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Utilizing Q-Rung Orthopair Fuzzy Bipolar Hypersoft Sets for Enhanced Chickenpox Diagnosis

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ABSTRACT

Due to the various and ambiguous symptoms of this disease, it is diffi- cult to diagnose. Moreover, this kind of common viral infection is marked by rashes which itch while giving flu-like symptoms. Similarly, traditional diagnostic means of extraction compared to the difficulty in treating un- treated cells are effective but not without their shortcomings This paper takes Q-Rung Orthopair Hypersoft Sets as a new paradigm law on a dif- ferent level, which is to say combining benefits from bipolar fuzzy sets and Orthopair Q-Rung fuzzy sets we get an amalgamated method which combines either or both of the former, as well as soft set theory. Based on the framework of Q-Rung Orthohedra fuzzy bipolar hypersoft, this model derives sharp representations for the two-sided and imprecise data in med- ical field. Meanwhile, it improves processing of dual-

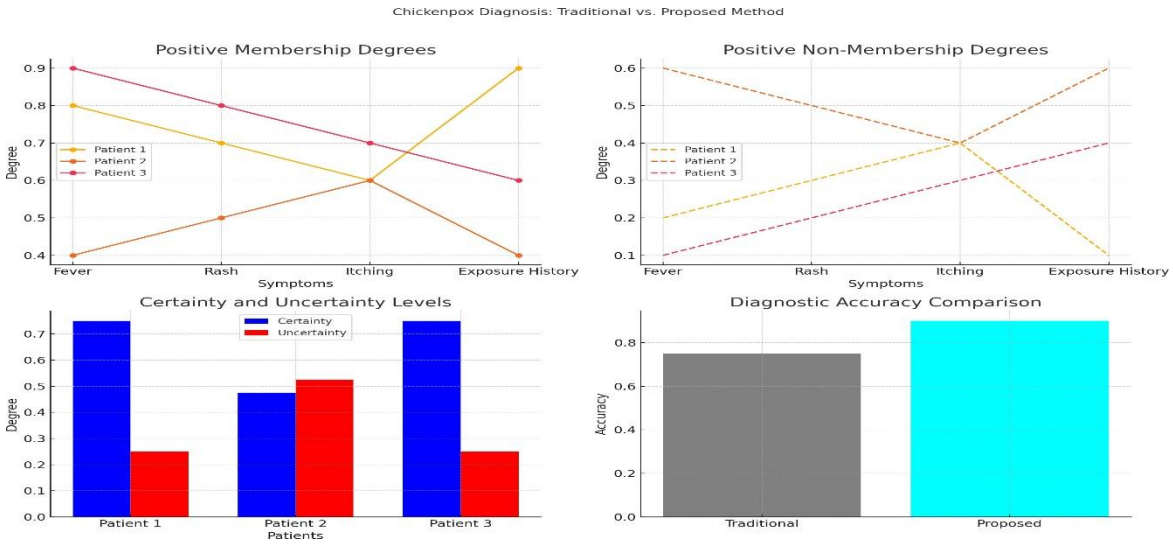
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aspect uncertain In the following we give a variety of diagnostic examples in order to illus- trate this new framework 's utility and compare it with traditional means of diagnosis.The results show that its diagnostic effectiveness and relia- bility are significantly better than traditional methods. This study offers a satisfactory diagnostic tool which uniquely combines all the properties of Q-ROFBHSs, resulting in better patient outcomes and more effective illness management in clinical setting

Keywords: Chickenpox Diagnosis, Bipolar Fuzzy Sets,Q-Rung Orthopair Fuzzy Hypersoft Sets, Medical Diagnosis, Uncertainty Management, Diagnostic Frame- work



Introduction

The chickenpox as a viral disease transmitted through the air and caused by the varicella-zoster virus, and is accompanied by certain signs, including a rash that itches, fever, and tiredness. Its fast transmission rates and possible con- sequences highlight why it is crucial to diagnose such diseases as quickly as possible since proper disease diagnosis is vital in managing diseases, and pre- venting the diseases from spreading across many communities around the world [1]. However, traditional diagnostic procedures remain popular even though they can encounter a number of problems. Lack of consistent manifestation of symptoms, lack of complete patient history, and interference from external envi- ronments pose uncertainty which makes it hard to guarantee the right outcome [2]. In response to these questions, we will introduce a new diagnostic framework based on QR-OFPBHS, an advanced method of increasing diagnostic accuracy [3]. This base of this framework is built on soft set theory which has been pro- posed by Molodtsov in 1999 that has proved its elasticity in handling dimension of uncertainty and impreciseness in various applications. Still, it only achieves suboptimal performance in certain medical diagnostic applications, such as

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di- agnosing chickenpox, even though it has not been fully explored [4]. Moreover, soft computing, of which fuzzy sets are a part, provides a suitable tool for reproducing information that is indistinct and unformed. While informative, original fuzzy sets have concept limitations especially in handling bipolarity, a key idea in medical analysis where symptoms are associated with disease in two ways. The Q-Rung Orthopair Fuzzy Hypersoft Set enhances the characteristics of the basic fuzzy sets with the concept of multiplicity of degrees of membership to support complex uncertainties with superior characteristics. This enables a mimicry of actual instances of medical practice that are nearly always complex and not easily defined. Moreover, the bipolar fuzzy sets are built on this frame- work and include positive and/or negative membership degrees which are very beneficial in diagnosing medical condition wherein some symptoms would con- firm or negate the probability of having a disease [5]. Hence, integrating these advanced ideas, the novel proposed theory of Q-Rung Orthopair Fuzzy Bipo- lar Hypersoft Set is beneficial in increasing the medical diagnostics field step forward. To overcome this problem, the Possibility q-Rung Orthopair Fuzzy Hypersoft Set model has been introduced to evaluate the passport quality more accurately and details with the measures of multiple criteria, and existing and possible uncertainties. This method can be used as a check list approach that needs to be implemented to enhance travel security and enhance immigration procedures across the globe by making sound decision [6]. The introduction of DFHSS from the existing basic structure of DFSS is to present detailed reg- ulation for handling complicated data having multiple attribute frames. This enhance increases the flexibility in modeling of uncertainty and decision mak- ing and brings higher level of accuracy in practice of real applications [7]. A great number of research articles have been published related to the application of Spherical Fuzzy Hypersoft Sets in decision support systems to solve those problems include higher uncertainty, multiple attributes. This approach shows its applicability by providing tight solutions for vast ranges of domains different from typical ADM problems [8]. This framework combines the features of soft sets [9], fuzzy sets [10], and bipolar fuzzy hypersoft sets [11] to create a highly efficient diagnostics that can address the potentially numerous influencing fac- tors. Not only in refining diagnosis but also in the readability of results, which in turn would lead to improved decision by the health care workers [2]. The diagnostic process within this framework involves several key stages: acquiring all encompassing patient attributes, identifying the details using a Q-Rung Or- thopair Fuzzy Bipolar Hypersoft Set, and lastly, performing decision-making in regard to probability of chickenpox with the help of spherical fuzzy hypersoft set based decision making algorithms [12]. Such an approach combines different data sources and thus eliminates the drawbacks of the probability-based diag- nostic methods used in medical practice, where the final decisions are made de- spite existing uncertainty. Further, this framework creates novel avenues for the advancement of medical diagnostic sciences [13]. Its usage therefore is promis- ing not only for chickenpox diagnosis but also for handling of similar issues in other infections and non simple disease conditions [14]. Through eradicating the drawbacks of traditional approaches, this approach is capable of changing the aspects of analyses of diseases by health professionals, thus improving healthcare practices. In conclusion, the present model for diagnosing chickenpox through the Q-Rung Orthopair Fuzzy Bipolar Hypersoft Sets

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is an enormous leap in the field of medical diagnosis. This framework is more accurate, flexible and of course easier to interpret through the combined use of different soft computing technologies. They overcome the deficiencies of the existing approaches and provide a foundation for the future works and improvements in the practical usage of IRCA, as well as in the general field of healthcare, to create a more individual-oriented and accurate decision-making process [15].

Aim and Scope of Study

Enhance Diagnostic Accuracy:[16] Develop a robust framework using bipolar Q-Rung fuzzy soft sets to improve the accuracy of chickenpox diag- nosis by effectively handling the uncertainties and ambiguities in medical data.

Model Complex Medical Scenarios:[2] Utilize the flexibility of Q- Rung fuzzy sets and the concept of bipolarity to model both positive and negative symptoms, providing a comprehensive diagnostic tool that reflects the details of the manifestations of the disease as chickenpox.

Integrate Multiple Data Sources:[17] Coordinate multiple types of patient data such as symptoms, past health history, and external condi- tion, in order to form stable and accurate diagnostic approach.

Improve Decision-Making:[18] Improve the diagnostic accuracy of chick- enpox by facilitating better understanding of the diagnosis results from the healthcare providers' side.

Provide a Flexible Diagnostic Tool:[19] It should be possible to extend and use a similar structure for other classes of infectious diseases or other medical conditions, making use of the generalizing qualities of both soft set theory and fuzzy logic.

