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A Multi-Criteria Framework for Evaluating Health Communication Strategies to Combat Vaccine Hesitancy

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Abstract
The effectiveness of vaccination programs against infectious illnesses is threatened by the evolution of vaccine resistance, which poses a severe danger to international public health initiatives. Conventional methods of addressing vaccine resistance have frequently been constrained by their one-dimensional emphasis, which ignores the intricate interactions between biological, epidemiological, and sociocultural elements influencing the development of resistance. In response, this research supports a multi-criteria strategy that incorporates several viewpoints and standards to comprehend and manage vaccination resistance fully. Five strategies—provider-patient communication, health education campaigns, social media campaigns, community outreach initiatives, and influencer partnerships—are incorporated into the framework. Ten criteria are employed to evaluate these strategies: impact, resistance to misinformation, inclusivity, penetration, community engagement, and facilitation of dialogue, credibility, establishment of trust, resource demands, and adaptability. The CRITIC method is utilized to ascertain the relative significance of each criterion, whereas the CoCoSo and TOPSIS methods are employed to prioritize the strategies according to their appropriateness. As indicated by the findings, the criterion of vaccine effectiveness holds the greatest significance, with trust and credibility following suit. It is determined that health education campaigns are the most effective approach to tackle vaccine hesitancy, whereas influencer partnerships are deemed to be the least effective.

Keywords
Epidemiology, healthcare systems, vaccination, public health, socio-cultural

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Introduction

The evolution of vaccination resistance presents a serious challenge to worldwide public health efforts in the ongoing fight against infectious diseases (Olson et al., 2020; Biasio, 2017). Traditional vaccination regimens lose their efficacy when viruses change and adapt, which can result in outbreaks and the reappearance of diseases that can be prevented (Jarrett et al., 2015). This research explores the socio-behavioral aspects of vaccination resistance, illuminating its complex nature. Through comprehension of the processes behind the emergence and propagation of resistance, scientists can create more precise and flexible vaccination strategies (Nowak et al., 2015). This research will aid in the creation of creative strategies to combat vaccination resistance and protect public health globally.

A thorough and multifaceted approach that considers the several elements impacting the efficacy of vaccination regimens is necessary to address the complicated issue of vaccine resistance. This research calls for a comprehensive approach that considers the demographic, socioeconomic, and cultural factors that influence vaccine acceptability and effectiveness, rather than concentrating only on antigenic drift or declining immunity. Through the integration of findings from other disciplines, researchers might enhance their comprehension of the mechanisms that underlie vaccine resistance (Strully et al., 2021). This multifaceted strategy makes it possible to create customized interventions that take into consideration the complex problems that vaccination resistance poses in various populations and circumstances.

This research provides insights into potential solutions to this urgent problem by examining an innovative multi-criteria approach to comprehending and combating vaccination resistance. It presents a framework that integrates many criteria, such as communication and information, historical and policy context, healthcare system and providers, and socio-cultural aspects, in recognition of the shortcomings of standard uni-dimensional assessments. Developing focused strategies to address vaccine resistance and improve vaccination outcomes requires an understanding of the interactions between historical and policy context, healthcare system and providers, and socio-cultural factors. The necessity for a comprehensive strategy that goes beyond the conventional emphasis on vaccine efficacy and safety is highlighted in this research. This research closed knowledge gaps and provided guidance for evidence-based policies and initiatives to reduce vaccination resistance globally by using a multi-criteria approach.

Literature Review

Global public health activities are severely hampered by vaccine hesitancy, which also jeopardizes the efficacy of vaccination campaigns. The significance of health communication tactics in tackling vaccine hesitancy and encouraging vaccine acceptance has come to light more and more in recent years. With an emphasis on using a multidisciplinary approach, this literature review section discusses studies that have been dedicated to the significance of health communication tactics in overcoming vaccine hesitancy.

Olivia Olson et al. (2020) conducted a systematic literature review on communication methods to address parental vaccine reluctance in the United States.

