Neutrosophic Sets and Systems {Special Issue: Neutrosophic Advancements And Their Impact on Research in Latin America}, Vol. 62, 2023

University of New Mexico

Evaluation of the Quality of Care in Nursing Homes

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Abstract. The purpose of this research was to use neutrosophic logic as an approach to evaluate the quality of nursing care in a nursing home in the city of Puyo, Ecuador. To achieve this objective, the AHP method was used in its neutrosophic modality, using trapezoidal neutrosophic numbers for the selection of a set of criteria of interest that would later be subjected to evaluation by experts in the field. During the analysis, the critical importance of certain aspects such as patient safety, resident and family satisfaction, and other specific factors were emphasized as fundamental components to be considered when looking for indicators that contribute to improving the quality of the services provided in this nursing home. The incorporation of neutrosophy and neutrosophic numbers in the evaluation of medical quality in the context of elderly care provided a comprehensive and accurate approach, taking into account the intricate nature and subjectivity that characterize this area of study.

Keywords: neutrosophic logic, quality, nursing, nursing home, NAHP, neutrosophic trapezoidal number

1 Introduction

Increased longevity is a remarkable achievement of modern medicine and public health. However, this achievement comes with significant long-term challenges. In a scientific context, these implications lie primarily in the growing proportion of older people in the world's population due to the demographic transition, a phenomenon that has manifested itself in recent decades.

The evaluation of the quality of nursing care in nursing homes represents a topic of deep interest in the scientific and public health field. As the world's population ages, the demand for specialized aged care becomes increasingly critical. In this context, nursing homes play an essential role in the long-term care of this vulnerable population. The quality of nursing care in these facilities takes on primary value, as it directly affects the well-being, safety, and quality of life of the residents.

Nursing care in nursing homes is characterized by complexity, as patients often present with a variety of medical, physical, cognitive, and emotional needs. The quality of care in these residences is closely related to the promotion of autonomy, quality of life, and psychological well-being of residents. Scientific studies have shown that a high-quality care environment contributes to patient satisfaction and a better quality of life while decreasing symptoms of depression and anxiety. Patient-centered care and individualization of care are fundamental pillars of care in nursing homes, and these practices have proven to be essential to promoting healthy aging.

As such, an effective decision-making process is essential to ensure that elderly patients receive appropriate care. Nursing professionals often must deal with a wide range of clinical and management situations in their daily work, from administering medications to managing complex medical cases. Proper decision-making requires an accurate assessment of the patient's condition, consideration of best clinical practices, and adaptation to the individual needs of each resident.[1]

To evaluate and improve the quality of nursing care in nursing homes, a robust, evidence-based decision-making process is essential. Neutrosophic decision-making has become a relevant approach in this context, as it addresses the complex and multidimensional nature of healthcare in almost any setting. The use of neutrosophic assessment in nursing care allows for consideration of the uncertainty and ambiguity inherent in clinical decisions

[2], which is common in the care of elderly patients with varied and often changing needs.

Neutrosophic assessment provides a framework to quantify the quality of nursing care in nursing homes more accurately, taking into account not only quantitative aspects but also qualitative and subjective aspects. This makes it possible to evaluate factors of various kinds through the use of neutrosophic systems.[3-18]. Additionally, neutrosophic assessment offers the ability to identify areas for improvement and adapt care based on residents' changing needs over time.[4]

Neutrosophic logic was proposed by mathematician and philosopher Florentin Smarandache in the 1990s. This theory represents an innovative approach to addressing complex situations involving uncertainty, ambiguity, and contradictory data. Unlike conventional fuzzy logic, which focuses primarily on uncertainty, neutrosophic logic incorporates three fundamental elements: true, false, and neutral. This extension allows uncertainty to be represented in a broader sense, which is especially relevant in situations in which information is incomplete or even conflicting.[5]

