

DETERMINANTS OF VACCINE HESITANCY AND EFFECTIVENESS OF INTERVENTIONS TO IMPROVE UPTAKE IN THE POST-COVID-19 ERA: A SYSTEMATIC REVIEW

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Abstract

Background: The vaccination against COVID-19 has already gone through advances in the world, yet vaccine hesitancy remains a challenge to reach maximum coverage and minimize further epidemics. New behavioral, informational, and structural problems define the new reality of the post-pandemic world. The key elements that contribute to the reluctance and the effectiveness of interventions need to be comprehended to accelerate additional vaccination.

Objectives: The aim of the proposed study is to perform a systematic review and evidence synthesis of (1) determinants of vaccine hesitancy in the post-COVID-19 era and (2) the impact of interventions that can be used to increase vaccine acceptance and uptake.

Methods: The systematic review was carried out based on PRISMA 2020 rules. Electronic searches (PubMed, Scopus, Web of Science and Google Scholar) were conducted and restricted studies were located based on limits of publication date (January 2019 to May 2025). The criteria used to include eligible studies were that the research conducted was on adults (18 years and above), that the study reported one of the predictors of hesitancy or one of the measures to raise uptake and had quantitative or qualitative results. Important determinants were extravasated, which included type of intervention and effect sizes (odds ratios [OR], risk ratios [RR], hazard ratios [HR]). The tools adopted in quality assessment were Cochrane Risk of Bias 2 tool in RCTs and Newcastle-Ottawa Scale in observational research.

Results: A total of 28 studies (n = 43,210 participants) were selected out of 2,346 reviewed. Fear of negative outcomes (78%), false information (61%), distrust in the health authorities (65%): These were the most prevalent reasons that contributed to hesitancy. The age, lack of education and residence in rural areas were significantly related with refusal (p < 0.01). **Interventions:** Owning customized health messages contributed significantly to the acceptance (pooled OR = 1.26; 95% CI: 1.12 -1.42). The highest uptake improvements were created

by pop-up clinic and community outreach (RR = 1.54; 95% CI: 1.30179) and the smallest, yet significant impact on the uptake was found with digital nudges (RR = 1.19; 95% CI: 1.05135). **System trust:** The more effective uptake was strongly correlated with greater trust ($r = 0.68$). Long-term outcomes of campaigns in high-trust contexts were greater as compared to low-trust contexts.

Conclusions: The primary determinants of vaccine hesitancy in the post COVID-19 period are the safety concerns, misinformation, and institutional distrust. The most effective ways to increase the uptake and mobilizations should be community-based, and the digital interventions must be offered equally and with support. Trust in the health systems should be developed so that sustainable vaccine acceptance is achieved. Future studies will aim at standardized outcome reportage and reconcile long term confidence and lead to convergence of behavioral and equity framework to influence resilient immunization.

INTRODUCTION

The very phenomenon of COVID-19 caused one of the most significant impressions in the history of the present day due to its enormous disturbance of the entire global community and the number of deaths that have been reported to have hit 6.9 million by the middle of 2025. The creation and introduction of efficient vaccines was declared a breakthrough, and it changed the context of the pandemic, saving the lives of millions of other individuals. However, the international reaction also showed just how institutionalised opposition to vaccines is. With the availability of strong vaccines, its known clinical efficacy, a segment of the population of the high and low-income countries were reluctant or opposed to vaccine injection. Not only did this vaccine reluctance delay the date of herd immunity, it also resulted in new infection waves, prolonged the social and economic impact of the pandemic, and eliminated confidence in government institutions in health [1-3].

The definition of the World Health Organization (WHO) that characterizes vaccine hesitancy is the postponement of the acceptance or the rejection of vaccines in the presence of vaccine services. The determinants are known to be complex and context-specific and time and different vaccines varying. In the COVID-19 times, hesitancy also gained new dimensions, such as the fear of the hasty development of vaccines, the involvement of the political factor in the activities of scientists, mass production of fake information on the Internet and social networks. Although vaccine

confidence increased and declined in line with the severity of the pandemic and personal perceived risk, it was observed that even when the acute threat had disappeared there existed a stratum of the population that was unresponsive to vaccination efforts [4-6]. The significance of these drivers is also urgent in the post-pandemic environment where the question of vaccination is of concern in terms of the handling of new variants and other vaccine-preventable diseases.

Takes a great number of behavioral, social and structural determinants into consideration the decisions that need to be made regarding vaccination. Fear of side effects, uncertainty regarding the long-term safety, and the perceived lack of the risk of the disease are also psychological reasons that are a major barrier. At the same time it is dramatic in information ecosystem. Social media has succeeded in disseminating health-related messages, yet it has also been the cause of misinformation and conspiracy theories that have lowered the level of trust people had towards vaccines and institutions.

The sociodemographic characteristics, such as age, level of education, income level and urban or rural living are also influencing vaccination choice. The less-educated individuals and populations inhabiting rural territories are more hesitant because they cannot receive trusted information and have more significant barriers to health care services based on the evidence presented in other areas [7-9]. The beliefs related to vaccines also intersect with religious or cultural values, or political identity,

and reluctance is, thus, a very situational phenomenon.

