AN EXPERT SYSTEM FOR DIAGNOSING INFANTS' DISEASES USING CLIPS.

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Abstract: This paper proposes a knowledge-based system to help parents diagnose some of their children's diseases at an early stage and to give them insight into whether they should see a doctor. It covers the most common diseases encountered by pediatric specialists, such as intestinal obstruction, dehydration, anemia, etc.
An overview of these diseases is provided, the etiology of the disease is outlined, and treatment suggestions for the most common diseases are given when possible. CLIPS was used to develop the proposed expert system.

Keywords: Infants' Diseases, CLIPS, Expert Systems, Knowledge-Based System.

I. INTRODUCTION

An expert system can be defined as a group of software that uses knowledge and inference techniques to solve problems in a selected domain in the same way as consultants do in that domain [1]. Expert system applications are one of the most important topics in modern information technology. Their use extends to fields like construction, medicine, agriculture, finance, education, and marketing [2].

CLIPS is a tool used for building complete rule-based and/or object-based expert systems [3].

In this paper, an expert system for diagnosing the most common diseases in infants under one year of age is presented. The remainder of this paper is organized as follows. Section 2 introduces the problem domain targeted by the expert system. the objectives of this study are presented in Section 3. Section 4 provides insights into previous work on this project. Sections 5 and 6 present the components of the diagnostic system. Conclusions are drawn in Section 7, while Section 8 presents part of the source code of this system.

II. PROBLEM STATEMENTS

Expert systems have been used in various fields of medicine to improve the quality of medical services [4]. In the medical field, we usually need experts, specialists, consultants to address the shortfalls that exist in healthcare.

In such situations, the proposed expert system will help fill the gap in experts' shortages, especially in pediatrician.

General practitioners often face a heavy workload and encounter a wide variety of medical cases. By utilizing expert systems to work alongside GPs as reliable tools for diagnosis, treatment recommendations, and decision support [5].

Medical expert systems can be used for the most common diseases in the population [6].

Early detection of diseases that specifically affect young children is necessary and should be evaluated immediately so that they can be overcome [7].

III. OBJECTIVES

The main objective was to develop an expert system for diagnosing childhood diseases. Such a system will help parents take the right measures as well as assist physicians in diagnosis. This system can help medical students to gain a better understanding of pediatric diseases.

The functionality of the proposed expert system is not limited to diagnosis, but also shows the user how to treat the patient and what actions to take.

Such programs would be very helpful in rural areas where there is a lack of medical care facilities.

IV. RELATED WORKS

There are numerous works that discuss diagnostic issues.

In [5], the authors discuss the problem of expert systems dealing with contagious viral infections in children on the desk using the certainty factor method (CF).

The proposed system includes diagnosis of tropical diseases caused by viral infections, treatment, and prevention recommendations.

In [8], the authors designed an SL5 object expert system using the SL5 object language to enable the user to correctly diagnose and treat silicosis disease by making suggestions by querying the symptoms.

In [9], the authors developed an expert system for diagnosing feeding problems in infants and children. CLIPS language has been used to develop this system.

Other diagnostic systems are described in [10]- [17].

V. SYSTEM DESCRIPTION

The expert system for diagnosing babies illnesses can be used by physicians as a tool to make an early diagnosis or a second diagnosis. This system can also be used as an early diagnosis by parents in rural areas where there is a lack of care facilities. The proposed system is rule-based. The rule-based language is a component of CLIPS (production system), the most widely used method for representing knowledge [18].

The extracted knowledge about diseases is converted into rules and these rules are stored in the knowledge base of CLIPS language. The knowledge base contains about 68 production rules for different types of children's diseases and symptoms to be realized. A rule consists of facts represented in the IF part and actions represented in the THEN part.

When facts or conditions are satisified and patterns match, the action of the corresponding rule is executed. The inference engine is the mechanism that matches the input facts with the applicable rules. The applicable rules are selected by the inference engine to be fired[18].

VI. KNOWLEDGE REPRESENTATION

The primary sources of knowledge for this expert system are physicians. In addition, reference books and reference websites for pediatric diseases in [19]- [27].