Over the years, the application of neutrosophic logic has spread to various fields, including artificial intelligence [6], decision-making, and risk management in multifaceted and complex scenarios. In the agricultural industry, for example, neutrosophic sets have been used to deal with uncertain data in the analysis and selection of optimal criteria for smart agriculture [7]. In risk management and the evaluation of investment projects, it has been widely used for decision-making in environments where the available information is usually partial and contradictory.[8]

In the field of science, its potential lies in the ability to model and analyze deep uncertainty, allowing professionals to make more informed decisions in complex and multifaceted contexts. In this sense, neutrosophic logic has found various applications in fields such as biomedicine [9], psychology [10], and education [11], environments where decision-making is often affected by incomplete or inconsistent data.

One of the fields where the application of neutrosophic logic stands out with special relevance is medicine. Decision-making in the medical setting is inherently complex due to the multifaceted nature of health conditions, variability in patient responses, and uncertainty in clinical data. Neutrosophic logic allows healthcare professionals to address ambiguity and uncertainty in treatment evaluation [12], the diagnosis of diseases [13] and clinical decision-making [14].

In line with the previous information, the present study focuses on the use of neutrosophic logic as a means to evaluate the quality of nursing care in a nursing home in the city of Puyo, Ecuador. The choice to use neutrosophic logic as part of the methodological approach to quality assessment is based on its ability to model and analyze uncertainty and ambiguity in data and perceptions. Given the diversity of factors that impact the satisfaction of residents and their families in a nursing home, neutrosophic logic provides an appropriate perspective to address the multidimensionality of this evaluation.

This study aims to contribute to the understanding of the factors that influence the satisfaction of residents and their families, and ultimately to improving the quality of care in nursing homes. Neutrosophic logic stands as a key tool in this process, allowing a more precise and nuanced evaluation in a context where uncertainty and ambiguity are recurrent elements.

2 Preliminaries

In this section, the fundamental meanings related to the neutrosophic set, single-valued neutrosophic sets, trapezoidal neutrosophic numbers, and the operations performed on trapezoidal neutrosophic numbers are established.

Definition 1. [15] introduces the concept of a neutrosophic set A within the space of points X, denoted as $x \in X$. This neutrosophic set is characterized by three distinct components: a truth-membership function $T_A(x)$, an indeterminacy-membership function $I_A(x)$, and a falsity-membership function $F_A(x)$. Each of these functions, namely $T_A(x)$, $I_A(x)$, and $F_A(x)$, maps to real standard or real nonstandard subsets of the interval $[-0, 1+]$, indicating that $T_A(x)$ $(x){:}\, X \rightarrow [-0, 1+]$, $I_A(x)$ $(x){:}\, X \rightarrow [-0, 1+]$, and $F_A(x)$ $(x){:}\, X \rightarrow [-0, 1+]$. It is important to note that there are no specific constraints imposed on the sum of $T_A(x)$, $I_A(x)$, and $F_A(x)$, allowing for flexibility in their values. In other words, the condition $0- \leq sup\, T_A(x) + sup\, I_A(x) + sup\, F_A(x) \leq 3+$ holds true.

Definition 2. Consider a universe of discourse X. A single-valued neutrosophic set A over X can be defined as an entity expressed in the format $A = \{\langle x, T_A(x), I_A(x), F_A(x)\rangle : x \in X\}$ where the following conditions apply:

- $T_A(x){:}\, X \rightarrow [0, 1]$
- $I_A(x){:}\, X \rightarrow [0, 1]$
- $F_A(x) : X \rightarrow [0, 1]$

Additionally, it is essential to note that $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$ holds true for all $x \in X$. These intervals, namely $T_A(x)$, $I_A(x)$, and $F_A(x)$, signify the degrees of truth-membership, indeterminacy-membership, and falsity-membership of x with respect to the set A, respectively.

For the sake of convenience, a single-valued neutrosophic number (SVNN) can be denoted as A = (a, b, c), where a, b, and c belong to the interval [0, 1], and their sum adheres to the condition $a + b + c \leq 3$.

