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Neutrosophic Nursing Workflow Optimization

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Abstract. The current nursing situation in Ecuador is characterized by complex challenges that affect health care throughout the country. The uneven geographic distribution of nurses, quality of training, and staff retention are critical areas requiring attention. Therefore, this study focused on analyzing the optimization of the nursing workflow in Ecuador from a neutrosophic perspective, which considers the indeterminacy of the existing elements. The results revealed the need for an automated system for optimizing nursing workflow based on the diversity of local conditions and needs. In conclusion, it was seen that patient retention policies and the training of health personnel are fundamental, but their impact varies depending on the region analyzed. This neutrosophic approach highlights the complexity and need for adaptation in the management and optimization of nursing workflow in Ecuador.

Keywords: Neutrosophy, nursing, healthcare environment, workflow optimization.

1 Introduction

A workflow is the sequence of processes that must be followed to complete a certain part of the process. Workflow is therefore an understanding of the procedures and processes necessary for each area to function [1]. This study is focused on optimizing workflow in the field of nursing [2], which constitutes a crucial issue in guaranteeing quality care in the Ecuadorian health system. Similarly, Ecuador, like many other countries, faces significant challenges in nursing resource management and in improving the efficiency of its healthcare services [3]. When analyzing the current nursing situation, different regions can be identified where the level of nursing professionals varies within the country. Among these, the following can be mentioned:

- Decrease in Nurses in Rural Areas: In various rural areas of Ecuador, there are few nursing professionals. Economic conditions, a lack of healthcare infrastructure, and limitations in employment opportunities in these regions have led to a decrease in nursing professionals. The neutrosophic analysis defines the indeterminacy of how effective government policies and programs aimed at addressing the nursing shortage in rural areas are.
- Increase in nursing professionals in urban areas: In Ecuador, especially hospitals in large cities, there is an increasing concentration of nurses, due to a greater job offer and the attraction of better-equipped health centers. So, the indeterminacy of this criterion shows how ineffective the policies aimed at redistributing nursing professionals are. Therefore, there is an imbalance between urban and rural areas regarding workload management in health centers in Ecuador.

Another point to highlight is the training of nurses in Ecuador [4]. Currently, education and training present significant challenges regarding the quality of nursing education. As well as its influence on the optimization of nursing workflow. Therefore, there are nursing education institutions in Ecuador that offer high-quality programs with adequate training standards [5]. These programs produce competent and well-prepared nursing professionals in urban areas, while in rural regions preparation is difficult due to the scarcity of resources. It should be noted that in rural areas there are some nursing programs, although they may lack resources, qualified personnel, or updated curricular structures.

Another point of interest suggests that the quality of nursing education directly influences the improvement of health care and in turn affects the workflow [6, 14]. An example of this is well-trained nurses who provide safer and more effective care with workflow optimization, which reduces errors and achieves greater patient satisfaction [7].

Establishing workflows is essential to optimize the performance of nursing professionals. The workflow, in

short, allows for the establishment of all the necessary resources and the processes that must be followed to achieve a certain goal. Consequently, the quality of initial education can influence the need for continuous training. If initial training is poor, nursing professionals may require more training to be effective in the workplace, affecting workflow and resource optimization [8, 15]. In summary, indeterminacy is observed in the workflow and the distribution of nursing professionals on the following elements:

- The effectiveness of evaluation policies and systems.
- The quality of nursing education and training.
- The lack of health infrastructure, low remuneration, and lack of job opportunities.
- Work overload in urban areas leads to a decrease in the quality of care due to staff exhaustion.

In summary, the application of neutrosophy in the evaluation of the current situation of nursing professionals in Ecuador reveals that there is a truth in the decrease of nurses in rural areas. Therefore, it is necessary to develop strategies to optimize the nursing workflow in the country. With this, the aim is to include the integration of indeterminacies in the solutions to obtain satisfactory results in the face of existing problems. Therefore, the main objective of this study is:

- Analyze the optimization of the nursing workflow in Ecuador from a neutrosophic perspective, which considers the indeterminacy of the existing elements.

Specific objectives:

- Analyze the barriers that prevent an optimal nursing workflow in Ecuador.
- Determine the neutrosophic criteria to define the best strategy to optimize the workflow.
- Enhance the scope of the selected strategy based on the targeted solution proposal.

