Remedy for Effective Cure of Diseases using Combined Neutrosophic Relational Maps

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ABSTRACT
This article is a comprehensive study to evaluate an effective method for curing the diseases using Combined Neutrosophic Relational Maps defined by Smarandache Florentin and W.B. Vasantha kandasamy [1], [2]. The Combined Neutrosophic Relational Maps was defined in this method becomes effective when the number of concepts can be grouped into two disjoint sets. This paper has four sections. In the first section we recall the fundamentals of Neutrosophic Relationship Maps (NRMs) and Combined Neutrosophic Relationship Maps (CNRMs). In section two, we explain the adaptation of Combined Neutrosophic Relationship Maps (CNRMs) to the problem. In the third section we give the expert's opinion to the problem. In the last section we give the conclusion based on our study.

Key Words
NRMs, CNRMS, Effective Cure of Diseases

1. INTRODUCTION

1.1. Basic Notions of Neutrosophic Relational Maps (NRMS)
In this section we just recall the notion of Neutrosophic Relational Maps (NRMs) and Combined Neutrosophic Relational Maps (CNRMs) [3], [4]. In Neutrosophic Relational Maps (NRMs) we divide the very causal nodes into two disjoint units. Thus for the modeling of a NRM we need a domain space and a range space which are disjoint in the sense of concepts. We further assume no intermediate relations exist within the domain and the range spaces. The number of elements or nodes in the range space need not be equal to the number of elements or nodes in the domain space. Throughout this section we assume the elements of a domain space are taken from the neutrosophic vector space of dimension n and that of the range space are neutrosophic vector space of dimension m. (m in general need not be equal to n). We denote by R the set of nodes R1,…, Rm of the range space, where R = {(x1,…, xm) ϵ xj = 0 or 1 for j = 1, 2, …, m}. If xi = 1 it means that node Ri is in the on state and if xi = 0 it means that the node Ri is in the off state and if xi = I in the resultant vector it means the effect of the node xi is indeterminate or whether it will be off or on cannot be predicted by the neutrosophic dynamical system. It is very important to note that when we send the state vectors they are always taken as the real state vectors for we know the node or the concept is in the on state or in the off state but when the state vector passes through the Neutrosophic dynamical system some other node may become indeterminate i.e. due to the presence of a node we may not be able to predict the presence or the absence of the other node i.e., it is indeterminate, denoted by the symbol I, thus the resultant vector can be a neutrosophic vector.

DEFINITION 1.1: Let D be the domain space and R be the range space with D1,…, Dn the conceptual nodes of the domain space D and R1,…, Rm be the conceptual nodes of the range space R such that they form a disjoint class i.e. $D \cap R = \varphi$. Suppose there is a FRM relating D and R and if at least a edge relating a Di Rj is an indeterminate then we call the FRM as the Neutrosophic relational maps. i.e. NRMs.

DEFINITION 1.2: A Neutrosophic Relational Map (NRM) is a Neutrosophic directed graph or a map from D to R with concepts like policies or events etc. as nodes and causalities as edges. (Here by causalities we mean or include the indeterminate causalities also). It represents Neutrosophic Relations and Causal Relations between spaces D and R .

Let Di and Rj denote the nodes of an NRM. The directed edge from Di to Rj denotes the causality of Di on Rj called relations. Every edge in the NRM is weighted with a number in the set {0, +1, –1, I}. Let eij be the weight of the edge Di Rj, eij $\in$ {0, 1, –1,I}. The weight of the edge Di Rj is positive if increase in Di implies increase in Rj or decrease in Di implies decrease in Rj i.e. causality of Di on Rj is 1. If eij = –1 then increase (or decrease) in Di implies decrease (or increase) in Rj. If eij = 0 then Di does not have any effect on Rj. If eij = I it implies we are not in a position to determine the effect of Di on Rj i.e. the effect of Di on Rj is an indeterminate so we denote it by I.

DEFINITION 1.3: When the nodes of the NRM take edge values from {0, 1, –1, I} we

say the NRMs are simple NRMs.