The research highlights the public health risk of decreased childhood vaccination rates and offers effective measures to fight hesitation. Out of 1239 studies, 75 were examined, resulting in a taxonomy of therapies and their efficacy. Furthermore, Biasio (2017) investigated the relationship between vaccine reluctance and health literacy, offering light on the influence of literacy on vaccination decisions. Low health literacy makes it difficult to absorb vaccine information and implement preventative actions. Although education levels correspond with vaccine acceptability, health literacy may differ from general education.

Jarrett et al.'s systematic review aims to identify and evaluate strategies for addressing vaccine hesitancy globally (Jarrett et al., 2015). They examined 166 peer-reviewed and 15 grey literature evaluation papers from January 2007 to October 2013. Multi-component and dialogue-based interventions worked best, with moderate-quality evidence supporting societal mobilization, mass media, healthcare staff training, non-financial incentives, and reminder/recall. Nowak et al. also explored the efficacy of applying commercial and social marketing strategies to tackle vaccine reluctance (Nowak et al., 2015). The study emphasizes the growing trend of individuals choosing to postpone or reject immunizations, and the necessity for creative strategies to address this hesitancy.

Strully et al. (2021) emphasized the immediate requirement for transparent, equitable, and community-focused approaches to tackle COVID-19 vaccine hesitancy and reduce health inequalities, especially among minority communities. Based on insights from focus groups and previous data, they highlighted the substantial obstacles presented by reluctance and access concerns in minority communities. The individuals promoted community-engaged initiatives that recognized past injustices, conveyed culturally suitable messaging, and utilized trusted voices to disseminate accurate vaccine information. Arede et al. (2019) investigated approaches to address vaccine hesitancy, acknowledging its complex nature and the necessity for tailored interventions across different age cohorts. Evans and French in their study discussed vaccine hesitancy during the COVID-19 pandemic and recommended ways to increase immunization rates (Evans and French, 2021). They emphasized the need to combat vaccine skepticism and disinformation to increase uptake.

The important topic of COVID-19 vaccine resistance and its consequences for international immunization campaigns has been examined by Dhama et al. (2021) who underlined how crucial it is to attain broad vaccine coverage to successfully contain the epidemic. Ihlen et al. (2021) addressed the challenge of vaccine skepticism in the context of COVID-19 vaccination by examining research on vaccine hesitancy and trust building through the lens of rhetorical situations. The authors advised on vaccination communication tactics by combining rhetoric and persuasion research with vaccine communication and trust research.

The strategies to enhance the acceptability of COVID-19 vaccines through efficient health communication were investigated by Motta et al. (2021). The study provides significant information for developing communication methods to address vaccine hesitancy and improve public health efforts during the pandemic. This literature review demonstrate the complex and varied reasons for vaccination hesitancy and highlight the significance of personalized interventions and clear communication in effectively addressing this hesitation.

Methodology

This study deployed a MCDM approach for ranking approach that can be used to reduce vaccine hesitancy. The robustness of selecting a strategy for vaccine hesitancy can be generated using a multi-criteria approach because several factors, which could be technical and non-technical are responsible for this hesitancy. Given this assertion, the current study adopts a multi-criteria framework as its methodology for dealing with this evaluation problem. The adopted framework combines the unique properties of CRITIC method and CoCoSo methods (Alinezhad et al., 2019; Yazdani et al., 2019). One of the uniqueness of a CRITIC method is that it uses the actual alternative-cum-criteria values to determine criteria significance for a decision-making problem. On the other hand, a CoCoSo method uses three performance indices to identify an alternative's suitability for a decision-making problem.

Alternatives

The proposed framework for assessing the role of health communication strategies in overcoming vaccine hesitancy using a multi-criteria approach consists of three main components: health communication strategies, evaluation criteria, and the multi-criteria decision-making (MCDM) technique. The alternatives considered five areas namely:

- **Provider-Patient Communication:** This strategy aims to improve the exchange of information between healthcare practitioners and patients to answer any inquiries, worries, or misunderstandings connected to vaccines.
- **Social Media Campaigns:** This include employing social media channels to distribute accurate vaccine information, interact with various audiences, and combat disinformation.
- **Health Education Campaigns:** This involves the creation and implementation of educational materials and campaigns with the aim of raising knowledge of vaccines, emphasizing their significance, and promoting their safety.
- **Community Outreach Programs:** This approach involves community-driven efforts to encourage immunization, tackle issues, and establish confidence within local populations.
- **Influencer Partnerships:** Engaging in collaborations with influential individuals or groups to promote immunization and disseminate reliable information to their followers.