The captured knowledge was transformed into the syntax of the CLIPS knowledge base (facts and rules). Currently, there are several rules in the expert system that help in the treatment of fifteen pediatric diseases.

A. *Intestinal obstruction*
Description:
Partial or complete intestinal obstruction. The contents of the intestine cannot pass through.
Symptoms: Feeding intolerance, irritability, vomiting, pain and abdominal distention.

B. *Dehydration*
Description:
A situation that results from excessive loss of body water. The most common causes of dehydration in children are vomiting and diarrhea.
Signs: A dry or sticky mouth, few or no tears when crying, and sunken eyes. In infants, the soft spot on the top of the head (fontanel) appears sunken. Less urination or fewer wet diapers than usual, dry, cool skin, irritability, and sleepiness or dizziness.

C. *Upper respiratory tract infection*
Description:
Infections involve the nose, sinuses, throat, larynx, and large airways.
Symptoms: Fever, runny nose, cough, sore throat, body aches, and fatigue.

D. *Cow's milk allergy*
Description:
Affects 2% to 6% of children, with prevalence highest in the first year of life. Allergy has been shown to resolve in approximately 50% of children within the first year of life and in 80-90% within the fifth year of life.

Symptoms: Frequent spitting up, vomiting.
Signs of abdominal pain or colic-like symptoms such as excessive crying or irritability (especially after breastfeeding)
Diarrhea, blood in stool, hives, scaly rash, and coughing or wheezing.

E. *Anal Fissure*
Description:
Tearing of the lining of the lower rectum (anus).
Symptoms: It may be itchy and cause pain. Also, vivid crimson blood may be seen on the toilet paper after wiping. A fissure may form if your child is constipated and tries to pass large, hard stools.

F. *Acute gastroenteritis*
Description:
A rapidly developing diarrheal illness, with or without symptoms and signs such as nausea, vomiting, fever, and abdominal pain. The illness is characterized by increased bowel movements with changes in consistency.
Symptoms: Diarrhea, abdominal pain, cramps, vomiting, irritability, loss of appetite.

G. *Anemia*
Description:
A child suffering from anemia does not have enough red blood cells or hemoglobin.
Symptoms: increased heart rate, shortness of breath, lack of energy or easy fatigue, dizziness or vertigo, especially when standing, headache, irritability, irregular menstruation and cycles.

H. *otitis media*
Description:
Inflammation of the middle ear is very common in young children.
Symptoms: Ear infections can cause ear pain, fever, temporary hearing loss, and other common symptoms such as loss of appetite and irritability.

I. *Mumps*
Description:
An acute, contagious, systemic viral disease that usually causes painful enlargement of the salivary glands, usually the parotid gland.
Symptoms: Pain and swelling of the salivary glands, especially in the jaw area. Difficulty speaking and chewing, earache, fever, headache, muscle aches, fatigue, and loss of appetite.

J. *Roseola*
Description:
Is a contagious viral disease. It causes high fever and a rash that develops when the fever subsides. It most commonly affects children under two years of age. Most children with roseola develop a mild upper respiratory illness followed by a high fever.

At this time, your child may not eat as usual, but may be difficult and irritable. The high fever often ends abruptly, and a pinkish-red flat or raised rash on the skin begins around the same time. The high fever often ends abruptly, and about the same time a pinkish-red flat or raised rash begins on the trunk. The rash usually spreads to the neck, face, arms, and legs.

K.   *Smallpox*

Description:
Chickenpox is a very contagious infection caused by the varicella zoster virus. It often affects children, but adults can also get it. The telltale sign of chickenpox is a very itchy rash with red blisters.
Symptoms: Severely itchy rash with red blisters, body aches, fever, fatigue, irritability, loss of appetite, headache [19]-[27].

