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Health Communication and Media Influence on Vaccine Uptake

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ABSTRACT



Objective: This research examines the effects of novel health communication affordances - algorithmic filtering, meme resonance, narrative transportation, cross-platform echo, and micro-influencer credibility on vaccine intentions and adherence, mediated by Health Communication Trust Calibration.

Methods: An observational, cross sectional study design with adult participants, validated constructs, and SPSS regression-mediational analysis with Hayes PROCESS macro.

Results: The findings suggest that the credibility of micro-influencers have the most significant impact on vaccine adherence, cross-platform echo perception and the awareness of the algorithm are instrumental in determining trust, particularly among peri-urban areas and older age groups. Health Meme Resonance is more important for younger participants, while narrative immersion continuously enhances persuasion across participants. In particular, Health Communication Trust Calibration operates as a continual mediator, suggesting that people update trust in a dynamic manner when faced with communication cues. Not only is this heterogeneous impact evident across particular population subgroups, but the overall relationship between heterogeneity and public health impact proved to be consistent across a wide variety of analyses with respect to student population and school characteristics.

Novelty: This work introduces five novel motivational constructs under-examined in research on vaccine communication and offers a distinctive theorization of trust calibration as a mediator of rather than a single state predictor. Combining behavioural economics, digital communication and trust recalibration together in one explanation model, this study pushes the theoretical boundary and resolves inconsistency from previous findings.

Implications for Research: The results are a blueprint for education-based campaigns around the world. They emphasize the necessity to have more empathetic micro-influencers, to have consistent messaging across all platforms, to have transparent algorithmic communication and to recognize that building trust is key. This model enables policymakers, educators, and eHealth programmers to develop cost-effective and globally scalable interventions that effectively reduce hesitancy and promote sustained resiliency in public health systems.

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1. Introduction

The world is currently experiencing the COVID-19 pandemic that has highlighted the pivotal importance of successful health communication on vaccine acceptance and compliance. Despite extraordinary progress of vaccine development, demonstration of exposure based on algorithm and fragmented channels of public information have challenged the public acceptance. New research underscores the power of media influence to increase trust or enhance hesitancy, on the basis of the framing and presentation of information (Diaz et al., 2025; Dwivedi & Sen, 2025; Dwyer et al., 2025). In the age of the surfacing of social media, health information is now more than ever mediated by algorithms filtering content visibility, thereby influencing public beliefs about vaccine safety and need (Lopez-Lopez et al., 2025; Potnis et al., 2025). Also, visual narratives and memes, and influencer-led campaigns have become potent,



under researched forces in PHC (Edgerton et al., 2016; Kostygina et al., 2020; Ope-Davies (Opeibi) & Shodipe, 2023). These stories serve to remind us that the decision to adopt or reject a vaccine cannot be attributed simply to biomedical factors but is shaped by socio digital environments in which issues of trust, engagement and persuasion are brought to the fore (Benzi et al., 2024; Hvalič-Touzery et al., 2024; Lin, 2025). To explain this phenomenon, we must leave the traditional models of communication behind to construct new ones that can account for the influences of media ecology on health behaviours.

The current dilemma revolves around competing influences of digital media on vaccine adoption. Although targeted persuasion and digital narratives have been identified as factors that promote compliance, overexposure to misinformation or politically misaligned manipulated content typically causes polarization and underestimation of risks (Gurung et al., 2025; Kumar et al., 2025; V I De Araujo et al., 2025). Academics warn that algorithms optimized for engagement, by default not accuracy, can end up promoting falsehoods that undermine vaccination efforts (Bridgman al. 2022). Furthermore, although influencer-driven tactics show promise with the youth market, concerns about credibility, trustworthiness, and authenticity persist (Jacobson & Harrison, 2022; Zniva et al., 2023). These contradictions suggest that digital media is a janus faced medium both having the potential to increase vaccine literacy and to strengthen vaccine hesitancy depending on the context and human psychology. Which communication elements enhanced trust and adherence, and which increased resistance, are crucial to elucidate, particularly in the context of preventive care.

There are three related theoretical positions underpinning this research. According to Nudge theory, if such hints to cognition are aligned with cognitive heuristics, the result may be a positive change in health behaviour (Thaler & Sunstein, 2021). Privacy calculus theory describes the decision-making process by which individuals evaluate the perceived benefits of health information against the risks of private data disclosure in communication processes (Chen et al., 2024; Li et al., 2025; T. Wang et al., 2016). According to narrative transportation theory, even when people are not aware of the influence of stories on them, they can be persuaded or attitudes can be changed more durably by personal stories (Beauvais & Stolle, 2025; Brock-Petroshius & Gilens, 2025; Fitzgerald & Green, 2017; Zamir & Kaunert, 2025). Collectively, these approaches present a strong conceptual model to explore the influence of new digital communication constructs on vaccine uptake and compliance.

However, despite a rise in the interest of health communication, the results in previous research studies have been mixed, which indicates there exists substantial voids in research. Some research provides evidence that algorithmic curation increases vaccine misinformation and reduces uptake Bridgman et al. (2022), Gomes et al. (2025), Loomba et al. (2021), Pennells et al. (2025), Sen & Abdullah (2025), and others that algorithmic exposure can improve the targeted delivery of pro-vaccine messages (Matsilele et al., 2022; Thaler & Sunstein, 2021; G. Wang et al., 2023). Memes and short-form content are similarly derided in certain literatures as frivolous or erroneous (Koickakudy, 2025; Rosen, 2025; Weikmann, 2025), but some recent work recognises the potential for enhancing engagement in humour and relatability (Qamar et al., 2025; Sewak et al., 2025). Story-based testimony has been established to be effective in enhancing persuasion through empathizing (Van Laer et al., 2019; Chung & Kim, 2021; Kim & Niederdeppe, 2022; Allington et al., 2023) or to do the reverse once its manipulative aims are detected. Similarly, influencer studies report mixed findings: celebrity endorsemen are often met with skepticism while micro-influencers are deemed more trustworthy thanks to their closer proximity to the public (Mututwa & Matsilele, 2022; Peretti-Watel et al., 2023). These paradoxes emphasize the necessity of a holistic framework that incorporates Algorithmic Curation Perception, Health Meme Resonance, Narrative Transportation in Testimonials, Cross-Platform Echo Perception and Micro-Influencer Credibility Index, with Health Communication Trust Calibration as a mediator. No study has hitherto explored these constructs collectively in such a systemized manner, constituting a strong case for novelty.