Advance Medical Diagnostic Research: Contribute to development of medical diagnostics by proposing a novel use of Q-Rung Orthopair fuzzy bipolar hypersoft sets to advance further investigations of this topic.

Framework Development: Hence, a novel framework based on another fuzzy set, namely Q-Rung Orthopair fuzzy bipolar hypersoft sets, should be created and applied to chickenpox diagnosis exclusively.cally for chick- enpox diagnosis. This includes formulation of mathematical framework, formation of soft sets and the formulation of algorithms for diagnosis.

Data Collection and Integration: Collect and integrate diverse types of data relevant to chickenpox diagnosis, including clinical symptoms, pa- tient history, laboratory results, and environmental factors. Ensure that the framework can accommodate and process this heterogeneous data ef- fectively.

Algorithm Design: Develop and test decision-making algorithms that leverage the Q-Rung Orthopair fuzzy bipolar hypersoft sets framework to accurately diagnose chickenpox. This is inventory of operation, calculation of membership, fuzzy reasoning and decision rules.

Validation and Testing: Perform a trial and evaluate the truly of the framework with hypothetically patient data. Compare the results given by the proposed framework with other diagnostic approaches.

Flexibility and Generalizability: Investigate relevance of the frame- work to other infectious diseases and illnesses. Describing its application for different types of diagnoses, illustrate how this method can be useful in a wider variety of cases.

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With regard to these aims and with the focus on this scope the study is posi- tioned to revolutionize the diagnostic process of chickenpox and similar diseases, enriching the option of healthcare providers with a powerful and dependable tool based on fuzzy logic and soft set theory.

Literature Review

Fuzzy set theory is developed by Zadeh (1965)[20], which is applied to model uncertainty and imprecision from the medical diagnostic process. Basically, the traditional fuzzy sets have proved useful in the synthesis of many Medi- cal Diagnostic systems with respect to More and Less than, which makes it possible to cope with the vagueness and ambiguity of symptoms. However, since the fuzzy sets fail to incorporate the complete reasoning of human, other advanced models like Intuitionistic fuzzy sets and Pythagorean fuzzy sets has been developed [21]., The (Q-ROFBHSS), proposed by Yager in 2016 extended the Intuitionistic and the Pythagorean fuzzy sets by generalizing the compu- tation of their coefficients [22] However, in q-ROFS, the sum of the square of membership and non-membership degrees raise to the power of q is less than equality to 1. This additional flexibility is meant for dealing with complicated and vague information which make Q-ROFBHSS appropriate for medical diag- nosis in which a number of symptoms and clinical signs present varying levels of uncertainty.Bipolar fuzzy sets brought in by Zhang (1994)[23] include a bipo- larity structure in order to represent positive and negative information. This characteristic is beneficial in the diagnosis of diseases where the presence as well as the absence of signs is important. Hypersoft sets, which is a generalization of soft sets offered by Molodtsov (1999)[24], offers a set that is parameterized in order to deliver multiple criteria decision making difficulties optimally. These two concepts when amalgamated into a single framework suggest a powerful tool for medical diagnosis.After single framework there demonstrate the extension of double frame soft set to double frame hypersoft set[25].After the introduc- tion of double frame soft set to double frame hypersoft set, the integration of Q-ROFBHSS with bipolar fuzzy sets and hypersoft sets give the Q-ROFBHSS. On this basis, this novel framework integrates the advantages of all the three approaches to better characterize diagnostic information as well as allowing elaboration of diagnostic information with greater detail as well as flexibility. The Q-ROFBHSS framework can accommodate any number of criteria and is different from others due to its capability to co-process conflicting information which makes the complexity of medical diagnosis ideal for use of the proposed method.The use of advanced fuzzy set theories in medical diagnosis has received considerable attention and has shown success in a variety of fields of study. For instance, to build the diagnostic models for the diabetes, cardiovascular dis- eases and cancer, the intuitionistic fuzzy sets were applied. Pythagorean fuzzy sets have been used to improve the diagnostic performance of neurological dis- orders and infectious diseases diagnosis system accuracy[26].Implementation of q-ROFBHSS should enhance diagnostic accuracy and certainty especially in dis- eases that have clinical manifestations that differ in each stratum of the affected individuals such as chickenpox.ced fuzzy set theories in medical diagnosis has shown promising results across various domains. For example, intuitionistic fuzzy sets have been used to develop diagnostic models for diabetes, cardio- vascular diseases, and cancer.

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Pythagorean fuzzy sets have been employed to enhance the accuracy of diagnostic systems for neurological disorders and in- fectious diseases[26]. The introduction of q-ROFBHSS is expected to further improve diagnostic accuracy and reliability, particular in the context of diseases like chickenpox, where symptoms can vary widely among patients.

Preliminaries

This section presents a brief description of the basic terms and concepts and provides a historical background. To read with understanding, the core ideas in texts, HSS are used to retrieve from compositions.

Definition 2.1 [27]

A fuzzy set θ is defined as $\theta = \{(p, P_\theta(p)) \mid p \in N\}$ such that $P_\theta : N \to J$, where $P_\theta(p)$ indicates the membership of $p \in \theta$.

(Peculiarity of fuzzy set) If θ and β are two fuzzy sets, then for all $p \in N$, we have:

1. $\theta \cup \beta = \{(p, \max\{P_\theta(p), P_\beta(p)\})\}$
2. $\theta \cap \beta = \{(p, \min\{P_\theta(p), P_\beta(p)\})\}$
3. $\theta^c = \{(p, 1 - P_\theta(p)) \mid p \in N\}$

When dealing with uncertain scenarios, fuzzy sets only highlight the degree of truth; nevertheless, there are situations inWhich levels of falsity should be considered to accurately implement fuzzy sets in these contexts

Definition 2.2. [28] An IFS W is written as $W = \{(p, < P_W(p), Q_W(p) >) \mid p \in N\}$ such that $P_W : N \to J$ and $Q_W : N \to J$, where $P_W(p)$ and $Q_W(p)$ indicates the truthness and falsness of $p \in W$ with $0 \leq P_W(p) + Q_W(p) \leq 1$ and the degree of hesitancy $H_W(p) = 1 - P_W(p) - Q_W(p)$.

Definition 2.3. [29] A Q-ROFS A in a universal set N is defined as $V = \{\langle p, \varsigma_{V(p)}, \varrho_{V(p)}\rangle \mid p \in N\}$, with the condition that

$0 \leq (\varsigma_{V(p)})^q + (\varrho_{V(p)})^q \leq 1, \quad (q \geq 1)$

The indeterminacy degree can be calculated as:

$\pi V(p) = [(\varsigma_V{}^q{}_{(p)} + \varrho_V{}^q{}_{(p)} - \varsigma_V{}^q(p)\, \varrho_V{}^q(p))^{1/q}$

Definition 2.4. [30][31] Consider a $S_{fSs}(N', J')$ and $G \subset J'$. The combination (N, G) is known as a Q-ROFSS over N', where $N' : G \to q - \mathrm{ROFSS}^{N'}$, which can be denoted as

$N_{nj}(p_i) = \{(p_i, f_j(p_i), g_j(p_i))_q \mid p_i \in N', q \geq 1\}$

with the condition

$0 \leq (f_j(p_i))^q + (g_j(p_i))^q \leq 1$

For simplicity, $N_{nj}(p_i) = (p_i, f_j(p_i), g_j(p_i))_q$ is denoted by $I_{nj} = (f_{ij}, g_{ij})$ representing a Q-ROFSs number (Q-ROFSS). Here the degree of hesitancy is defined as

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$\Pi_{Imj} = [1 - ((f_{ij})^q + (g_{ij})^q)]^{1/q}$

Definition 2.5. [32]
Let N be the universal set, and let $b_1, b_2, b_3, \ldots, b_n$ represent n distinct attributes associated with N , where the values of these attributes belong to the sets $\epsilon_1, \epsilon_2, \ldots, \epsilon_n$ respectively, with the condition that $\epsilon_i \cap \epsilon_j = \emptyset$ for i ≠j.
Let $\epsilon_1 \times \epsilon_2 \times \ldots \times \epsilon_n = B = \{k_{1h}, k_{1m}, \ldots, k_{1n}\}$ be a set of sub-parameters.
A pair (R, B) is defined as a q-ROPFHSS over the universal set N , where $R : B \rightarrow \{qROFS\}^N$ represents the collection of qROF ⊆ Y , and it can be expressed as:
$(R, B) = \{(b', R_B(b')) \mid b' \in B, R_B(b') \in \{qROFS\}^N, q \in [0, 1]\}$
Where
$R_B(b') = \{(n', \psi_B(b')(n'), \psi'_B(b')(n')) \mid n' \in N, q \geq 1\}$
and satisfies the constraint that
$0 \leq (\psi_B(b')(n'))^q + (\psi'(b')(n'))^q \leq 1$ and $q \geq 1$.
Definition 2.6. [33] A pair $(\Phi\phi, \alpha)$ is defined as a soft set ϕ over N , where $\Phi_N : X \rightarrow P(N)$.
Example 2.7. Let $V = \{p_1, p_2, p_3, p_4, p_5, p_6\}$, and $\alpha = \{e_1, e_2, e_3, e_4\}$. The approximate elements of soft set $\phi = (\Phi\phi, \alpha)$ are:
$\Phi\phi(e_1) = \{p_1, p_3, p_6\}$,
$\Phi\phi(e_2) = \{p_2, p_3, p_5\}$,
$\Phi\phi(e_3) = \{p_4, p_5, p_6\}$,
$\Phi\phi(e_4) = \{p_1, p_2, p_5\}$.
Soft set ϕ is stated as $\phi = \{\Phi\phi(e_1), \Phi\phi(e_2), \Phi\phi(e_3), \Phi\phi(e_4)\}$ or:
$\phi = \{(e_1, \{p_1, p_3, p_6\}), (e_2, \{p_2, p_3, p_5\}), (e_3, \{p_4, p_5, p_6\}), (e_4, \{p_1, p_2, p_5\})\}$.