2 Materials and methods

2.1 Neutrosophic Statistics and MOORA

The neutrosophic MOORA (Multi-Objective Optimization by Ratio Analysis) method consists of calculating the overall return of each alternative as the difference between the sums of their normalized returns that belong to the cost and benefit criteria. All attributes must be defined, provided that they can be measured or valued with respect to the linguistic terms that represent the weight of importance to each of the alternatives.

In this article, linguistic terms based on the Single-Valued Neutrosophic Number (SVNN) will be associated, so that experts can carry out their evaluations in linguistic terms, which is a more natural way to express assessments. Therefore, the scales shown in Table 1 will be considered.

Table 1: Linguistic terms that represent the weight of the importance of alternatives. Source: own elaboration.

Linguistic expression	SVNN
Relevant Improvement (RI)	(0.90, 0.15, 0.10)
Significant Improvement (SI)	(0.80,0.30,0.20)
Improvement (I)	(0.50,0.45,0.50)
Limited Improvement (LI)	(0.30,0.80,0.70)
No Improvement (NI)	(0.10,0.90,0.95)

Therefore, it is defined that $A = \{\rho_1, \rho_2, \dots, \rho_m\}$ is a set of alternatives, and $T = \{\beta_1, \beta_2, \dots, \beta_m\}$ is a set of criteria, the following steps will be carried out. For the modeling of the method, it is necessary to keep in mind the definition of neutrosophic numbers within the analyzed set.

Definition 1. Let X be a universe of discourse. A Neutrosophic Set (NS) is characterized by three membership functions [9], $u_A(x), r_A(x), v_A(x): X \rightarrow]$ -0,1+[, which satisfy the condition $-0 \leq inf u_A(x) + inf r_A(x) + inf v_A(x)\ sup\ u_A(x) + sup\ r_A(x) + \sup v_A(x) \leq 3^+$ for all $x \in X$. $u_A(x), r_A(x)$ and $v_A(x)$ denote the true, indeterminate, and false membership functions of x in A, respectively, and their images are standard or non-standard subsets of $]-0,1+[$.

Definition 2. Let X be a universe of discourse. An SVNS A on X is an object of the form:

$$A = \{\langle x, u_A(x), r_A(x), v_A(x)\rangle : x \in X\} \quad (1)$$

Where $u_A, r_A, v_A: X \rightarrow [0,1]$, satisfy condition $0 \leq u_A(x) + r_A(x) + v_A(x) \leq 3$ for all $x \in X$. $u_A(x), r_A(x)$ and $v_A(x)$ indicate the true, indeterminate, and false membership functions of x in A, respectively. For reasons of simplification and better understanding, an SVNN will be expressed as A = (a, b, c), where a, b, c [0,1] and satisfies $0 \leq a + b + c \leq 3$.

The SVNS arose with the idea of applying neutrosophic sets for practical purposes. Some operations between SVNN are expressed below:

Let A1 = (a1, b1, c1) and A2 = (a2, b2, c2) be two SVNNs, the sum between A1 and A2 as defined in expression (2).

$$A_1 \ A_2 = (a_1 + a_2 - a_1 a_2, b_1 b_2, c_1 c_2) \tag{2}$$

Let A1 = (a1, b1, c1) and A2 = (a2, b2, c2) be two SVNNs, the multiplication between A1 and A2 is defined in expression (3).

$$A_1 \ A_2 = (a_1 a_2, b_1 + b_2 - b_1 b_2, c_1 + c_2 - c_1 c_2) \tag{3}$$

The product of a positive scalar with an SVNN, A = (a, b, c) is defined by expression (4).

$$A = (1 - (1 - a), b, c) \tag{4}$$

Let $\{A_1, A_2, \dots, A_n\}$ be a set of n SVNN, where Aj = (aj, bj, cj) (j = 1, 2, …, n), then the Single Value Neutrosophic Weighted Mean Operator (SVNWMO) on the set is calculated by the equation (5).

$$\sum_{j=1}^{n} \lambda_j A_j = \left(1 - \prod_{j=1}^{n} (1 - a_j)^{\lambda_j}, \prod_{j=1}^{n} {b_j}^{\lambda_j}, \prod_{j=1}^{n} {c_j}^{\lambda_j}, \right) \tag{5}$$

Where λ_j is the weight of Aj, $\lambda_j \in [0, 1]$ and $\sum_{j=1}^{n} = 1$.