VII. USER INTERFACE

The proposed system interacts with users to solve a specific problem. The system interface includes a menu and yes/no questions, as shown in Figure 1, that ask the user to select one of the cough symptoms that their baby is suffering from. For example, if the baby suffers from shortness of breath in addition to cough, the user selects number 2 among the cough symptoms.

```
Determine Cough-symptom

Is his cough accompanied by any of these symptoms
==========================

1- A cyanosis in his/her part of the body,

2- dyspnoea ,

3- There are no symptoms associated

0- go to Main Menu

Type number of your choice then hit return key

Choice:
```
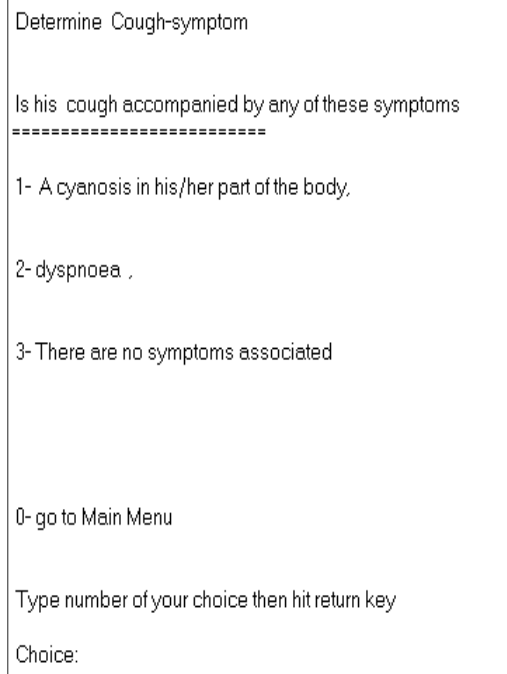
Figure. 1 Cough symptoms menu

The second type of questions are questions with simple answers Yes (Y) or No (N). The expert system asks the user about his symptoms. The user answers with a simple yes or no.
The system infers the result based on the user's answers. For example, the system asks the user whose child has anemia, "Is there diarrhea? (Yes/No)" If the user answers no. Another question is asked, "Is the child pale. (Yes/No)?", and the questions continue until the final node of disease symptoms is reached, at which point the exact diagnosis is indicated, as shown in Figure 2 as part of the decision tree.
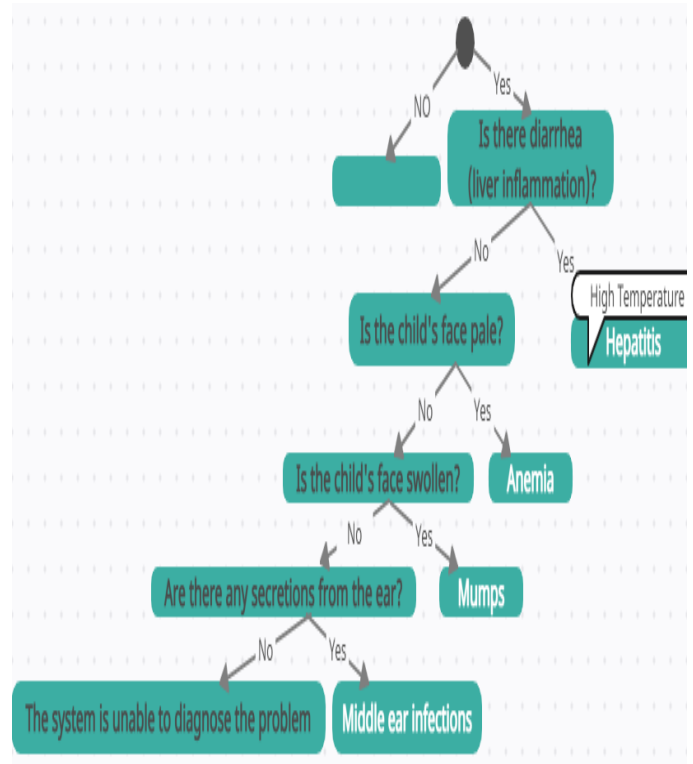

Figure. 2 Part of the decision tree

These questions are an explanation of the symptoms. The facts and the conclusions of an inference engine are stored in a database for each case.