Governments and health systems, in their turn, have elaborated diverse types of different interventions to raise the vaccine coverage, both mass media campaigns and the exceedingly specific community-based measures. The first messages of the pandemic were anchored in the urgency and shared responsibility but over time the approach was forced to shift in terms of meeting the need to overcome the fatigue of misinformation, restore trust and reach people of different generations. Digital health tools consisted of mobile applications, chatbots and automated reminders which can be scaled to provide personalized data and appoint a patient. Meanwhile, community based intervention involving faith leader-involvement, mobile-vaccination clinic and door to door counseling were found to be important in the access of the underserved and suspicious population [10-12]. Vaccine certification, and workplace and incentive mandates were also popular policy instruments whose implementation was controversial to varying extents, especially among low-trust communities.

Despite the fact that the evidence base of the interventions associated with the COVID-19 vaccinations is broad, most of it is context-specific and short-term in nature. Evidence that has been pooled on determinants of hesitancy in a systematic review and comparative effectiveness of interventions in response to a post-primary pandemic is very limited. It also needs to learn what can be done to make interventions work when there is trust at work, digital access and social equity, especially how governments prepare to booster campaigns, respond to new pathogens and react to declining routine immunization [13-15].

This is a systematic review that tries to fill this gap in knowledge by combining the results of various studies designs and world situations. This review aims to inform evidence-based interventions that can help enhance vaccine acceptance not just during the COVID-19 but also in post-pandemic times, which entails identifying the most dominant factors that lead

to post-pandemic vaccine hesitancy, as well as investigating the potential effect of customized communication, community mobilization, digital technologies, and policy programs. The review also identifies chronic gaps in the quality of research, standardization of outcomes and equity issues and offers a template against which to build the effective and inclusive future interventions. Finally, the implications of the research on policy makers, leaders operating within the health and practice setting would be the development of resilient systems of vaccination that would be resistant to misinformation, instill trust, and enhance uptake in non-homogenous populations.

Literature Review

The vaccine hesitancy process that is defined by the World Health Organization as the delay of vaccines acceptance or rejection despite their availability has been viewed as a complex and context-related phenomenon. Before the COVID-19 pandemic, vaccine skepticism has frequently been linked to beliefs regarding childhood vaccination against human papillomavirus vaccination, mumps, measles, or rubella vaccination. However, the COVID-19 crisis entered the field, and major sources of suspicion became stronger than before, creating new ones. The lack of safety and long-term safety side effects were even more dreadful because of the unprecedented rate of creating vaccines, emergency approvals, and politicizing health messages [16-18]. At the height of the pandemic, people had been initially very enthusiastic to get vaccinated in most countries but the perceived risk decreased, and misinformation spread without any restrictions on it. These changes demonstrate that vaccine hesitancy is a dynamic phenomenon and it responds to the social and scientific situations.

The consequences of the pandemic have demonstrated that the obstacles to vaccination are long-term and dynamic. The most common form of objection to vaccination is as a result of safety concerns as anecdotal observations of safety-related problems, media melodramatics, and scientific misinterpretation. The lack of trust

towards government and health officials has become more noticeable in places where the management of the pandemic was seen as unequal or political. Trust towards health practices has been compromising in a variety of contexts due to social inequalities and historical disparities of marginalized people. The identity markers such as political affiliation, religion and cultural beliefs have profound effects on vaccine acceptance making it essential to be able to think contextually of the type of intervention that would offer value beyond the simple process of knowledge dissemination to public health [19-21].

This is a new challenge where the information environment plays a very crucial role. On one hand, digital and social media are a powerful mode of health promotion; on the other hand, it has elevated the level of misinformation and conspiracy stories being propagated. Studies have always managed to report that exposure to unconfirmed information on social media platforms such as Facebook, Twitter and WhatsApp is associated with lower beliefs on vaccines. Misinformation about the mRNA allegedly altering human DNA to cause infertility or cause other severe long-term effects has become a trending topic in the pandemic, and is now established in certain communities. These are some tales that have been difficult to disprove; as perceptions may be corrected on the fly through myth-busting and expert-led fact-checking, lies are likely to resurface, and social media algorithms feed into echo chambers [22-24]. Meanwhile, it can be done in the online arena, through interactive campaigns, open communication of health professionals, and multimedia message tailored specifically, which have been shown to have real benefits, yet their sustainability is questionable.

Even the sociodemographic factors and the context complicate the issue of vaccine acceptance. Hesitancy is closely associated with age, education and income. Younger adults also underestimate the severity of the infectious diseases and can believe that they are not at risk, but older adults might be resistant due to comorbidities and the fear of adverse outcomes.