Definition 3: Consider three values $\tilde{\alpha}, \tilde{\alpha}, \tilde{\alpha} \in [0,1]$, along with four values $a_1, a_2, a_3, a_4 \in \mathbb{R}$, where $a_1 \leq a_2 \leq a_3 \leq a_4$. In such a scenario, a single-valued trapezoidal neutrosophic number denoted as $\tilde{a} = \langle (a_1, a_2. a_3, a_4); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$, represents a specific neutrosophic set defined on the set of real numbers, R. This set's truth-membership, indeterminacy-membership, and falsity-membership functions are described as follows:

$$T_{\tilde{a}}(x) = \begin{cases} \alpha_{\tilde{a}} \left(\frac{x-a_1}{a_2-a_1}\right), a_1 \leq x \leq a_2 \\ \alpha_{\tilde{a}}, \quad a_2 \leq x \leq a_3 \\ \alpha_{\tilde{a}} \left(\frac{a_3-x}{a_3-a_2}\right), a_3 \leq x \leq a_4 \\ 0, \quad otherwise \end{cases} \tag{1}$$

$$I_{\tilde{a}}(x) = \begin{cases} \frac{(a_2-x+\beta_{\tilde{a}}(x-a_1))}{a_2-a_1}, \quad a_1 \leq x \leq a_2 \\ \beta_{\tilde{a}}, \quad a_2 \leq x \leq a_3 \\ \frac{(x-a_2+\beta_{\tilde{a}}(a_3-x))}{a_3-a_2}, \quad a_3 \leq x \leq a_4 \\ 1, \quad otherwise \end{cases} \tag{2}$$

$$F_{\tilde{a}}(x) = \begin{cases} \frac{(a_2-x+\gamma_{\tilde{a}}(x-a_1))}{a_2-a_1}, \quad a_1 \leq x \leq a_2 \\ \gamma_{\tilde{a}}, \quad a_2 \leq x \leq a_3 \\ \frac{(x-a_2+\gamma_{\tilde{a}}(a_3-x))}{a_3-a_2}, \quad a_3 \leq x \leq a_4 \\ 1, \quad otherwise \end{cases} \tag{3}$$

where $\alpha\tilde{a}$, $\beta\tilde{a}$, and $\gamma\tilde{a}$ represent the maximum truth-membership degree, minimum indeterminacy-membership degree, and minimum falsity-membership degree, respectively.

Definition 4: Consider two single-valued trapezoidal neutrosophic numbers, $\tilde{a} = \langle (a_1, a_2, a_3, a_4);\ \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$ and $\tilde{b} = \langle (b_1, b_2, b_3, b_4);\ \alpha_{\tilde{b}}, \beta_{\tilde{b}}, \gamma_{\tilde{b}} \rangle$, as well as any non-null number on the real number line, denoted as λ. In this context, a set of defined operations is introduced as follows:

1. Addition: $\tilde{a} + \tilde{b} = \langle (a_1 + b_1, a_2 + b_2, a_3 + b_3, a_4 + b_4); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle$ (4)
2. Subtraction: $\tilde{a} - \tilde{b} = \langle (a_1 - b_4, a_2 - b_3, a_3 - b_2, a_4 - b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle$ (5)
3. Inversion: $\tilde{a}^{-1} = \langle ({a_4}^{-1}, {a_3}^{-1}, {a_2}^{-1}, {a_1}^{-1}); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$, where $a_1, a_2, a_3, a_4 \neq 0$. (6)
4. Multiplication by a scalar number: $\lambda\tilde{a} = \begin{cases} \langle (\lambda a_1, \lambda a_2, \lambda a_3, \lambda a_4); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle, & \lambda > 0 \\ \langle (\lambda a_4, \lambda a_3, \lambda a_2, \lambda a_1); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle, & \lambda < 0 \end{cases}$ (7)