Exploiting these voids, the current study seeks to explore the effect of Algorithmic Curation Perception, Health Meme Resonance, Narrative Transportation in Testimonials, Cross-Platform Echo Perception, and Micro-Influencer Credibility Index on Vaccine Uptake Intention and Adherence, with a focus on the mediation of Health Communication

Trust Calibration. The study specifically examines 11 hypotheses (H1–H11) to elucidate the direct and indirect influences of the communication and media-related factors on vaccine-related behaviours. Theoretical contribution The theoretical contribution is that the intersection of behavioural economics, digital communication and trust calibration are woven together in a single framework, vaccine engagement. From a practical perspective, results will help inform educators, policy makers and eHealth developers how to create campaigns that are empathetic, contextually grounded, and care about privacy as a tool to sustain trust and adherence. The implications are international in scope, providing perspectives on communicative education that can work to address and overcome hesitancy, and increase the resiliency of public health systems. It adds to scholarly and practical applications on education, communication, and preventive health by examining creative constructs that may not be explored widely in previous literature.

2. Method and materials

2.1 Study design

This study used an observational cross-sectional design to assess the impact of new health communication variables on intention and adherence to vaccination. Observational study design is commonly applied to medical and public health studies to enable evaluation of exposure–outcome associations in unaltered real-world settings without any experimental intervention (Song & Chung, 2021). This approach is specifically useful for VCM, for which ethical and contextual considerations restrict randomised interventions. Cross-sectional observational studies have been found to be useful in providing an insight on the behavioural determinants of vaccine acceptability especially when considered along with strong statistical techniques of analysis (Aw et al., 2021; Hu et al., 2022). Informed by behavioural communication theories and health belief models, the current design has been formulated for systematic data collection in a naturalistic setting without sacrificing methodological quality.

2.2 Sample and setting observation

Adult participants were recruited in Da Nang, Vietnam, over the period from 2023 to 2024, and they constituted a diverse; varying in age, education, and media experiences. Inclusion criteria was ≥ 18 years, access to digital media channels and prior exposure to vaccination media campaigns. Participants who received digital health communication in the context of vaccination were purposively sampled. This is akin to methods employed in medical research where sampling can be targeted to represent subpopulations of interest (Nguyen et al., 2022). Based on Cohen's power analysis, the minimum sample size was estimated for statistical power ≥ 0.80 at $\alpha = 0.05$, with sufficient sensitivity to detect medium effect sizes (Cohen, 1992; Wang et al., 2021). Both online and offline data were collected using secure survey software by health centers, in line with current guidance on mixed mode recruitment in vaccine behaviour research (Nguyen & Hoang, 2023).

2.3 Research instrument and measurement

Algorithmic Curation Perception is the perception of people that digital platforms weight and screens health contents by algorithms. This framing influences if people see selective exposure as a result of system design as opposed to neutral information flow. Recent studies suggest that algorithmic filtering impacts both trust and vaccination decisions by spreading some narratives and suppressing others (Cinelli et al., 2021). Roozenbeek et al. (2022) observe that algorithmic orientation leads users to approach vaccine information with critical scrutiny or withdraw owing to perceived bias. This variable is important because it shows how digital curation system influences the intention of vaccine uptake. Health Meme Resonance describes how funny, or visually appealing, memes about vaccination, draw an emotional response and stick with a person. Research demonstrates that health-focused memes are exceedingly shareable and effective at shaping vaccine attitudes by using humor to deliver persuasive information (Kearney et al., 2022). Wang et al. (2023) revealed that memes constitute low-threshold health messages that contribute to the

development and reinforcement of norms particularly among younger recipients. This schema highlights the power of informal, creative expression to facilitate or inhibit vaccine engagement on the basis of how a message is framed.

Narrative Transportation in Testimonials reflects how immersed an individual is in personal testimonials on vaccination that they encounter through digital media. Immersion reportedly fosters empathy and lessens counter-arguing, and as a result makes persuasion more effective (Van Laer et al., 2019). Kim and Niederdeppe (2022) identified that narrative-driven testimonials can be highly effective in positively change audience attitudes toward vaccination by creating emotional connections through empathy for lived experiences. The measurement of narrative transportation demonstrates how real stories impact the adherence of vaccines, regardless of facts in messages. CPEP applies to how people are perceiving consistency of vaccine messages across media formats. Strong messages encouraging vaccination are persuasive when the key messages are consistent across platforms (Mututwa & Matsilele, 2022). Peretti-Watel et al. (2023) note that uncertainty diminishes and behaviours align when a message is repeated across media. It accounts for the fact that vaccine campaigns are amplified or attenuated in the combined impact of media environments on intention and adherence.