Definition 2.8. [34] A pair (Φ_ϑ, γ) is defined as a fuzzy soft set over N , where $\Phi_\vartheta : \gamma \rightarrow P(\vartheta)$ and $P(\vartheta)$ is a combination of whole fuzzy subsets over N , $\gamma \subseteq Y$.
Definition 2.9. [35] A pair $(\Phi_{I\vartheta}, \gamma)$ is referred to as an intuitionistic fuzzy soft set over N , where
$\Phi_{I\vartheta} : \gamma \rightarrow P(I\vartheta)$
and $P(I\vartheta)$ is a combination of whole IF subsets over N , $\gamma \subseteq Y$.

Definition 2.10. [**?**] Let $N = \{p'_1, p'_2, \ldots, p'_n\}$ be the universe and $X = \{e'_1, e'_2, \ldots e_n\}$ is a set of parameters so, these parameters of each element of X are:

$$X_1 = \{v'_{11}, v'_{12}, \ldots, v'_{1n}\},$$
$$X_2 = \{v'_{21}, v'_{22}, \ldots, v'_{2n}\},$$
$$X_3 = \{v'_{31}, v'_{32}, \ldots, v'_{3n}\},$$
$$\vdots$$
$$X_n = \{v'_{n1}, v'_{n2}, \ldots, v'_{nn}\}.$$

Then $X = X_1 \times X_2 \times \ldots \times X_n = \{v'_1, v'_2, v'_3, \ldots, v'_r\}$ here each $v'_i (i = 1, 2, \ldots, r)$ and $v = \prod_{i=1}^{n} |X_i|, |\cdot|$ identified the set of cardinality, and is a MAAF is a mapping:

$$\phi_H : \gamma \rightarrow P(N)$$

and is defined as:

$$\phi_H(\{v'_1, v'_2, \ldots, v'_k\}) = P(\{p'_1, p'_2, \ldots, p'_n\})$$

The pair (ϕ_H, γ) is referred to as a hypersoft set.

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Definition 2.11. [**?**] FHSS and IFHS sets are hypersoft sets defined in Eq.5, where P (N) is replaced with P (ϑ) and P (Iϑ).

Definition 2.12. [**?**] A PFS W written as W = {(a, < B_W (a), C_W (a) >) | a ∈ N } such that B_W : N → J and C_W : N → J. Here the condition is $0 \leq B_W(a)+C_W(a) \leq 1$ and the degree of hesitancy is $D_W(a) = 1-B_W(a)-C_W(a)$.
$0 \leq (B_W(a))^2, (C_W(a))^2 \leq 1$
Supposing
$(B_W(a))^2 + (C_W(a))^2 \leq 1$

So,the indetermination degree of a ∈ N to W is $\pi_W(a) = \sqrt{(1 - [(B_W(a))^2 + (C_W(a))^2])}$ and $\pi_W(a) \in [0, 1]$. In what follows, $(B_W(a))^2 + (C_W(a))^2 + (\pi_W(a))^2 = 1$.
Otherwise, $\pi_W(a) = 0$ whenever
$(B_W(a))^2 + (C_W(a))^2 = 1$.

Definition 2.13. [**?**] A pair $(\Phi_{P\vartheta}, \gamma)$ known as PFSS if a map
$\Phi_{P\vartheta} : \gamma \longrightarrow P(P\vartheta)$
is defined as $\Phi_{P\vartheta} = (B_W(a)), (C_W(a))$ known as PFSN with
$0 \leq (B_W(a))^2 + (C_W(a))^2 \leq 1$
for $\Phi_{P\vartheta} \in [0, 1]$.

Definition 2.14. [**?**] Assume N be a universal set and P (N) be a power set of N , and $\mathbf{X} = \{e_1, e_2, e_3, \ldots, e_n\}$, $(n \geq 1)$ be a set of attributes, and set X_i a set of corresponding sub-attributes of X_j respectively with $e_i \cap e_j = \emptyset$ for $n \geq 1$ for each i, $j \in \{1, 2, 3, \ldots, n\}$ and
$i \neq j$. The pair $(\Phi_{P\vartheta}, e_1 \times e_2 \times e_3 \ldots e_n = \gamma)$ is prefered to as PFHSS over N and its mapping is
$\Phi_{P\vartheta} : e_1 \times e_2 \times e_3 \ldots \times e_n = \gamma \longrightarrow PFS^N$
PFHSN can be symbolized as $\Phi_{P\vartheta} = ((B_W(a)(\xi), C_W(a)(\eta))$, with
$0 \leq (B_W(a))(\xi)^2 + (C_W(a))(\eta)^2 \leq 1$

Q-Rung Orthopair Fuzzy Bipolar HyperSoft Set (Q-ROFBHSS)
Definition 3.1. Consider a universal set N and a parameter universe R. For any subset S of R, a triplet (T, U, S) is termed a q-rung orthopair fuzzy bipolar hypersoft set (q-ROFBHSS) over N . Here, T and U are functions defined as T : S → F (N) and U : ¬S → F (N), respectively, which must satisfy the conditions:
$0 \leq (\mu_T^+(s)(n))^q + (\mu_U^+(\neg s)(n))^q \leq 1$,

$0 \leq (\mu_T^-(s)(n))^q + (\mu_U^-(\neg s)(n))^q \leq 1$,

for all s ∈ S, ¬s ∈ ¬S, and n ∈ N . Additionally, the values $\mu_T^+(s)(n)$ and $\mu_T^+(\neg s)(n)$ represent the degrees of belongingness and non-belongingness of an

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element n in N and for any $q \geq 1$, they satisfy:
$0 \leq (\mu_T^+(s)(n))^q + (\mu_T^+(\neg s)(n))^q \leq 1$,

$0 \leq (\mu_U^-(s)(n))^q + (\mu_U^-(\neg s)(n))^q \leq 1$,

Furthermore, a q-ROFBHSS over N generates two parameterized q-rung orthopair fuzzy subsets on N that adhere to the aforementioned equations. For any s ∈ S, T (s) and U (¬s) are defined as the sets of s- and ¬s-approximate elements of the q-ROFBHSS (T, U, S), respectively.

Example 3.2. Q-Rung Orthopair Fuzzy Bipolar Hypersoft Set (Q- ROFBHSS)
Let $N = \{x_1, x_2, x_3, \}$ be the set of four parameters given from different patients. Assume that the parameters of these objects $x_i \in N$, i = 1, 2, 3, 4 are given by the following attributes A_1, A_2, A_3:
$A_1(x_1) = a_{11}$, $A_2(x_1) = a_{12}$,$A_3(x_1) = a_{13}$
$A_1(x_2) = a_{21}$, $A_2(x_2) = a_{22}$,$A_3(x_2) = a_{23}$
$A_1(x_3) = a_{31}$, $A_2(x_3) = a_{32}$,$A_3(x_3) = a_{33}$
The parameters A_1, A_2, A_3 represent the attributes for each patient x_1, x_2, x_3,.
$\mu_{A_1}(x_1) = [0.7, 0.8]$, $\nu_{A_1}(x_1) = [0.2, 0.1]$
$\mu_{A_1}(x_2) = [0.6, 0.7]$, $\nu_{A_1}(x_2) = [0.3, 0.2]$
$\mu_{A_1}(x_3) = [0.9, 0.85]$, $\nu_{A_1}(x_3) = [0.1, 0.15]$

Bipolar Fuzzy Set (BFS)
$\mu^+_{A_2}(x_1) = 0.8$, $\mu^-_{A_2}(x_1) = -0.3$
$\mu^+_{A_2}(x_2) = 0.7$, $\mu^-_{A_2}(x_2) = -0.2$
$\mu^+_{A_2}(x_3) = 0.9$, $\mu^-_{A_2}(x_3) = -0.1$

Hypersoft Set (HSS)
$H(x_1) = \{A_1, A_2\}$
$H(x_2) = \{A_1, A_2\}$
$H(x_3) = \{A_1, A_2\}$

Q-Rung Orthopair Fuzzy Bipolar Hypersoft Set (Q-ROFBHS)
$Q(x_1) = (\mu^+_{A1}(x_1),\mu^-_{A1}(x_1),\nu^+_{A1}(x_1), \nu^-_{A1}(x_1),\mu^+_{A2}(x_1),\mu^-_{A2}(x_1))$
$=(0.7,-0.3,0.2,-0.1,0.8,-0.3)$
$Q(x_2) = (\mu^+_{A1}(x_2),\mu^-_{A1}(x_2),\nu^+_{A1}(x_2), \nu^-_{A1}(x_2),\mu^+_{A2}(x_2),\mu^-_{A2}(x_2))$
$=(0.6,-0.2,0.3,-0.2,0.7,-0.2)$
$Q(x_3) = (\mu^+_{A1}(x_3),\mu^-_{A1}(x_3),\nu^+_{A1}(x_3), \nu^-_{A1}(x_3),\mu^+_{A2}(x_3),\mu^-_{A2}(x_3))$
$=(0.9,-0.1,0.1,-0.15,0.9,-0.1)$

The Q-ROFBHS Q provides a detailed and nuanced representation of the membership, non-membership, and bipolar characteristics of each attribute for every

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element in the universe X. This comprehensive technique allows for im- proved decision-making in complex diagnostic scenarios like chickenpox diagnosis.

