

NIPAH VIRUS USING RESTRICTED BOLTZMANN MACHINE

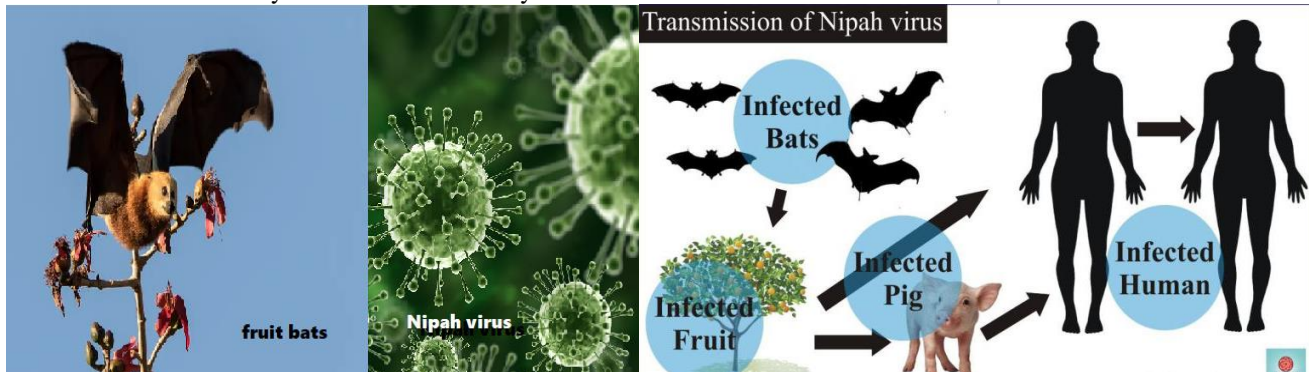
Velpula Sandhya Raniand, Dr.Havalath Balaji
Sreenidhi Institute of Technology and Science, Medchal, Telangana.

Abstract : Nipah virus is an infectious virus which is caused by fruit bats. Recently in 2018 there was a deadly outbreak that occurred in Kerala where many of people got infected and died due to Nipah virus. In this model we are using deep learning concept which helps to predict the occurrence of infected virus using Restricted Boltzmann Machine. It is a feature selection algorithm where particular data will be selected by applying matrix of weights associated with the connection between the hidden layer and the visible layer. Firstly, it was identified in Malaysia Kampung Sungai Nipah in 1998. The fertility rate people affected with Nipah virus was around 70%. Transmission of this infected virus is done by bats-to-human, animals-to-human and human-to-human. Particular signs and symptoms will be exhibited for the person affected with Nipah virus. Cerebrospinal fluid serum test will be done by collecting White Blood Cells, Glucose and Protein by using Restricted Boltzmann machine. This deep learning algorithm will give the numeric results such that we can identify whether the patient is affected with Nipah virus. Prevention measures should be taken as “prevention is better than cure” because there is no vaccine for Nipah virus which is eventually more dangerous.

IndexTerms - Deep Learning, Nipah Virus, Restricted Boltzmann Machine.

I. INTRODUCTION

Nipah virus is a zoonotic virus which is caused due to infected bats also called as flying fox or fruit bats. Zoonotic means the transmission of diseases from vertebrate's animals to humans. Nipah virus belongs to the genus of Henipaviral. Nipah virus was firstly identified in the year 1999 in a village known as Kampung Sungai Nipah during the outbreak among the pig farmers in Malaysia, later it was also recognized in Bangladesh in 2001. Recently it was also identified in Kerala unexpectedly where there was a major outbreak, people were infected by consuming date palm sap that was contaminated by virus-carrying bats. Nipah has been occurred last 15 years ago but identified in 2001 Siliguri, 2007 Nadia and recently in 2018 there was a major outbreak in Kozhikode and Malappuram district of Kerala where many people were affected with Nipah virus. Flying bats can be found in Asia, East Africa, and Pacific Islands. The major outbreak occurred in Malaysia, Bangladesh and India. Fruit bats are the natural hosts which transmit deadly diseases along with Ebola and Zika. Nipah virus is carried by fruit bats, it doesn't make bats sick because it has high metabolic rate and high body temperature. Their immune system will fight against possible infections that occur. Some bats were infected from bats saliva where the transmission of virus is done from one to another which is very harmful spreadable disease. Virus may infect to human if they consume a fruit nibbled with infected bats.