Micro Influencer Credibility Index measures how reliable influencers with smaller followings (who are sometimes considered more real and closer to reality than stars are. Apuke and Omar (2021) demonstrated a sophisticated influence of credibility and its importance for the persuasive impact of the health campaigns; by a similar token, Chen et al. (2023) note the growing influence of micro-influencers in vaccine attitudes. This factor may project that community-level opinion leaders play a differential role in promoting vaccine uptake. Health Communication Trust Calibration assesses the extent to which people modulate their trust from doubt to trust as they encounter health communication. Huang et al. (2023) note that trust is dynamic, not fixed, and is adjusted with incoming new information. Krick et al. (1997) also highlight that appropriate trust allows players to compromise between caution and compliance. In the role of mediator, this construct accounts for the fact that communication antecedents are translated into vaccine usage through associated perceptions of transparency, balance, and willingness to act. Vaccine Uptake Intention Adherence encompasses decision to be vaccinated and compliance with the recommended course of vaccination booster. Loomba et al. (2021) found that communication strategies have direct effects on vaccine intentions, and Yoon et al. (2023) established trust in communication as a predictor of adherence to full vaccination. This dependent variable represents the definitive behavioural end point of interest, and encompasses intention and behaviour to prevent it.

2.4 Data analysis

Data were managed and analyzed using SPSS ver. 27.0. respondents were profiled using descriptive statistics means, SD, frequencies. The reliability was examined based on cronbach's α and composite reliability, and the validity was evaluated by KMO and Bartlett's test. Bivariate correlations analyzed the associations between constructs. The direct effect on vaccine uptake Intention and Adherence was tested using multiple linear regression models for algorithmic curation perception, health meme resonance, Narrative transportation in testimonials, cross-platform echo perception, and micro-influencer credibility Index. We used the Process macro by Hayes for the mediation analysis (Model 4) to test the indirect effect of health communication trust calibration, with bootstrap resampling (5,000 iterations) to indicate confidence intervals. Cut off value was performed with a 5% significance level ($p < 0.05$), which is accordance with the reporting of standard medical research.

3. Results

3.1 Respondent characteristics and vaccine related behaviours

Table 2 presents selected socio-demographic and provocative characteristics among the respondents which offer a broad profile of the study population. The sample was only slightly female (< 50%), suggesting a relatively even male:

female ratio (58.7%) among the 480 participants. The average age was 34.9 years (SD = 11.2), ranging from 18 to 68 years, which indicates coverage of young, middle-aged and older adults. Educational level was relatively high with 61% describing themselves as holding tertiary qualifications, 12.5% postgraduate qualifications and 26.5% secondary education. This suggests that a majority of the participants were reasonably educated that usually correlates with high awareness level of preventive health actions. Residence was predominantly urban 64.6%, and peri-urban based 35.4%, and showed variations to media access and exposure to health campaigns. With regard to vaccine-related behaviours, the average intention to vaccinate score on a 7 point Likert scale was 5.11, reflecting mostly positive attitudes towards vaccination and some interplay with hesitancy among some of the subgroups. Crucially, only 63% claimed to have actually taken the full course of vaccinations, a disparity between intention and behaviour. This difference is consistent with an inequity observed worldwide in which high reported intention does not necessarily mean high action due to, for example, misinformation, perceived risk or logistical obstacles (Loomba et al., 2021; Yoon et al., 2023). In general, the sample appears to be demographically diverse but a population rich in education who tend to have positive attitudes towards vaccines, albeit with considerable room for improvement in full vaccine completion. This profile provides the basis for discussing the interaction between communication and media variables and trust that shape vaccine uptake and adherence.

3.2 Descriptive statistics and reliability

Descriptive statistics and reliability indices for the study constructs are presented in Table 3. Mean scores ranged from 4.53 (Trust Calibration) to 5.05 (Vaccine Uptake Intention & Adherence) on a 7-point scale, suggesting moderately high levels of endorsement for all constructs. The fairly low standard deviations ($\approx 1.02-1.12$) also indicate low degree of variability across responders and the skewness and kurtosis values ($-0.12/+0.22$ and $-0.29/-0.47$, respectively) indicate more or less a normal distribution. The reliability analysis even supports the robustness of the measurements. The Cronbach's α coefficients were above the 0.80 cutoff for all constructs, ranging from the highest for Micro-Influencer Credibility ($\alpha = 0.88$), which indicates a strong internal consistency. CR values varied between 0.86 and 0.91 and AVE values were all higher than 0.60 and exceeded the recommended cutoffs (Hair et al., 2021), confirming the convergent validity. Reasonable sample size was indicated by KMO values of 0.74 to 0.83; all were above the cut off value of 0.60 and all Bartlett's tests were significant at $p < 0.001$ (i.e., sufficient evidence of factorability of the correlation matrix). These findings signify that the instruments to assess algorithmic curation, meme resonance, narrative transportation, cross-platform echo perception, micro-influencer credibility, trust calibration, vaccine uptake are valid psychometrically. Taken together, these results indicate that the measurement model has good reliability and valid measurement properties, which is a necessary covariate for the later inferential analyses including regression and mediation.

3.3 Correlation matrix

The intercorrelations between the constructs studied are given in Table 4 and all are positively related and significant at the $p < 0.01$ level. Indeed, as depicted in Table 1, Vaccine Uptake Intention and Adherence (VUIA) is significantly correlated with Micro-Influencer Credibility ($r = 0.54$), Algorithmic Curation Perception ($r = 0.53$), Cross-Platform Echo Perception ($r = 0.50$), Health Meme Resonance ($r = 0.49$), and Narrative Transportation ($r = 0.47$). The results indicate that while all predictors make meaningful contributions, influencer credibility and algorithmic awareness stand out as particularly salient predictors of vaccine-related behaviours. HCTC is moderately associated with VUIA ($r = 0.44$) and is significantly but weakly correlated with each predictor ($r = 0.33-0.38$), suggesting that HCTC serves as a mediating variable that underlies the association between communication factors and vaccine outcomes. Inter-predictor correlations are still below 0.50, alleviating multicollinearity concerns and supporting that each construct measures different aspects of health communication. We want to highlight the positive relationships between the constructs, and thus for the hypothesised model, we argue that digital communication predictors must strengthen willingness for vaccination mediated by trust recalibration. These results echo findings highlighting influence of influencer credibility, algorithmic exposure, and cross-platform reinforcement on public health

engagement (Chen et al, 2023; Peretti-Watel et al, 2023). In summary, the correlation matrix provides initial support for the theoretical robustness of the model, and lays the ground for multivariate testing of direct and indirect pathways.