Chicken-Pox Diagnosis Model

Let X be the set of patients, and E be the set of diagnostic criteria (attributes), such as fever, rash, itching, and exposure history.

Collecting Data: Each patient $x \in X$ is evaluated for each attribute $e \in E$, resulting in the following representation:

$$D_x = \{(e, \mu_{e,x}, \nu_{e,x}) \mid e \in E\} \quad (1)$$

where $\mu_{e,x}$ and $\nu_{e,x}$ are the membership and non-membership degrees for attribute e of patient x.

Constructing QROFBHS: The Q-Rung Orthopair Fuzzy Bipolar Hypersoft Set for patient x is constructed as:

$$\tilde{H}_x = \{(e, \langle \mu^+_{e,x}, \nu^+_{e,x} \rangle, \langle \mu^-_{e,x}, \nu^-_{e,x} \rangle) \mid e \in E\} \quad (2)$$

where $\langle \mu^+_{e,x}, \nu^+_{e,x} \rangle$ and $\langle \mu^-_{e,x}, \nu^-_{e,x} \rangle$ are the positive and negative membership pairsfor attribute e of patient x.

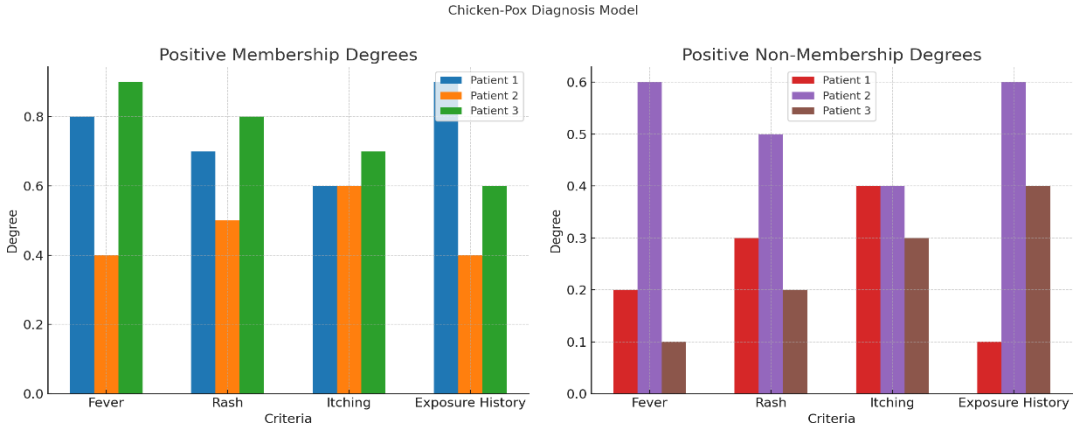
Diagnosis Decision: The overall degree of certainty Cert_x and uncertainty Uncert_x for diagnosing chickenpox in patient x is calculated as:

$$\text{Cert}_x = \frac{1}{|E|} \sum_{e \in E} \mu^+_{e,x} \quad (3)$$

$$\text{Uncert}_x = \frac{1}{|E|} \sum_{e \in E} \nu^+_{e,x} \quad (4)$$

The diagnosis is made based on a threshold θ:

$$\text{Diagnosis}_x = \begin{cases} \text{Chickenpox Positive} & \text{if } \text{Cert}_x > \theta \\ \text{Chickenpox Negative} & \text{if } \text{Uncert}_x > \theta \\ \text{Further Testing Required} & \text{otherwise} \end{cases} \quad (5)$$



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Figure: Graphically Representation of Chicken Pox Diagnosis Model:
Personalized Healthcare Treatment Plans

Data Collection: Let X be the set of patients**.**
Let E be the set of health attributes (medical history, current health status, etc.).

Data Representation: Each patient $x \in X$ has attributes $e \in E$ represented by membership $\mu_{e,x}$ and non-membership $\nu_{e,x}$ degrees.

Q-Rung Orthopair Fuzzy Bipolar Hypersoft Set:

$\tilde{H}_X = \{(e, \langle \mu^+_{e,x}, \nu^+_{e,x} \rangle, \langle \mu^-_{e,x}, \nu^-_{e,x} \rangle) \mid e \in E\}$ (6)

Positive membership: $\mu^+_{e,x}$(favorable health indicators).

Negative membership: $\nu^+_{e,x}$ (risk factors).

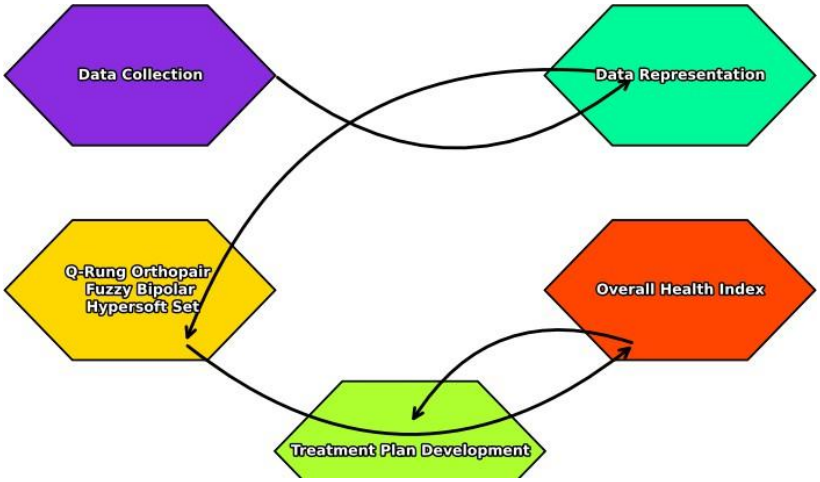


Figure 3: Flow chart of suggested technique

Example 3.3. 1. Data Collection: Let X be the set of patients. Let E be the set of health attributes:

E = {Blood Pressure, Blood Sugar, Cholesterol Levels, Exercise Frequency, Diet Quality} (9)

Data Representation: Each patient $x \in X$ is evaluated for each attribute $e \in E$.
Represent the data using membership $\mu_{e,x}$ and non-membership $\nu_{e,x}$ degrees.

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Tables for Data Representation

Attribute	μ^+_{e,x_1}	ν^+_{e,x_1}	μ^+_{e,x_2}	ν^+_{e,x_2}	μ^+_{e,x_3}	ν^+_{e,x_3}
Blood Pressure	0.8	0.2	0.6	0.4	0.4	0.6
Blood Sugar	0.7	0.3	0.5	0.5	0.3	0.7
Cholesterol Levels	0.6	0.4	0.4	0.6	0.5	0.5
Exercise Frequency	0.9	0.1	0.7	0.3	0.6	0.4
Diet Quality	0.8	0.2	0.5	0.5	0.7	0.3

Table 1: Membership and Non-membership Degrees for Patients

Rung Orthopair Fuzzy Bipolar Hypersoft Set:

$\tilde{H}_X = \{(e, \langle \mu^+_{e,x}, \nu^+_{e,x} \rangle, \langle \mu^-_{e,x}, \nu^-_{e,x} \rangle) \mid e \in E\}$ (10)

Positive membership: $\mu^+_{e,x}$ favorable health indicators).
Negative membership: $\nu^+_{e,x}$ (risk factors).

2. Q-Rung Orthopair Fuzzy Bipolar Hypersoft Set:

$\tilde{H}_X = \{(e, \langle \mu^+_{e,x}, \nu^+_{e,x} \rangle, \langle \mu^-_{e,x}, \nu^-_{e,x} \rangle) \mid e \in E\}$ (10)

Positive membership: $\mu^+_{e,x}$ favorable health indicators).
Negative membership: $\nu^+_{e,x}$ (risk factors).