DEFINITION 1.4: Let D1, …, Dn be the nodes of the domain space D of an NRM and let R1, R2,…, Rm be the nodes of the range space R of the same NRM. Let the matrix N(E) be

defined as N (E) = (eij) where eij is the weight of the directed edge Di Rj (or Rj Di) and eij ∈ {0, 1, –1, I}. N (E) is called the Neutrosophic Relational Matrix of the NRM

.**DEFINITION 1.6:** Let D1, …, Dn and R1,…, Rm denote the nodes of a NRM. Let A = (a1,…, an), ai ∈ {0, 1, –1} is called the Neutrosophic instantaneous state vector of the domain space and it denotes the on-off position of the nodes at any instant. Similarly let B = (b1,…, bn) bi ∈ {0, 1, –1}, B is called instantaneous state vector of the range space and it denotes the on-off position of the nodes at any instant, ai = 0 if ai is off and ai = 1 if ai is on for i = 1, 2, …, n. Similarly, bi = 0 if bi is off and bi = 1 if bi is on for i = 1, 2,…, m.

DEFINITION 1. 7: Let D1,…, Dn and R1, R2,…, Rm be the nodes of a NRM. Let Di Rj

(or Rj Di) be the edges of an NRM, j = 1, 2,…, m and i = 1, 2,…, n. The edges form a directed cycle. An NRM is said to be a cycle if it possess a directed cycle. An NRM is said to be acyclic if it does not possess any directed cycle.

DEFINITION 1. 8: A NRM with cycles is said to be a NRM with feedback.

DEFINITION 1. 9: When there is a feedback in the NRM i.e. when the causal relations flow through a cycle in a revolutionary manner the NRM is called a Neutrosophic dynamical system

DEFINITION 1. 10: Let Di Rj (or Rj Di) $1 \le j \le m$, $1 \le i \le n$, when Rj (or Di) is switched on and if causality flows through edges of a cycle and if it again causes Rj (or Di) we say that the Neutrosophical dynamical system goes round and round. This is true for any node Rj (or Di) for $1 \le j \le m$ (or $1 \le i \le n$). The equilibrium state of this Neutrosophical dynamical system is called the Neutrosophic hidden pattern.

DEFINITION 1.11: If the equilibrium state of a Neutrosophical dynamical system is a unique Neutrosophic state vector, then it is called the fixed point. Consider an NRM with R1, R2, …, Rm and D1, D2,…, Dn as nodes. For example let us start the dynamical system by switching on R1 (or D1). Let us assume that the NRM settles down with R1 and Rm (or D1 and Dn) on, or indeterminate on, i.e. the Neutrosophic state vector remains as (1, 0, 0,…, 1) or (1, 0, 0,…I) (or (1, 0, 0,…1) or (1, 0, 0,…I) in D), this state vector is called the fixed point.

DEFINITION 1.12: If the NRM settles down with a state vector repeating in the form A1 → A2 → A3 → …→ Ai → A1 (or B1 → B2 → …→ Bi → B1) then this equilibrium is called a limit cycle.

METHODS OF DETERMINING THE HIDDEN PATTERN

Let R1, R2,…, Rm and D1, D2,…, Dn be the nodes of a NRM with feedback. Let N(E)

be the Neutrosophic Relational Matrix. Let us find the hidden pattern when D1 is switched on i.e. when an input is given as a vector; A1 = (1, 0, …, 0) in D; the data should pass through the relational matrix N(E). This is done by multiplying A1 with the Neutrosophic relational matrix N(E). Let A1N(E) = (r1, r2,…, rm) after thresholding and updating the resultant vector we get A1E ∈ R, Now let B = A1E we pass on B into the system $(N(E))^T$ and obtain $B(N(E))^T$. We update and threshold the vector $B(N(E))^T$ so that $B(N(E))^T \in D$. This procedure is repeated till we get a limit cycle or a fixed point.