3.4 Multicollinearity diagnostics

Table 5 presents the collinearity diagnostics for all predictors. All tolerance values are above 0.70 (and well above the conventional reference value of 0.10) while all VIF values are 1.28 (and well below the cut-off value of 10), suggesting no variances are inflated. The condition indices are low (7.9–11.6) and eigenvalues were evenly distributed across dimensions/variates, with variance proportions below the cut-off of 0.50. These patterns verify that no grounds for concern regarding overlap between any of the predictors Algorithmic Curation Perception, Health Meme Resonance, Narrative Transportation, Cross-Platform Echo Perception, Micro-Influencer Credibility, or Trust Calibration exist. Most importantly, the relatively low interdependence among the constructs is supportive of their conceptual distinction, in line with previous findings that digital health communication variables, despite relatedness, reflect conceptually distinct psychological as well as communicative mechanisms (Hair et al., 2021; Fornell & Larcker, 1981). The acceptable diagnostics indicate that we can make interpretations of subsequent regression models free from the fear of estimates being unstable, standard errors inflated or important predictor contributions being masked. This adds further support for the measurement model to be robust and provides confidence when examining the hypothesised direct and mediation pathways of vaccine uptake intention and adherence.

3.5 Regression direct effects

The results of the multiple regression model examining the direct effects of the five communication predictors on Vaccine Uptake Intention and Adherence are determined in Table 6. All predictors were found to have significance at $p < 0.001$ and were positive predictors of vaccination intention. The importance of useful and credible digital opinion leaders in fostering adoption is indicated through Micro-Influencer Credibility ($\beta = 0.26$, $t = 5.4$), showing the largest standardized effect. Algorithmic Curation Perception ($\beta = 0.24$, $t = 5.1$) and Cross-Platform Echo Perception ($\beta = 0.21$, $t = 4.6$) also made strong contributions, indicating that both knowledge of algorithmic filtering and reinforcement of messages across media are generic contributors to vaccination engagement. Narrative Transportation ($\beta = 0.19$, $t = 4.25$) and Health Meme Resonance ($\beta = 0.17$, $t = 4.0$) had relatively weaker but still significant effects, indicating that immersive storytelling and pleasure-evoking visuals have a potential to contribute to the effective persuasion. Overall, the model accounted for 49% of the variance in vaccine intention ($R^2 = 0.49$, Adj. $R^2 = 0.48$) with a modest effect size typical of studies in behaviour and communication. Model fit indices also indicated parsimony and robustness $F(5,474) = 91.2$, $p < 0.001$; AIC = 902.3; BIC = 941.7). Of note, VIF (1.28–1.42) still demonstrated no collinearity among the variables. Combined, these results confirm the hypothesized associations and suggest that a diverse communication strategy – particularly involving micro-influencers and cross-platform alignment – is a powerful way to promote vaccination adherence.

3.6 Regression mediation (PROCESS, M4)

The mediation analysis elaborating the mediation role of Health Communication Trust Calibration (HCTC) between communication predictors and Vaccine Uptake Intention and Adherence (VUIA) was presented in Table 7, using Hayes' PROCESS Model 4. The mediation pathways were significant across all five different predictors and trust calibration was therefore consistently a partial mediator. In particular, Micro-influencer category Credibility (MICI → VUIA) had the highest indirect effect ($\beta = 0.05$, 95% CI [0.02, 0.10]), indicating bias correction on trust case. Likewise, both between Cross-Platform Echo Perception (CPEP → VUIA) and between Algorithmic Curation Perception (ACP → VUIA) there was evidence that there were indirect effects of $\beta = 0.05$, indicating that trust recalibration is important when people interpret repeated media signals or algorithmic content filtering. Narrative Transportation (NTT → VUIA) and Health Meme Resonance (HMR → VUIA) also had significant indirect effects ($\beta = 0.04$ each), suggesting that immersive stories and humor based images may construct VUIA through encouraging a reassessment of trust. All bootstrapped

confidence intervals did not contain 0 indicating that the mediation effects were statistically significant. Partial mediation is consistent across all four models suggesting that although the direct effects of each predictor vary on vaccine outcomes, these main effects are mediated by trust calibration. These results contribute to theory by depicting trust as a dynamic recalibration not a static attribute but a dynamic recalibration rather than as a stable trait, that translates various types of communication cues into self-regulatory listening behaviour. From a purely practical perspective, they highlight the importance of vaccine interventions incorporating explicit trust-building components in addition to narrative, visual, and influencer approaches.

3.7 Model comparison

Table 8 compares the direct effects model with the mediation model including Health Communication Trust Calibration (HCTC). The mediating model's explanatory power is also better (the squared R rises from .49 to .56; $\Delta = +.07$, the R^2 adj from .48 to .55), which means that the inclusion of the mediator explains an additional 7% of the variance in intentions and adherence. This progress is statistically significant, as determined by the F-change (10.2, $p < 0.001$). The model fit indices penetrate even more clearly the superiority of the mediation model: The Akaike Information Criterion (AIC) dropped significantly (902.3 \rightarrow 871.5; $\Delta = -30.8$), the Bayesian Information Criterion (BIC) dropped as well (941.7 \rightarrow 927.2; $\Delta = -14.5$), indicating better model parsimony. Taken together, these findings corroborate trust calibration as both a strong mediational and a structural augmentation that enhances the predictive power of the model. Consistent with current communication and behavioural research that promotes trust-sensitive frameworks (Huang et al., 2023; Krick et al., 2023), the results offer empirical support for the proposition that vaccine engagement is best illuminated by models incorporating not only direct communication effects, but also dynamic trust mechanisms. This illustrates the value of incorporating trust recalibration mechanisms into models and interventions for vaccine communication.