4. **Overall Health Index:**

$$\text{Health}_x = \frac{1}{|E|} \sum_{e \in E} \mu^+_{e,x} \tag{11}$$

5. **Treatment Plan Development:**

$$\text{Plan}_x = \begin{cases} \text{Standard Treatment} & \text{if Health}_x \leq \theta_1 \\ \text{Enhanced Treatment} & \text{if } \theta_1 < \text{Health}_x \leq \theta_2 \\ \text{Intensive Treatment} & \text{if Health}_x > \theta_2 \end{cases} \tag{12}$$

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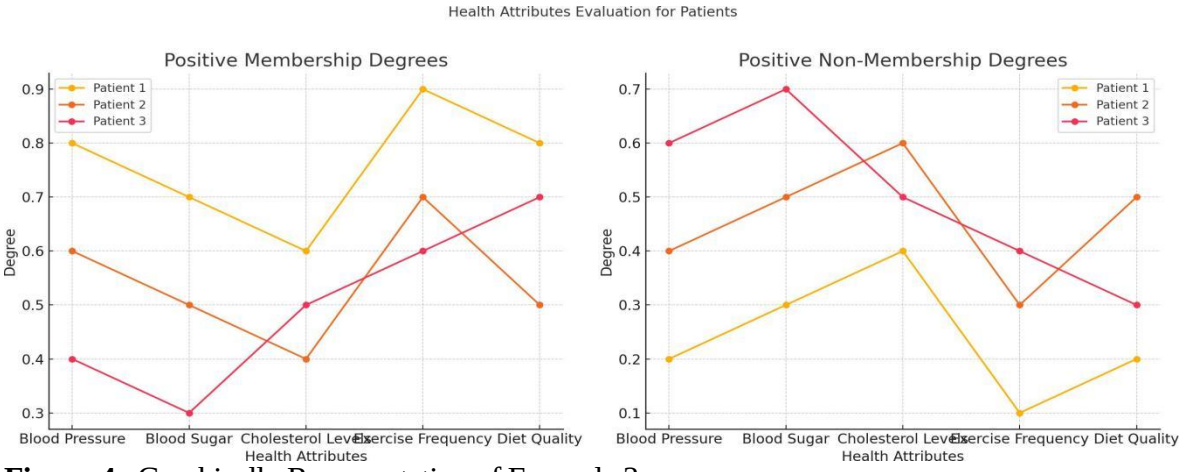


Figure 4: Graphically Representation of Example 3:

Definition 3.4 Let N be a universal set and $\xi_1 = (T_1, U_1, R_1)$, $\xi_2 = (T_2, U_2, R_2)$ of two Q-ROFBHSSs over N . The set ξ_1 is known as Q-ROFBH subset of ξ_2, indicates as $\xi_1 \sqsubseteq \xi_2$, if

1. $R_1 \subseteq R_2$,
2. $T_1(r) \subseteq T_2(r)$ (that is, $\mu^{+}_{T1}(r)(n) \leq \mu^{+}_{T2}(r)(n), \mu^{-}_{T1}(r)(n) \geq \mu^{-}_{T2}(r)(n)$)

And $U_1(\neg r) \supseteq U2(\neg r)$ (that is, $\mu^{+}_{U2}(\neg r)(n) \leq \mu^{+}_{U1}(\neg r)(n)$, $\mu^{-}_{U2}(\neg r)(n) \geq \mu^{-}_{U}(\neg r)(n)$ for all $r \in R1$ and $n \in N$.

Example 3.5. Let Q-ROFBHSS (T, U, R) on N be as defined in Example 1.
For $R_1 = \{r_1 = \text{infected}, r_2 = \text{recovered}\} \subseteq R$, we give a new Q-ROFBHSS (T_1, U_1, R_1), this is given in Table 4:

Table 4. The Q-ROFBHSS (T_1, U_1, R_1)

(T_1, U_1, R_1)	r_1	r_2
v_1	⟨(0.6, 0.7), (0.4, 0.3)⟩	⟨(0.4, 0.5), (0.6, 0.5)⟩
v_2	⟨(0.5, 0.4), (0.3, 0.4)⟩	⟨(0.3, 0.4), (0.7, 0.5)⟩
v_3	⟨(0.3, 0.9), (0.7, 0.1)⟩	⟨(0.4, 0.2), (0.6, 0.8)⟩
v_4	⟨(0.9, 0.5), (0.1, 0.5)⟩	⟨(0.6, 0.7), (0.4, 0.3)⟩

It is clear from Definition 8 that $(T_1, U_1, R_1) \sqsubseteq (T, U, R)$.

Definition 3.6. Let N be a universal set. Consider $\xi_1 = (T_1, U_1, R_1)$ and $\xi_2 = (T_2, U_2, R_2)$ are two q-ROFBHSSs over N . Then, ξ_1 and ξ_2 are said to be equal, if $\xi_1 \sqsubseteq \xi_2$ and $\xi_2 \sqsubseteq \xi_1$.

Definition 3.7. Let N be a universal set and $\xi = (T, U, R)$ be a q-ROFBHSS. Then, its
complement $\xi^c = (T^c, U^c, R)$ is a Q-ROFBHSS over N with $T^c(r)(n) = (\mu^{-}_{T}(r)(n), \mu^{+}_{T}(r)(n))$ and $U^c(\neg r)(n) = (\mu^{-}_{U}(\neg r)(n), \mu^{+}_{U}(\neg r)(n))$ for all $r \in R$, $\neg r \in \neg R$ and $n \in N$.

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Example 3.8. Let $\xi = (T, U, R)$ be the Q-ROFBHSS over a universe N as con- sidered in Example 1. Then, by Definition 10, its complement $\xi^c = (T^c, U^c, R)$ is computed in Table 5:

Table 5. Table for the complement of (T, U, R).

ξV	r_1	r_2	r_3
v_1	⟨(0.5, 0.3), (0.4, 0.6)⟩	⟨(0.2, 0.1), (0.8, 0.9)⟩	⟨(0.4, 0.2), (0.6, 0.8)⟩
v_2	⟨(0.6, 0.4), (0.3, 0.7)⟩	⟨(0.3, 0.5), (0.7, 0.5)⟩	⟨(0.5, 0.3), (0.5, 0.7)⟩
v_3	⟨(0.7, 0.2), (0.6, 0.5)⟩	⟨(0.4, 0.6), (0.5, 0.3)⟩	⟨(0.6, 0.1), (0.4, 0.9)⟩
v_4	⟨(0.8, 0.4), (0.2, 0.7)⟩	⟨(0.5, 0.3), (0.5, 0.6)⟩	⟨(0.3, 0.5), (0.7, 0.4)⟩

Definition 3.9. A Q-ROFBHSS on a universe U is referred to as a relative null Q-ROFBHSS, denoted by (Θ, A, B), if $\Theta(\zeta)(\kappa) = (\varphi^+_{\Theta}(\zeta)(\kappa) = 0, \varphi^-_{\Theta}(\zeta)(\kappa) = 1)$
Θ
and $A(\neg\zeta)(\kappa) = (1, 0)\ \forall\zeta \in B, \neg\zeta \in \neg B, \kappa \in U$.

Definition 3.10. A Q-ROFBHSS on a universe U is referred to as a related absolute Q-ROFBHSS, represented by (A, Θ, B), if $A(\zeta)(\kappa) = (\varphi^+_A(\zeta)(\kappa) = 1, \varphi^-_A(\zeta)(\kappa) = 0)$ and $\Theta(\neg\zeta)(\kappa) = (0, 1)\ \forall\zeta \in B, \neg\zeta \in \neg B, \kappa \in U$.

Definition 3.11. Let (X_1, Y_1, B_1) and (X_2, Y_2, B_2) be two Q-ROFBHSSs over a universe U. Then, the "AND" operation on (X_1, Y_1, B_1) and (X_2, Y_2, B_2), denoted by $(X_1, Y_1, B_1) \cap (X_2, Y_2, B_2)$, is defined as $(X, Y, B_1 \times B_2)$ where for all $(\zeta_i, \zeta_j) \in B_1 \times B_2$, $(\neg\zeta_i, \neg\zeta_j) \in \neg B_1 \times \neg B_2$, and $\kappa \in U$,

$X(\zeta_i, \zeta_j)(\kappa) = \min(\varphi^+_{X1}(\zeta_i)(\kappa), \varphi^+_{X2}(\zeta_j)(\kappa)), \max(\varphi^-_{X1}(\zeta_i)(\kappa), \varphi^-_{X2}(\zeta_j)(\kappa))$

And

$Y(\neg\zeta_i, \neg\zeta_j)(\kappa) = \min(\varphi^+_{Y1}(\neg\zeta_i)(\kappa), \varphi^+_{Y2}(\neg\zeta_j)(\kappa)), \max(\varphi^-_{Y1}(\neg\zeta_i)(\kappa), \varphi^-_{Y2}(\neg\zeta_j)(\kappa))$.

Definition 3.12. Let (X_1, Y_1, B_1) and (X_2, Y_2, B_2) be two Q-ROFBHSSs over a universe U. Then the "OR" operation on (X_1, Y_1, B_1) and (X_2, Y_2, B_2), indi- cated by $(X_1, Y_1, B_1) \cup (X_2, Y_2, B_2)$, is defined as $(X^0, Y^0, B_1 \times B_2)$ where for all $(\zeta_i, \zeta_j) \in B_1 \times B_2$, $(\neg\zeta_i, \neg\zeta_j) \in \neg B_1 \times \neg B_2$, and $\kappa \in U$,

$X^0(\zeta_i, \zeta_j)(\kappa) = (\max(\varphi^+_{X1}(\zeta_i)(\kappa), \varphi^+_{X2}(\zeta_j)(\kappa)), \min(\varphi^-_{X2}(\zeta_i)(\kappa), \varphi^-_{X2}(\zeta_j)(\kappa))$

And

$Y^0(\neg\zeta_i, \neg\zeta_j)(\kappa) = \max(\varphi^+_{Y1}(\neg\zeta_i)(\kappa), \varphi^+_{Y2}(\neg\zeta_j)(\kappa)), \min(\varphi^-_{Y1}(\neg\zeta_i)(\kappa), \varphi^-_{Y2}(\neg\zeta_j)(\kappa))$.