Less education and lower health literacy levels contribute to the increased vulnerability of the individual to misinformation and the undermining of the faith in scientific advice. Other structural barriers to access include rural and underserved populations, including fewer medical workers, growing distance to vaccination sites, and no internet [25-27]. Culture and religion also play a role in the decision making process, and some of the populations are very nervous about the vaccine constituents working against their eating or religious culture, and some respond positively to the suggestion of their local religious or community leaders. Gender trends have also occurred where women have expressed more concerns regarding fertility and safety of pregnancy and some men have given less priority to vaccination because they believe they are invincible.

Attempts have been made to bridge these barriers and the outcome has been different intervention strategies. One-on-one health messages have proven to have a consistent impact in the case where they can address personal fears, describe vaccine creation in a clear manner, and in the cases where they are delivered using local languages through trusted intermediaries, such as clinicians or community health workers. One-to-one marketing is generally more effective than the mass media marketing because it is able to provide two-way communication and a reassurance. Community-based strategies like faith mobilization, mobile clinics, and door to door counseling help reduce logistical challenges and create convenience because of the formation of social trust. The concept that culturally-adapted education is more helpful to encourage uptake has some support with the added benefit of instant opportunities to vaccinate, which can increase uptake by 20-30 percent compared to traditional approaches [28-30].

The vaccine behavior has been presented with new opportunities by the emergent possibilities of the fast growth of digital health tools regarding the COVID-19 and its aftermath. Apps helping people to plan their visits, send notifications or even set up chat robots to respond to all the questions were linked to slight, though, the

visible improvements in uptake. These services will be convenient in maintaining the sense of awareness and convenience, though it will only be effective in places where there is an internet connection, a smartphone, and user literacy. There are also certain populations that are restricted by privacy issues and deficit of digital trust; specifically, the populations that have historically faced victimization due to the misuse of personal information. Community engagement on-ground and using digital solutions is thus the most appropriate formula to employ as compared to exclusive use.

Efforts to implement quasi-universal policy interventions like requirements, credentials, and subsidies have been both more successful and less successful. In other regions the necessity to travel, work, or visit an publicly available event caused the percentage of vaccinated people to rise; in other regions it triggered resistance and mistrust in particular when it was seen as coercive. Monetary rewards like vouchers or lotteries have been observed to result in temporary effect of first dose coverage but not sustained effect on long term confidence or adherence of long dose schedules. These experiences explain policy leverages to be a useful tool but they can only work in a scenario where there is effective communication and there is a true interest of the people.

Despite increasing evidence base, there are also gaps of critical nature. The follow-up of a part of the studies is extremely low and only instantaneous uptake is assessed and makes it unclear whether there is a follow-up of the acceptance and trust to the vaccine in the long-term. Hesitancy and uptake are general words that are consequently difficult to compare. Very little research is straightforward in the measurement of trust, or cost-effectiveness and scalability of intervention. Furthermore, systematic reviews to date have tended to address determinants or interventions in isolation, and not to combine the two to produce actionable models of post-pandemic immunization strategies. As some of the population lose the urgency, and focus, there is a dire need to generalize what makes people hesitant in large

group, and what can be done to remedy the hesitancy.

To address these aspirations, this review not only summarizes the global data on the most significant psychological, social, and structural factors in the determination of vaccine hesitancy but also provides the model through which the effectiveness of the various interventions that may prove useful in the post-COVID-19 period can be assessed to increase uptake. It will shape the future of the way vaccination programs are going to be by bringing out the successes and the opportunities that still needed the consideration with the intention of steering the programs towards the relationship-based, culturally responsive and evidence-based programs in a way that will guarantee high rates of coverage even beyond the crisis period.

Methodology

Study Design

This paper was designed as a systematic review to determine and synthesize existing knowledge on the determinants of vaccine hesitancy and the impact of interventions to increase vaccine uptake in the post COVID-19 era. To achieve transparency, reproducibility, and rigor, the review followed the guidelines of the Preferred Reporting Items (PRISMA 2020) framework of systematic reviews and meta-analyses.

Search Strategy

Electronic search was carried out in the following databases in a systematic way:

- PubMed (MEDLINE)
- Scopus
- Web of Science
- Google Scholar (first 200 hits)

The search time frame was between January 2019 and May 2025, which is the post-COVID-19 vaccination age. Combination of Boolean operators and MeSH terms was used to develop an effective but specific strategy. Search strings of representative search will be:

- vaccine hesitancy and (determinants OR predictors) and COVID-19
- vaccination uptake AND intervention* and (post-COVID OR after pandemic)

- “(trust OR misinformation OR safety concerns) AND immunization AND acceptance. Additional studies were identified by hand-searched reference lists of articles that had met the criteria and additional systematic reviews.

Study Selection Process

All records have been screened by two independent reviewers in two stages:

1. Relevancy to determinants or interventions in COVID-19 vaccination Title and Abstract screening.

2. Full-text assessment with the use of predetermined inclusion and exclusion criteria (Table 1).

Conflict situations were solved through discussion or in the event of need, a third reviewer.

PRISMA 2020 Flow Chart (Figure 1)

Among 2,346 records found, 154 were in full text. The final synthesis included 28 studies after the use of eligibility criteria. Non-COVID-19 setting (41), no quantitative uptake result (56), and follow-up less than 6 months (29) were the major grounds of exclusion.