1.2 Transmission of Nipah virus:

Firstly, it was recognised in the outbreak of Malaysia and later in Singapore, humans were affected by contact or body fluids such as blood, urine or excreta of flying fox on fruits.

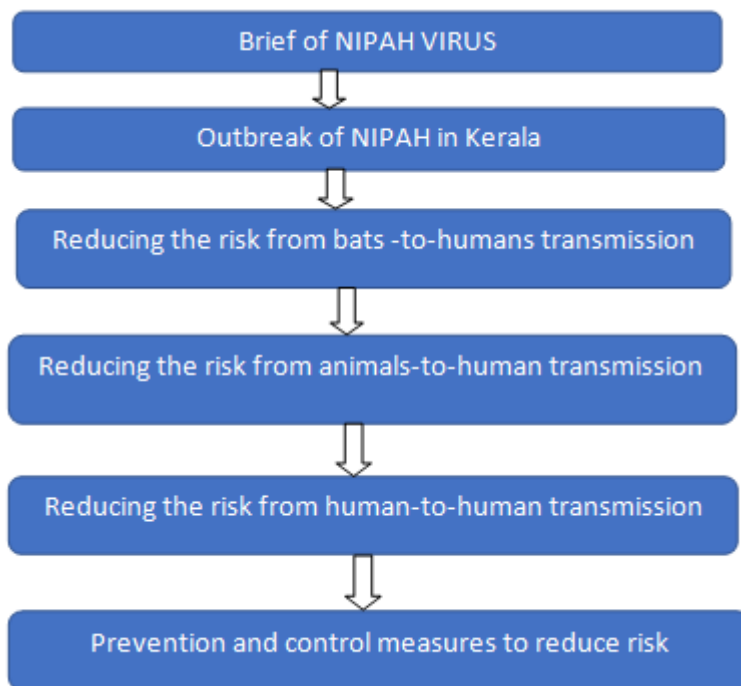


Figure 3: Reducing transmission risk of Nipah virus.

Pigs or other animals consume these infected fruits were the occurrence of Nipah virus takes place or also by unprotected contact with the tissue of infected animals. There is no proper vaccine so we can reduce the risk factor by educating the people about the control measures and prevention. We can diminish the risk of spreading virus from bats-to-human by only collecting the fresh raw date palm juice or washed fruits before consumption. Fruits with sign of bats should be avoided were circumstances of transmission virus will be more. We can reduce the risk from transmission from animals-to-humans by wearing protective gloves or clothes while handling sick pigs. We should avoid contact with sick animals as much as possible. We can also reduce the risk from human-to-human transmission by avoiding physical contact with infected people and we should also ignore using their towels or their belongings. We should regularly wash our hands after taking care or visiting sick people.

WHO (World Health Organisation) issued guidance to take all the prevention methods by State Government of Kerala along with Central Minister of Health and Family. They are supporting for the people getting affected or the risk of transmitting virus by technical guidance.

1.3 Symptoms and Signs of infected people:

Infected people initially have symptoms or particular signs such as fever, headache, vomiting, dizziness, unconscious, blood pressure, reduced reflexes, and neurological signs. Incubation period is of 4-14 days after which the person can exhibit symptoms. This virus is similar to Influenza or Flue. Across 20% of people infected with Nipah virus and having acute Encephalitis make recovery but long-term neurological conditions have been occurred by analysing the previous reports. Asymptomatic infection may also occur in some cases were the person will just carry the virus without having any symptoms. People affected with Nipah virus hashigh fertility rate of about 70% to die. Form a long period of time the consequences of virus have been noted that personality changes also transpire. Death has been raised after some months and even years after the signs and symptoms have been took place for the people infected with Nipah virus.