Example 3.13. Representing the group of six cars by $U = \{e_1, e_2, \ldots, e_6\}$, and two Q-ROFBHSSs over U as $\Theta_1 = (Q_1, S_1, R_1)$ as well as $\Theta_2 = (Q_2, S_2, R_2)$, We may let $P = \{r_1$ = reduced weight, r_2 = elevated engine performance, r_3 = expanded dimensions, r_4 = enhanced velocity, r_5 = secure operation$\}$ represent a general set of criterias. Here, the set $R_1 = \{r_1$ = reduced weight, r_2 = elevated engine performance$\}$ and $R_2 = \{r_3$ = expanded dimensions$\} \subseteq P$ can be thought of as subsets of a general set of criteria. This will be shown below for q = 7, displaying Tables 5 and 6 respectively for the q-ROFBHSSs Θ_1 and Θ_2 in this case.

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Table 2: Table for the Q-ROFBHSS (Q_1, S_1, R_1).

(Q_1, S_1, R_1)	j_1	j_2
e_1	⟨(0.5, 0.7), (0.4, 0.3)⟩	⟨(0.7, 0.6), (0.3, 0.4)⟩
e_2	⟨(0.6, 0.5), (0.3, 0.2)⟩	⟨(0.8, 0.4), (0.2, 0.5)⟩
e_3	⟨(0.7, 0.8), (0.2, 0.3)⟩	⟨(0.5, 0.7), (0.4, 0.6)⟩
e_4	⟨(0.8, 0.6), (0.3, 0.4)⟩	⟨(0.6, 0.5), (0.3, 0.2)⟩
e_5	⟨(0.9, 0.7), (0.1, 0.2)⟩	⟨(0.7, 0.8), (0.2, 0.3)⟩
e_6	⟨(0.6, 0.9), (0.4, 0.5)⟩	⟨(0.8, 0.3), (0.5, 0.2)⟩

Table 3: Table for the Q-ROFBHSS (Q_2, S_2, R_2).

(Q_2, S_2, R_2)	r_3
e_1	⟨(0.5, 0.8), (0.4, 0.2)⟩
e_2	⟨(0.7, 0.6), (0.3, 0.4)⟩
e_3	⟨(0.8, 0.7), (0.2, 0.3)⟩
e_4	⟨(0.6, 0.5), (0.3, 0.4)⟩
e_5	⟨(0.7, 0.6), (0.3, 0.4)⟩
e_6	⟨(0.9, 0.8), (0.1, 0.2)⟩

Table 4: Table for the Q-ROFBHSS $\xi 1 \cap \xi 2$.

$(Q_1, S_1, R_1) \cap (Q_2, S_2, R_2)$	(r_1, r_3)	(r_2, r_3)
e_1	⟨(0.5, 0.7), (0.4, 0.3)⟩	⟨(0.7, 0.8), (0.2, 0.5)⟩
e_2	⟨(0.6, 0.5), (0.3, 0.2)⟩	⟨(0.8, 0.6), (0.2, 0.4)⟩
e_3	⟨(0.7, 0.8), (0.2, 0.3)⟩	⟨(0.5, 0.7), (0.4, 0.5)⟩
e_4	⟨(0.8, 0.6), (0.3, 0.4)⟩	⟨(0.6, 0.7), (0.3, 0.2)⟩
e_5	⟨(0.9, 0.7), (0.1, 0.2)⟩	⟨(0.7, 0.8), (0.2, 0.3)⟩
e_6	⟨(0.6, 0.9), (0.4, 0.5)⟩	⟨(0.8, 0.5), (0.2, 0.4)⟩

Table 5: Table for the Q-ROFBHSS $\xi 1 \cup \xi 2$.

$(Q_1, S_1, R_1) \cup (Q_2, S_2, R_2)$	(r_1, r_3)	(r_2, r_3)
e_1	⟨(0.6, 0.7), (0.3, 0.4)⟩	⟨(0.8, 0.6), (0.2, 0.4)⟩
e_2	⟨(0.7, 0.5), (0.3, 0.2)⟩	⟨(0.8, 0.7), (0.2, 0.3)⟩
e_3	⟨(0.8, 0.6), (0.3, 0.4)⟩	⟨(0.7, 0.5), (0.4, 0.5)⟩
e_4	⟨(0.9, 0.7), (0.1, 0.2)⟩	⟨(0.5, 0.6), (0.4, 0.3)⟩
e_5	⟨(0.6, 0.9), (0.4, 0.5)⟩	⟨(0.8, 0.7), (0.2, 0.3)⟩
e_6	⟨(1, 0), (0, 1)⟩	⟨(0.8, 0.5), (0.2, 0.4)⟩

Proposition 1

Let U be a universe and let $\Theta_1 = (Q_1, S_1, R_1)$ and $\Theta_2 = (Q_2, S_2, R_2)$ be q-

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ROFBHSSs on U. Then:

1. $(\Re_1 \cup \Re_2)^c = (\Re_1)^c \cap (\Re_2)^c$,
2. $(\Re_1 \cap \Re_2)^c = (\Re_1)^c \cup (\Re_2)^c$.

Proof

1. From Definitions 10 and 14, $(\Re_1 \cup \Re_2)^c = (Q^0, S^0, R_1 \times R_2)$ where

$Q^0{}_C(r, s) = Q^c{}_1(r) \cap Q^c{}_2(s)$

And

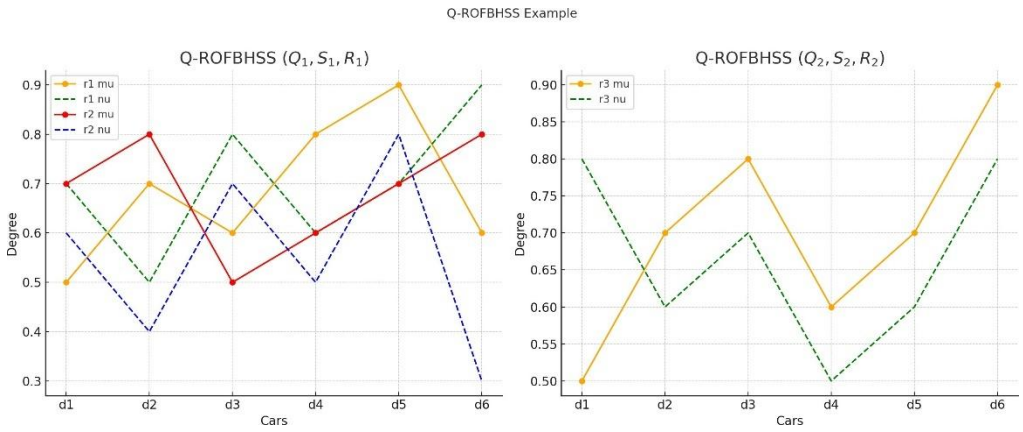
$S^0{}_c(\neg r, \neg s) = S^c{}_1(\neg r) \cup S^c{}_2(\neg s)$

for all $(r, s) \in R_1 \times R_2$ and $(\neg r, \neg s) \in \neg R_1 \times \neg R_2$. By Definition 10,

$(\Re_1)^c = (Q^c{}_1, S^c{}_1, R_1)$ and $(\Re_2)^c = (Q^c{}_2, S^c{}_2, R_2)$.

Therefore, $(\Re_1)^c \cap (\Re_2)^c = (Q^{c1} \cap Q^{12}, S^{c1} \cap S^{c2}, R_1 \times R_2)$.

Hence, $(\Re_1 \cap \Re_2)^c = (\Re_1)^c \cup (\Re_2)^c$.



Similarly, we have $(\Re_1 \cap \Re_2)^c = ((Q^{c1} \cup Q^{12}, S^{c1} \cup S^{c2}, R_1 \times R_2)$. By Definition 10

$(\Re_1 \cap \Re_2)^c = ((Q^0{}_C, S^0{}_C, R_1 \times R_2)$.

Hence, $(\Re_1 \cap \Re_2)^c = (\Re_1)^c \cup (\Re_2)^c$.

