

# An Expert System for Diagnosing West Nile virus Problem Using CLIPS

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**Abstract:** West Nile virus (WNV) is a mosquito-borne flavivirus that was first identified in 1937 in the West Nile district of Uganda. The virus is now widely distributed throughout the world and is considered a significant public health concern. WNV is primarily transmitted to humans through the bite of infected mosquitoes, with birds serving as the primary reservoir host. Most people infected with WNV will not experience any symptoms, but approximately 1 in 5 will develop a fever, and a smaller percentage may develop more severe symptoms such as meningitis or encephalitis. There is no specific treatment for WNV infection, and prevention efforts focus on mosquito control measures and personal protective measures to avoid mosquito bites. While WNV is not typically considered a major threat to human health, outbreaks have occurred sporadically in various parts of the world, and ongoing surveillance and research are necessary to better understand and control the virus. Objectives: This paper will solve the problems of treatment of West Nile virus (WNV) through correct diagnosis and treatment. Methods: In this research, we provide an expert system for the diagnosis of West Nile virus (WNV) which will help doctors to explore everything related to the problems of West Nile virus (WNV). We look forward to providing simplified answers to West Nile virus (WNV).[1]

**Keywords:** Artificial Intelligence, Expert Systems, WNV, problem, clips.

## 1- INTRODUCTION

West Nile virus (WNV) is the leading cause of mosquito-borne disease in the continental United States. It is most spread to people by the bite of an infected mosquito. Cases of WNV occur during mosquito season, which starts in the summer and continues through fall. There are no vaccines to prevent or medications to treat WNV in people. Fortunately, most people infected with WNV do not feel sick. About 1 in 5 people who are infected develop a fever and other symptoms. About 1 out of 150 infected people develop a serious, sometimes fatal, illness. You can reduce your risk of WNV by using insect repellent and wearing long-sleeved shirts and long pants to prevent mosquito bite.[2]



**Doctors typically divide West Nile virus (WNV) symptoms into three categories based on their severity: asymptomatic, mild, and severe.**

- Asymptomatic: Most people who are infected with WNV will not experience any symptoms and will not realize they have been infected. In fact, it is estimated that up to 80% of people infected with WNV are asymptomatic.
- Mild: About 20% of people infected with WNV will develop mild symptoms, including fever, headache, body aches, nausea, vomiting, and occasionally a skin rash. These symptoms typically last a few days to a few weeks, and people usually recover completely.
- Severe: Less than 1% of people infected with WNV will develop severe symptoms, including meningitis (inflammation of the lining of the brain and spinal cord) or encephalitis (inflammation of the brain). Severe cases of WNV can cause high fever, headache, neck stiffness, confusion, coma, seizures, paralysis, and even death. These symptoms can last for several weeks, and some people may experience long-term complications.

It is important to note that while the majority of WNV infections are asymptomatic or mild, the virus can cause severe illness in some individuals, particularly those with weakened immune systems or other underlying medical conditions. If you experience any symptoms of WNV or are concerned that you may have been exposed to the virus, it is important to contact your healthcare provider for guidance.[3]

**What causes WNV?**

West Nile virus (WNV) is caused by an RNA virus belonging to the Flaviviridae family. The virus is primarily transmitted to humans through the bite of infected mosquitoes, particularly those of the Culex genus, which are found in many parts of the world. Mosquitoes become infected with WNV by feeding on infected birds, which are the primary reservoir host for the virus. WNV can also be transmitted to other animals, including horses, dogs, cats, and other mammals, through mosquito bites or contact with infected animals or their body fluids. In rare cases, WNV can also be transmitted through blood transfusions, organ transplants, or from mother to baby during pregnancy, delivery, or breastfeeding. While WNV is not directly contagious from person to person, a small number of cases have been reported in which the virus was likely transmitted through blood transfusion, organ transplant, or breast milk.[4]

## 2. EXPERT SYSTEM

An expert system is a computer program that is designed to mimic the decision-making ability of a human expert in a specific domain or field. It uses a knowledge base, a set of rules, and a reasoning engine to provide advice, recommendations, or solutions to users based on their inputs and queries.