DEFINITION 1. 13: Finite number of NRMs can be combined together to produce the

joint effect of all NRMs. Let N(E1), N(E2),…, N(Er) be the Neutrosophic relational matrices of the NRMs with nodes R1,…, Rm and D1,…,Dn, then the combined NRM is represented by the neutrosophic relational matrix N(E) = N(E1) + N(E2) +…+ N(Er).

Description of the Problem and Justification for using Combined NRM Model

The achievement of Science has paved way for more and more Research and development in the field of medicine. As a result it is seen that thousands and thousands of valuable lives are being saved in every seconds all over the world. Because now-a-days there is a pill for every ill. At the same time it is of greater concern that so many tragic deaths are taking place due to easily curable diseases. None can turn a blind eye to this. What are the factors causing this tragedy? To what extent? Firstly the blame starts from the individual who suffers from an illness. His negligence, lack of time, fear of expenses, blind belief in advertisements, and little knowledge gathered from here and there about the diseases and medicines, non-availability of doctors nearby etc compel him even go for self-medication. Self medication in most of the cases is very dangerous and can cause serious medical complications. In some cases the "Fast Food "culture is being followed towards medication also. They consult the doctor available nearby and blindly consume the medicines prescribed by him because of quick relief from the illness is preferred, without giving due thought to the type and severity of the disease. Even quacks are consulted and taken advice from. This practice is imminent among low income groups in general and also among illiterate rural poor in particular. Unqualified and Underqualified doctors not being able to diagnose the disease correctly may prescribe medicines that may cause a "magic effect" to the patient. Overlooking the killing "side effects "of some medicines and subjecting the patients to undergo various tests like X-rays, Scanning etc which are unnecessary in that context are also cannot be ruled out. Committing medical errors, circulating life expired medicines , giving false hope , not diverting patient to

other hospitals having better facilities are also very common. They prefer pill to ill forgetting moral responsibility and professional ethics. When considering the above facts, it is not impertinent to say that it is our social responsibility to carry out a deep study about this problem and the conclusion drawn to be made public to create a general awareness among the people. Since from our linguistic questionnaire and the field of study, we observed that most of the attributes and their relations were dominated by uncertainty and impreciseness [5], [6]. Also the data is an unsupervised one and when the number of concepts can be grouped into two disjoint sets, no statistical tool other than neutrosophic tool has the capacity to analyze effectively and can give the hidden pattern. Hence it is chosen here.

2. ADAPTATION OF FRM TO THE PROBLEM

Using the linguistic questionnaire and the experts opinion [7],[8],we divide the very causal associations into two disjoint units, a domain space (Doctor) and a range space (Patient) which are disjoint in the sense of concepts. Using the opinion we obtain the hidden patterns. We have taken as the concepts / nodes of domain only 7 notions which pertain to the Doctor.

D1 – Negligence to discuss the problem faced by the patients in detail.

D2 – Quacks acting as specialists

D3 – Under qualification and Lack of experience

D4 – Prescribing substitute medicines with deadly side effects.

D5 – Incorrect diagnosis

D6 – Business motive

D7 – Stress response from Doctors

D1, D2,…, D7 are elements related to the doctor's opinion which is taken as the domain space. We have taken only 6 nodes / concepts related to the patients in this study. These concepts form the range space which is listed below.

P1 – Lack of interest in consulting competent doctors.

P2 – Self- medication

P3 – Negligence to diseases and Irregularity in taking drugs

P4 – Not expressing about the health to the doctor properly.

P5 – Lack of guidance

P6 – Poverty and Economic Crisis

3. EXPERT'S OPINION

The directed graph and the associated relational matrix A as given by the first expert is given below.