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$$(E_1 \diamond E_2)(\neg r) = \begin{cases} E_1(\neg r), & \text{if } \neg r \in (\neg F_1) \setminus (\neg F_2), \\ E_2(\neg r), & \text{if } \neg r \in (\neg F_2) \setminus (\neg F_1), \end{cases}$$

Definition 3.14. Let $\xi_1 = (D_1, E_1, F_1)$ and $\xi_2 = (D_2, E_2, F_2)$ are Q-ROFBHSSs on U. Then, the EU of ξ_1 and ξ_2, denoted by $\xi_1 \cup_E \xi_2$, is a Q-ROFBHSS $((D_1 \triangle D_2), (E_1 \diamond E_2), F_1 \cup F_2)$ on U, defined as follows:

$$(D_1 \triangle D_2)(r) = \begin{cases} D_1(r), & \text{if } r \in F_1 \setminus F_2, \\ D_2(r), & \text{if } r \in F_2 \setminus F_1, \\ D_1(r) \cup D_2(r), & \text{if } r \in F_1 \cap F_2, \end{cases}$$

$$(E_1 \diamond E_2)(\neg r) = \begin{cases} E_1(\neg r), & \text{if } \neg r \in (\neg F_1) \setminus (\neg F_2), \\ E_2(\neg r), & \text{if } \neg r \in (\neg F_2) \setminus (\neg F_1), \\ E_1(\neg r) \cap E_2(\neg r), & \text{if } \neg r \in (\neg F_1) \cap (\neg F_2), \end{cases}$$

where $D_1(r) \cup D_2(r) = \{(u, v) \mid u \in D_1(r), v \in D_2(r)\}$.

Definition 3.15. Let $\xi_1 = (D_1, E_1, F_1)$ and $\xi_2 = (D_2, E_2, F_2)$ are Q-ROFBHSSs over U. Then, the RU of ξ_1 and ξ_2, denoted by $\xi_1 \cup_R \xi_2$, is a Q-ROFBHSS $((D_1 \triangle D_2), (E_1 \diamond E_2), F_1 \cap F_2)$ on U, where

$$(D_1 \triangle D_2)(r) = D_1(r) \cup D_2(r) \quad \text{for all } r \in F_1 \cap F_2,$$

$$(E_1 \diamond E_2)(\neg r) = E_1(\neg r) \cap E_2(\neg r) \quad \text{for all } \neg r \in (\neg F_1) \cap (\neg F_2),$$

provided $F_1 \cap F_2 \neq \emptyset$, $(\neg F_1) \cap (\neg F_2) \neq \emptyset$.

Definition 3.16. Let $\xi_1 = (D_1, E_1, F_1)$ and $\xi_2 = (D_2, E_2, F_2)$ be two q-ROFBHSSs over U. Then, the extended intersection of ξ_1 and ξ_2, represented by $\xi_1 \cap_E \xi_2$, is a q-ROFBHSS $((D_1 \triangle D_2), (E_1 \diamond E_2), F_1 \cup F_2)$ on U, defined as follows:

$$(D_1 \triangle D_2)(r) = \begin{cases} D_1(r), & \text{if } r \in F_1 \setminus F_2, \\ D_2(r), & \text{if } r \in F_2 \setminus F_1, \\ D_1(r) \cap D_2(r), & \text{if } r \in F_1 \cap F_2. \end{cases}$$

Figure 5: Graphically Representation of Example 6:

Example 7

Let ξ_2 = (D2, E2, F 2) be a Q-ROFBSS over U , with R2 = {r1, r2, r3} given by Table 10, and ξ_1 = (Q1, S1, R1) be the Q-ROFBSS on the universe U , as considered in Example 4. Then, their extended union $\xi_1 \cup_E \xi_2$ and the extended intersection $\xi_1 \cap_E \xi_2$ are, respectively, displayed in Tables 7 and 8. The tabular arrangements of the restricted intersection and union are provided by Tables 9 and 10.

Table 6: Table for the Q-ROFBHSS (D_2, E_2, F_2).

(D_2, E_2, F_2)	r1	r2	r3
e_1	(0.3, 0.9), (0.5, 0.1)	(0.6, 0.3), (0.4, 0.7)	(0.7, 0.9), (0.3, 0.1)
e_2	(0.5, 0.8), (0.4, 0.2)	(0.9, 0.5), (0.1, 0.5)	(0.5, 0.7), (0.4, 0.2)
e_3	(0.9, 0.8), (0.1, 0.1)	(0.7, 0.7), (0.05, 0.2)	(0.7, 0.7), (0.3, 0.3)
e_4	(0.2, 0.7), (0.8, 0.2)	(0.4, 0.4), (0.6, 0.5)	(0.9, 0.8), (0.1, 0.1)
e_5	(0.5, 0.6), (0.4, 0.4)	(0.3, 0.9), (0.7, 0.1)	(0.8, 0.4), (0.2, 0.5)

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e_6	(0.6, 0.9), (0.25, 0.1)	(0.5, 0.3), (0.4, 0.1)	(0.6, 0.6), (0.4, 0.2)

Table 7: Table for the extended union $\xi 1 \cup E\ \xi 2$

$\xi_1 \cup_E \xi_2$	r1	r2	r3
e_1	(0.5, 0.9), (0.4, 0.1)	(0.7, 0.3), (0.3, 0.7)	(0.7, 0.9), (0.3, 0.1)
e_2	(0.7, 0.8), (0.3, 0.2)	(0.9, 0.5), (0.1, 0.5)	(0.5, 0.7), (0.4, 0.2)
e_3	(0.9, 0.4), (0.1, 0.5)	(0.7, 0.7), (0.05, 0.3)	(0.7, 0.7), (0.3, 0.3)
e_4	(0.5, 0.5), (0.5, 0.4)	(0.4, 0.2), (0.6, 0.7)	(0.9, 0.8), (0.1, 0.1)
e_5	(0.9, 0.6), (0.1, 0.4)	(0.5, 0.8), (0.4, 0.1)	(0.8, 0.4), (0.2, 0.5)
e_6	(1, 0), (0, 1)	(0.5, 0.3), (0.4, 0.4)	(0.6, 0.6), (0.4, 0.2)

Table 8: Table for the extended intersection $\xi 1 \cap E\ \xi 2$

$\xi_1 \cap_E \xi_2$	r1	r2	r3
e_1	(0.3, 0.9), (0.5, 0.1)	(0.6, 0.6), (0.4, 0.4)	(0.7, 0.9), (0.3, 0.1)
e_2	(0.5, 0.8), (0.4, 0.1)	(0.8, 0.7), (0.1, 0.2)	(0.5, 0.7), (0.4, 0.2)
e_3	(0.9, 0.8), (0.1, 0.1)	(0.6, 0.7), (0.4, 0.2)	(0.7, 0.7), (0.3, 0.3)
e_4	(0.2, 0.7), (0.8, 0.2)	(0.1, 0.4), (0.6, 0.5)	(0.9, 0.8), (0.1, 0.1)
e_5	(0.5, 0.9), (0.4, 0.0)	(0.3, 0.9), (0.7, 0.1)	(0.8, 0.4), (0.2, 0.5)
e_6	(0.6, 0.9), (0.25, 1)	(0.4, 0.5), (0.6, 0.1)	(0.6, 0.6), (0.4, 0.2)

Table 9: Table for the restricted union $\xi 1 \cup R\ \xi 2$

$\xi_1 \cup_R \xi_2$	r1	r2
e_1	(0.5, 0.9), (0.4, 0.1)	(0.7, 0.3), (0.3, 0.7)
e_2	(0.7, 0.8), (0.3, 0.2)	(0.9, 0.5), (0.1, 0.5)
e_3	(0.9, 0.4), (0.1, 0.5)	(0.7, 0.7), (0.05, 0.3)
e_4	(0.5, 0.5), (0.5, 0.4)	(0.4, 0.2), (0.6, 0.7)
e_5	(0.9, 0.6), (0.1, 0.4)	(0.5, 0.8), (0.4, 0.1)
e_6	(1, 0), (0, 1)	(0.5, 0.3), (0.4, 0.4)

Table 10: Table for the restricted intersection $\xi 1 \cap R\ \xi 2$

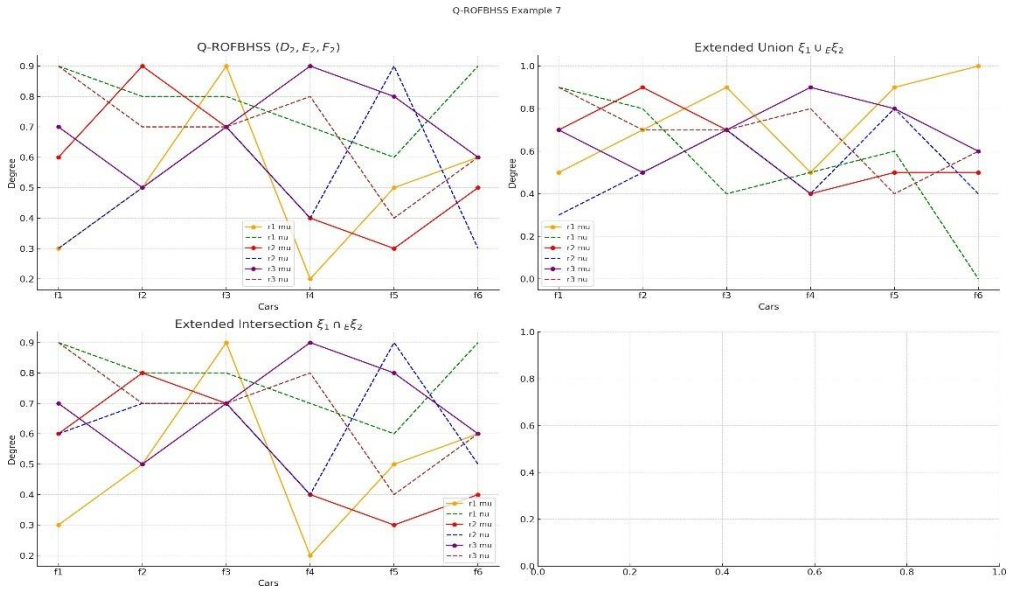
$\xi_1 \cap_R \xi_2$	r1	r2
	(0.3, 0.9), (0.5, 0.1)	(0.6, 0.6), (0.4, 0.4)
e_1	(0.5, 0.8), (0.4, 0.1)	(0.8, 0.7), (0.1, 0.2)
e_2	(0.9, 0.8), (0.1, 0.1)	(0.6, 0.7), (0.4, 0.2)
e_3	(0.2, 0.7), (0.8, 0.2)	(0.1, 0.4), (0.6, 0.5)
e_4	(0.5, 0.9), (0.4, 0.0)	(0.3, 0.9), (0.7, 0.1)
e_5	(0.6, 0.9), (0.25, 1)	(0.4, 0.5), (0.6, 0.1)
e_6		