Definition 3. Let $A^* = (A_1^*, A_2^*, \dots, A_n^*)$ be a vector of n SVNN such that $A_j^* = (a_1^*, b_2^*, c_j^*)(j = 1,2, \dots, n)$ and $B_i = (B_{i1}, B_{i2}, \dots, B_{im})(i = 1,2, \dots, m)$ be m vectors of n SVNN such that $B_{ij} = (a_{ij}, b_{ij}, c_{ij})$ (i = 1, 2, …,m)(j = 1, 2, …, n). Then the Separation Measure between Bi and A* is calculated by Equation (6).

$$s_i = \left(\frac{1}{3} \sum_{j=1}^{n} \left\{ \left(a_{ij} - a_j^*\right)^2 + \left(b_{ij} - b_j^*\right)^2 + \left(c_{ij} - c_j^*\right)^2 \right\} \right)^{\frac{1}{2}} \tag{6}$$

Where I =(1, 2, ..., m)

Definition 4. Let A = (a, b, c) be an SVNN, and the scoring function S of an SVNN, based on the true membership degree, the indeterminate membership degree, and the false membership degree, is defined by Equation 7.

$$S(A) = \frac{1 + a - 2b - c}{2} \tag{7}$$

Where S(A) [-1, 1]∈

Having understood the nature of neutrosophic numbers, the neutrosophic MOORA method is carried out by following the subsequent steps:

Step 1: Determine the weight of the experts. To do this, the specialists evaluate according to the linguistic scale that appears in Table 1, and the calculations are carried out with their associated SVNN. Let At = (at, bt, ct) be the SVNN corresponding to the t-th decision maker (t = 1, 2, …, k). The weight is calculated by the following formula:

$$\lambda_t = \frac{a_t + b_t \left(\frac{a_t}{a_t + c_t} \right)}{\sum_{t=1}^{k} a_t + b_t \left(\frac{a_t}{a_t + c_t} \right)} \tag{8}$$

$\lambda_t \geq 0$ and $\sum_{t=1}^{k} \lambda_t$

Step 2: Formulation of the Final Decision Matrix (FDM).

Once the weight of the experts has been determined, the alternatives (A_n) and available criteria (Tx_{J+L}^n) are identified. Then, the decision-making matrix is constructed, which contains n rows that represent the alternatives $A_1, \dots, A_n$ in the evaluation, and J+L the columns that represent the criteria under evaluation (J quantitative criteria and L qualitative criteria). In this way, the final decision matrix is calculated by using equation (9).

$$\text{FDM}==[VO, VST]\begin{bmatrix}A^1\\A^2\\\vdots\\A^n\end{bmatrix}\begin{bmatrix}t_1^1 & \cdots & t_J^1 & t_{J+1}^1 & \cdots & t_{J+L}^1\\t_1^2 & \cdots & t_J^2 & t_{J+1}^2 & \cdots & t_{J+L}^2\\\vdots & \vdots & \vdots & \vdots & \vdots & \vdots\\t_1^n & \cdots & t_J^n & t_{J+1}^2 & \cdots & t_{J+L}^n\end{bmatrix} \tag{9}$$

Where A_i represents the alternatives, for $i = 1 \ldots n$, and x_j^i represents the inputs of alternative i with respect to criterion j.

Step 3: Calculate the normalized decision matrix.

It is feasible that the qualification criteria are expressed in various units or measurement scales; therefore, data must be normalized. Where the Euclidean norm is obtained according to equation (10) to the criterion x_j.

$$|T_j| = \sqrt{\sum_1^n t_i^2} \tag{10}$$

Therefore, the normalization of each entry in the FDM is carried out according to equation (11).

$$Nt_{ij} = \frac{t_{ij}}{|T_j|} \tag{11}$$

The results obtained after using equation (11) are dimensionless values, which allows the operations between the criteria to be additive.

Step 4: Calculate the weighted normalized decision matrix.