Selection of criteria

Effective health communication methods are crucial in addressing vaccine hesitancy and promoting widespread acceptance of immunizations. This section examines the crucial criteria necessary for assessing the effectiveness of these techniques across several dimensions. Each criterion, including impact measurement, misinformation counteraction, accessibility assurance, participation fostering, and trust building, plays a crucial role in the success of vaccination campaigns.

Effectiveness

- **Impact**: Measure effectiveness in boosting vaccination rates and dispelling hesitancy while enhancing overall public health outcomes and community resilience.
- **Misinformation Counteraction**: Combat false narratives, ensuring accurate information dissemination to dispel doubts and build trust in vaccines.

Accessibility and reach

- **Inclusivity**: Reach diverse populations, addressing varied needs and barriers to access, fostering equitable vaccine acceptance and healthcare engagement.
- **Penetration**: Ensure widespread outreach across platforms and communities, maximizing engagement and uptake of vaccination initiatives.

Engagement and interaction

- **Community Involvement**: Engage local stakeholders, fostering collaboration to tailor communication strategies and build community trust in vaccination efforts.
- **Dialogue Facilitation**: Foster open, respectful conversations, addressing concerns and building understanding between healthcare providers and the community.

Trust and credibility

- **Credibility**: Establish trust through transparent, reliable communication, leveraging credible messengers and evidence-based information to enhance vaccine confidence.
- **Trust Building**: Cultivate confidence in vaccines and healthcare systems through consistent, responsive communication, fostering enduring trust in vaccination initiatives.

Sustainability and longevity

- **Resource Requirements**: Evaluate necessary resources, including financial, personnel, and technological support, to implement effective communication strategies.
- **Adaptability**: Flexibly adjust messaging and tactics based on feedback and evolving circumstances, ensuring relevance and resonance with target audiences.

CRITIC method

This method uses criteria standard deviation and correlation coefficients to determine the criteria's importance towards making informed decisions for evaluation problems. This approach allows this method to assign ideal values to criteria (Mukhametzyanov, 2021).

Step 1: Construct a decision matrix for an evaluation problem using appropriate strategies and associated criteria.
Step 2: Determine the normalised values of the entries in the matrix using the appropriate normalisationexpression. Equation (1) presents the mathematical expression for normalizing a benefit-based criterion. On the other hand, a non-benefit-based criterion could be normalised using Equation (2).

$$r_{ij} = \frac{x^i_{max} - x_{ij}}{x^i_{max} - x^i_{min}} \quad (1)$$

$$r_{ij} = \frac{x_{ij} - x^i_{min}}{x^i_{max} - x^i_{min}} \quad (2)$$

Step 3: Determine the standard deviations of the criteria using the normalised values of the criteria. Equation (3) gives the mathematical expression used to determine the criteria's standard deviations.

$$s_j = \sqrt{\frac{1}{m-1}\left(r_{ij} - \bar{r}_i\right)^2} \quad (3)$$

Step 4: Determine the criteria's correlation coefficients using the criteria's normalised values. This study used Equation (4) to determine the correlation coefficients of the criteria.

$$c_{jk} = \frac{\Sigma(r_{ij} - r_k)(r_{ik} - r_k)}{\Sigma(r_{ij} - r_k)^2 \Sigma(r_{ik} - r_k)^2} \quad (4)$$

Step 5: Compute the criteria's importance using their standard deviations and correlation coefficients. Equation (5) shows the mathematical expression used to compute the criteria's importance.

$$w_j = s_j \Sigma\left(1 - |c_{jk}|\right) \quad (5)$$

CoCoSo Method

This method of implementation is underpinned by the concept of constructing a decision matrix for an evaluation problem. Similar to the CRITIC method, information in a decision matrix is normalised before CoCoSo implementation. Once, the normalised matrix has been constructed, the following steps are used to implement a CoCoSo method.
Step 1: Compute the power weight of comparability (Gi) values for the selected strategies identified for an evaluation problem. Equation (6) is used to generate this comparability value. The sum of the weighted comparability (Hi) values is also generated as a pre-requisite for this method implementation (Equation 7).