2.2 Methodology

Section 2.2 of the study introduces the concept of the Neutrosophic Analytical Hierarchical Process (Neutrosophic AHP or NAHP) and provides a framework for its application. The Neutrosophic AHP is an extension of the Analytical Hierarchical Process (AHP) proposed by Thomas Saaty in 1980. AHP is a decision-making technique that structurally organizes complex problems into a hierarchical format, allowing for a systematic evaluation of decision criteria and alternatives. In the Neutrosophic AHP, a set of linguistic scales is utilized for the representation of factors, sub-factors, and strategies involved in the decision-making process. These scales are defined based on expert opinions and are aligned with the neutrosophic framework [16-20-21-22]. The neutrosophic pair-wise comparison matrix is established following these scales, allowing experts to evaluate the relationships between factors and sub-factors. Consistency in expert judgments is an essential consideration in the Neutrosophic AHP. A pair-wise comparison matrix is considered consistent when it maintains a transitive relation, ensuring that the lower, median, and upper values of triangular neutrosophic numbers within the matrix are consistent. The weight of factors is calculated by transforming the neutrosophic pair-wise comparison matrix into a deterministic matrix. The result is a deterministic matrix that represents the importance or weight of each factor.

The ranking of priorities is determined based on the Eigenvector X, which is derived from the deterministic matrix. This involves normalizing column entries and calculating the total of row averages, providing a clear understanding of the factors' importance. Consistency checks, by considering the Consistency Index (CI), help assess the reliability of expert evaluations. A formula that involves the maximum eigenvalue (λ_{max}) d, the order of the matrix (n) is used to calculate the CI. If the Consistency Ratio (CR) is less than or equal to 0.1, it is considered that expert evaluations are sufficiently consistent, allowing for the application of NAHP. For reviewing the whole methodology see [17-19].

2.3 Study Methodology

The present study focuses on establishing the parameters for evaluating the quality of nursing care in a nursing home located in the city of Puyo, Ecuador. To conduct this evaluation, a methodology was employed involving the participation of three experts in the field of nursing care and decision-making. Through a collaborative process, the Idea Generation and Consensus technique was applied to identify and define the fundamental criteria for assessing the quality of care in the nursing home. The analysis resulting from this technique yielded a set of criteria and sub-criteria for evaluation that were considered highly relevant to nursing care in the nursing home. The selected criteria, which will serve as a guide for measuring the quality of nursing care, are broken down as follows:

Criterion 1: Competence of Nursing Staff
- Subcriterion 1.1: Evaluation of Qualifications and Training of Nurses.
- Subcriterion 1.2: Evaluation of Perceived Experience in Elderly Care.
- Subcriterion 1.3: Evaluation of Participation in Continuous Training Programs.

Criterion 2: Personalized Care Planning
- Subcriterion 2.1: Evaluation of the Development of Individualized Care Plans.
- Subcriterion 2.2: Evaluation of Recording and Monitoring of Provided Care.

Criterion 3: Patient Safety
- Subcriterion 3.1: Evaluation of the Implementation of Measures to Prevent Falls and Injuries.
- Subcriterion 3.2: Evaluation of the Safe Administration of Medications.
- Subcriterion 3.3: Evaluation of Response Protocols for Emergency Situations.
- Subcriterion 3.4: Evaluation of Infection Prevention in the Care Environment.

Criterion 4: Communication and Interpersonal Relations
- Subcriterion 4.1: Evaluation of Effective Communication with Residents and their Families.
- Subcriterion 4.2: Evaluation of Respect and Empathy in Interactions with Residents.
- Subcriterion 4.3: Evaluation of Encouraging Resident Participation in Decision-Making.
- Subcriterion 4.4: Evaluation of Effective Communication with Other Professionals for Comprehensive Patient Care.