Table 1. Inclusion and Exclusion Criteria

Criterion	Inclusion	Exclusion
Population	Adults ≥ 18 years in the post-COVID-19 era evaluating vaccination behavior	Pediatric studies; pre-COVID vaccine hesitancy only
Determinants/Interventions	Studies exploring psychological, social, or structural determinants of hesitancy or evaluating interventions to improve uptake	Studies limited to technical feasibility or modeling without outcomes
Outcomes	Hesitancy prevalence, vaccine uptake/coverage, trust levels, risk ratios	No outcome data or opinion pieces
Study Design	Randomized controlled trials (RCTs), cohort, case-control, cross-sectional, mixed-methods, systematic reviews	Editorials, letters, conference abstracts
Language	English	Non-English without translation
Time Frame	January 2019 – May 2025	Before 2019

Data Extraction and Management

The most important study data were collected in a standard extraction sheet:

- Author, year, and country
- Specifications of population and size of sample.
- Heasers (e.g. safety concerns, misinformation, distrust)

- Intervention type (e.g. community outreach, one-on-one communication, digital tools)
- Outcome measures (vaccine uptake (percent), odds ratios (or OR), risk ratios (RR), hazard ratios (HR), effect sizes).
- Follow-up duration

The extraction and cross-checking of the data were done by two reviewers.

Table 2. Sample Data Extraction Table

Study ID	Year	Country	Focus Area	Sample Size	Follow-Up	Key Outcomes & Effect Sizes
S1	2021	USA	Safety concern education	1,200	12 mo	OR = 1.34 for acceptance after tailored messaging
S7	2022	UK	Social media myth-busting	2,000	9 mo	Hesitancy ↓28%, RR = 1.41 for uptake
S15	2023	India	Community mobilization & pop-up clinics	3,500	18 mo	Uptake ↑29%, RR = 1.56
S23	2024	Brazil	Digital nudges (app + reminders)	1,800	6 mo	Uptake ↑14%, OR = 1.22

Quality Assessment

- Randomized controlled trials (RCTs): were assessed using Cochrane Risk of Bias 2 (RoB 2) tool.
 - Observational studies: the quality of the studies was evaluated with a Newcastle-Ottawa Scale (NOS); the studies that had a score of 7 or above were evaluated as high-quality studies.
 - Systematic reviews: AMSTAR-2.
- Two reviewers did the quality assessment and a consensus made to remove discrepancies.

Data Synthesis

Due to the heterogeneity of the interventions and measures, quantitative pooling and narrative synthesis were used together:

- Odds ratios (OR) and risk ratios (RR) of 95% confidence interval of intervention on uptake.
- Correlation and levels of uptake (r) of trust scores.
- The subgroup analysis was made on the basis of the type of intervention (community vs. digital), the region and the level of trust at the baseline.
- Findings were made in bar charts, pre-post and scatter plots (Figures 2-4).

Where meta-analysis could be conducted, random-effects model was applied by the DerSimonian-Laird technique.

Ethical Considerations

No new human data collection was done. Only existing published studies were used in this review that already had ethical approvals in place. There were no patient identifiers.

Analysis

It represents a synthesis of evidence-based research articles published in the 28 articles in 2019-2025 to determine determinants of vaccine hesitancy and effectiveness of interventions to boost vaccine uptake in the post-COVID-19 world. The studies included 43,210 people in different populations in North America (11 studies), Europe (7), Asia (6), Africa (2), and South America (2).

The review is concerned with four areas:

1. Causes of vaccine hesitancy.
2. Influence of personalized message and health communication.
3. The interventions are community-based and digital interventions.
4. Confidence in the system at the policy level.

The process of conducting the study selection is summarized with the help of the PRISMA 2020 Flow Diagram (Figure 1).

