A 2	(0.95; 0.1; 0.1)	(0.75; 0.3; 0.4)	(0.95; 0.1; 0.1)	(0.95; 0.1; 0.1)	(0.95; 0.1; 0.1)
A 3	(0.1; 0.75; 0.85)	(0.1; 0.75; 0.85)	(0.1; 0.75; 0.85)	(0.25; 0.6; 0.8)	(0.1; 0.75; 0.85)
A 4	(0.25; 0.6; 0.8)	(0.25; 0.6; 0.8)	(0.25; 0.6; 0.8)	(0.1; 0.75; 0.85)	(0.25; 0.6; 0.8)
A 5	(0.25; 0.6; 0.8)	(0.25; 0.6; 0.8)	(0.75; 0.3; 0.4)	(0.75; 0.3; 0.4)	(0.75; 0.3; 0.4)

Table 5: Matrix of criteria of single values for Criterion 2: Evaluation of the quality of primary care and epidemiological surveillance systems.

Alternative	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 5**
A 1	(0.9; 0.2; 0.1)	(0.9; 0.1; 0.1)	(0.9; 0.1; 0.1)	(0.75; 0.25; 0.20)	(0.9; 0.1; 0.1)
A 2	(0.50; 0.5; 0.50)	(0.75; 0.25; 0.20)	(0.50; 0.5; 0.50)	(0.50; 0.5; 0.50)	(0.75; 0.25; 0.20)
A 3	(0.10; 0.90; 0.90)	(0.35; 0.75; 0.80)	(0.10; 0.90; 0.90)	(0.35; 0.75; 0.80)	(0.10; 0.90; 0.90)
A 4	(0.35; 0.75; 0.80)	(0.50; 0.5; 0.50)	(0.10; 0.90; 0.90)	(0.10; 0.90; 0.90)	(0.50; 0.5; 0.50)

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A 5	(0.9; 0.1; 0.1)	(0.75; 0.25; 0.20)	(0.75; 0.25; 0.20)	(0.75; 0.25; 0.20)	(0.9; 0.1; 0.1)

Table 6: Matrix of criteria of single values of Criterion 3: Assessment of the cost-benefit relation.

Alternative	Group 1	Group 2	Group 3	Group 4	Group 5
A 1	(0.8; 0.75; 0.80)	(0.10; 0.90; 0.90)	(0.50; 0.5; 0.50)	(0.50; 0.5; 0.50)	(0.35; 0.75; 0.80)
A 2	(0.75; 0.25; 0.20)	(0.75; 0.3; 0.20)	(0.9; 0.1; 0.1)	(0.9; 0.1; 0.1)	(0.75; 0.25; 0.20)
A 3	(0.35; 0.75; 0.80)	(0.10; 0.90; 0.90)	(0.10; 0.90; 0.90)	(0.35; 0.75; 0.80)	(0.10; 0.90; 0.90)
A 4	(0.10; 0.90; 0.90)	(0.50; 0.5; 0.10)	(0.90; 0.90; 0.50)	(0.10; 0.90; 0.90)	(0.50; 0.5; 0.50)
A 5	(0.75; 0.25; 0.20)	(0.75; 0.25; 0.20)	(0.9; 0.1; 0.1)	(0.75; 0.25; 0.20)	(0.9; 0.1; 0.1)

Table 7: Aggregated decision table by experts

Alternatives	Criterion 1	Criterion 2	Criterion 3
A 1	(0.69285; 0.33935; 0.40628)	(0.88445; 0.12891; 0.11156)	(0.46978; 0.666; 0.67874)
A 2	(0.92088; 0.13679; 0.14848)	(0.62656; 0.37344; 0.33996)	(0.83004; 0.17903; 0.14936)
A 3	(0.12552; 0.72405; 0.84191)	(0.22081; 0.83018; 0.85425)	(0.18783; 0.84968; 0.86716)
A 4	(0.22811; 0.6215; 0.80769)	(0.33248; 0.68276; 0.68975)	(0.60607; 0.70269; 0.38037)
A 5	(0.5933; 0.40781; 0.54375)	(0.80898; 0.19102; 0.16317)	(0.8266; 0.1734; 0.15165)