VIII.CONCLUSION & FUTURE WORK

The output of the system includes a high level of childhood diseases and their symptoms, as well as the treatment suggestions needed to overcome these diseases. Detecting diseases at an early stage can enable us to overcome them and treat them appropriately. The CLIPS program is used because of its flexibility, ease of use and low cost. The proposed system can help physicians and patients by providing a decision support system, interactive training tools, and expert advice. The system is part of an intelligent pediatric disease diagnosis system.
CLIPS keeps in memory a fact list, a rule list, and an agenda containing activated rules. Only 22 rules are presented below out of 68.
We recommend that our expert system be extended to infants older than one year and at a lower stage of disease, and that it be converted to machine learning techniques instead of rule-based techniques.
During testing, the system never made an incorrect diagnosis according to the rules used. The system suggests that a complete expert system is viable and can be extremely useful in providing a consistent diagnosis.
    This expert system is considered a base for future systems; diseases will be added at a low level.

IX. EXPERT SYSTEM SOURCE CODE:

```
;***********************
;
;defacts 1:
;         initializes the program
;*****************************
;
 (deffacts init (start))
;-----------------R1-------------------------------------------
```

```
;*************************
(defrule mainmenu (start) ?ml <- (start) => (printout t crlf crlf
crlf crlf crlf crlf ) (printout t" An expert system for Diagnosis of
some infants  diseases" crlf crlf
" Main Menu" crlf
" ========" crlf crlf crlf
" 1- to start running the program " crlf crlf
" 0- Quit the program " crlf crlf crlf
" Type number of your choice then hit return key" crlf crlf "
Choice: " ) (bind ?response (read))
(if (eq ?response 1) then (assert (type 0-1))    else  (if (eq
?response 0) then (assert (type quit))) (printout t crlf) (retract
?ml) ))
```
;------------------R2--
```
;*******************
(defrule Det-age (type 0-1) => (printout t crlf crlf  crlf crlf)
(printout t "Enter the age of your baby in months  then hit return
key"crlf crlf crlf crlf crlf crlf  " Age is: " ) (bind ?response
(read)) (not (numberp ?response ))
(if   (and  (< ?response 13)(>  ?response 0)) then (assert
(response  ?response))) else (if   (or (> ?response 12)(<
?response 1))  then (assert (type 0-1-1))) )
```
;---------------R3--
```
;***********************
(defrule weight  (response ?response)  => (printout t crlf crlf
crlf crlf) (if  (and (< ?response 5)(> ?response 0)) then (printout
t "The optimal weight must be " (+ 3.5 (* ?response  0.75)) crlf
crlf crlf "Otherwise your baby need to seen by a healthcare
provider "crlf crlf)) else (if  (and (< ?response 9)(> ?response
4)) then (printout t "the optimal weight must be " (+  3.5 (+  (*
4  0.75)  (* (- ?response 4)  0.5))) crlf crlf crlf " Otherwise your
baby need to seen by a health care provider "crlf crlf))  else (if
(and (< ?response 13)(> ?response 8)) then (printout t "the
optimal weight must be " (+  3.5 (+ (* 4   0.75)  (* 4 0.5) (*(-
?response 8)   0.25)) ) crlf crlf crlf  "otherwise your baby need
to seen by a healthcare provider " crlf crlf) ) (printout t" Enter
any key  to continue " crlf crlf ) (bind ?response1 (read)) (assert
(type 0-1-0)) )
```
;------------------R4--
```
;***********************
(defrule user-quits (type quit) => (printout t "You have QUIT
the program." crlf) (halt))
```
;------------------R5--
```
;***********************
(defrule  OutrnageAge (type 0-1-1) => (printout t crlf crlf crlf)
(printout t "The program does not support this age. It  supports
only the  age range from 1 month to a year" crlf crlf crlf crlf )
(printout t" enter any key   to  go to try again" crlf crlf ) (bind
?response (read)) (assert  (type  previous)))
```
;------------------R6--
```