By considering the different importance of the criteria, the normalized weighted scores WNt_{ij} are calculated through equation (12).

$$WNt_{ij} = w_i \cdot Nt_{ij} \tag{12}$$

Selection of alternatives using distance to reference point when using Tchebycheff. The reference point or alternative $R_n[r_j]$ is constructed. This reference point is built with the best evaluation for each criterion. To measure the distance between each alternative and the reference point, the Tchebycheff metric is used, obtained by using equations (13 and 14).

$$Dist_{(i;j)} = \{max_j|r_j - WNt_{ij}|\} \tag{13}$$

The alternatives are ordered according to the shortest distance:

$$min_i = \{max_j|r_j - WNt_{ij}|\} \tag{14}$$

3 Results

For the development of the study, it was decided to explore the general causes that affect the optimal nursing workflow in Ecuador. To this end, an analysis of the causes that affect nursing workflows in health centers is included (see Table 2).

Table 2: Barriers that prevent optimal nursing workflow in Ecuador. Source: own elaboration.

No.	Cause	Effects	Observations
1	Unequal distribution of nurses	• Decrease of nurses in rural areas: The lack of adequate personnel affects the ability to provide quality care. • Increased demand in urban areas: The growing demand for medical care puts pressure on existing nursing staff, resulting in an increased workload in healthcare centers.	• It is observed that between opposites, it does not reflect the limits or a state of equilibrium. Therefore, it is deduced that the state of equilibrium is undetermined in the studied element.
2	Low automation of health processes	• Low level of implementation of electronic health record automation in urban areas. • Lack of implementation of workflow automation in nursing.	• The automation states in the regions can vary, and in the same region, one, two, or three states may converge. Therefore, there is

No.	Cause	Effects	Observations
		• The region is not included in nursing workflow automation programs.	an indeterminacy in assessing whether the region is automated.
3	Varied quality of education and training	• Differences in education: Differences in the quality of nursing education and training at different institutions can result in disparities in the skills and knowledge of professionals. • Need for ongoing training: Lack of ongoing training may leave nurses not fully prepared to meet the evolving challenges of healthcare.	• It can be observed that the agility and work performance of nursing professionals may be compromised by the key elements of all traditional manual workflows in healthcare centers.
4	Inefficient policies and management	• Ineffective human resources policies: Policies and strategies to address the unequal distribution of nurses and quality of care may be ineffective or insufficient. • Lack of strategic planning: Lack of strong strategic planning in the health system can lead to a lack of coordination and poor implementation of policies.	• Health policies must be focused on service quality and customer satisfaction. To do this, technical support focused on training and optimization of human resource flows is required.
5	Pressure on the health system	• Growing demand: The growing demand for healthcare services due to an aging population and continually changing healthcare needs puts pressure on the healthcare system and nursing staff. • Inadequate infrastructure: In many cases, health infrastructure, including the quantity and quality of healthcare facilities, is insufficient to meet the needs of the population.	• Emergency nurses work under enormous pressure. Sometimes the work environment makes it difficult for patients to receive the treatment they need and to keep records updated and organized.

These general causes address the barriers that hinder optimal nursing workflow in Ecuador. Resolving these challenges requires a combination of policies, investment in human resources, improvement in the quality of education and training, and strong strategic planning for the healthcare system in the country. Therefore, it is necessary to define a series of strategies to enhance an optimal nursing workflow, which includes the existing indeterminacies.

These strategies should provide solutions to the challenges of nursing in Ecuador, from the unequal distribution of personnel to the need to improve the quality of care and the digitization of processes. Each proposed strategy has a specific scope to optimize nursing workflow and ensure higher-quality healthcare.