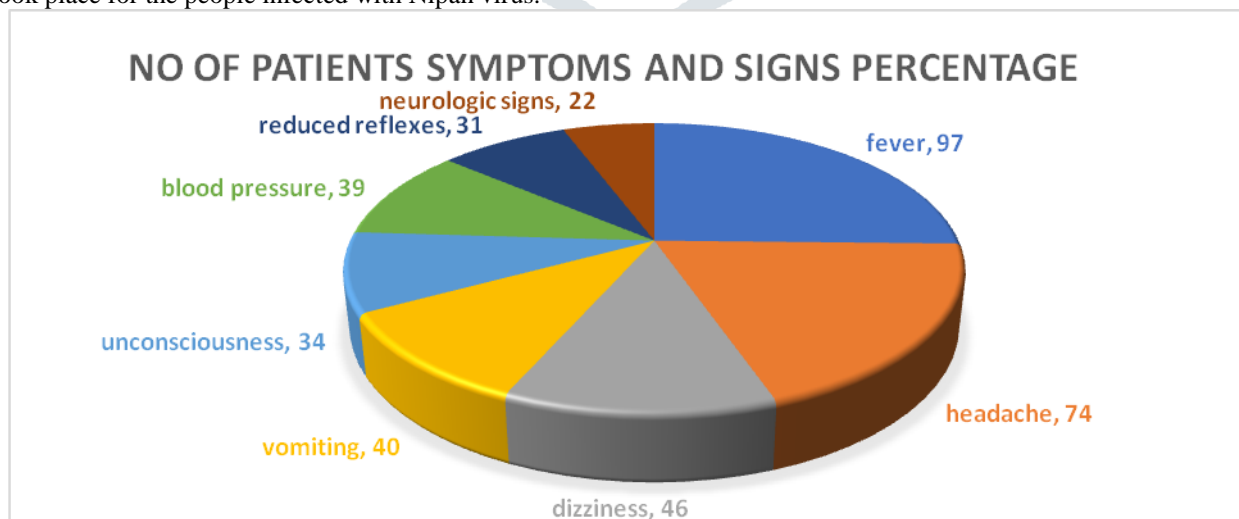


Figure 4: Symptoms and Signs

The percentage of occurrence of fever will be of 97% which will be common for most of the people affected with Nipha virus, neurological signs is about 22%, reduced reflexes is about 31%, blood pressure is about 39%, becoming unconscious is about 34%, vomiting 40%, dizziness 46% and headache is about 74% for most of the people. If the person is affected with any of the

symptoms then we can justify that person is infected. These are the major symptoms that occur for the people who got infected with Nipah virus.

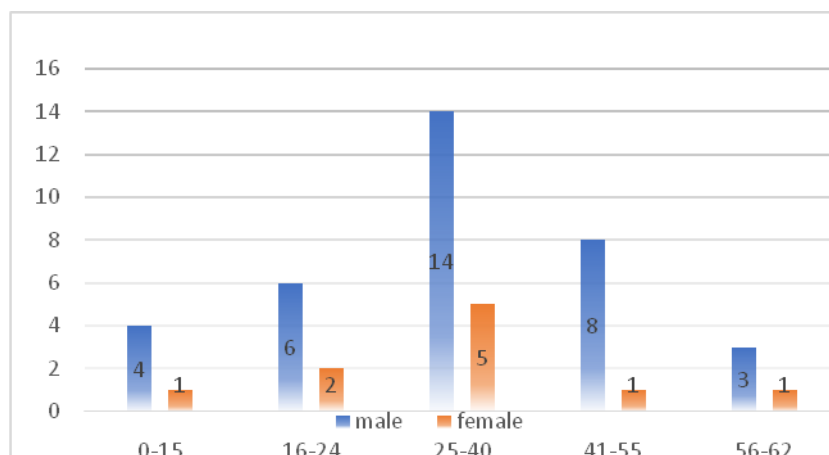


Figure 5: Male and Female patients affected with Nipah virus

If we observe the above figure (5) the people affected with Nipah virus are more in male rather than female. From age 25-45 the occurrence of Nipah virus is more than other age people.