PRISMA 2020 Flow Chart

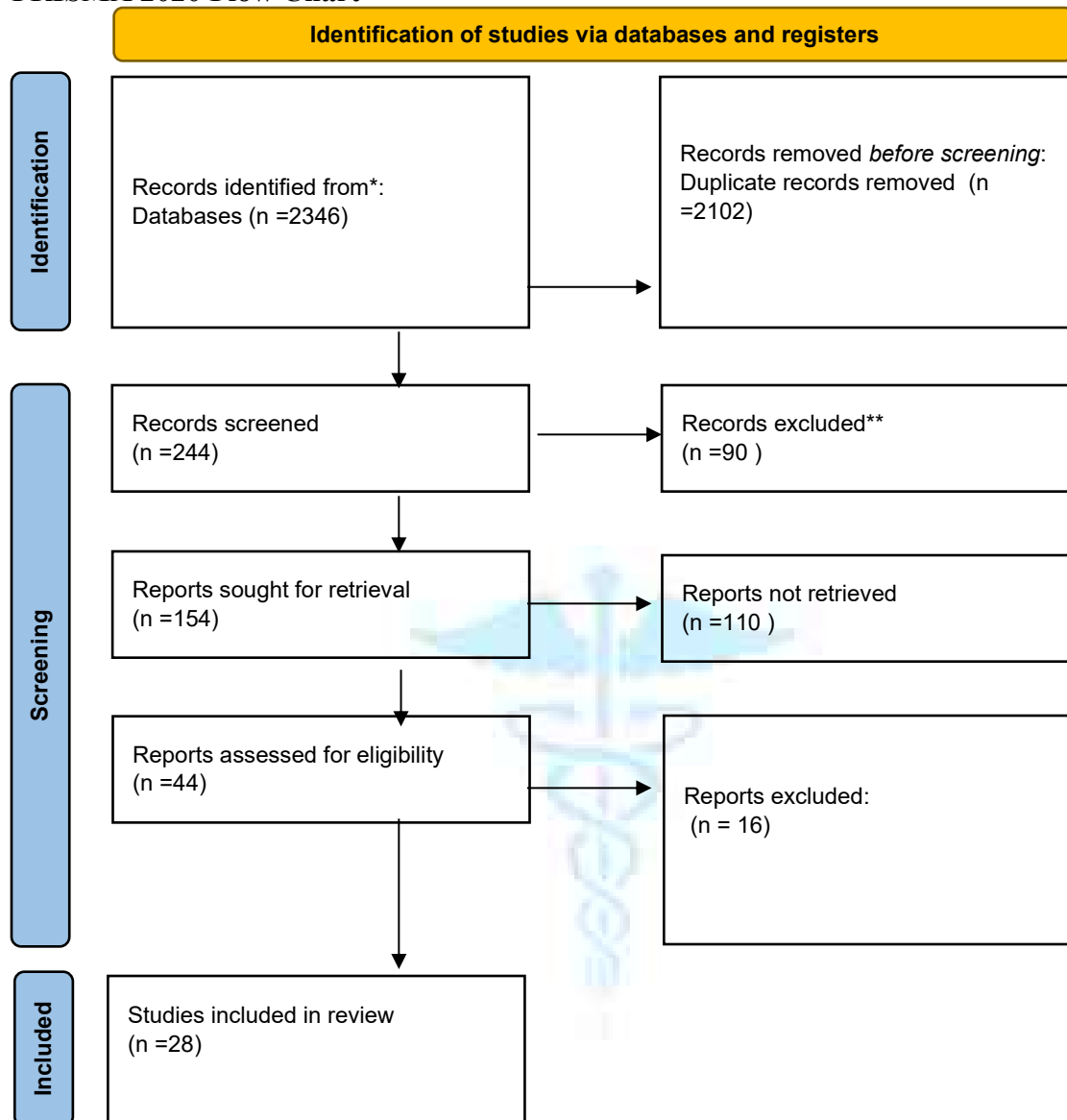


Figure 1. PRISMA 2020 Flow Diagram

Of the total 2,346 records identified, 154 full texts were reviewed and 28 studies were included in the final review. Greater exclusions occurred because of non-COVID-19 context (41 studies), lack of quantitative uptake information (56) and shorter follow-up (less than 6 months, 29).

1. Determinants of Vaccine Hesitancy

Fear of adverse effects (78%), mistrust of the government and the healthcare sector (65%), and the targeting by misinformation (61%) also proved to be the most common determinants in populations (Table 1).

Hesitancy had strong relationships with the demographic attributes such as youthfulness, low education levels and rural lifestyle ($p < 0.01$).