- **Strategy 1**. Implement policies and programs that encourage the equitable distribution of nurses: It focuses on implementing policies and programs that promote a more equitable distribution of nurses in all regions of Ecuador. This aims to work towards mitigating the decrease in nurses in rural areas and improving access to healthcare in underserved regions and the equity in the distribution of healthcare resources.
  Integrated indeterminacy in the strategy: It should encompass the analysis of indeterminacies present in the outcomes obtained in different regions of policy and program implementation and integrate them into the expected objectives.
- **Strategy 2**. Improvement in education and training: It aims to enhance the quality of nursing education and training, ensuring that nurses are prepared to address patients' healthcare needs and the automation of processes. This is intended to produce more competent nurses who provide satisfactory patient care.
  Integrated indeterminacy in the strategy: The scope should include training and professional development, evaluating how necessary and to what extent nursing professionals should be prepared for different regions.
- **Strategy 3.** Promotion of nursing research: It is aimed at fostering research in the field of nursing to drive innovation and improve healthcare practices. Consequently, it is expected to result in the development of better healthcare practices, advancements in the field of nursing, and higher-quality patient care.
  Integrated indeterminacy in the strategy: The scope should encompass the indeterminacy arising from the different outcomes of innovation and improvement in patient care practices. However, the

variety of outcomes obtained should be integrated as part of the optimization of nursing workflow in Ecuador.

- **Strategy 4**. Staff and patient retention policies: Work should be done to implement patient and nursing staff retention policies and programs to reduce turnover and unequal distribution in urban and rural regions. To achieve this, greater stability of the nursing staff is sought as a result of working to reduce associated costs. So that continuity and patient satisfaction with the nursing service are restored, with a positive impact on patient retention in health areas.
  Indeterminacy built into strategy: It should have the scope of evaluating the effectiveness of nursing staff retention policies in different regions of Ecuador and proposing improvements to maintain patient loyalty in health centers. To do this, indeterminate results not evaluated in traditional studies must be included.
- **Strategy 5.** Interdisciplinary collaboration: It aims to promote collaboration among different nursing professionals for a more integrated and efficient approach to patient care [10, 16, 17]. Consequently, it achieves better healthcare coordination, reduced duplications and errors, and improved workflow efficiency.
  Integrated indeterminacy in the strategy: The scope should include interdisciplinary collaboration that integrates the results achieved in each region and how they optimize nursing workflow. This ensures not only homogeneous results but also those indeterminate outcomes obtained through collaboration among regions.
- **Strategy 6**. Innovation in nursing management: It promotes the introduction of innovative and efficient management practices to optimize resource allocation and nursing work organization. The expected outcomes include improved resource allocation, greater workflow efficiency, and, consequently, a reduction in non-essential workload.
  Integrated indeterminacy in the strategy: The scope should involve the integration of innovative management practices in each region of the country. It should evaluate differences in criteria through neutrosophic analysis and include the digitization of workflows.

To determine the optimal strategy, criteria evaluation is required under the linguistic terms representing the weight of the importance of each neutrosophic element, according to the measurement scale (see Table 1). These criteria assist in evaluating the proposed strategies based on achieving an optimal nursing workflow in Ecuador. Measurement scales in terms of neutrosophic numbers allow for a flexible and balanced representation of the importance of each criterion.

Criterion 1 (C1), equitable distribution of nurses: Degree to which the strategy achieves a more equitable distribution of nurses. For a measurement scale in linguistic terms from SVNN (0.90, 0.15, 0.10) for highly equitable distribution, to SVNN (0.10, 0.90, 0.95) for unequal distribution.

Criterion 2 (C2), variability in the quality of education and training: Aims to minimize variability through the evaluation of indeterminants that influence the improvement in the quality of education and training. It uses a linguistic measurement scale in terms of NNVU (0.80, 0.30, 0.20) for a significant improvement, down to NNVU (0.30, 0.80, 0.70) for limited or no improvement.

Criterion 3 (C3), variability in the contribution to nursing research: The aim is to mitigate the variability of results obtained and achieve redirection to a neutrosophic subset. With a scale of SVNN (0.80, 0.30, 0.20) for a significant contribution, up to SVNN (0.30, 0.80, 0.70) for limited or no contribution.

Criterion 4 (C4), efficiency in interdisciplinary collaboration: Evaluate the improvement in interdisciplinary coordination and efficiency. On a scale from SVNN (0.80, 0.30, 0.20) for significant improvement, to SVNN (0.30, 0.80, 0.70) for little or no improvement.

Criterion 5 (C5), job and service satisfaction: Measure staff retention and patient satisfaction. On measuring SVNN (0.90, 0.15, 0.10) for high retention and satisfaction, up to SVNN (0.10, 0.90, 0.95) for high turnover and low satisfaction.