$$G_i = \sum_{j=1}^{n} {r_{ij}}^{w_j} \quad (6)$$

$$H_i = \sum_{j=1}^{n} r_{ij}\, w_j \quad (7)$$

Step 2: Compute the strategies' aggregated appraisal scores for the decision-making problem. First, Equation (8) is used to generate the first score for the strategies. Second, Equation (9) is used to determine the strategies' second scores. Lastly, Equation (10) is used to produce the third score for the strategies. Equation (10)

contains an extra parameter that is used to merge the contributions of the product and sum values of a strategy when selecting an appropriate strategy for an evaluation problem.

$$S_i^1 = \frac{G_i + H_i}{\sum G_i + H_i} \tag{8}$$

$$S_i^2 = \frac{H_i}{\min_i H_i} + \frac{G_i}{\min_i G_i} \tag{9}$$

$$S_i^3 = \frac{\lambda H_i + (1-\lambda) G_i}{\lambda \max_i H_i + (1-\lambda) \max_i G_i} \tag{10}$$

Step 3: Generate the final score of the strategies using the results from Equations (8) to (10). This study used Equation (11) to generate the strategies final scores.

$$S^i = (S_i^1 S_i^2 S_i^3)^{\frac{1}{3}} + \frac{1}{3}(S_i^1 S_i^2 S_i^3) \tag{11}$$

TOPSIS Method

TOPSIS is among the frequently used MCDM in decision science. This acceptance is because it uses the unique properties of criteria and alternatives to determine the suitability of alternatives for a decision-making problem. First, this method considers the ideal solutions for criteria. Second, it considers the non-ideal solutions of criteria for the same selection or evaluation problem. To determine these solutions, information from a decision matrix are used as the basis of judgment.

A decision matrix is developed using criteria values for the different alternatives for a decision-making problem (Equation 12). This matrix contains information obtained from experts with respect to a specific problem. Hence, it needs to be processed to generate a weighted matrix for determining the idealness and non-idealness of criteria solutions.

$$D = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \tag{12}$$

The weighted matrix contains the normalised values of the criteria with respect to the alternatives. In addition, it contains the weights of the criteria with respect to a decision-making problem. First, the normalised matrix is generated using the criteria orientation – benefit or cost criteria. Equation (13) presents the expression for normalizing criteria with benefits orientations, while Equation (14) is used to generate the normalised values for cost-oriented criteria

$$r_{ij} = \frac{x_j^{max} - x_{ij}}{x_j^{max} - x_j^{min}} \tag{13}$$

$$r_{ij} = \frac{x_{ij} - x_j^{min}}{x_j^{max} - x_j^{min}} \tag{14}$$

Criteria weights are generated using appropriate MCDM methods. As per this study, a CRITIC method is adopted. This method is selected because it uses less data

to generate criteria weights vis-à-vis the actual values of the criteria with respect to the alternatives for a decision making problem.
After the normalised values and criteria weights estimation, they are combined to generate the weighted normalised matrix used to determine the criteria ideal and non-ideal solutions (Equation 15).

$$D = \begin{bmatrix} w_1 x_{11} & \cdots & w_n x_{1n} \\ \vdots & \ddots & \vdots \\ w_1 x_{m1} & \cdots & w_n x_{mn} \end{bmatrix} \quad (15)$$

$$y_{ij} = w_j r_{ij} \quad (16)$$

From Equation (15), the ideal solutions are determined using Equation (17). On the other hand, Equation (18) is used to generate the non-ideal solutions for a decision-making problem.

$$x_j^+ = \begin{cases} \max\limits_i y_{ij} \; If benefit - oriented criteria \\ \min\limits_i y_{ij} \; If cost - oriented criteria \end{cases} \quad (17)$$

$$x_j^- = \begin{cases} \min\limits_i y_{ij} \; If benefit - oriented criteria \\ \max\limits_i y_{ij} \; If cost - oriented criteria \end{cases} \quad (18)$$

Based on the ideal and non-ideal solutions, the distance of each alternative is calculated as follows:
Equation (19) gives the expression for the alternatives' distances from the ideal solutions, and

$$d_i^+ = \sqrt{\left(y_{ij} - y_j^+\right)^2} \quad (19)$$

Equation (20) gives the expression for the alternatives' distances from the non-ideal solutions.

$$d_i^- = \sqrt{\left(y_{ij} - y_j^-\right)^2} \quad (20)$$

The suitability of an alternative is determine based on the alternative's closeness coefficients. This coefficient is determined based on the relationships between the alternatives' distances from the ideal and non-ideal solutions.