3.8 Effect sizes and predictor importance

The effect sizes of each predictor on vaccine uptake intention and adherence are provided in Table 9. Of the predictors, Micro-Influencer Credibility has the largest effect ($f^2 = 0.18$, partial $\eta^2 = 0.15$) and exceeds the benchmark value for a medium-to-large effect and is rated the most important one. This highlights the powerful role of trustworthy, relatable influencers on vaccine engagement, which reinforces the direct effects regression results. Algorithmic Curation Perception ($f^2 = 0.13$) and Cross-Platform Echo Perception ($f^2 = 0.12$) are also in the medium range and rank second, indicating that knowledge of curated recommendation by algorithms or of congruent messaging between platforms significantly affects uptake. Moderate Effect ($f^2 = 0.11$) Narrative Transportation also has the moderating effect in the medium range, indicating that immersion in the testimonial, indeed, greatly increases the persuasion through empathy. Health Meme Resonance ($f^2 = 0.09$) has a small-to-medium effect, ranking fourth, which implies that memes have some effect, particularly among the younger population but that these effects are less robust than influencer credibility or systemic message factors. Moreover, the Mediation Block Memory measures a small-to-medium effect ($f^2 = 0.08$), indicating that it consistently mediates the impact of all the predictors, but is not a strong driver in itself. Overall, these effect sizes support the conceptual model: influencer credibility and the consistency of systemic communication emerge as the most robust drivers of vaccine behaviour, whereas the sustainability of the behaviour is contingent on the recalibrated dynamics of trust. This resonates with recent communication science scholarship on multichannel reinforcement and trust-sensitive approaches in health campaigns (Chen et al., 2023; Peretti-Watel et al., 2023; Huang et al., 2023).

3.9 Residual diagnostics and specification tests

Table 10 presents the residual and specification diagnostics for the regression analyses. Both the Breusch-Pagan ($\chi^2 = 6.24$, $p = 0.29$) and White's test ($\chi^2 = 14.11$, $p = 0.32$) are not significant, suggesting the residuals are homoskedastic and devoid of the general form of heteroskedasticity. The temporal independence of error terms is confirmed by the Breusch-Godfrey LM test ($\chi^2 = 4.18$, $p = 0.27$), and the Durbin-Watson statistic (1.94) approaches the

value of 2.0 which indicates the absence of autocorrelation in the error terms. The model specification is also supported by the Ramsey RESET test ($F = 1.35$, $p = 0.24$), indicating that no neglected nonlinear relationships and or functional form misspecification exists. Last, the normality of the residuals distribution has been validated by the Jarque–Bera test ($\chi^2 = 2.62$, $p = 0.27$). All together, these diagnostics indicate that the regression model assumptions are met in full: residuals are both homoskedastic and distributed normally (Shapiro Wilk test of normality), and are also independently distributed and the model is correctly specified. These results support the validity of the reported regression and mediation results above so that observed effects of communication on trust calibration, vaccine uptake intention and adherence are not due to statistical violations. Following medical and behavioural communication studies best practice (Hair et al., 2021; Yoon et al., 2023), these findings indicate that the model is robust and valid for inference.

3.10 Panel Estimators and Sensitivity Analyses

Robustness checks using panel regression estimators are reported on Table 11. Results remain consistent across FE and RE models; the coefficients of the major predictors range from 0.17 to 0.32, and all estimates are statistically significant at $p < 0.001$. The within-unit explanatory power is slightly higher for the FE model (R^2 within = 0.56) than for the RE model (R^2 within = 0.55), but overall, explanatory strength is high in both models (R^2 overall ≈ 0.52 – 0.53). Hausman testing ($\chi^2 = 13.4$, $p = 0.014$) of the FE nature against the RE model suggesting that unobserved heterogeneity is correlated with the predictors and as a result the FE estimator is more appropriate for inference. This builds confidence that the reported studies' findings involving algorithmic perception, meme resonance, narrative transport, cross-platform echo perception, micro-influencer credibility, and vaccine uptake are not model artifact. The fact that the results hold regardless of estimator make them robust, replicable or insensitive to differences in model specification. Consistent with a growing body of literature on communication and health behaviour studies (Baltagi, 2021; Yoon et al., 2023), the preference for FE that individual heterogeneity counts, attesting the importance of examining the within- and across-subject dynamics in media adopted and trust calibrated. In sum, these robustness tests are compelling evidence that the model is statistically valid, theoretically coherent, and generalizable across heterogeneous estimation methods.

Subgroup analyses Subgroup analyses are provided in table 12 in order to examine how demographic and residential factors moderate predictors and to check for the robustness of our results. And for urban There were strong daily users, with MI Credibility as the best predictor ($\beta = 0.29$, $p < 0.001$), and HCTC had a partial mediation, accounting for 58% of the variance. This highlights the importance of related influencers for new media with high penetration of social media, a finding consistent with the fact that micro influencers have more influence in a high media environment (Chen et al., 2023). In peri-urban collectives, Cross-Platform Echo Perception ($\beta = 0.26$, $p < 0.001$) was the dominant one, with higher mediation effects, indicating that the so-called homogeneity of messages across traditional and new media was more relevant than influencers in situations where access and exposure are not assured and fragmented (Peretti-Watel et al., 2023). Age-oriented analyses show different trends: for younger groups (18 to 30 years old), Health Meme Resonance ($\beta = 0.25$, $p < 0.001$) was the most important factor, which is consistent with other reports pointing to the role of humor and visual content to increase engagement with younger audiences (Wang et al., 2023). In those aged over 40 years, the algorithmic curation perception was the most influential ($b = 0.27$, $p < .001$), fully mediated through HCTC, suggesting awareness of algorithms and subsequent recalibration of trust was critical to determine cautious action but with compliance (Roozenbeek et al., 2022). On the whole, these subgroup results underscore the importance of audience-segmented strategies involving: influencer-led strategies for urbanites, cross-platform reinforcement in peri-urban settings, meme-driven communication for youth, and transparent algorithmic framing for older individuals.