Criterion 5: Living Conditions and Resident Well-being
- Subcriterion 5.1: Evaluation of Food Quality and Nutrition.
- Subcriterion 5.2: Evaluation of Comfort and Cleanliness of Facilities.
- Subcriterion 5.3: Evaluation of Recreational and Social Activities Programs.

Criterion 6: Dignity and Respect
- Subcriterion 6.1: Evaluation of the Quality and Satisfaction Level with the Treatment Provided to Residents and Families.
- Subcriterion 6.2: Evaluation of the Implementation of Activities Promoting Resident Autonomy.
- Subcriterion 6.3: Evaluation of Privacy Respect During Daily Activities.
- Subcriterion 6.4: Evaluation of Privacy Respect for Patients and Families During Visits and Common Activities.

Criterion 7: Resident and Family Satisfaction
- Subcriterion 7.1: Evaluation of Service and Activity Accessibility.
- Subcriterion 7.2: Evaluation of Staff Availability.
- Subcriterion 7.3: Evaluation of Quality of Life in the Residence.
- Subcriterion 7.4: Evaluation of Resource Availability.

These criteria and subcriteria, selected following a collaborative analysis with experts, constitute the foundation for evaluating the quality of nursing care in the nursing home. The application of the Neutrosophic AHP Method will enable the assessment and prioritization of these criteria based on their importance and attractiveness, providing a systematic and scientific approach to decision-making in the field of elderly care nursing.

3 Results

To assess the quality of nursing care in the nursing home, the Neutrosophic AHP Method was applied to the criteria and subcriteria defined in the methodology. Through a weighting and evaluation process by experts, the relative importance of each criterion and subcriterion in the quality of nursing care was determined. For this purpose, the linguistic variable evaluation scale proposed by Saaty and described in [16] was used. Each of the groups and subcriteria was assessed by each expert to obtain matrices as shown in Table 1.

Table 1: Criteria evaluation matrix, according to Expert 1.

	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7
Criterion 1	$\tilde{1}$	$\tilde{1}$	$1/\tilde{3}$	$\tilde{1}$	$1/\tilde{3}$	$\tilde{1}$	$1/\tilde{3}$
Criterion 2	$\tilde{1}$	$\tilde{1}$	$1/\tilde{3}$	$\tilde{1}$	$\tilde{1}$	$\tilde{1}$	$1/\tilde{3}$
Criterion 3	$\tilde{3}$	$\tilde{3}$	$\tilde{1}$	$\tilde{3}$	$\tilde{1}$	$\tilde{3}$	$\tilde{1}$
Criterion 4	$\tilde{1}$	$\tilde{1}$	$1/\tilde{3}$	$\tilde{1}$	$1/\tilde{3}$	$1/\tilde{3}$	$1/\tilde{5}$
Criterion 5	3	$\tilde{1}$	$\tilde{1}$	$\tilde{3}$	$\tilde{1}$	$1/\tilde{3}$	$\tilde{1}$
Criterion 6	$\tilde{1}$	$\tilde{1}$	$1/\tilde{3}$	$\tilde{3}$	$\tilde{3}$	$\tilde{1}$	$\tilde{1}$
Criterion 7	$\tilde{3}$	$\tilde{3}$	$\tilde{1}$	$\tilde{5}$	$\tilde{1}$	$\tilde{1}$	$\tilde{1}$

Taking into account the average values of the evaluations, a weight vector was derived for each of the criteria and subcriteria. This methodology allowed for quantifying the contribution or importance of each subcriterion in the context of the evaluated system. The results of this process are summarized in Table 2.

This weight calculation strategy is crucial in decision-making as it provides a quantitative basis for identifying which of the subcriteria have a greater impact on the evaluated system. This information is essential for directing efforts and resources to specific areas that require improvement or prioritized interventions, thus maximizing the effectiveness of decisions and actions taken in the context of nursing care in the nursing home.

Table 2: General evaluation matrix of the analyzed criteria and sub-criteria.