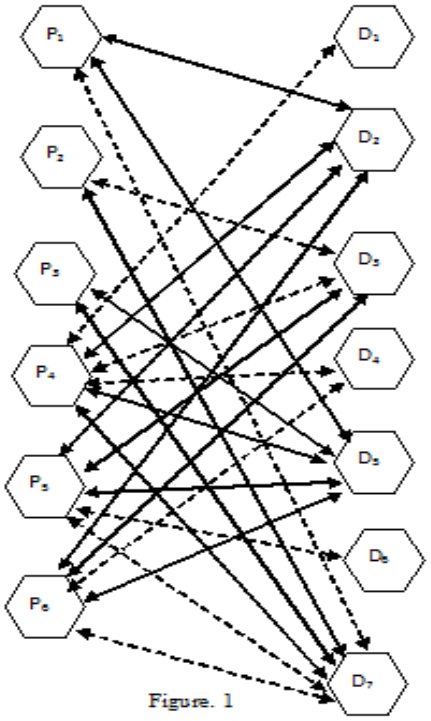

Figure. 1

$$A = \begin{array}{c} \\ D_1 \\ D_2 \\ D_3 \\ D_4 \\ D_5 \\ D_6 \\ D_7 \end{array} \begin{array}{c} \begin{array}{cccccc} P_1 & P_2 & P_3 & P_4 & P_5 & P_6 \end{array} \\ \begin{pmatrix} 0 & 0 & 0 & I & 0 & 0 \\ 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & I & 0 & I & 1 & 1 \\ 0 & 0 & 0 & I & 0 & I \\ 1 & 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & I & 0 \\ I & 1 & 1 & 1 & I & I \end{pmatrix} \end{array}$$

Suppose we consider the node P5 to be in the on state and rest of the nodes in the off state. That is the Lack of guidance is in the ON state and the rest of the nodes are in the off state

(i.e. X0 = [0 0 0 0 1 0], the effect of the dynamical system is given below.

Let X0 = [0 0 0 0 1 0]

X0 AT = [0 1 1 0 1 I I] = Y0

Y0 A = [I2 + 2 2I I+1 2I+2 2I2 + 3 I2 + 3]

→ [1 I 1 1 1 1] = X1

$X_1 A^T$ = [I 4 $I^2 + I + 2$ 2I 5 I 4I+2]

→ [I 1 1 I 1 I 1] = Y_1

Y_1A = [I + 2 I+1 2 $2I^2 + I + 3$ $I^2 + I + 3$ $I^2 + I + 3$]

→ [1 1 1 1 1 1] = X_2

$X_2 A^T = [I \quad 4 \quad 2I+2 \quad 2I \quad 5 \quad I \quad 3I+3]$

$\rightarrow \quad [I \quad 1 \quad 1 \quad I \quad 1 \quad I \quad 1] \quad = Y_1$

$Y_1 A = [I+2 \quad I+1 \quad 2 \quad 2I^2+I+3 \quad I^2+I+3 \quad I^2+I+3]$

$\rightarrow \quad [1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1] \quad = X_2$

After updating and thresholding the instantaneous vector at each stage we obtain the following chain.

$X_0 \rightarrow Y_0 \rightarrow X_1 \rightarrow Y_1 \rightarrow X_2 \rightarrow Y_1 \rightarrow X_2$, X_0 is the fixed point. According to first expert's opinion, when the concept P_5 is in the ON state, the following concepts P_1 , P_2 , P_3, P_4 , P_6 ,D_2 ,D_3 , D_5 , D_7 are also becomes ON state and D_1 ,D_4 , D_6 becomes indeterminate state denoted by 'I'.

The directed graph and the associated relation matrix B as given by the second expert is given below.