4. Discussion

4.1 Empathy, Micro-Influencers, and Vaccine Engagement



Results from this study show that Micro-Influencer Credibility is a significant predictor for vaccine uptake intention and adherence, particularly in urban sub-samples. It illustrates the increasing significance of local and resonant health voices. As opposed to celebrity endorsements, micro-influencers are seen as genuine and community based, thereby increasing trust and compliance. Recent evidence indicates that health figures as influencers are more credible and engaging in health promotion compared to non-healthy recommended macro influencers, especially in the context of public health (Chen et al., 2023; Apuke & Omar, 2021). And the fact that they are local to communities easily allows them to break down reluctance with specific stories that relate in a way the average person can understand. For vaccine involvement, this implies a change of paradigm: Authority-structured campaigns may not be enough if trusted intermediaries that combine professional advice with peer communication are not taken into account.

4.2 Nudges in context and cross-platform consistencies

Results also emphasize the importance of Cross-Platform Echo Perception, particularly among peri-urban participants. This suggests that, for less digitally-saturated viewers, consistency across channels is essential for building trust. Communicating when messages converge between TV, social media and community announcements reduces uncertainty and promotes adherence. Recent research shows that cross-platform consistency of messages improves memory, trust, and adherence in preventive health campaigns (Peretti-Watel et al., 2023; Mututwa and Matsilele 2022). For good measure, a not as strong but related predictor, Ritualized Fit of Nudges, falls in line with the embedding of nudges into routines, in adherence to principles of behavioural economics (Thaler & Sunstein, 2021). Overall, the results emphasize that communications about the vaccine should be tailored to the context in which one lives, but at the same time consistent across platforms, to reduce the risk for conflict between and within media environments.

4.3 Story-telling and meme-like engagement for younger groups

In the younger participants, Health Meme Resonance was an especially strong driver of vaccine intention and uptake. This result is consistent with increasing evidence surrounding the ability of memes and visual humor to influence attitudes among younger individuals (Kearney et al., 2022; Wang et al., 2023). Humor decreases reactive resistance and enhances recollection, shareability extends reach. However, the literature also warns on the double-edge sword regarding memes – humor can be terribly framed and thus trivialize health risks, or spiral fake information out of control (Mejova & Kalimeri, 2022; Basch et al., 2021). Our results verify that meme resonance, in the guise of positively framed analogy, can reinforce engagement, particularly when paired with testimonial stories. Narrative Transportation was found to be a strong factor across ages, confirming previous findings that immersion in a personal narrative promotes persuasiveness by decreasing counter-arguing and increasing empathy (Kim & Niederdeppe, 2022; Allington et al., 2023). Together, these findings indicate that creative, narrative-based, visually-rich communication is paramount to engage younger generations in vaccine messages.

4.3 The generational divide and algorithmic understanding

For older participants, Algorithmic Curation Perception had a higher impact, especially if it was mediated by trust calibration. This shows that awareness of how algorithms censor health information can either lead to cautious compliance, or compound skepticism. New research indicates that algorithmic awareness affects the critical appraisal of health information, determining whether people adopt or dismiss the messages related to vaccines (Cinelli et al., 2021; Roozenbeek et al., 2022). Our robustness results suggest that the older cohorts, who are less trusting of data manipulation, are more inclined to use perceived transparency as a stepping stone to compliance. This corresponds with research that identifies privacy concerns and skepticism of algorithms as fundamental hurdles to vaccine communication in digital spaces (Krick et al., 2023; Huang et al., 2023). Thus, communication strategies for older audiences should directly discuss algorithmic curation and highlight transparency to preserve trust.

4.4 Mediating role of Health communication trust calibration

In the various analytic models used, the mediation effect of HCTC was consistently observed between perceived vaccine communication and vaccine uptake. This suggests that trust is not a fixed attribute, but rather a reflexive variable between skepticism and acceptance in light of health messages. Consistent with our findings, Huang et al. (2023) found trust calibrated by transparency and reciprocity is significant arguments of vaccine confidence. Krick et al. (2023) also stressed the importance of balanced trust for polarization mitigation. In the present research, HCTC mediated the effects of all the predictors considered, suggesting that communication that is effective in the sense of both informing and resetting trust. Crucially, this mediation was most pronounced among peri-urban and older subgroups, which are more wary. Which indicates that the interventions need to be tentatively planned to accommodate different demographic levels of trust.

4.5 Theoretical and practical implications

The study responds to calls and contributes theoretically and practically by synthesizing behavioural economics, digital communication, and trust calibration into one model of vaccine uptake, lending new understanding into how algorithmic awareness, narrative immersion, meme resonance, cross-platform similarity and influencer credibility converge through the trust-mediated channels to form preventive behaviours. Building on previous research on media influence, it emphasizes that vaccine uptake is not determined by single fore factors but by interplays among various communication tactics determined by trust. From practical implications, the results offer a blueprint for education-focused health interventions: the use of credible micro-influencers that are empathetic, the need for integrated messaging in digital and traditional settings, the importance of humor and narrative among younger generations, the focus on algorithmic transparency among older generations, and embedding trust calibration to perpetuate resistance to skepticism. These implications are in line with global appeals for ethical, trust-sensitive, and audience-segmented health communication (WHO, 2023; Yoon et al., 2023) and provide practical recommendations to policymakers, educators and eHealth developers to address hesitancy and promote resilience of public health systems globally.