II. DEEP LEARNING

2.1 Deep learning is a part of machine learning. The data will be transformed into number of layers, where each layer will perform the specific process. Deep Learning is usually achieved by utilizing neural system engineering. In deep learning training and testing of the data will be done to predict the best result. We can focus on the prediction of health issues by using the learning algorithms. Learning process can be done in both supervised and unsupervised manner. Big data and high-performance maintenance can be done by using deep learning.

2.2 Proposed Work:

We use deep learning for implementation through high level programming. Transmission of data is done between number of layers such that it can predict to generate accurate output. here the performance is done from one layer to another in a specific manner such that redundancy can be removed in the layered structure. Many works have been done to detect high yield techniques for remedy of finding different diseases. Similarly, here we are checking whether the particular patient is affected with Nipah virus or not by using Restricted Boltzmann Machine (RBM). It has a structure like bipartite graph were intra communication between two nodes are maintained in a layer.

III. METHODOLOGY

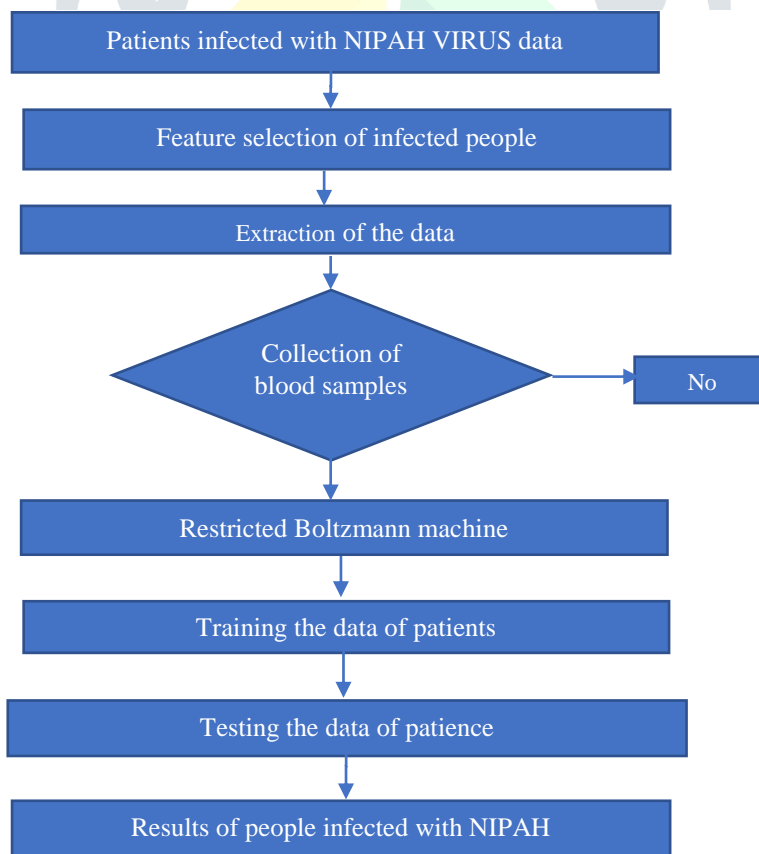


Figure 6: Dataflow diagram by using Restricted Boltzmann machine.

Firstly, the feature selection is done based on the weights provided to different symptoms in Nipah virus by using neural networks. Those features are extracted by using the data values applied to Restricted Boltzmann Machine for classification. The process model consists of data where feature selection and extraction will be done by using Restricted Boltzmann Machine. Appropriate linkage will be formed between each layer and predict the result by historical information. The figure mentioned below detects whether the candidate is affected with Nipah virus or not by extracting the data in a particular manner.