Case Study

The proposed framework applicability was evaluated using information collected from experts in vaccine management. The experts' selection is also based on their years of experience as managers and technocrats in vaccine administering among different ages of people. To apply the framework, this study designed a questionnaire that contains information about the strategies from three experts (E1, E2 and E3). Table 1 contains the information used to design a questionnaire for data collection.

Table 1: Linguistic for the strategy evaluation

Linguistic variables	**TFN**
Very High (VH)	(0.8,0.9,1.0,1.0)
High (H)	(0.6,0.7,0.8,0.9)
Moderate (M)	(0.4,0.5,0.6,0.7)
Low (L)	(0.2,0.3,0.4,0.5)
Very low (VL)	(0.0,0.1,0.2,0.3)

Based on these experts' knowledge on vaccine administering, they were assigned weights of 0.4 for E1, 0.3 for E2 and 0.3 for E3. These weights were used to aggregate their linguistics values for the different strategies. This study used Equation (21) to convert the aggregated TFN values to single index (Ighravwe and Oke, 2022).

$$x_i^s = \frac{\left[x_{4i}^s x_{3i}^s + \frac{1}{3}(x_{4i}^s - x_{3i}^s)^2\right] - \left[x_{2i}^s x_{1i}^s + \frac{1}{3}(x_{2i}^s - x_{1i}^s)^2\right]}{x_{4i}^s + x_{3i}^s - x_{2i}^s - x_{1i}^s} \quad (21)$$

Table 2 presents the single index for the strategies

Criteria	Provider-patient communication	Social media campaigns	Health education campaigns	Community outreach programs	Influenc partnersh
Impact	2.13	2.31	5.72	5.72	3.01
Misinformation counteraction	2.13	4.64	5.72	3.51	1.87
Inclusivity	4.33	3.51	4.33	4.33	2.85
Penetration	2.85	4.64	4.64	2.42	1.90
Community involvement	2.85	4.33	4.02	5.72	2.13
Dialogue facilitation	5.72	3.51	3.01	3.01	2.85
Credibility	5.72	1.87	4.02	5.72	2.85
Trust building	5.72	2.26	5.72	4.02	2.85
Resource requirements	4.64	4.33	4.33	4.33	3.01
Adaptability	5.72	5.72	4.64	5.72	5.72

The information in Table 2 was normalised using Equation 22 to generate a normalised decision matrix for the framework application (Table 3).

$$r_i^s = \frac{x_i^s}{\sqrt{(x_i^s)^2}} \quad (22)$$

Table 3: Normalised values for the evaluation problem

Criteria	**S1**	**S2**	**S3**	**S4**	**S5**
Impact	0.23	0.25	0.62	0.62	0.33
Misinformation Counteraction	0.25	0.54	0.66	0.41	0.22
Inclusivity	0.49	0.40	0.49	0.49	0.33
Penetration	0.37	0.60	0.60	0.31	0.24
Community Involvement	0.32	0.48	0.45	0.64	0.24
Dialogue Facilitation	0.68	0.42	0.36	0.36	0.34
Credibility	0.59	0.19	0.42	0.59	0.30
Trust Building	0.59	0.23	0.59	0.41	0.29
Resource Requirements	0.50	0.46	0.46	0.46	0.32
Adaptability	0.46	0.46	0.38	0.46	0.46

This study used the normalised values in Table 3 to determine the criteria importance. The CRITIC method, in the framework, was used to process the normalised information for the criteria importance. Equations 3 to 6 present the mathematics used for the information processing.