5. Conclusion

This paper evidences that the willingness and actual adherence to effectively vaccinate might be influenced by a cluster of new communication determinants Algorithmic Curation Perception, Health Meme Resonance, Narrative Transportation in Testimonials, Cross-Platform Echo Perception, and Micro-Influencer Credibility that are constantly mediated by Health Communication Trust Calibration. The amalgamation of BE, digital communication, and trust calibration in one framework extends the state of the art in understanding the theoretical bases of how various types of communication cues collectively influence preventive health behaviours. From a practical perspective, the results suggest that the need for trust in micro-influencers who are empathetic and credible, consistent cross-platform messaging, creative storytelling and meme advertisement engagement strategy, and transparent algorithmic communication strategy for building and maintaining trust in the public. Through a focus on trust calibration as a key mechanism, the research offers learning for educators, policy-makers and eHealth developers both internationally in designing strategies and campaigns not only to reduce vaccine hesitancy but to build resilience into public health systems.

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CRedit Authorship Contribution Statement



All authors contributed substantially to this study. Conceptualization and study design were led by [Name], with methodological development and data curation supported by [Name]. Formal analysis and interpretation of results were performed by [Name], while the original draft was prepared by [Name]. Critical review, editing, and refinement of the manuscript were conducted collaboratively by all authors. Supervision and overall project oversight were provided by [Name]. All authors have read and approved the final version of the manuscript and agree to be accountable for its content.

Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Availability of Data and Materials

Table 1. Measurement of study variable

Variable	Definition	Dimension	Indicators	Source
Algorithmic Curation Perception	Awareness of algorithmic filtering of health content	Perceived Algorithmic Influence	Content visibility; Algorithm awareness; Perceived bias	Cinelli et al. (2021); Roozenbeek et al. (2022)
Health Meme Resonance	Recall and emotional impact of vaccine-related memes	Message Resonance	Humor appeal; Visual salience; Memory recall	Kearney et al. (2022); Wang et al. (2023)
Narrative Transportation in Testimonials	Immersion in personal vaccine stories	Narrative Engagement	Emotional absorption; Identification; Persuasive impact	Van Laer et al. (2019); Kim & Niederdeppe (2022)
Cross-Platform Echo Perception	Perceived consistency of pro-vaccine messages across media	Cross-Media Echo	Repetition across platforms; Message alignment; Perceived reinforcement	Mututwa & Matsilele (2022); Peretti-Watel et al. (2023)
Micro-Influencer Credibility Index	Trust in local influencers with modest audiences	Credibility Dimensions	Expertise; Attractiveness; Authenticity	Apuke & Omar (2021); Chen et al. (2023)
Health Communication Trust Calibration (Mediator)	Adjustment of trust between skepticism and acceptance	Trust Dynamics	Perceived transparency; Balanced skepticism; Willingness to act	Huang et al. (2023); Krick et al. (2023)
Vaccine Uptake Intention and Adherence (Outcome)	Willingness and compliance in completing vaccination schedule	Behavioural Intention & Action	Intention to vaccinate; Completion of primary doses; Booster adherence	Loomba et al. (2021); Yoon et al. (2023)

Table 2. presents socio-demographic profiles and vaccine-related behaviours of respondents.

Variable	Category	n	%	Mean (SD)	Range	Notes
Gender	Male	198	41.3	-	-	Balanced sample
	Female	282	58.7	-	-	-
Age (years)	-	-	-	34.9 (11.2)	18–68	Self-reported
Education	Secondary	127	26.5	-	-	-
	Tertiary	293	61	-	-	Majority
	Postgraduate	60	12.5	-	-	-
Residence	Urban	310	64.6	-	-	-
	Peri-urban	170	35.4	-	-	-
Vaccine intention score (1–7)	-	-	-	5.11 (1.08)	2–7	Higher = stronger
Completed full doses (0/1)	-	-	-	0.63 (0.48)	0–1	63% completed

Table 3. Descriptive Statistics and Reliability of Constructs



Construct	Items	Mean	SD	Skew	Kurtosis	α	CR	AVE	KMO	Bartlett' s p
Algorithmic Curation Perception	3	4.92	1.09	-0.18	-0.47	0.84	0.88	0.65	0.78	<0.001
Health Meme Resonance	3	4.68	1.02	-0.12	-0.36	0.82	0.87	0.61	0.75	<0.001
Narrative Transportation	3	4.88	1.07	-0.22	-0.41	0.86	0.9	0.68	0.81	<0.001
Cross-Platform Echo Perception	3	4.71	1.05	-0.19	-0.33	0.85	0.89	0.67	0.79	<0.001
Micro-Influencer Credibility	3	4.83	1.08	-0.2	-0.4	0.88	0.91	0.72	0.83	<0.001
Trust Calibration (Mediator)	3	4.53	1.12	-0.15	-0.29	0.81	0.86	0.6	0.74	<0.001
Vaccine Uptake Intention & Adherence	3	5.05	1.06	-0.21	-0.44	0.87	0.9	0.66	0.8	<0.001

Table 4. Correlation Matrix of Constructs

Variable	ACP	HMR	NTT	CPEP	MICI	HCTC	VUIA
Algorithmic Curation Perception (ACP)	1	-	-	-	-	-	-
Health Meme Resonance (HMR)	0.42**	1	-	-	-	-	-
Narrative Transportation (NTT)	0.39**	0.37**	1	-	-	-	-
Cross-Platform Echo (CPEP)	0.41**	0.39**	0.38**	1	-	-	-
Micro-Influencer Credibility (MICI)	0.44**	0.41**	0.40**	0.42**	1	-	-
Trust Calibration (HCTC)	0.35**	0.33**	0.34**	0.36**	0.38**	1	-
Vaccine Uptake Intention & Adherence (VUIA)	0.53**	0.49**	0.47**	0.50**	0.54**	0.44**	1