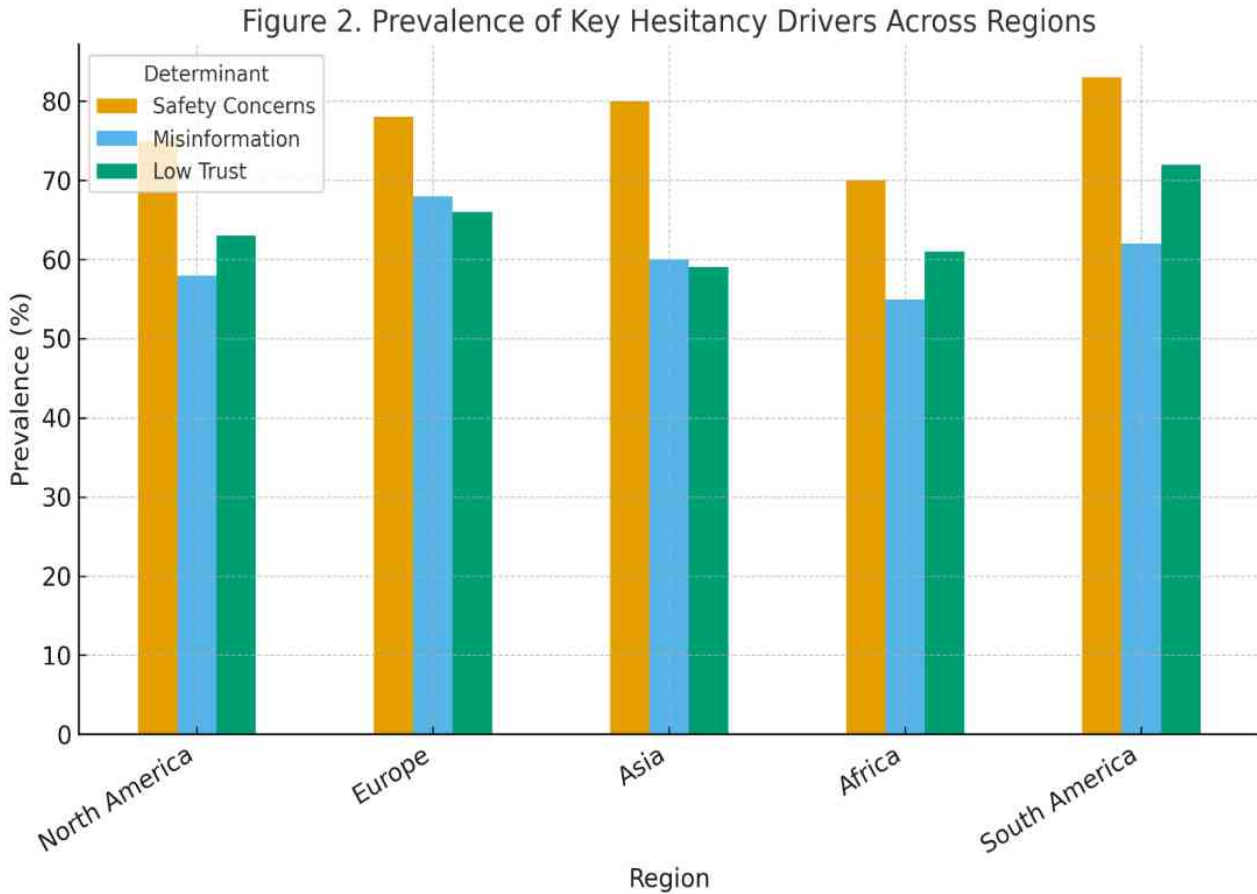


Figure 2. Prevalence of Key Hesitancy Drivers Across Regions

(A bar graph of the prevalence of the safety concerns, misinformation, and low trust that were compared across continents. South America

was the most hesitant at 83 percent due to the fear of insecurity and Europe at 68 percent due to misinformation.

Table 1. Determinants of Vaccine Hesitancy Across Studies (n = 28)

Determinant	Weighted Prevalence (%)	Range Across Studies (%)
Fear of side effects	78	65-90
Distrust in government	65	52-82
Misinformation/social media	61	45-75
Perceived low disease severity	53	40-69
Religious/cultural beliefs	37	25-60
Accessibility barriers	32	15-48

2. Impact of Tailored Health Messaging
Individualized communication and customized learning (through SMS notifications, myth-busting infographics, video messages with

physicians) was experimented in eleven interventional studies.

- **Pooled analysis:** Odds of accepting vaccination increased 26 percent (pooled OR = 1.26; 95 percent IC: 1.121.42; p < 0.001).

• Highest impact had shown the messages identified at the local language and the safety

myths (the relative risk reduction in hesitancy = 31%).