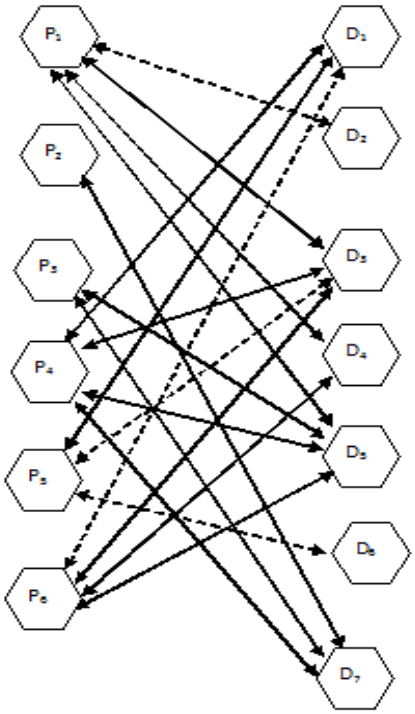

Figure 2

$$B = \begin{array}{c} \\ D_1 \\ D_2 \\ D_3 \\ D_4 \\ D_5 \\ D_6 \\ D_7 \end{array} \begin{array}{c} \begin{array}{cccccc} P_1 & P_2 & P_3 & P_4 & P_5 & P_6 \end{array} \\ \begin{pmatrix} 0 & 0 & 0 & 1 & 1 & I \\ I & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & I & 1 \\ 1 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & I & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 \end{pmatrix} \end{array}$$

Suppose we consider the node P5 to be in the on state and rest of the nodes in the off state. That is the Lack of guidance is in the ON state and the rest of the nodes are in the off state (i.e. X0 = [0 0 0 0 1 0], the effect of the dynamical system is given below.

Let $X_0 = [0 \quad 0 \quad 0 \quad 0 \quad 1 \quad 0]$

$X_0 B^T = [1 \quad 0 \quad I \quad 0 \quad 0 \quad I \quad 0] = Y_0$

$Y_0 B = [I \quad 0 \quad 0 \quad I+1 \quad 2I^2+1 \quad 2I]$

$\rightarrow [I \quad 0 \quad 0 \quad 1 \quad 1 \quad I] \quad = X_1$

$X_1 B^T = [I^2+2 \quad I^2 \quad 3I+1 \quad 2I \quad 2I+1 \quad I \quad 1]$

$\rightarrow [1 \quad I \quad 1 \quad I \quad 1 \quad I \quad 1] \quad = Y_1$

$Y_1 B = [I^2+I+2 \quad 1 \quad 2 \quad 4 \quad I^2+I+1 \quad 2I+2]$

$\rightarrow [1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1] \quad = X_2$

$X_2 B^T = [I+2 \quad I \quad I+3 \quad 2 \quad 4 \quad I \quad 3]$

$\rightarrow [1 \quad I \quad 1 \quad 1 \quad 1 \quad I \quad 1] \quad = Y_2$

$Y_2 B = [I^2+3 \quad 1 \quad 2 \quad 4 \quad I^2+I+1 \quad I+3]$

$\rightarrow [1 \quad 1 \quad 1 \quad 1 \quad 1 \quad 1] \quad = X_2$

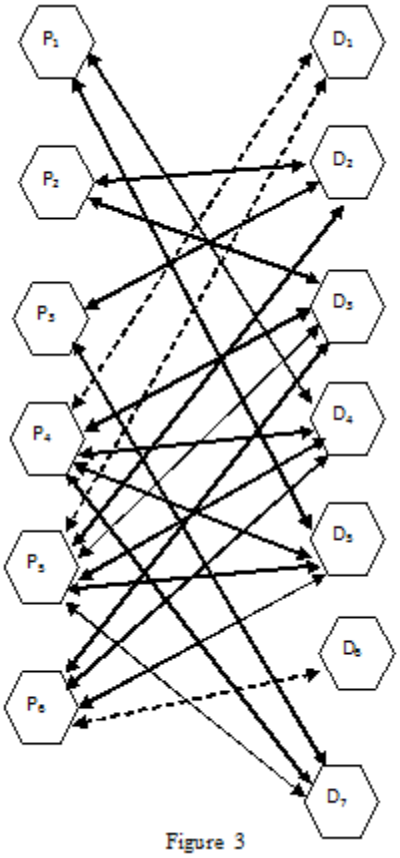

Figure 3

$$C = \begin{array}{c} \\ D_1 \\ D_2 \\ D_3 \\ D_4 \\ D_5 \\ D_6 \\ D_7 \end{array} \begin{array}{c} \begin{array}{cccccc} P_1 & P_2 & P_3 & P_4 & P_5 & P_6 \end{array} \\ \begin{pmatrix} 0 & 0 & 0 & I & I & 0 \\ 0 & 1 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & I \\ 0 & 0 & 1 & 1 & 1 & 0 \end{pmatrix} \end{array}$$

After updating and thresholding the instantaneous vector at each stage we obtain the following chain.