Expert systems are typically built using artificial intelligence (AI) techniques such as rule-based systems, decision trees, fuzzy logic, and machine learning. They can be used in a wide range of applications, from medical diagnosis and financial analysis to engineering design and troubleshooting.

Expert systems work by incorporating the knowledge and expertise of human experts into a computerized format, allowing the system to replicate the decision-making processes of these experts. The knowledge base is created by inputting relevant information and rules into the system, which are then used by the reasoning engine to make decisions or provide advice. Users interact with the system by inputting data, answering questions, or providing feedback, and the system responds with recommendations or solutions based on its knowledge base and reasoning algorithms.

Overall, expert systems can be a valuable tool for augmenting human decision-making, providing reliable and consistent advice and guidance in complex domains.[5]

### How Do Expert Systems Work?

Expert systems work by utilizing a knowledge base, a set of rules, and a reasoning engine to provide advice, recommendations, or solutions to users based on their inputs and queries. Here is a step-by-step process for how expert systems work:

1. Knowledge acquisition: Experts in a specific domain or field are consulted to gather information, knowledge, and rules about the domain. This information is then organized and incorporated into a knowledge base.

2. Knowledge representation: The knowledge base is created a specific representation language to organize the information and rules in a format that can be easily accessed processed by the reasoning engine.

3. Inference engine: The reasoning engine, also known as the inference engine, is the part of the system that uses the knowledge base to reason and make decisions. The inference engine works by using a set of algorithms to match the input provided by the user to the rules and information in the knowledge base.

4. User interface: The user interface allows the user to interact with the system. The user may input data, answer

questions, or provide feedback, and the system responds with recommendations or solutions based on its knowledge base and reasoning algorithms.

5. Explanation: The expert system provides explanations for its recommendations or decisions to help the user understand the reasoning behind the advice or solution.

Overall, expert systems use a combination of knowledge and rules to make decisions, mimicking the decision-making ability of human experts. By utilizing a knowledge base and a reasoning engine, expert systems can provide consistent and reliable advice and solutions in complex domains.[6]

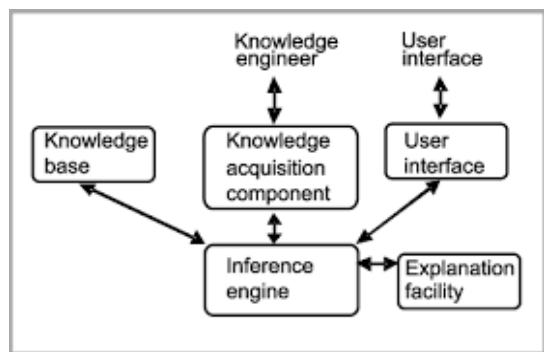


Figure1: The structure of the expert system

using  
and

### 3. What Is Knowledge Representation?

Knowledge representation is the process of organizing and structuring information in a way that can be easily accessed, processed, and used by an artificial intelligence system, such as an expert system. For an AI system to make decisions or provide recommendations, it needs to have a way of representing the knowledge and rules of a particular domain.

There are various techniques for knowledge representation, such as semantic networks, frames, rules, and ontologies. Each technique has its own advantages and disadvantages, and the choice of technique depends on the particular application and domain.

For example, in a medical diagnosis system, knowledge representation might involve organizing symptoms and diseases in a hierarchical structure, with each symptom and disease having specific attributes and relationships to other symptoms and diseases. This information can be represented using a semantic network or an ontology, which allows the system to reason and make decisions based on the information and relationships within the knowledge representation.

Overall, knowledge representation is a crucial component of AI systems, as it provides a means for organizing and structuring information in a way that can be easily accessed and used by the system.[8]

### 4. LITERATURE REVIEW

There is a lot of Expert System that were designed to diagnose human and Plant Diseases such as Problems of Teeth and Gums, Skin Diseases, cough, and other types of Illness. But there is no specialized expert system for diagnosis of West Nile virus diseases available free and use a language CLIPS. This expert system was characterized to be easy to use by specialists and user concerned. This is due to the coordinated application interface. We have built up this expert system to help specialists in diagnosing West Nile virus so as to prescribe a suitable treatment. Symptoms of West Nile virus disease can vary depending on the cause. Expert system is a computer application of Artificial Intelligence (AI) [7]

### 5. MATERIALS AND METHODS

The aim of an expert system designed to diagnose West Nile virus diseases is to present various symptoms and ask the user to select the specific type of symptoms they are experiencing. The expert system then provides a diagnosis of the illness as well as recommendations for the user.