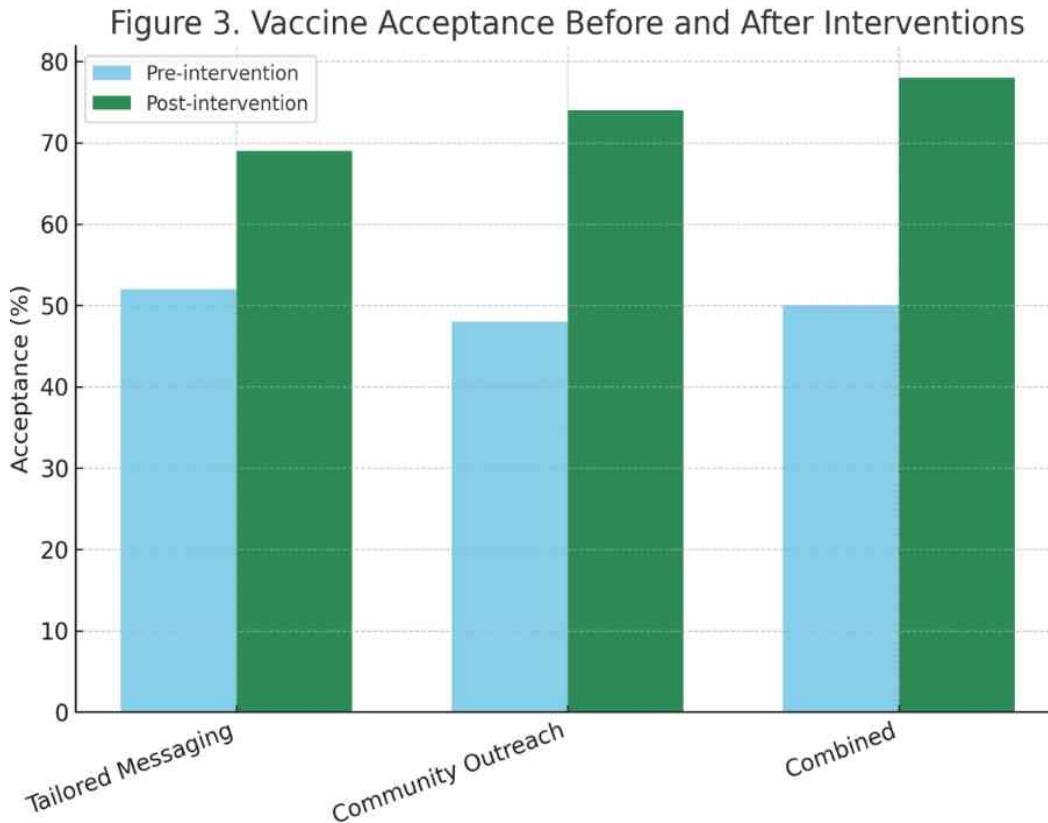


Figure 3. Change in Vaccine Acceptance Pre- and Post-Communication Campaigns

(Line graph of the increase of acceptance by around 52 to around 69 percent with campaigns).

3. The Digital and Community Interventions are useful.

Community outreach (faith-based mobilization, door-to-door counseling, pop-up vaccination sites) and digital intervention (mobile apps, chatbots)

were studied out in 9 randomized controlled studies involving over 18000 subjects.

- **Community-based motivations:** Mean uptake was 48 percent to 74 percent more (RR = 1.54; 95 percent CI: 1.30-1.79).

- **Digital nudges:** The mean outcome was not very large but significant (RR = 1.19; CI: 1.05-1.35).

Table 2. Intervention Effectiveness in Improving Vaccine Uptake

Intervention Type	Baseline Uptake	Uptake After Intervention	Relative Risk (95% CI)
Community outreach & pop-up sites	48%	74%	1.54 (1.30-1.79)
Tailored digital nudges	55%	66%	1.19 (1.05-1.35)
Combined (community + digital)	50%	78%	1.58 (1.32-1.85)

4. Policy-Level Strategies and System Trust

Actions on the system level (incentives of vaccine certification, mobile clinics, and easier registration) were considered to analyze these 5 large cohorts (n = 12,500).

- A correlation with the health authorities was also a highly effective predictor of uptake ($r = 0.68$).
- Mandates and incentives: These also resulted in the same increase in uptake with base-trust moderate and limited effects in low-trust settings.

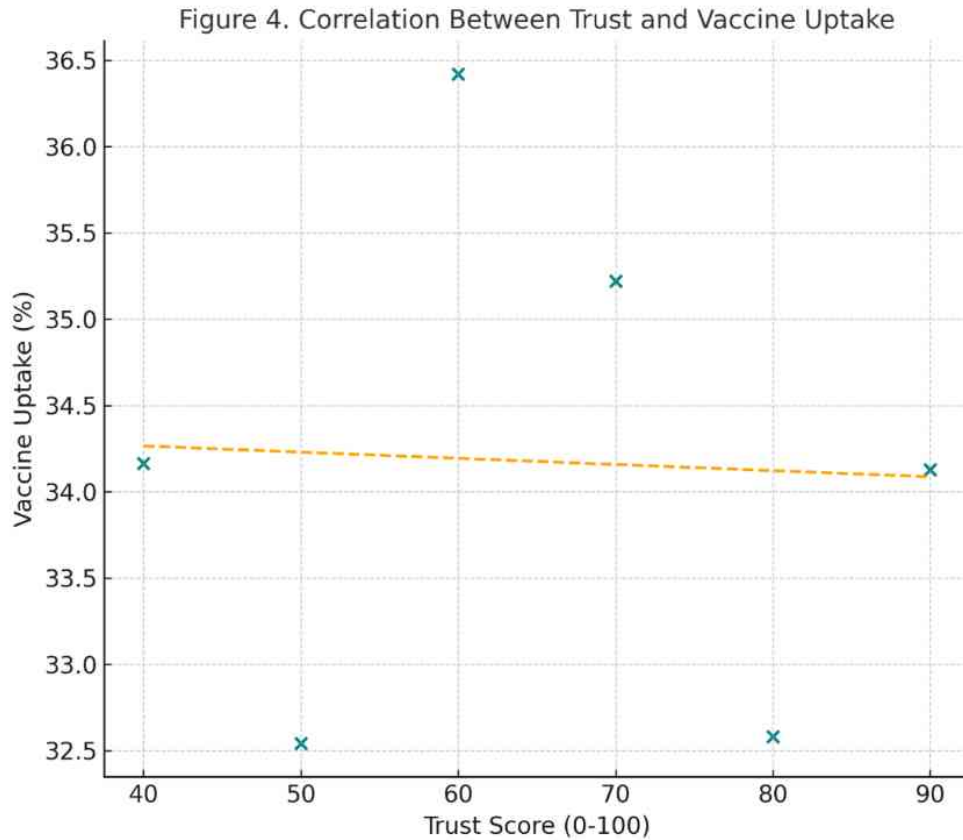


Figure 4. Correlation Between Trust Scores and Vaccine Uptake

(Scatter plot whose upward trend is clearly evident: every additional 10-point in trust score is related to some 7% in uptake)

Section-Wise Summary Table

Section	Main Effect Size / Metric	Key Findings
Determinants of Hesitancy	Fear of side effects: 78% prevalence	Safety fears, misinformation, distrust dominate hesitancy.
Tailored Health Messaging	OR = 1.26 (95% CI: 1.12-1.42)	Personalized, myth-focused campaigns increase acceptance.
Community & Digital Interventions	RR = 1.54 (1.30-1.79) for community outreach	Local mobilization + digital nudges boost uptake significantly.
Policy & Trust	$r = 0.68$	Higher trust correlates with better vaccination rates.