3.1 Data Preprocessing:

In data preprocessing steps will be followed where the selection of only three features will be done from a file. Then the normalization of data will be done by following min max normalization such that we can get the input vector range between 0 and 1 to avoid complexity. The neighboring dataset will diverge into training dataset and test dataset such as 20% will be of test data and the remaining 80% of training dataset. The Upper bound (UB) preference is 1 and the lower bound preference is 1. to find min max normalization of data we use equation (1)

$$X_{norm} = (X - X_{min}) / (X_{max} - X_{min}) \cdot (UB - LB) \dots \dots \dots (1)$$

3.2 Restricted Boltzmann Machine Classification:

Restricted Boltzmann Machine is a model which has a structure like a bipartite graph and it is an energy-based model. Its graphical structure has an undirected graph. It has a visible layer and hidden layers by adding weights. The input values are directly assigned with the visible layer. The real-valued data can be applied to RBM which has a similar structure as Gaussian Bernoulli type architecture. Modified RBM with binary logistic hidden units and the real values of Gaussian visible units can be used in classification.

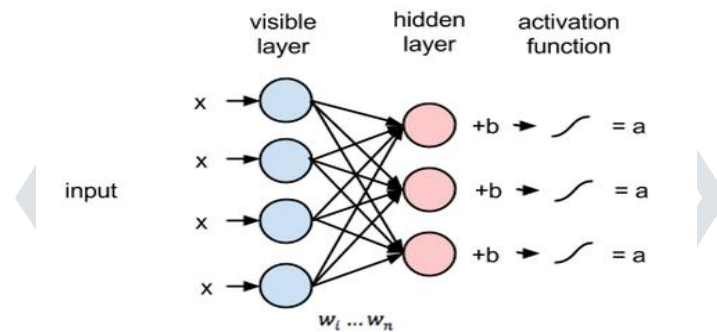


Figure 7: Basic structure of RBM.

A Restricted Boltzmann Machine is a definite kind of a Markov random field which consists of two layers. One layer of an RBM comprises of visible input units, v , which are associated with the other layer of shrouded stochastic units h either 0 or 1. The basic structures demonstrate the essential access of data. The appropriation of state $\{v, h\}$ of a RBM is indicated by the accompanying vitality work.

$$E(v, h) = \sum_j \frac{(v_j - b_j)^2}{\sigma_j^2} - \sum_{i,j} \frac{v_i}{\sigma_i} * w_{i,j} * h_j - \sum_j c_j h_j \dots \dots \dots (2)$$

W is the weights applied represents from visible to hidden layer comprising as w_{ij} of associations between neurons v_i and h_j , b represents to a visible bias vector. The positioning of all the parameters can be indicated by $\theta = \{W, b, a\}$. joint probability distribution is computed using formula (2). to obtain maximum probability the Distribution computation energy is kept minimum as the negative energy increases in probability and vice versa (

$$P(v, h) = \exp(-E(v, h)) / Z \dots \dots \dots (3)$$

Where Z is partition function by summing all the pairs of visible and hidden unit given by below equation.

$$Z = \sum_{v, h} e^{-E(v, h)} \dots \dots \dots (4)$$

The conditional probability distribution of each unit is given by the sigmoid activation function of the input it receives using below formula:

$$P(h_j | v) = \text{sigm}(\sum_i w_{i,j} v_i + c_j) \dots \dots \dots (5)$$

$$P(v_i | h) = N(\sum_j w_{i,j} h_j + b_i, \sigma_i) \dots \dots \dots (6)$$

$$\text{Sigm}(x) = 1 / (1 + \exp(-x)) \dots \dots \dots (7)$$

Computing $p(r, x)$ is unmanageable, but it is possible to compute $p(r|x)$, samples from it or we can choose the most likely happening class under this model. Reasonable number of classes can be computed exactly and efficiently by conditional distribution C . to compute energy distribution when there is classification related problem, we use the below formula, Distribution of energy function as:

$$P(v, h, r) = \exp(-E(v, h, r)) / Z \dots \dots \dots (8)$$

Using the distribution given in equation (8) the classes are predicted such as to check patient has been infected or not.