Overall, knowledge representation is a crucial component of AI systems, as it provides a means for organizing and structuring information in a way that can be easily accessed and used by the system.[8]

### 6. EXPERT SYSTEM SOURCE CODE

```
;;;=====
;;;      West Nile Virus Expert System
;;;
;;; This expert system diagnose West Nile Virus problems
;;;
;;;=====
```

```
(deffunction ask-question (?question $?allowed-values)
  (printout t ?question)
  (bind ?answer (read))
  (if (lexemep ?answer)
      then (bind ?answer (lowercase ?answer))))
```

```
(while (not (member ?answer $?allowed-values)) do
  (printout t ?question)
  (bind ?answer (read))
  (if (lexemep ?answer)
    then (bind ?answer (lowercase ?answer))))
?answer)
```

```
(deffunction ask-num (?question ?a1 ?a2 )
  (printout t ?question)
  (bind ?answer (read))
  (while (or ( < ?answer ?a1) ( > ?answer ?a2)) do
    (printout t ?question)
    (bind ?answer (read))
  )
?answer)
```

```
(deffunction yes-or-no-p (?question)
  (bind ?response (ask-question ?question yes no y n))
  (if (or (eq ?response yes) (eq ?response y))
    then TRUE
    else FALSE))
```

```
...*****
;;;
;;;* STARTUP RULES *
...*****
;;;
```

```
;;; This Rule print a banner message
```

```
(defrule system-banner ""
  (declare (salience 10))
  =>
  (printout t crlf crlf)
  (printout t " The West Nile Virus Expert System")
  (printout t crlf crlf))
```

```
;;; Rule for printing the final diagnosis and recommendation
```

```
(defrule print-diagnosis""
  (declare (salience 10))
  (diagnosis ?item1)
```

```
(recommend ?item2)
```

```
=>
```

```
(printout t crlf crlf)
```

```
(printout t " Diagnosis: " ?item1)
```

```
(printout t crlf crlf)
```

```
(printout t " recommendation:" ?item2)
```

```
(printout t crlf crlf)
```

```
)
```

```
::-----R1-----
```

```
(defrule Q1 ""
```

```
(not (diagnosis ?))
```

```
(not (recommend ?))
```

```
(not (Q1 ?))
```

```
=>
```

```
(if (yes-or-no-p "Q1:Is there any flu-like symptoms, such as fever, headache, muscle weakness, joint pain, and fatigue, particularly during the summer months (yes/no) ? ")
```

```
    then (assert (Q1 yes))
```

```
        else (assert (Q1 no))
```

```
)
```

```
)
```

```
::-----R2-----
```

```
(defrule Q1yes ""
```

```
(not (diagnosis ?))
```

```
(not (recommend ?))
```

```
(Q1 yes)
```

```
=>
```

```
(assert (Diagnosis "Your symptoms may be caused by West Nile virus infection.))
```

```
(assert (Recommend "The only treatment for West Nile virus infection is supportive care. Antibody or antiviral therapies play no role. People should take normal precautions to avoid mosquito bites. Public health prevention strategies include surveillance of dead birds, mosquito-control programs and screening of blood products"))
```

```
)
```

```
::-----R3-----
```

```
(defrule Q2 ""
```

```
(not (diagnosis ?))
```

```
(not (recommend ?))
```

(Q1 no)

(not (Q2 ?))

=>

(if (yes-or-no-p "Q2: Did you have a history of recent travel to or residence in an area where West Nile virus (yes/no)? ")

then (assert (Q2 yes))

else (assert (Q2 no))

)

)

::-----R4-----

(defrule Q2yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 yes)

=>

(assert (Diagnosis "Your symptoms may be caused by West Nile virus infection."))