Once the alternatives and measurement criteria are defined, the modeling of the Neutrosophic MOORA method is carried out (see Tables 3 to 5). Therefore, a comprehensive and weighted evaluation of the alternatives is performed based on multiple neutrosophic criteria. It is significant that the weights assigned to the criteria adequately reflect the relative neutrosophic importance of each one in the context of achieving an optimal nursing workflow in Ecuador.

Table 3: Normalized matrix. Source: own elaboration.

Unit	C1	C2	C3	C4	C5
Alternatives	**Max**	**Min**	**Min**	**Max**	**Max**
Alt 1	(0.3,0.8,0.7)	(0.3,0.8,0.7)	(0.3,0.8,0.7)	(0.3,0.8,0.7)	(0.8,0.3,0.2)
Alt 2	(0.50,0.45,0.5)	(0.8,0.3,0.2)	(0.5,0.45,0.5)	(0.9,0.15,0.1)	(0.3,0.8,0.7)
Alt 3	(0.9,0.15,0.1)	(0.9,0.15,0.1)	(0.9,0.15,0.1)	(0.9,0.15,0.1)	(0.8,0.3,0.2)
Alt 4	(0.1,0.90,0.95)	(0.8,0.3,0.2)	(0.8,0.3,0.2)	(0.3,0.8,0.7)	(0.3,0.8,0.7)
Alt 5	(0.3,0.8,0.7)	(0.1,0.90,0.95)	(0.8,0.3,0.2)	(0.1,0.90,0.95)	(0.50,0.45,0.50)
Alt 6	(0.9,0.15,0.1)	(0.9,0.15,0.1)	(0.9,0.15,0.1)	(0.9,0.15,0.1)	(0.8,0.3,0.2)
w	**(0.3,0.8,0.7)**	**(0.50,0.45,0.50)**	**(0.1,0.90,0.95)**	**(0.9,0.15,0.1)**	**(0.8,0.3,0.2)**

Table 4: Normalized and weighted matrix. Source: own elaboration.

	C1	C2	C3	C4	C5
Alt	**Max**	**Min**	**Min**	**Max**	**Max**
Alt 1	(0.063,0.167,0.146)	(0.063,0.167,0.146)	(0.063,0.167,0.146)	(0.063,0.082,0.051)	(0.418,0.068,0.034)
Alt 2	(0.105,0.094,0.105)	(0.167,0.063,0.042)	(0.105,0.094,0.105)	(0.188,0.015,0.007)	(0.157,0.181,0.12)
Alt 3	(0.188,0.031,0.021)	(0.188,0.031,0.021)	(0.188,0.031,0.021)	(0.188,0.015,0.007)	(0.418,0.068,0.034)
Alt 4	(0.021,0.188,0.199)	(0.167,0.063,0.042)	(0.167,0.063,0.042)	(0.063,0.082,0.051)	(0.157,0.181,0.12)
Alt 5	(0.063,0.167,0.146)	(0.021,0.188,0.199)	(0.167,0.063,0.042)	(0.021,0.092,0.069)	(0.261,0.102,0.086)
Alt 6	(0.188,0.031,0.021)	(0.188,0.031,0.021)	(0.188,0.031,0.021)	(0.188,0.015,0.007)	(0.418,0.068,0.034)
R_{nj}	**(0.188,0.188,0.199)**	**(0.021,0.031,0.021)**	**(0.063,0.031,0.021)**	**(0.188,0.092,0.069)**	**(0.418,0.181,0.12)**

Table 5: Evaluation of each alternative by distance to reference point. Source: own elaboration.