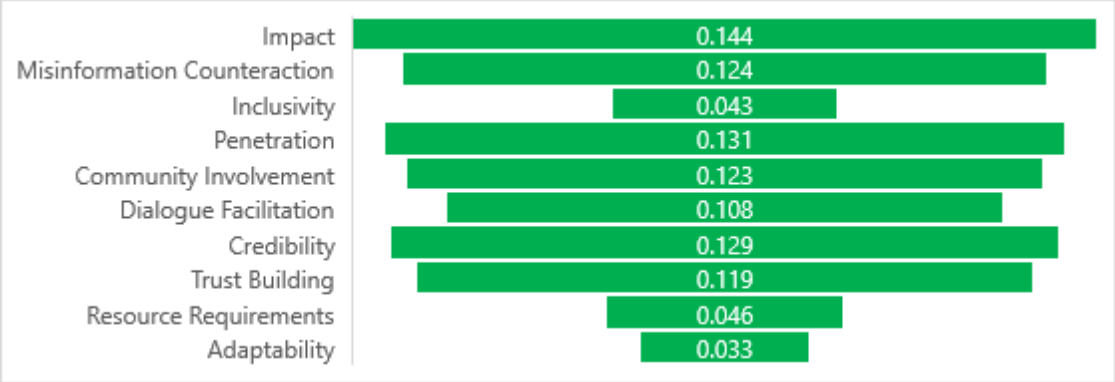

Figure 1: Weights of the selected criteria

Figure 1 shows the importance of the selected criteria based on the CRITIC method. These results show that impact of vaccine is the most importance criterion that affect its acceptance in the case study. Adaptability is identified as the least importance criterion that affect vaccine acceptability. This study presents the aggregated weights of the criteria in Figure 2. The information in this figure shows that the most significant criterion for dealing with vaccine hesitancy is vaccine effectiveness. Next, we observed that the issue of trust and credibility has higher significance when compared with the other criteria. The issue of vaccine sustainability and longevity is least significant when addressing the vaccine hesitancy issues (Figure 2).

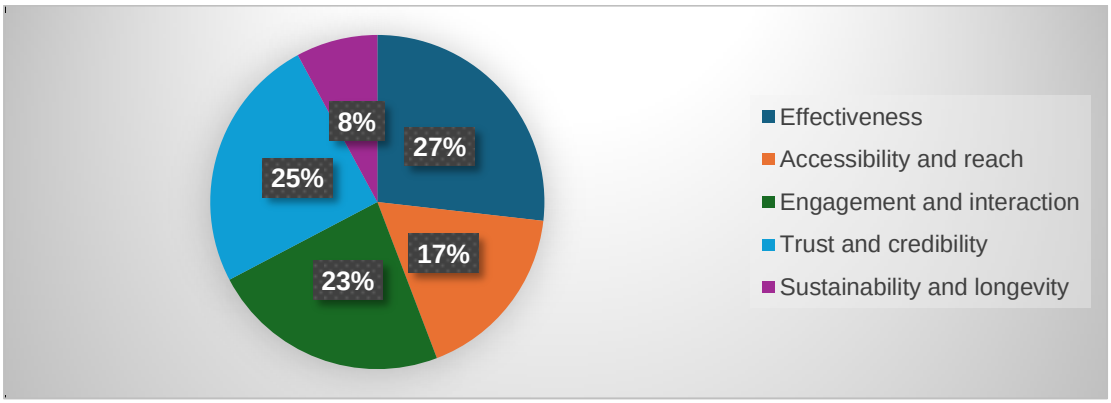

Figure 2: Aggregated significance of the criteria

This study used the normalised values of the strategies in Table 3 and the criteria importance in Figure 1 to implement the CoCoSo method. Using a contribution factor of 0.5, this study generated the results in Table 4.

Table 4: CoCoSo method results

	S1	S2	S3	S4	S5
H	0.430	0.392	0.522	0.481	0.289
G	9.142	9.055	9.355	9.273	8.833
SCORE 1	0.200	0.198	0.207	0.204	0.191
SCORE 2	0.047	0.043	0.057	0.053	0.032
SCORE 3	0.969	0.956	1.000	0.988	0.923
CoCoSo value	0.212	0.204	0.232	0.223	0.179

The results in the last column of Table 4 were used to rank the strategies on the basis of the higher the better. Hence, we deduced that the most suitable strategy for vaccine administering is health education campaigns (S3). On the other hand, we observed that influencer partnership (S5) was the least suitable strategy for vaccine administering. Figure 3 provides more information about the ranking of the other strategies.