Steps in training Restricted Boltzmann Machine are:

1. Take the training data set directly to visible unit.

2. To update the hidden states use sigmoid activation function equation number 7.
3. For i th hidden unit compute activation function using equation number 5.
4. Set the visible unit value to 12 using formula 3 and unit value to 0 using equation 6.
5. Compute the positive statistics for edge $(e_{ij})=v_i * h_j$.
6. Again, reconstruct the visible unit using the similar technique. For each visible unit, compute the activation energy using equation 5 and update the state.
7. Now update hidden units again, and compute $(e_{ij})=v_i * h_j$ which is the negative statistics for each stage.

In Restricted Boltzmann Machine the visible units are used to find the distribution of hidden units and the hidden units are used to compute the distribution of visible units until the required stable state have been obtained. If the people have the above symptoms and signs the person should consult doctor and check cerebrospinal fluid serum test where the blood samples were collected and check the count of White blood cells, Glucose level, Protein level.

1.	WBC Count, cells/mcL	4,000-11,000
2.	Protein level, mg/dL	20-40
3.	Glucose level, mmol/L	2.5-4.4

Table 1: Cerebrospinal fluid range of a normal person.

If the count is more then we can justify that the person is infected with Nipah virus. Cerebrospinal fluid test has been examined to detect any disruption that occur in our brain. The cerebrospinal fluid test consists the level of our glucose, protein and White Blood cells count. If the people have the above symptoms check cerebrospinal fluid serum test where the blood samples were collected and check the count of White blood cells, Glucose level, Protein level. If the count is more then we can justify that the person is infected with Nipah virus. The Cerebrospinal fluid is filled in ventricles in human body. Brain controls our entire body system where it is surrounded with CSF fluid.

IV. PERFORMANCE AND EVALUTION

4.1 White Blood cells:

White blood cells (WBC) are the cells of immune system. They help to protect our body against infectious diseases as well as foreign invaders. WBC are also called as leukocytes. The bone marrow continuously produces WBC until they fight against any infectious diseases. The normal range od WBC count must vary between 4,000-11,000 cells/mcL. The persons affected with Nipah virus has very less WBC count.

No of patients	1	2	3	4	5	6
WBC Count cells/mm3	1000	2000	4000	5000	9000	2500

Table 2: WBC count of people infected with Nipah.

WBC count which is ranging from 1,000-9,000 normally the WBC count mast vary from 4,000-11,000 but for some patients the WBC count is less such that it can be identified that the particvular patient has been affected with some infection

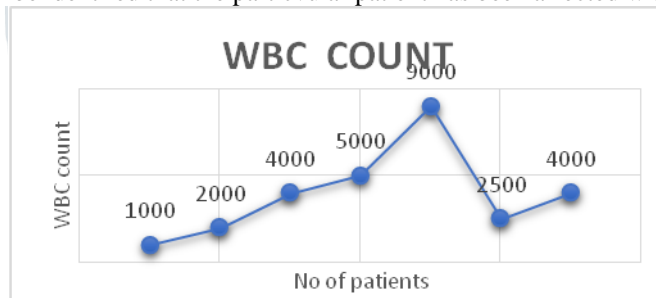


Figure 8: Shows the content of “Table 2” values of Nipah patients

If u observe the above graph we have considered having WBC count is less in some patients were wecan identify the sign that the patients has been infected.They are manufacutred in bone marrow which is a spongy tissue inside some of our larger bones.

4.2 Protein level:

Proteins are the reduisite nutrients for human body. They are one of the building blocks of our cell tissue which is like a fuel source. Energy density of proteins are more. Proteins are the large complex molecules which consists of amino acids.

No of patients	1	2	3	4	5	6	7
Protein Level mg/dL	23	47	30	58	69	145	54

Table 3: Protein level of people infected Nipah.

Normally the level of protein should range from 20-40 mg/dL. Here if u observe the above graph the protein level of some patients is more which are the signs of tumour or some occurrence infections.

