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An expert system for feeding problems in infants and children

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Abstract

A lot of infants have significant food-related problems, as well as spitting up, rejecting new foods, or not accepting to eat at specific times. These issues are frequently ordinary and are not a sign that the baby is unwell. According to the National Institutes of Health, 25% of generally developing infants and 35% of babies with neurodevelopmental disabilities are tormented by some sort of feeding problem. Some, for example rejecting to eat specific foods or being overly finicky, are momentary and don't cause any health dangers.

This paper proposes an expert system that can be used to successfully diagnose Feeding problems in infants and children. The suggested systems were found to be beneficial approach in addition to existing impartial ones. So far as the authors are aware, this is the initial effort of using an expert system in attaining good performance in a real world application. This expert system was designed and implemented to help parents diagnose these problems and get a recommendation of how to deal with infants and children.

Keywords: Feeding assessment, Feeding problems, Food aversion, Food refusal, expert systems

1. Introduction

Infancy feeding problems are projected to happen in up to 25% of generally developing children and in up to 35% of children having neurodevelopmental disabilities. One familiar definition of feeding problems is the incapability or refutation to eat specific foods. Problems with feeding can lead to important unconstructive nutritional, developmental and psychological sequelae. Since the harshness of these sequelae is connected to the age at onset, level and interval of the feeding problem, before time identification and administration are significant. The purpose of this paper is to provide guidelines to recognize feeding problems in the first three years of life; to present a newly developed instrument to assess the presence of feeding problems and watch the effects of management; and to explain basic management methods that may get rid of or enhance feeding dysfunction [1, 4].

Many of infants have significant food-related problems, as well as spitting up, rejecting new foods, or not accepting to eat at specific times. These issues are frequently ordinary and are not an sign that the baby is unwell. According to the National Institutes of Health, 25% of generally developing infants and 35% of babies with neurodevelopmental disabilities are tormented by some sort of feeding problem. Some, for example rejecting to eat specific foods or being overly finicky, are momentary and don't cause any health dangers [7, 8].

Nevertheless, problems for instance food allergies, vomiting, and constantly rejecting foods and liquids may designate and fundamental medical condition. It can have unpleasant effects on an infant's health and may need medical attention. Swallowing disorders, medically identified as dysphagia, may happen at dissimilar stages throughout the infant's swallowing progression, and consist of [12, 34, 40].

- Oral Phase: The oral stage is incorporated of sucking, chewing, and moving foods and/or liquids to the throat.
- Pharyngeal Phase: The pharyngeal phase is when the infant starts to swallow and move food down the throat, yet closes off the throat to prevent it from going into the airway, which keeps out choking.
- Esophageal Phase: The esophageal phases contains calming and contraction the openings of the esophagus and pushing food into the stomach

2. Expert System Language

Expert Systems language is a group of programs that aid the knowledge engineer in building expert system through the creation of knowledge (rules and facts). See figure 1 for details. An expert system is typically consists of at least three main components [14, 15, 17].

- **Knowledge Base**

The knowledge base is a collection of rules and facts derived from the human expert. Rules typically takes the form:
IF <antecedent> THEN <consequent>
The antecedent is the condition that must be satisfied. When the antecedent is satisfied, the rule is triggered and is said to "fire". The consequent is the action that is performed when the rule fires.

- **Inference Engine**

The inference engine is the main processing element of the expert system. The inference engine select rules from the agenda to fire. If no rules found in the agenda, the inference engine must get information from the end user to be able to add more rules to the agenda. It uses knowledge base, in order to conclude situations. It is responsible for collecting the data from the end user, by asking questions and applying it wherever necessary.

- **User Interface**

A user interface is the technique the expert system interacts with the end user. These can be through dialog boxes, command prompts, forms, or other input methods.

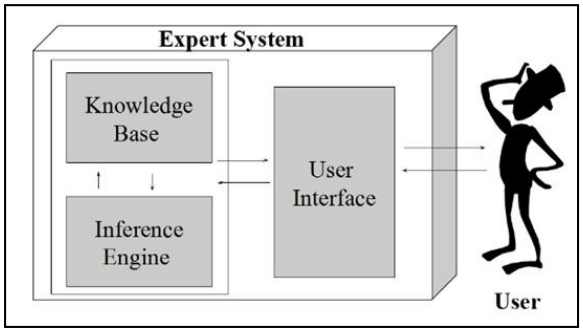

Fig 1: Components of Expert Systems

The proposed Expert System for Feeding Problems in Infants and Children diagnosis was designed and implemented using, CLIPS Language [15].

CLIPS is a public domain software tool for building expert systems. The name is stands for "C Language Integrated Production System [15].

3. Materials and Methods.

The proposed expert system will ask the user a number of questions about the signs and symptoms of the patient and at the end of the session the diagnosis and the recommendation for taking care of the patient.

4. Literature Review

There is no dedicated expert system for feeding problems in infants and children in the literature; however, there are a good number of medical expert systems that were designed to help with diagnosing diseases such as: Foot problem, Male fertility problems, Ear problems, Hearing Problems, neck pain problems, low back pain problems, eye problems, and endocrine problems [5, 6, 11, 13, 16, 18, 33].