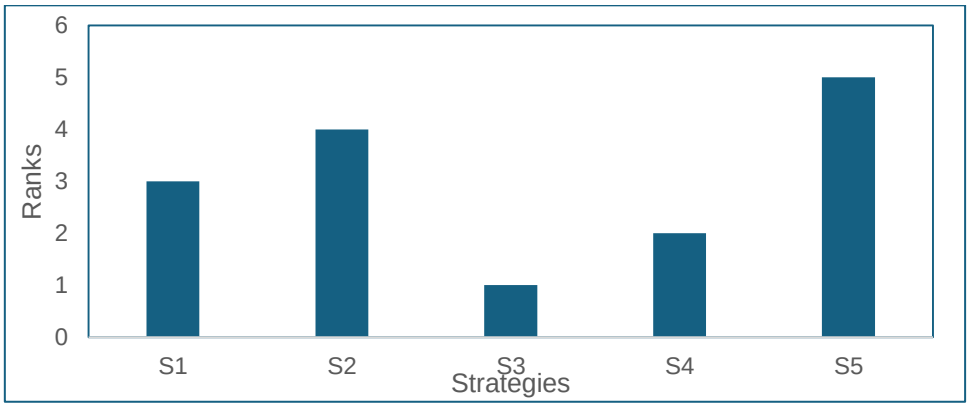

Figure 3: Ranking of the strategies

TOPSIS method

Table 5 presents the ideal solutions for the different criteria used for the evaluation process. The information in this table shows that 60 per cent of the ideal solutions for the criteria came from provider-patient communication. The criteria for non-ideal solutions are also contained in this table. From the non-ideal solutions, the influencer partnerships strategy contributed 60 per cent to the strategy distance from the non-ideal solutions.

Table 4: Solutions for the criteria

Criterion	Non-ideal	Ideal
Impact	0.0331	0.0893
Misinformation counteraction	0.0273	0.0818
Inclusivity	0.0142	0.0211
Penetration	0.0314	0.0786
Community involvement	0.0295	0.0787
Dialogue facilitation	0.0367	0.0734
Credibility	0.0245	0.0761
Trust building	0.0274	0.0702
Resource requirements	0.0147	0.0230
Adaptability	0.0125	0.0152

The information in Table 4 was used to determine the vaccine strategies' suitability towards addressing its hesitancy among specific groups of people. Table 5 shows the vaccine strategies distances from the identified solutions in Table 4. These distances were used to generate the strategy's closeness coefficients (Figure 4).

Table 5: Strategies distances from the solutions for the evaluation problem

Strategies	Ideal	Non-ideal
Provider-patient communication	0.0905	0.0798
Social media campaigns	0.1526	0.0694
Health education campaigns	0.1526	0.1088
Community outreach programs	0.1526	0.0971
Influencer partnerships	0.1526	0.0216

According to the TOPSIS results, provider-patient communication is identified as the most suitable strategy for addressing the problem of vaccine hesitancy. Similarly, this method identified the least suitable strategy as influencer partnership; this observation is consistent with the result obtained from the CoCoSo method (Figure 4).