Criteria and Subcriteria	**Relative importance**	**Contribution to the general system**
Nursing Staff Competence		**0.09**
Evaluation of the Qualification and Training of Nurses	0.325	0.028
Elderly Care Experience Evaluation	0.590	0.051
Evaluation of Participation in Continuing Training Programs	0.085	0.007
Personalized Care Planning		**0.0967**
Evaluation of the Development of Individualized Care Plans	0.500	0.048
Evaluation of the Registry and Monitoring of the Care Provided	0.500	0.048
Patient safety		**0.2208**
Evaluation of the Implementation of Measures to Prevent Falls and Injuries	0.116	0.026
Assessment of Safe Medication Administration	0.144	0.032
Evaluation of Response Protocols in Emergency Situations.	0.468	0.103
Evaluation of Infection Prevention in the Care Environment	0.272	0.060
Communication and Interpersonal Relationships		**0.0685**
Effective Communication with Residents and Their Families	0.091	0.006
Respect and Empathy in Interactions with Residents	0.217	0.015
Promoting Resident Participation in Decision Making	0.518	0.036
Effective Communication with Other Professionals	0.174	0.012
Living Conditions and Wellbeing of Residents		**0.1543**
Food Quality and Nutrition	0.590	0.091
of the Comfort and Cleanliness of the Facilities	0.325	0.050
Recreational and Social Activities Programs	0.085	0.013
Dignity and Respect		**0.1598**
Quality and Satisfaction with the Treatment Provided to Residents and Family Members	0.178	0.028
Autonomy of Residents	0.466	0.074
Respect for Patient Privacy	0.178	0.028
Privacy of Patients and Families During Visits and Common Activities.	0.178	0.028
Resident and Family Satisfaction		**0.2141**
Accessibility of Services and Activities	0.294	0.063
Personnel Availability.	0.196	0.042
Quality of Life in the Residence	0.351	0.075
Resource Availability	0.159	0.034

The conducted analysis has helped identify the most relevant criteria in the context of evaluating the quality of nursing care services in the assessed nursing home. In this regard, patient safety and resident and family satisfaction stand out as the most prominent criteria in terms of importance, as perceived by the experts. These results indicate the significant importance attached to patient safety and resident and family satisfaction in the nursing care assessment process within the nursing home.

A comprehensive analysis of all evaluated variables that influence the system revealed that the evaluation of emergency response protocols, the assessment of infection prevention in the care environment, the quality of food and nutrition, resident autonomy, accessibility of services and activities, as well as the quality of life in the nursing home, are elements of paramount importance from the experts' perspective. These findings highlight the need for a detailed evaluation of these aspects to obtain clear indicators that allow for measuring and improving the quality of the service provided in the nursing home.

Based on the obtained results, a pilot interview was conducted on 10 residents and 10 family members associated with these residents. Each of them was asked to complete the provided form, taking into account the assessments they perceived as correct considering each of the previously selected criteria. These assessments are associated with neutrosophic numbers so that the level of certainty, falsity, and indeterminacy of each evaluation can be evaluated. Using the related operations, the following summary table was obtained.

Table 3: Average evaluations obtained by residents and family members.

Evaluated Aspects	Residents (Average)	Relatives (Average)
Evaluation of Response Protocols in Emergency Situations	⟨(0.2, 0.4, 0.6, 0.7); 0.8, 0.1, 0.1⟩	⟨(0.3, 0.5, 0.6, 0.8); 0.6, 0.2, 0.2⟩
Evaluation of Infection Prevention in the Care Environment	⟨(0.1, 0.3, 0.4, 0.6); 0.9, 0.05, 0.05⟩	⟨(0.2, 0.4, 0.5, 0.7); 0.7, 0.15, 0.15⟩
Food Quality and Nutrition	⟨(0.4, 0.6, 0.7, 0.9); 0.6, 0.2, 0.2⟩	⟨(0.5, 0.7, 0.8, 0.9); 0.5, 0.3, 0.2⟩
Resident Autonomy	⟨(0.1, 0.3, 0.4, 0.6); 0.9, 0.05, 0.05⟩	⟨(0.2, 0.4, 0.5, 0.7); 0.7, 0.15, 0.15⟩
Accessibility of Services and Activities	⟨(0.2, 0.4, 0.6, 0.7); 0.8, 0.1, 0.1⟩	⟨(0.3, 0.5, 0.6, 0.8); 0.6, 0.2, 0.2⟩
Quality of Life in the Residence	⟨(0.4, 0.6, 0.7, 0.9); 0.6, 0.2, 0.2⟩	⟨(0.5, 0.7, 0.8, 0.9); 0.5, 0.3, 0.2⟩