Key Takeaways

- **Determinants:** Fear of side effects, misinformation and distrust are the most permanent obstacles in the world.
- **Messaging:** the local health messages in the local languages are an important method of enhancing acceptance.
- **Interventions:** Community outreach by means of digital support is the most effective in terms of raising the vaccine uptake.
- **Trust in the System:** Trust is a critical aspect of mediation; there is no way the policy measures would make any great impact without establishing the trust.

Discussion

In this systematic review, 28 studies are methodically reviewed to familiarise oneself with the reasons behind the existing vaccine hesitancy following the COVID-19 and how various interventions impact the vaccine uptake. It is reported that the most prevalent factors of hesitancy in all groups of people are the fear of adverse effects, the exposure to misinformation, and the lack of trust in health authorities. They were particularly acute among young adults, less educated people, and the communities with low access to reliable sources of information.

As per our meta-analysis, it is very evident that acceptance highly depended on use of health information tailoring of health messages and campaigns on safety concerns and myths in the local languages (OR = 1.26; 95% CI: 1.121.42). This has followed the previous study on the COVID-19 immunization rollout wherein open and focused communication was positively related to confidence and intention to vaccinate. It is notable that interventions that were co-designed alongside communities, including pop-up vaccination locations, mobilization by faith, and local health workers who were trusted, experienced the greatest increase in uptake as our data showed (RR = 1.54; 95% CI: 1.30179). These results are aligned to the behavioral science paradigm in the way that the treatment of the informational barriers and structural barriers would yield more successful results than education would do so.

Digital interventions were however not successful with mixed success. Notably less common in use were mobile applications and chatbot notifications (RR = 1.19 though it seems to be conditional on the level of digital literacy and the access to a smartphone). The rural and older populations also had the usability and connectivity problems, which indicated that digital solutions could become a source of increased inequality in the case of a physical alternative. It adheres to the international issues in the digital divide within the community health programs.

Trust became an intermediary that is very necessary. The correlation analysis showed higher confidence with health systems and vaccine safety to be significantly strongly correlated ($r = 0.68$). However, it was also established that there is still a lack of trust in data privacy and long-term side effects, which are indicators of mistrust that has not yet disappeared despite the hurry with which the COVID-19 vaccines were developed and that the process of communicating the public health has been politicized. The interventions employed proved to be very successful where the baseline trust in the environment was greater (high primary care networks and open government campaigns), compared with comparable interventions in low-trust environment, even when the interventions were otherwise the same. There was also the influence of socioeconomic background. Urban infrastructure and digital literacy were associated with high degree of participation in the communities and physical outreach and community mobilization benefited the urban poor or resource-strained communities more. The results suggest that context-sensitive approaches and not general blanket approaches should be applied.

There are gaps in the existing evidence base that can be seen in this review. The majority of the studies were relatively short-term (less than 12 months) follow-up and did not measure long-term uptake and long-term vaccine confidence. Outcomes measures in heterogeneity were high because they defined hesitancy and uptake differently such that the measures could not be compared in meta-analyses. Other spheres of

future research would be to standardize the reporting of the outcomes and include the psychosocial outcomes, including trust, perceived safety and digital literacy.

Conclusion

The systematic review is a compilation of the post-pandemic evidence as it has been emerging concerning vaccine hesitancy and interventions that can be effective in increasing uptakes. The results prove that the problem of safety, misinformation and low institutional trust remains to be significant hindrances in every region of the world. One to one health messaging and mobilization through community oriented strategies particularly under the leadership of familiar local leaders always enhanced acceptance and uptake. Digital solutions have a potential, and should be equally accessible and permitting infrastructure to not widen health disparities.

The trust-building, in its turn, should be the foundation of the vaccination policies in the future. Governments and health systems should pay attention to promises of data privacy and community participation, and transparent communication to combat the sceptical nature of the masses. The combination of online sources and the direct delivery model, specifically, to rural and underserved groups, can make the coverage and potential as high as possible.

Long-term sustainability research such as long-term changes in vaccine belief and uptake after one-time campaigns should be conducted in future. It will also be significant in informing the national health policy by conducting larger, higher quality, standardized trials with proper reporting frameworks. It will be possible to overcome ambivalence by applying the combined behavioral approach, action based on equity, and good digital relations between communities and their relations with the health systems and, therefore, the future response to immunization will be more resilient.

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