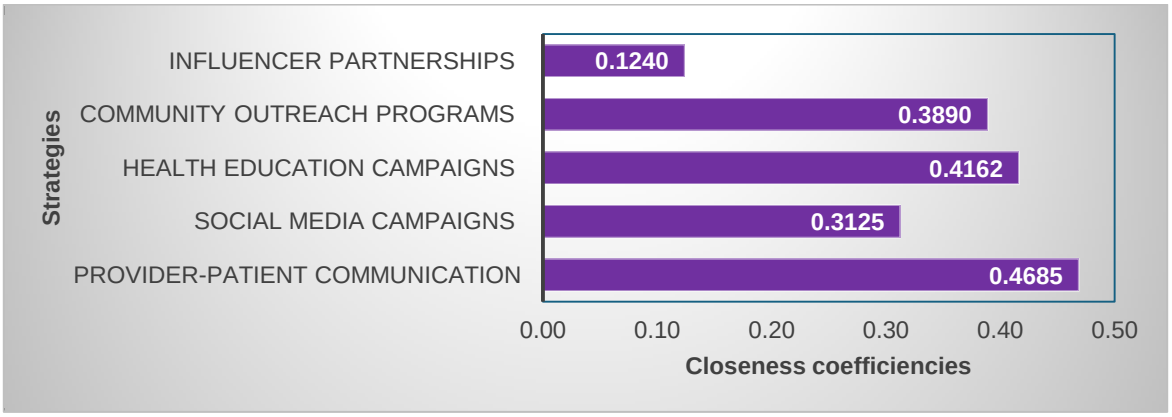

Figure 4: Strategies closeness coefficients

The information in Table 4 and Figure 4 were used to generate aggregated values for the strategies (Figure 5). The results obtained showed that the ranking of the strategies based on the TOPSIS and aggregated results were the same. Hence, we deduced that the most suitable strategies for addressing the vaccine hesitancy problem is provider-patient communication. On the other hand, influencer partnership is a suitable strategy for addressing the problem.

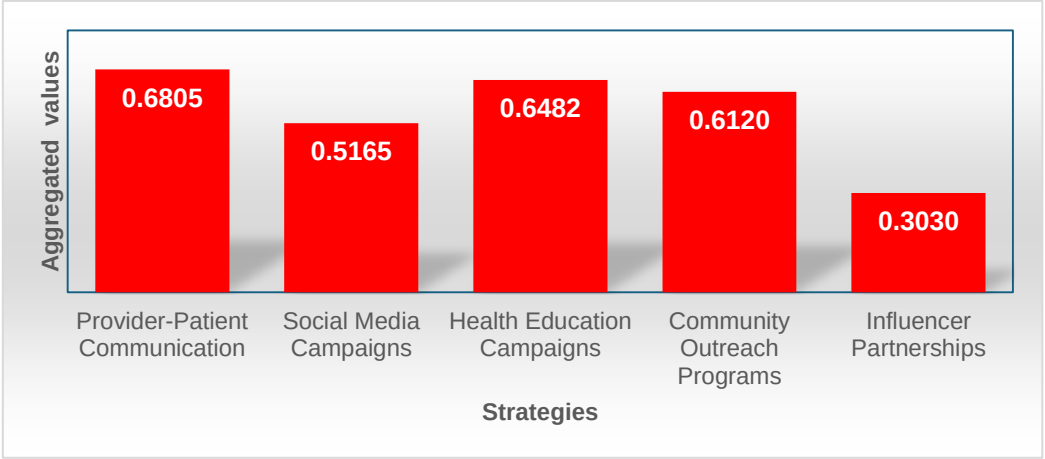

Figure 5: Aggregated values for the strategies

Conclusion

This study has investigated the possibility of using a multi-criteria approach to identify a suitable strategy for vaccine administration. First, it identified strategies for overcoming vaccine hesitancy among people. Second, this study identified the criteria for evaluating the strategies implementation - effectiveness, accessibility and reach, engagement and interaction, trust and credibility, sustainability and longevity. The identified strategies and criteria were used to design a decision matrix for the evaluation problem. A CRITIC method was used to determine the criteria significance for the strategies evaluation, while this study used a CoCoSo and TOPSIS methods to determine the strategy's suitability for addressing the problem of vaccine hesitancy. Based on the information obtained from three experts, this study observed that the most significant criterion for the evaluation problem was the impact of the vaccine. On the other hand, vaccine acceptability was identified as the least significant criterion. When the criteria significance was aggregated, we observed that vaccine effectiveness was the most significant criterion – contribution factor of 28%, while its sustainability and longevity was the least significant – contribution factor of 8%. For the strategy's suitability, this study observed that the most suitable strategy for vaccine administration was health education campaigns. On the other hand, we observed that influencer partnership was the least suitable strategy for vaccine administration. Despite this study's observations, there is a possibility of extending the number of criteria to encompass the unique attributes of a case study. In addition, stakeholders' requirements could be used to extend the proposed framework's applicability to generate more insights into vaccine hesitancy.

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