Figure 6: Graphically Representation of Example 7:

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Top Left Plot: Membership (μ) and non-membership (ν) degrees for parameters r_1 (less weight), r_2 (high engine power), and r_3 (large size) across the six cars for (D_2, E_2, F_2).
Solid lines with circles represent the membership degrees. Dashed lines with crosses represent the non-membership degrees.

Top Right Plot: Membership (μ) and non-membership (ν) degrees for the extended union $\xi_1 \cup_E \xi_2$ across the six cars for parameters r_1, r_2, and r_3.
Solid lines with circles represent the membership degrees. Dashed lines with crosses represent the non-membership degrees.

Bottom Left Plot: Membership (μ) and non-membership (ν) degrees for the extended intersection $\xi_1 \cap_E \xi_2$ across the six cars for parameters r_1, r_2, and r_3

Solid lines with circles represent the membership degrees. Dashed lines with crosses represent the non-membership degrees.
The x-axis represents the different cars (f_1, f_2, . . . , f_6), and the y-axis represents the degree values. Different colors are used to differentiate the parameters.Lemma

Let $\Theta_1 = (D_1, E_1, F_1)$ and $\Theta_2 = (D_2, E_2, F_2)$ be two Q-ROFBHSSs on a universe U. Then:

1. $\Re_1 \cup_E \Re_2$ is the largest q-ROFBHSS over U which encompasses both $\Re_1$ and $\Re_2$.

2. $\Re_1 \cap_R \Re_2$ is the smallest q-ROFBHSS over U that is contained within both $\Re_1$ and $\Re_2$.

Proof. The proof is straightforward and follows directly from the definitions. □

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Theorem

Let $\mathfrak{R}_1 = (D_1, E_1, F_1)$ and $\mathfrak{R}_2 = (D_2, E_2, F_2)$ be two q-ROFBHSSs on the universe U. Then:

1. $(\mathfrak{R}_1 \cup_E \mathfrak{R}_2)^c = (\mathfrak{R}_1)^c \cap_E (\mathfrak{R}_2)^c$,
2. $(\mathfrak{R}_1 \cap_E \mathfrak{R}_2)^c = (\mathfrak{R}_1)^c \cup_E (\mathfrak{R}_2)^c$,
3. $(\mathfrak{R}_1 \cup_R \mathfrak{R}_2)^c = (\mathfrak{R}_1)^c \cap_R (\mathfrak{R}_2)^c$,
4. $(\mathfrak{R}_1 \cap_R \mathfrak{R}_2)^c = (\mathfrak{R}_1)^c \cup_R (\mathfrak{R}_2)^c$.

Proof. 1. By Definitions 10 and 15, we obtain $(\Re_1 \cup_E \Re_2)^c = ((D_1 \oplus D_2)^c, (E_1 \oplus E_2)^c, F_1 \cup F_2)$, where

$$(D_1 \oplus D_2)^c(r) = \begin{cases} D_1^c(r), & \text{if } r \in F_1 - F_2, \\ D_2^c(r), & \text{if } r \in F_2 - F_1, \\ D_1^c(r) \cap D_2^c(r), & \text{if } r \in F_1 \cap F_2 \end{cases} = (D_1^c \oplus D_2^c)(r) \quad \text{(by Definition 17)},$$

and

$$(E_1 \oplus E_2)^c(\neg r) = \begin{cases} E_1^c(\neg r), & \text{if } \neg r \in (\neg F_1) - (\neg F_2), \\ E_2^c(\neg r), & \text{if } \neg r \in (\neg F_2) - (\neg F_1), \\ E_1^c(\neg r) \cup E_2^c(\neg r), & \text{if } \neg r \in (\neg F_1) \cap (\neg F_2) \end{cases} = (E_1^c \oplus E_2^c)(\neg r) \quad \text{(by Definition 17)}.$$

Hence, $(\mathfrak{R}_1 \cup_E \mathfrak{R}_2)^c = (\mathfrak{R}_1)^c \cap_E (\mathfrak{R}_2)^c$.

2. The proof for $(\mathfrak{R}_1 \cap_E \mathfrak{R}_2)^c = (\mathfrak{R}_1)^c \cup_E (\mathfrak{R}_2)^c$ follows similarly by applying Definitions 10 and 15.
3. The proof for $(\mathfrak{R}_1 \cup_R \mathfrak{R}_2)^c = (\mathfrak{R}_1)^c \cap_R (\mathfrak{R}_2)^c$ follows similarly by applying Definitions 10 and 16.
4. The proof for $(\mathfrak{R}_1 \cap_R \mathfrak{R}_2)^c = (\mathfrak{R}_1)^c \cup_R (\mathfrak{R}_2)^c$ follows similarly by applying Definitions 10 and 16.

□

So, that's the some examples and lemma to handling the uncertainty and complexity in chicken-pox.

Conclusion

In summary, the integration of q-Rung Orthopair Fuzzy Sets, bipolar fuzzy sets, and hypersoft sets into a single diagnostic framework represents a significant advancement in the field of medical diagnosis. The q-ROFBHSS framework offers a powerful tool for handling the uncertainty and complexity inherent in diagnosing diseases like chickenpox. Future research should focus on the practical implementation and validation of this framework in clinical settings, as well as exploring its potential applications in diagnosing other infectious diseases. Furthermore , the size of the soft matrix changes according by taking suitable bits of message and can also do the operation in the rows instead the columns.

FUTURE GUIDES

Extension to Other Diseases: Adapt the framework for diagnosing other diseases with similar symptoms, such as measles and rubella.

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Machine Learning Integration: Enhance diagnostic accuracy by com- bining the fuzzy framework with machine learning algorithms for auto- mated and real-time diagnosis.

Advanced Data Collection: Incorporate electronic health records, wear- able devices, and patient-reported outcomes to enrich the dataset and improve precision.

Clinical Trials: Perform large scaled clinical trials to confirm the use of the model and to compare it with current approaches in various contexts.

Decision Support Systems: Use the fuzzy framework to create decision support systems that will help the care givers make better decisions.

Interdisciplinary Applications: Explore the framework's utility in other fields, such as finance and engineering, to solve complex problems.

Real-time Monitoring: Implement real-time health monitoring systems for continuous assessment and early warning of diseases.

Patient-Centric Approaches: Personalize the diagnostic model by in- corporating patient preferences and feedback into the process.

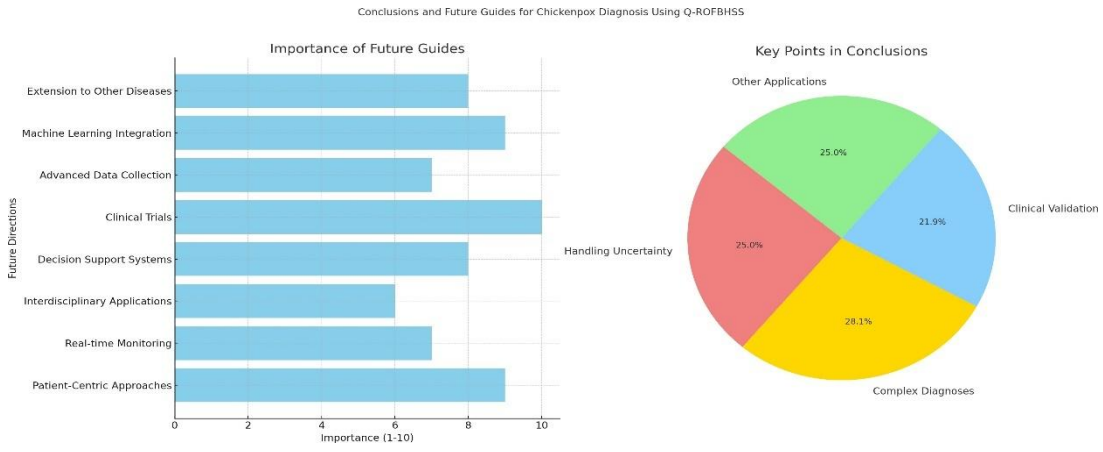


Figure 7: Importance of Future Guides and Key Points in Conclusion

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