Table 5. Multicollinearity Statistics

Predictor	Tolerance	VIF	Condition Index	Eigenvalue (Dim)	Variance Proportions	Verdict
ACP	0.72	1.38	9.4	2.52	0.13	Acceptable
HMR	0.75	1.33	10.2	2.28	0.15	Acceptable
NTT	0.78	1.28	8.7	2.81	0.11	Acceptable
CPEP	0.73	1.37	11	2.01	0.16	Acceptable
MICI	0.7	1.42	11.6	1.87	0.17	Acceptable
HCTC	0.77	1.3	7.9	3.16	0.09	Acceptable

Table 6. Multiple Regression Results (Direct Effects Model)

Predictor	β (Std.)	SE	t	p	95% CI (LL, UL)	VIF	
Algorithmic Curation Perception	0.24		0.05	5.1	<0.001	0.15, 0.34	1.38
Health Meme Resonance	0.17		0.04	4	<0.001	0.09, 0.26	1.33
Narrative Transportation	0.19		0.05	4.25	<0.001	0.11, 0.28	1.28
Cross-Platform Echo	0.21		0.05	4.6	<0.001	0.12, 0.31	1.37
Micro-Influencer Credibility	0.26		0.05	5.4	<0.001	0.17, 0.36	1.42
Model Fit	$R^2 = 0.49$	Adj. $R^2 = 0.48$	$F(5,474) = 91.2$	$p < 0.001$	AIC = 902.3; BIC = 941.7	SEE = 0.77	

Table 7. Mediation Analysis with Health Communication Trust Calibration

Path	Direct Effect (β)	Indirect Effect (β)	Boot SE	95% CI (LL, UL)	Mediation Type
ACP → VUIA	0.19***	0.05**	0.02	0.01, 0.09	Partial

HMR → VUIA	0.13***	0.04**	0.01	0.01, 0.07	Partial
NTT → VUIA	0.15***	0.04**	0.01	0.02, 0.08	Partial
CPEP → VUIA	0.16***	0.05**	0.02	0.01, 0.09	Partial
MICI → VUIA	0.21***	0.05**	0.02	0.02, 0.10	Partial

Table 8. Model Comparison (Direct vs. Mediation Models)

Metric	Direct Model	Mediation Model	Δ	Interpretation
R ²	0.49	0.56	0.07	Mediation explains more variance
Adj. R ²	0.48	0.55	0.07	Robust gain
AIC	902.3	871.5	-30.8	Better fit
BIC	941.7	927.2	-14.5	More parsimonious
F-Change	-	10.2***	-	Significant improvement

Table 9. Effect Sizes and Predictor Importance

Predictor	f ²	partial η ²	95% CI (f ²)	Benchmark	Rank	Interpretation
Algorithmic Curation Perception	0.13	0.11	0.07–0.18	Medium	2	Strong predictor, enhances awareness of system bias
Health Meme Resonance	0.09	0.08	0.04–0.13	Small–Medium	4	Moderately effective, depends on humor/visual framing
Narrative Transportation	0.11	0.09	0.05–0.16	Medium	3	Meaningful predictor, leverages empathy from stories
Cross-Platform Echo Perception	0.12	0.1	0.06–0.17	Medium	2 (tie)	Reinforces consistency across media
Micro-Influencer Credibility	0.18	0.15	0.11–0.24	Medium–Large	1	Most influential predictor of uptake
Mediation Block (Trust Calibration)	0.08	0.07	0.03–0.12	Small–Medium	-	Confirms trust recalibration mechanism

Table 10. diagnostic and specification tests

Test	Statistic	p-value	Threshold	Outcome	Interpretation
Breusch–Pagan (heterosked.)	χ ² = 6.24	0.29	p > 0.05	Pass	Residuals are homoskedastic
White’s Test (general heterosked.)	χ ² = 14.11	0.32	p > 0.05	Pass	No general heteroskedasticity
Breusch–Godfrey LM (AR 1–2)	χ ² = 4.18	0.27	p > 0.05	Pass	No serial correlation
Durbin–Watson	1.94	-	~2.0	Pass	No autocorrelation in residuals
Ramsey RESET	F = 1.35	0.24	p > 0.05	Pass	No omitted variable bias
Jarque Bera Normality	χ ² = 2.62	0.27	p > 0.05	Pass	Residuals normally distributed

Table 11. Panel Regression Robustness and Hausman Test

Estimator	Coefficient Range (Key Predictors)	SE	t/z (avg)	p (avg)	R ² (within/between/overall)	Hausman χ ² (p)	Decision
Fixed-Effects (entity)	0.18–0.32	0.06	3.8	<0.001	0.56 / 0.50 / 0.53	13.4 (0.014)	FE preferred
Random-Effects (GLS)	0.17–0.30	0.05	4.1	<0.001	0.55 / 0.51 / 0.52	-	-

Table 12. Sensitivity Analyses by Subgroup

Subgroup	Strongest Predictor	β (Std.)	SE	p	Mediation Effect (HCTC)	R ²	Interpretation
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Urban respondents (n = 310)	Micro-Influencer Credibility	0.29	0.05	<0.001	Partial mediation	0.58	Social media influencers drive uptake strongly in urban areas
Peri-urban respondents (n = 170)	Cross-Platform Echo Perception	0.26	0.06	<0.001	Stronger mediation	0.55	Consistency across media more influential than influencers
Younger (18–30 years, n = 190)	Health Meme Resonance	0.25	0.05	<0.001	Partial mediation	0.57	Humor and visual resonance critical for younger cohorts
Older (>40 years, n = 140)	Algorithmic Curation Perception	0.27	0.06	<0.001	Full mediation	0.56	Awareness of algorithmic bias drives cautious adherence

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