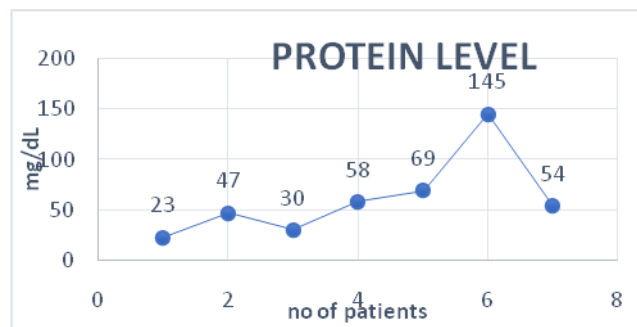


Figure 9: Shows the content of “Table 3” values of Nipah patients

Doctor cleans our back with antiseptic and applies a local anaesthetic. This numbs the puncture site to minimize pain. It may take a few moments to start working. Then, they insert a needle into our lower spine and they extract some small amount of CSF into the needle. Then the doctor removes the needle after accumulating adequate fluid from the body. They clean and dress up the site where they have inserted the needle. Later they send CSF sample to laboratory for analysis.

4.3 Glucose level:

In cerebrospinal fluid test we will measure the aggregate glucose level, or sugar level present in the fluid of a human body. people infected with virus will have high glucose level as their blood gets infected by the consumption of infected food which is converted into glucose. the level of glucose may be high without knowing because it does not often any signs. infected blood carries throughout every cell present in our body.

No of patients	1	2	3	4	5	6	7
Glucose Level mmol/L	2.6	5.5	3.3	4.6	4.8	3.9	3.2

Table 4: Glucose level of people infected with Nipah.

Glucose test helps in identifying the conditions that had been raised in our body such as infections and tumors.

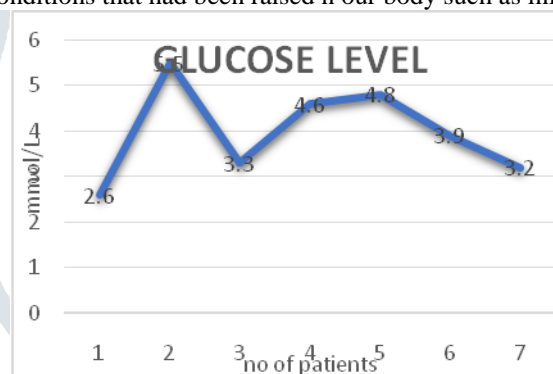


Figure 10: Shows the contents of “Table 4” values of Nipah patients.

CSF is a clear fluid surrounded with brain and spinal cord is the better course of action for testing the conditions because it is in direct connection with brain. and spine. We will examine all the above results and monitor whether the particular person is affected with Nipah virus or not in a particular order by using our algorithm.

V. PREVENTION

First acupuncture for human beings is Intensive Support Care (ISC) by WHO for the people affected with Nipah virus. The ISC focuses on symptoms such that they can remove the infection by taking care of the symptoms that affected people with Nipah virus. Personal Protection Equipment (PPE) should be taken for the workers and the people who collect samples from patients. Contact tracing should be done because we can reduce the risk of virus transmission. Nipah virus can be averted by avoiding to exposure of sick pigs or bats and also with direct contact with sick or unhealthy people. We should also avoid drinking raw date sap because “prevention is better than cure”. A centime vaccine, using the Hendra protein which provides defensive antibodies which has been lately used in Australia to protect horses from Hendra virus but the result was not up to the mark. So, the government are trying to access the accurate vaccine to avoid Nipah virus.

VI. CONCLUSION

Restricted Boltzmann machine in deep learning was effectively prepared for prediction of data. Nipah virus is caused by infected flying bats which had high metabolic rate. Recently major outbreak occurred in Kerala were many people got infected. We are collecting the samples such that we can analyse and predict the occurrence of our infection that occurred. People living in rural areas doesn't understand about the infection but by symptoms they can analyse and consult doctor for sample test which can be

done rural as well as urban areas. Transmission of Nipah virus for human is mostly by date palm sap which had been consumed by infected bats. Understanding of these diseases could lead to the breakage of treatment were prevention is done. Here we should avoid contact with infected pigs and animals which are sick and certain prevention measures should be taken We will get the satisfactory outcome were the prediction of infectious can be identified with accuracy National centre for disease control is presently in Kerala reviewing the situation occurred by bats.

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