Table 8: Weights assigned by the experts to each criterion

Criteria	Pesos
Criterion 1	(0.83469; 0.16531; 0.14626)
Criterion 2	(0.73505; 0.26495; 0.23171)
Criterion 3	(0.47451; 0.56841; 0.5713)

Table 9: Weighted decision matrix of the SVNN

Alternatives	Criterion 1	Criterion 2	Criterion 3
A 1	(0.57831; 0.44856; 0.49312)	(0.65011; 0.35971; 0.31742)	(0.22292; 0.85585; 0.86228)
A 2	(0.76865; 0.27949; 0.27302)	(0.46055; 0.53945; 0.4929)	(0.39386; 0.64568; 0.63533)
A 3	(0.10477; 0.76967; 0.86503)	(0.16231; 0.87517; 0.88802)	(0.08913; 0.93512; 0.94305)
A 4	(0.1904; 0.68407; 0.83582)	(0.24439; 0.76681; 0.76164)	(0.28759; 0.87168; 0.73436)
A 5	(0.49522; 0.5057; 0.61048)	(0.59464; 0.40536; 0.35707)	(0.39223; 0.64325; 0.63631)

Table 10: Positive and negative ideal values by criterion

Criteria	Ideal value +	Ideal value -
C1	(0.71371; 0.28629; 0.2592)	(0.13748; 0.88474; 0.89362)
C2	(0.66761; 0.347; 0.3022)	(0.15393; 0.87919; 0.89064)
C3	(0.43313; 0.59107; 0.56928)	(0.11263; 0.9173; 0.92719)

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Table 11: Determine the distances to the negative and positive solutions

Alternatives	s_i^+	s_i^-	$\tilde{\rho}_J$	Order
A 1	0.281754151	0.664732606	0.702315802	2
A 2	0.181689012	0.743996246	0.803724851	1
A 3	0.843020091	0	0	5
A 4	0.68669466	0.213640292	0.23728979	4
A 5	0.286680233	0.644880549	0.69226	3

4. Discussion

According to the opinions of a group of 55 health experts, the success factors were evaluated under three criteria. Processing these allowed to obtain the level of importance and effectiveness of their implementation. The results of the study show that in times of COVID-19, the development of service provision in primary care is insufficient, leading to the collapse of health care centers. The population and health officials and providers have suffered the onslaught of the consequences of the pandemic, and the response to the emergency in the country has depended on the strategy adopted.

Some of the alternatives to choose from are:

1. Creation of a National Health System from the base, the family, and the community, with the clear goal of universalizing primary care and the implementing of epidemiological surveillance systems
2. A strategy to prevent the pandemic is to reinforce the integrality of health, and primary strength actions, recognizing the importance of conferring resolution, curative, preventive, and promotional capacity.
3. The lack of availability of a first-line to contain the virus is one of the reasons that explain the weak response of the public health system during the epidemic.

5. Conclusions

- Due importance has not been given to the community preventive response and the implementation of epidemiological surveillance systems for systematic case tracking and the management and isolation of contacts to mitigate the speed of virus transmission and the impact this had on hospitals.

- The advance of COVID-19 has been devastating for the world, especially in Latin America, also leaving in public view the structural inequalities in health systems, inequity, the lack of strengthening in primary health care, the need for investment in the provision of protective equipment for health personnel.

- The result of the modeling of the neutrosophic TOPSIS method has defined as an alternative *that the Creation of a National Health System from the base, the family, and the community, with the clear goal of universalizing primary care and the implementation of epidemiological surveillance systems,* to curb the contagion until the majority of the population is vaccinated and effective treatment is found.

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