;***********************
(defrule  previousrule ?p <- (type   previous ) => (retract ?p)
(assert (type 0-1)) (refresh Det-age) )
```
;------------------R7--
```
;***********************
(defrule templevel ?p <-  (type 0-1-0) => (printout t crlf crlf crlf)
(retract ?p) (printout t " Determine  Temperature level " crlf crlf
crlf " Temperature  menu" crlf
"=======================" crlf crlf
" 1- His/Her  Temperature is high , " crlf crlf crlf
" 2- His/Her  Temperature is Febrile(exteremly high), " crlf crlf
" 3- His/Her  Temperature is normal  " crlf crlf crlf
" 4- His/Her  Temperature is low " crlf crlf crlf
```

```
" 0- go to Main Menu " crlf crlf " Type number of your choice
then hit return key" crlf crlf " Choice: " ) (bind ?response (read))
(if (eq ?response 1) then (assert (type 0-1-0-1))) else (if (eq
?response 2) then (assert (type 0-1-0-2)(temp hot))) else (if (eq
?response 3) then (assert (type 0-1-0-3)(temp  normal))) else (if
(eq ?response 4) then (assert (type 0-1-0-4))) else (if (eq
?response 0) then (assert (start))(reset)(run)) )
```
;------------R8---
```
;***********************
(defrule  veryhot-temp?m8<-  (type  0-1-0-1)=>(printout  t
"Depending on your answers and my good experience, " crlf crlf
" ===================== " crlf
" Your child   suffers from Bacterial Infecion" crlf crlf crlf
"Signs that your child has a viral  fever" crlf
"=========================         "crlf            "include
exhaustion, paleness, loss of appetite, irritation, body pains, and
weakness. " crlf "When infants have a very high temperature,
they will experience seizures or convulsions of the body. " crlf
"A convulsion will make them tremble and shudder, and their
eyes will roll back into their heads." crlf crlf crlf " Medical
treatments " crlf
"=========================== " crlf
" Your child's pediatrician would be able to give proper
recommendation about his or her fever." crlf "Aside from
recording his or her body temperature, " crlf "your pediatrician
will have blood tests and urine tests performed. If the findings
are grave, " crlf "he may refer your child to a child specialist.
He may also suggest confinement in a hospital. " crlf"Back at
home, there are remedies to help lessen symptoms of viral fever
in kids. " crlf "You can help lower the temperature by giving a
sponge bath and making your child drink lots of liquids to
prevent dehydration. " crlf "Make your child rest while he or
she is suffering from the disease. " crlf"There are also medicines
to lower fever such as paracetamol or ibuprofen. " crlf "
ibuprofen can be given as an alternative to paracetamol for those
who are more than three months, 7.5 mg for kg for  every six
hours" crlf " and is not recommended in cases of dehydration
and renal diseases. " crlf " If your child is suffering from a
bacterial infection, you may give him or her antibiotics. " crlf "
There is no medication for a viral infection but the only
medication for the symptoms. " crlf crlf))
```
;---------------R9---
```
;***********************
(defrule cold-temperature ?m9 <- (type 0-1-0-4) => (printout t
crlf crlf crlfcrlf crlf ) (retract ?m9)
(printout t "===========================" crlf) (printout
t " Depending on your answers and my good experience, " crlf
crlf " ===================== " "A cold is usually pretty
minor and doesn't require a visit to the doctor, but it *can* turn
into something more serious. Any time cold symptoms last for
more than about 10 days, a visit to his healthcare provider is
warranted." crlf crlf))
```
;----------------------R10--
```
;***********************
(defrule hot-temp ?m10<- (type 0-1-0-2) => (printout t
"         Medical       treatments           "        crlf
"===========================" crlf
```

```
" Must give your baby antipyretic" crlf   " if your child's
temperature not fall within an hour you should consult a
pediatrician" crlf "-------------------finished---------------" crlf
crlf crlf " ========" crlf crlf crlf
```