In the context of evaluating the quality of care in the nursing home, trapezoidal neutrosophic numbers have been employed to represent the assessments made by residents and family members. Specifically, the evaluation of food and nutrition quality shows differences in the perceptions of residents and family members. Residents assign a relatively high degree of truth, indicating a reasonable perception in this regard, but with some ambiguity in their assessments. On the other hand, family members assign a slightly higher degree of truth, suggesting a more positive perception, although with greater variability in opinions.

Patient safety, assessed through emergency protocols and infection prevention, receives reasonable evaluations from both residents and family members. However, the indeterminacy is significant, reflecting uncertainty and variability in perceptions. This highlights the importance of addressing these aspects more effectively to ensure resident safety.

Resident autonomy is an aspect that receives high degrees of truth from both residents and family members, indicating a positive perception in this area. However, the high indeterminacy emphasizes the variability in opinions, suggesting that some residents may feel more autonomous than others.

4 Discussion

The use of neutrosophy, particularly neutrosophic numbers, contributes significantly to the field of medical quality assessment in contexts related to the care of the elderly. This approach is particularly relevant in a context where subjectivity, uncertainty, and variability in perceptions are inherent factors. By incorporating neutrosophic numbers into the assessment, a more precise representation of the opinions of residents, family members, and healthcare professionals can be obtained, effectively addressing ambiguity and doubt in their assessments.

Medical care in nursing homes is characterized by being multidimensional and complex, involving multiple factors and agents. The use of neutrosophic logic in this aspect provides a tool that reflects the richness of opinions and perspectives in this environment. The evaluation of medical quality in elderly care settings requires continuous adaptability as the needs of residents evolve. Neutrosophic numbers offer the necessary flexibility to reflect changes in perceptions over time and adjust strategies accordingly. Additionally, by considering not only the degree of truth but also the degree of indeterminacy and falsity in assessments, the complexity of medical care is recognized, and inherent uncertainty is captured.

In this context, the evaluation of medical quality is not limited to rigid quantitative metrics. Instead, it opens up to understanding nuances, contexts, and the experiences of those involved. Neutrosophic numbers allow for weighing perceptions, identifying areas of consensus and disagreement, and ultimately guiding decision-making to improve the care of elderly residents.

Conclusion

The study conducted in the nursing home in the city of Puyo, Ecuador, has validated the utility of neutrosophic logic as an effective approach to evaluating the quality of nursing care. The application of the neutrosophic version of the AHP method has provided valuable guidance in identifying the criteria and elements of utmost relevance in the evaluation of nursing care. The critical importance of patient safety, the satisfaction of both residents and their families, and other specific factors have been highlighted as fundamental areas in the search for indicators to improve the quality of services in this nursing home.

The inclusion of neutrosophy and neutrosophic numbers in the assessment of medical quality in elderly care settings has provided a comprehensive and precise approach, considering the intricate nature and subjectivity that characterizes this area of study. Furthermore, the analysis conducted in this study equips healthcare professionals, administrators, and family members with a deeper understanding of residents' perceptions, enabling them to make informed decisions aimed at optimizing care and the quality of life in this elderly care institution.

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Received: October 29, 2023. **Accepted:** December 18, 2023