$X_0 \rightarrow Y_0 \rightarrow X_1 \rightarrow Y_1 \rightarrow X_2 \rightarrow Y_2 \rightarrow X_2$, X_0 is the fixed point. According to second expert's opinion, when the concept P_5 is in the ON state, the following concepts P_1 , P_2 , P_3, P_4 , P_6 , D_1 ,D_3, D_4 ,D_5 , D_7 are also becomes ON state and D_2 , D_6 becomes indeterminate state denoted by 'I'. The directed graph and the associated relational matrix C as given by the third expert is given below.

Suppose we consider the node P_5 to be in the on state and rest of the nodes in the off state. That is the Lack of guidance is in the ON state and the rest of the nodes are in the off state.

(i.e. X_0 = [0 0 0 0 1 0] , the effect of the dynamical system is given below. Let X_0 = [0 0 0 0 1 0]

$X_0 C^T$ = [I 1 1 1 1 0 1] = Y_0

$Y_0 C$ = [2 2 2 I^2+4 I^2+5 3]

→ [1 1 1 1 1 1] = X_1

$X_1 C^T$ = [2I 3 4 4 4 I 3]

→ [I 1 1 1 1 I 1] = Y_1

$Y_1 C$ = [2 2 2 I^2+4 I^2+5 I^2+3]

→ [1 1 1 1 1 1] = X_1

After updating and thresholding the instantaneous vector at each stage we obtain the following chain.

X0 → Y0→ X1 → Y1 →X1, X0 is the fixed point. According to third expert's opinion, when the concept P5 is in the ON state, the following concepts P1, P2 , P3, P4, P6, D2, D3, D4, D5, D7 are also becomes ON state and D1 , D6 becomes indeterminate state denoted by 'I'.

The Combined directed graph and the associated relational matrix D after updating is given below.

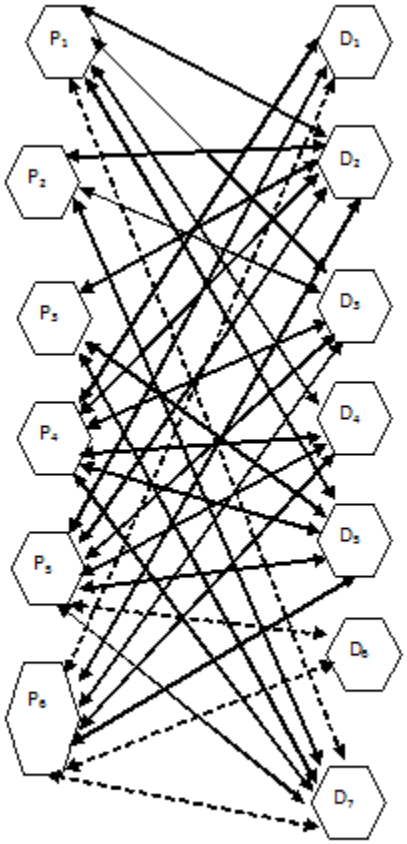

Figure 4

$$D = \begin{array}{c} \\ D_1 \\ D_2 \\ D_3 \\ D_4 \\ D_5 \\ D_6 \\ D_7 \end{array} \begin{array}{c} \begin{array}{cccccc} P_1 & P_2 & P_3 & P_4 & P_5 & P_6 \end{array} \\ \begin{pmatrix} 0 & 0 & 0 & 1 & 1 & I \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & I & I \\ I & 1 & 1 & 1 & 1 & I \end{pmatrix} \end{array}$$

Suppose we consider the node P_5 to be in the on state and rest of the nodes in the off state. That is the Lack of guidance is in the ON state and the rest of the nodes are in the off state

(ie. X_0 = [0 0 0 0 1 0] , the effect of the dynamical system is given below.