" 1- Continue if your child still lethargic sleepy, even after low temperature " crlf crlf
" 0- Quit the program " crlf crlf crlf " Type number of your choice then hit return key" crlf crlf " Choice: ") (bind ?response (read)) (if (eq ?response 1) then (assert (type 0-0-0)) else (if (eq ?response 0) then (assert (type quit)))   ))

;-----------------------R11--------------------------------------
;***************************
(defrule tempfallcon ?m11<- (type 0-0-0) => (printout t crlf crlf) (printout t " Is still lethargic sleepy, even after low temperature (yes/no)?"crlf crlf crlf)   (bind ?answer (read)) (if (or (eq ?answer yes)(eq ?answer y)) then (assert (type 0-0-0-a))) else (if (or (eq ?answer no)(eq ?answer n)) then (assert (type 0-0-0-b))))

"-----------------------R12--------------------------------------
;***************************
(defrule yeslttlemove (type 0-0-0-a) => (printout t crlf crlf crlf) (printout t "Your child may suffer from bacterial infection, a visit to his healthcare provider is warranted" crlf crlf crlf crlf crlf "For more information Enter any key then press Enter   ... please" crlf crlf) (bind ?response (read)) (assert (type 0-1-0-1))) "==========================" crlf crlf))

;-----------------------R13--------------------------------------
;***************************
(defrule NOlttlemove (type 0-0-0-b) =>   (assert (type 0-1-0-3)))

;-----------------------R14--------------------------------------
;***************************
(defrule norml-temp ?m14<- (type 0-1-0-3) => (printout t crlf crlf) (printout t " IS your baby suffer from
cough (yes/no)?"crlf crlf crlf) (bind ?answer (read)) (if (or (eq ?answer yes)(eq ?answer y))
then (assert (type 0-1-0-3-1))) else (if (or (eq ?answer no)(eq ?answer n)) then (assert (type 0-1-0-3-2))))

;-----------------------R15--------------------------------------
;***************************
(defrule Coughing-symptom ?m15<- (type 0-1-0-3-1) => (printout t crlf crlf crlf) (retract ?m15) (printout t
" Determine Cough-symptom " crlf crlf crlf
" Is his   cough accompanied by any of these symptoms " crlf
"==========================" crlf crlf
" 1- A cyanosis in his/her part of the body, " crlf crlf crlf " 2- dyspnoea , " crlf crlf crlf " 3- There are no symptoms associated " crlf crlf crlf crlf crlf crlf " 0- go to Main Menu " crlf crlf crlf " Type number of your choice then hit return key" crlf crlf " Choice: ") (bind ?response (read)) (if (eq ?response 1) then (assert (type 0-1-0-3-1-1)))
Else (if (eq ?response 2) then (assert (type 0-1-0-3-1-2))) else (if (eq ?response 3) then (assert (type 0-1-0-3-1-3)))
Else (if (eq ?response 0) then (assert (start))(reset)(run)))

;-----------------------R16--------------------------------------
;***************************
(defrule BluenessNormalTemp (and (type 0-1-0-3-1-1)
   (temp normal)) => (printout t "If the child does not suffer from high temperature " crlf crlf "And suffers from cyanosis or dyspnoea accompanied by bouts of cough" crlf crlf "Your child may have swallowed foreign body" crlf crlf crlf "This body may have reached the lung" " Overview about swallowed foreign body " crlf
"========================== " Crlf crlf "Pain in the neck, throat, chest, or abdomen (belly) may be symptoms of foreign body ingestion. Your child may refuse to eat or have

trouble swallowing, gagging, vomiting (throwing up). He may also have breathing problems, such as coughing or wheezing (high-pitched sound when breathing " crlf crlf crlf " Medical treatments " crlf
"========================== " crlf crlf "). Tests, such as barium swallow, computerized tomography (CT) scan, endoscopy, or x-rays may be needed for diagnosis. Treatment will depend on the object's type and size and how long it has been inside the body. " crlf "
Bowel movement:You may need to look in your child's stool every time he has a bowel movement. This is done if caregivers think that the object is likely to be passed out of his body. Walking can help get your child's bowels moving. Foods like fruit, bran, and prune juice can help your child have a BM. Drinking water can help too. Caregivers may give your child fiber medicine. Do not give your child other medicine, such as laxatives."
crlf crlf))

"-----------------------R17--------------------------------------
;***************************
(defrule Blueness2 ?m17 <- (type 0-1-0-3-1-1) => (printout t crlf crlf " Your child may be suffering from 1. Pneumonia Or 2. bronchial   Asthma or laryngitis   : " crlf
"==========================" crlf