(assert (Recommend "The only treatment for West Nile virus infection is supportive care. Antibody or antiviral therapies play no role. People should take normal precautions to avoid mosquito bites. Public health prevention strategies include surveillance of dead birds, mosquito-control programs and screening of blood products"))

)

::-----R5-----

(defrule Q3 ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(not (Q3 ?))

=>

(if (yes-or-no-p "Q3: Did you have encephalitis or meningitis (yes/no) ? ")

then (assert (Q3 yes))

else (assert (Q3 no))

)

)

::-----R6-----

(defrule Q3yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 yes)

=>

(assert (Diagnosis "Your symptoms may be caused by West Nile virus infection."))

(assert (Recommend "The only treatment for West Nile virus infection is supportive care. Antibody or antiviral therapies play no role. People should take normal precautions to avoid mosquito bites. Public health prevention strategies include surveillance of dead birds, mosquito-control programs and screening of blood products"))

)

::-----R7-----

(defrule Q4 ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(not (Q4 ?))

=>

(if (yes-or-no-p "Q4: Did you have a history of exposure to mosquitoes (yes/no)? ")

then (assert (Q4 yes))

else (assert (Q4 no))

))

::-----R8-----

(defrule Q4yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 yes)

=>

(assert (Diagnosis "Your symptoms may be caused by West Nile virus infection."))

(assert (Recommend "The only treatment for West Nile virus infection is supportive care. Antibody or antiviral therapies play no role. People should take normal precautions to avoid mosquito bites. Public health prevention strategies include surveillance of dead birds, mosquito-control programs and screening of blood products")))

::-----R9-----

(defrule Q5 ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 no)

(not (Q5 ?))

=>

(if (yes-or-no-p "Q5: Did the laboratory tests, such as a serologic test or PCR, confirm the presence of West Nile virus THEN consider the possibility of West Nile virus infection (yes/no)?")

then (assert (Q5 yes))

else (assert (Q5 no))

))

::-----R10-----

(defrule Q5yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 no)

(Q5 yes)

=>

(assert (Diagnosis "Your symptoms may be caused by West Nile virus infection."))

(assert (Recommend "The only treatment for West Nile virus infection is supportive care. Antibody or antiviral therapies play no role. People should take normal precautions to avoid mosquito bites. Public health prevention strategies include surveillance of dead birds, mosquito-control programs and screening of blood products")))

::-----R11-----

(defrule Q6 ""

(not (diagnosis ?))

---



(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 no)

(Q5 no)

(not (Q6 ?))

=>

(if (yes-or-no-p "Q6:Is there a West Nile virus outbreak in the community or region THEN consider the possibility of West Nile virus infection (yes/no)?")

then (assert (Q6 yes))

else (assert (Q6 no))

)

)

::-----R12-----

(defrule Q6yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 no)

(Q5 no)

(Q6 yes)

=>

(assert (Diagnosis "Your symptoms may be caused by West Nile virus infection."))

(assert (Recommend "The only treatment for West Nile virus infection is supportive care. Antibody or antiviral therapies play no role. People should take normal precautions to avoid mosquito bites. Public health prevention strategies include surveillance of dead birds, mosquito-control programs and screening of blood products")))

::-----R13-----

(defrule Q7 ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 no)

(Q5 no)

(Q6 no)

(not (Q7 ?))

=>

(if (yes-or-no-p "Q7:IF other possible causes of the patient's symptoms have been ruled out THEN consider the possibility of West Nile virus infection (yes/no)?")

then (assert (Q7 yes))

else (assert (Q7 no))

))

::-----R14-----

(defrule Q7yes ""

(not (diagnosis ?))

(not (recommend ?))

(Q1 no)

(Q2 no)

(Q3 no)

(Q4 no)

(Q5 no)

(Q6 no)

(Q7 yes)

=>

(assert (Diagnosis "Your symptoms may be caused by West Nile virus infection.))

(assert (Recommend "The only treatment for West Nile virus infection is supportive care. Antibody or antiviral therapies play no role. People should take normal precautions to avoid mosquito bites. Public health prevention strategies include surveillance of dead birds, mosquito-control programs and screening of blood products")))

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