Let X_0 = [0 0 0 0 1 0]

$X_0 D^T$ = [1 1 1 1 1 I 1] = Y_0

$Y_0 D$ = [I+4 3 3 6 I^2+6 I^2+2I+4]

$\rightarrow$ [1 1 1 1 1 1] $= X_1$

$X_1 D^T$ = [I+2 6 5 4 5 2I 2I+4]

$\rightarrow$ [1 1 1 1 1 I 1] $= Y_0$

$Y_0 D$ = [I+4 3 3 6 $I^2 + 6$ $I^2 + 2I + 4$]

$\rightarrow$ [1 1 1 1 1 1] $= X_1$

After updating and thresholding the instantaneous vector at each stage we obtain the following chain.

X0 $\rightarrow$ Y0$\rightarrow$ X1 $\rightarrow$ Y0 $\rightarrow$X1, X0 is the fixed point. According to combined expert's opinion, when the concept P5 is in the ON state, the following concepts P1 , P2 , P3, P4 , P6 , D1 ,D2 ,D3 , D4 ,D5 , D7 are also becomes ON state and D6 becomes indeterminate state denoted by 'I'.

4. CONCLUSION

As per expert's opinion, when there is "Lack of guidance", a patient cannot remain enlightened and latest informed about his disease and its cure. Correct guidance can make him aware of the consequences of not approaching a competent doctor in time and taking medicines strictly adhering to the correct dosage and at correct interval. It also suggests the ways and means for the excuses put forward by the patient like lack of time, non availability of doctors nearby and the fear of meeting the expenses. Underqualified doctors with less experience and under mental stress most of the time and reluctant to study the old history of the patient and not discussing about the current problem in detail can go to wrong diagnosis and prescribe medicines that are harmful and sometimes have no scientific base. At times such medicines may seem to work through powerful placebo effects.

Doctors and hospitals function only with business motive is also a factor to be avoided. Because they consider the patients as milch cows. So greater care should be exercised in selecting the doctors/hospitals whenever a medical treatment is required. Matters like specially qualified doctors, availability of relevant equipments and nature of care and service provided by them to be found out thoroughly in advance. As far as possible, we should enlighten ourselves regarding the illness and the source of medical care we are planning to accept from. To get the correct guidance from qualified persons is the best way for effective and correct medication.

It is apt to remember here what Mr. Scott Alexander said "All good is hard. All evil is easy. Dying, losing, cheating and mediocrity is easy. Stay away from easy". May it be malady or remedy.

5. REFERENCES

[1] W. B. Vasantha Kandasamy , Florentin Smarandache., Fuzzy Cognitive Maps And Neutrosophic Cognitive Maps. xiquan Phoenix 2003.

[2] Kosko, B., January, 1986, "Fuzzy Cognitive Maps", International journal of man-machine studies, pp.62-75

[3] Vasantha Kandasamy, W.B., and Yasmin Sultana**,** FRM to Analyse the Employee-Employer Relationship Model, J. Bihar Math. Soc**.,** 21 (2001) ,25-34.

[4] Vasantha Kandasamy, W.B., and Yasmin Sultana, Knowledge Processing Using Fuzzy Relational Maps, Ultra Sci., **12** (2000) 242-245.

[5] Vasantha Kandasamy, W.B., M. Mary John and T. Kanagamuthu. Study of Social Interaction and Woman Empowerment Relative to HIV/AIDS, Maths Tiger, 1(4) (2002) 4-7.

[6] W. B. Vasantha Kandasamy, Florentin Smarandache., Fuzzy Cognitive Maps and Neutrosophic Cognitive Maps.

[7] Yasmin Sultana**,** Construction of Employee-Employee Relationship Model using Fuzzy Relational Maps, Masters Dissertation, Guide: Dr. W.B. Vasantha Kandasamy, Department of Mathematics, Indian Institute of Technology, April 2000.

[8] Smarandache, F**.** Definitions Derived from Neutrosophics, In Proceedings of the First International Conference on Neutrosophy, Neutrosophic Logic, Neutrosophic Set, Neutrosophic Probability and Statistics, University of New Mexico, Gallup, 1-3 December 2001.