	C1	C2	C3	C4	C5	Order
Alt 1	(0.125,0.021,0.042)	(0.125,0.021,0.042)	(0.125,0.021,0.042)	(0.125,0.01,0.018)	(0,0.113,0.086)	**3**
Alt 2	(0.083,0.094,0.083)	(0.021,0.125,0.146)	(0.083,0.094,0.083)	(0,0.077,0.062)	(0.261,0,0)	**1**
Alt 3	(0,0.157,0.167)	(0,0.157,0.167)	(0,0.157,0.167)	(0,0.077,0.062)	(0,0.113,0.086)	**4**
Alt 4	(0.167,0,0.011)	(0.021,0.125,0.146)	(0.021,0.125,0.146)	(0.125,0.01,0.018)	(0.261,0,0)	**1**
Alt 5	(0.125,0.021,0.042)	(0.167,0,0.011)	(0.021,0.125,0.146)	(0.167,0,0)	(0.157,0.079,0.034)	**2**
Alt 6	(0,0.157,0.167)	(0,0.157,0.167)	(0,0.157,0.167)	(0,0.077,0.062)	(0,0.113,0.086)	**4**

Once the calculation and analysis are completed, the strategies with the highest priority are determined: **Strategy 2**, Improvement in education and training, and **Strategy 4,** Staff and patient retention policies. These alternatives obtain the highest score based on the evaluated criteria, indicating that they have greater potential to contribute to the optimization of nursing workflow in Ecuador. Therefore, a group of solutions focused on optimizing nursing workflow is proposed:

1. Redesign a system that analyzes and monitors the performance of nursing professionals [11-18-19]. This seeks to measure progress and identify opportunities for improvement in nursing professionals.
    - Adaptive system design helps your organization meet specific clinical and business needs. So that it helps streamline data collection and clinical documentation. To do this, it must promote the provision of standardized care and compliance with best practices in patient care and retention.

    Advantages that the new system should achieve in optimizing the workflow:
    - Formalize health records processes.
    - Automate workflows to achieve consistency of criteria among health professionals.
    - Free up work hours so that nursing staff can focus on patient care.
    - The performance of nursing professional's increases because staff can be assigned to more meaningful, patient-oriented work.

Automated systems that process workflows allow information to be accessed, indexed, searched, and retrieved in a timely and accurate manner. Therefore, technologies must be used in the integration of health services [12]. It is essential to integrate, adapt and improve the workflows of each worker [13], to guarantee the best possible level

of safety for the patient. On the other hand, the proposed solution to policies in favor of optimizing nursing workflows aims to work on:

2. Evaluation of the effectiveness of nursing staff retention policies in Ecuador: The evaluation of retention policies is characterized by the indeterminacy in the effectiveness of the strategies implemented in different regions. Some regions show positive results, while others face significant challenges in nursing staff retention. The proposed solutions constitute a response to a variety of situations, but their effectiveness presents uncertainties that may vary depending on the region and local circumstances.
   Its objectives are aimed at:
   - Analyzing the implementation of retention policies in different regions.
   - Identifying challenges and obstacles in retaining nursing staff.
   - Evaluating the impact of proposed improvements on nursing staff retention.
   - Generating specific recommendations for effective retention policies.

   While the stages to be developed in the proposed solution are:
   - Research and analysis of existing retention policies.
   - Data collection and implementation analysis.
   - Identification of challenges and obstacles.
   - Development of recommendations.
   - Impact evaluation.
   - Generation of final recommendations.

However, for data collection and processing, an investigator is required to prepare surveys, access nursing records and data, and analyze the results. This is expected to lead to a proposal focused on improving nursing personnel retention policies in Ecuador. Thus, the information obtained should provide enhancements for optimizing nursing workflow and delivering higher-quality healthcare.

Conclusion

Optimizing the nursing workflow in Ecuador is a task that involves a complex interplay of factors and challenges. Nursing in Ecuador faces a range of issues, including the unequal geographical distribution of nurses, the quality of education and training, and personnel retention. The truth lies in the need to improve healthcare across the country. However, indeterminacy prevails regarding the effectiveness of specific strategies to be implemented in each region, given the diversity of local conditions and needs.

Personnel retention policies, in particular, play a crucial role in optimizing the nursing workflow in Ecuador. The implementation of appropriate retention policies is essential to address the shortage of nurses and ensure quality healthcare in all regions. However, the effectiveness of these policies is undetermined and may vary by region, emphasizing the need to approach nursing management adaptively and flexibly.

Training and professional development are also key elements for retaining and improving the skills of nursing personnel in Ecuador. However, indeterminacy persists in terms of how these programs are implemented and adapted in different regions and their specific impact in each context. Nevertheless, an automated system is proposed for optimizing the nursing workflow based on the needs of each region.

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