 "Infants with asthma have sensitive, easily irritated airways in their lungs. When exposed to certain triggers – like viruses, allergens, secondhand smoke, chemical irritants, cold air or pollution – the airways become more inflamed, "crlf crlf
"producing increased mucus, mucosal swelling and muscle contraction. This results in airway obstruction, chest tightness, coughing, shortness of breath and wheezing. " crlf crlf
"The way asthma affects a child also varies from person to person, and symptoms may get better or worse at certain times. " crlf crlf "In some infants, asthma symptoms get better as the child grows. " crlf crlf "While asthma can't be cured, symptoms can be managed by following the treatment plan you develop with your child's healthcare provider. "crlf crlf
 "Symptoms: "crlf
"1.Coughing on *expiration* (breathing out), especially at night " crlf

"2.Wheezing on expiration" crlf

"3.Difficulty breathing " crlf

"4.Shortness of breath when exercising or playing" crlf

"5.Rapid heartrate "crlf crlf

     (printout t " For More   Information " crlf " choose the number   from   menu"   crlf "==========================" crlf crlf " 1- **Pneumonia, " crlf " 2- Bronchiolitis**, " crlf crlf
" 0- go to Main Menu " crlf crlf crlf " Type number of your choice then hit return key" crlf crlf " Choice: ") (bind ?response (read)) (if (eq ?response 1) then (assert (define 1))) else (if (eq ?response 2) then (assert (define 2))) else (if (eq ?response 0) then (assert (start))(reset)(run))))

;-----------------------R18--------------------------------------
(defrule define-pneumonia (define 1)=>(printout t"Depending on your answers and my good experience, " crlf crlf " ======================= " crlf" Pneumonia is a bacterial or viral infection of the lung that causes the lungs' airpockets (alveoli) to become inflamed. Lungs may produce extra fluid,

which can accumulate in the airways. Healthcare providers often use x-rays to diagnose pneumonia." crlf crlf crlf
"Signs that your child has a viral fever" crlf
"=========================== "crlf "include Fever, Cough, Rapid breathing, Decreased activity and poor eating, A grunting sound when your child exhales , grunting sound when your child exhales, Retractions— drawing in of muscles and skin around neck and chest with each breath . " crlf crlf crlf crlf
" How is pneumonia treated " crlf
"=========================== " crlf " Many infants can be treated without having to stay in the hospital. If the pneumonia is severe, a caregiver may want your child to stay in the hospital for treatment. Troubled breathing, dehydration, high fever, and the need for oxygen or medicines are reasons to stay in the hospital. Your child may need extra oxygen to help with troubled breathing" Crlf cflr crlf "If your child has a bacterial pneumonia, your child will usually need to take antibiotics. Antibiotics are not used to treat a viral pneumonia. Viral pneumonia will usually go away without medicine. Caregivers may have your child take antibiotics if the cause of the pneumonia is not known" crlf crlf crlf))

;------------------------R19---------------------------------------
(defrule **Bronchiolitis** (define 1) => (printout t "Depending on your answers and my good experience, " crlf crlf
" ===================== " crlf " Bronchiolitis is caused by an infection that affects the tiny airways—called the bronchioles— that lead to the lungs" crlf. "As these airways become inflamed, they swell and fill with mucus, making breathing difficult. " crlf " This disease affects mostly infants and young infants—typically during the first 2 years of life, with peak occurrence at 3 to 6 months. " crlf "Bronchiolitis is usually caused by **RSV (Respiratory Syncytial Virus)**. It can be also caused by colds, influenza (flu) and human metapneumovirus (hMPV, which may also cause pneumonia" crlf crlf crlf "Signs that your child has a viral fever" crlf
"=========================== "crlf "include Fever, Cough, Rapid breathing, Rapid, shallow breathing, A grunting sound when your child exhales, Retractions— drawing in of muscles and skin around neck and chest with each breath . " crlf crlf crlf crlf))

;------------------------R20---------------------------------------
;************************
(defrule DifficultyBreathingNormal (and (type 0-1-0-3-1-2) (temp normal)) => (assert (type 0-1-0-3-1-1))
(assert (type normal)))

;------------------------R21---------------------------------------
;************************
(defrule nooneofthem (type 0-1-0-3-1-3)=>(assert (type 0-1-0-3-1-2)))

;------------------------R22---------------------------------------
;************************
(defrule DifficultyBreathingHot (and (type 0-1-0-3-1-2) (temp hot))=>(assert (type 038)))

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