5. Knowledge representation

The main source of the knowledge for this expert system are physicians and specialized websites. The captured knowledge have been converted into CLIPS Knowledge base syntax (facts and rules). Here is a brief identification of feeding problems in infants and children problems that the expert system can help the user with.

5.1 Symptoms of Infant Feeding Problems

Infants with feeding problems may show a few symptoms, but signs and symptoms may vary according to every person and the brutality of the feeding issues.

General signs and symptoms of infant feeding problems comprise [35, 36].

- Semi-circled the back and body whilst feeding
- Meticulousness or shortage of attentiveness during feeding
- Rejecting to eat food and drink fluids
- Rejecting various textures of food
- Extremely lengthy feeding times
- Chewing problems
- Difficulty with bottle and/or breast feeding
- Coughing during feeding times
- Extreme drooling
- Complexity in coordinating breathing with eating and drinking
- Augmented nasal staleness throughout meals
- Husky, or breathy sound quality
- Rescreening spitting up and/or vomiting
- Frequent pneumonia or respiratory infections
- Slow weight gain or development

Infants having feeding problems may as well be at risk for: Dehydration, aspiration, chronic lung disease, or poor nutrition.

5.2 Diagnosis of Infant Feeding Problems

When a baby is having complexity with feeding, it's significant to call the pediatrician right away. Although feeding problems are frequently insignificant, it's essential to seek medical action in case there is a fundamental medical matter.

The pediatrician will usually begin by testing the infant and addressing and diagnose any medical clarifications for the feeding complication, including, if applicable, the attendance of excessive reflux or metabolic disorders. A pathologist who specializes in take cares of infants and children with feeding and swallowing disorders may as well test out the baby's symptoms, and if appropriate, recommend a pathology early involvement [37, 40].

5.3 Treatment Options for Infant Feeding Problems

Treatment differs very much depending on the reason and signs of the feeding matters.

The following are amongst a few handling options for babies with feeding problems [38-40].

- Medical treatment.
- Feeding therapy.
- Nutritional modification.
- Encouraging an increased approval of new foods and textures.
- Food temperature and texture modification.
- Postural or positioning modifications.
- Behavior administration techniques.
- Mouth training to make the mouth muscles stronger
- Tongue movement and chewing training
- Encouraging various types of foods, as well different textures
- Assist with sucking improvement
- Changing food textures and liquid thickness to make sure secure swallowing

In urgent situation cases involving feeding disorders, hospitalization may be essential. The baby may as well require feeding tube while there in order to take in enough nutrition.

Nevertheless, the majority of cases of infant feeding problems are deal with before hospitalization. As said earlier, nutritional therapy and/or regular meetings with baby's doctor are enough to assist with feeding. A team approach between parents, caregivers, baby's pediatrician, and professionals

such as dietitians, therapists, and speech pathologists is often the main optimal way to overcome these problems.
In some instances, an infant may be placed on a precise diet and approved nutritional supplements, the majority often when they are underweight, undergoing treatment, and experiences developmental delays [39].

5.4 Causes of Infant Feeding Problems

The following are a few causes of feeding and swallowing disorders in infants [40].

1. **Medical Causes of Infant Feeding Problems**

- Traumatic birth injuries that lead to neurological disorders, such as cerebral palsy
- Cleft lip and/or cleft palate
- Autism
- Neck and head abnormalities
- Premature birth
- Low birth weight
- Respiratory problems
- Heart disease
- Gastrointestinal disorders
- Medications that decrease appetite

2. **Non-medical Causes of Infant Feeding Problems**

Non-medical reasons that may affect a baby's feeding patterns include [38].
The baby may be stressed or scared about something

- The baby isn't receiving enough attention or emotional care from parents and/or loved ones (feels alone, anxious)
- The baby simply does not like the tastes, smell, and/or texture of certain foods

5.5 Infant Feeding Problems Prognosis and Long-term Outlook

When the feeding problems are addressed as early as the baby begins to show signs of feeding problems, for example losing weight and rejecting to eat, the prognosis is generally favorable and is typically resolved within short period of health conditions or effect. When the baby left untreated, nonetheless, infant feeding problems may guide to a myriad of problems, including delayed physical development, delayed mental development, learning disorders, and more. Actually, these developmental delays may stay within infant through childhood and into and through maturity.
Once specific foods with high nutritional value is not a part of a growing infant's diet, there is a possibility that oral motor development will be delayed, which in turn can guide to more delays, such as speech problems, slow growth, cognitive matters, and behavioral disorders [1, 4].

6. Conclusions

In this paper we proposed an expert system that can be used to successfully diagnose feeding problems in infants and children. The suggested system was found to be beneficial approach in addition to existing impartial ones. So far as the authors are aware, this is the initial effort of using an expert system in attaining good performance in a real world application. This expert system was designed and implemented in CLIPS language to help parents diagnose their infant and children problems and get a recommendation of how to them.

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