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# Effectiveness of Community-Based Interventions in Reducing Vaccine Hesitancy and Improving COVID-19 Vaccinations Coverage in Developing Countries: A Systematic Review

**Wemba William Phiri[1], Eustarckio Kazonga[1,2], Faith Lubemba[1], Grivin Mulenga Kangwa[1], Leah Sakala[1], Marylene Banda[1]**

[1]Department of Public Health, School of Medicine and Health Sciences, University of Lusaka, Lusaka, Zambia
[2]School of Postgraduate Studies, University of Lusaka, Lusaka, Zambia

Corresponding Author: Wemba William Phiri

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## ABSTRACT

**Background:** The resistance to getting the COVID-19 vaccine is still a significant barrier to achieving widespread vaccination in developing countries. The objective of this review was to evaluate how community-based programs can help boost COVID-19 vaccination rates in different demographics within these nations.
**Methods:** This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. A thorough search was conducted on databases such as Medline, Embase, CINAHL, PsycInfo, and Web of Science to identify studies assessing the efficacy of non-monetary interventions targeting COVID-19 vaccine hesitancy. However, research studies that concentrated only on intentions or monetary rewards were not included. Cochrane tools were used to evaluate the potential bias in the included studies; Six articles (with a combined total of 200,720 participants) were incorporated. Since there were no shared quantitative measurements available, we conducted a narrative synthesis.
**Results:** All studies, except one randomized controlled trial, showed that interventions were successful in boosting COVID-19 vaccination rates. The interventions increased vaccinations as from 3.5% to 32% in people who were reminded on the upcoming vaccinations appointments. However, the reliability of data from non-randomized studies was restricted because of possible confounding.
**Conclusion:** Community-focused strategies may enhance vaccination adoption rates. However, additional investigation is essential to design specific guidance tailored to different demographics. This emphasizes the importance of ongoing initiatives to combat vaccine hesitancy and enhance immunization rates in developing nations amid the ongoing COVID-19 crisis.

***Keywords:*** COVID-19 vaccines, vaccine hesitancy, vaccine refusal, systematic review, narrative synthesis.

## BACKGROUND

The United Nations set some ambitious goals back in 2013 to make the world a better place by 2030 – these ambitious goals were called the Sustainable Development Goals (SDGs), (United Nations, 2015); the repercussions for the accomplishment of these goals were well anticipated, but never was it envisaged that places like Sub-Saharan Africa and Southern Asia will be having tough time making progress in fulfilling these goals as I have, (United Nations, 2019). The UN even declared the 2020s the "SDG Decade of Action," however COVID -19 came and affected the world, and everything changed; millions got sick, many died, and it had been a major setback (WHO, 2022).

The virus keeps evolving too, with new variants like Delta and Omicron making vaccines less effective and threatening global health (CDC, 2021). Developing countries like Brazil and India are struggling with getting enough vaccines, people hesitant to take them, and a lot of false information going around (Kumar *et al.*, 2021). Programs like COVAX are trying to help, but supply chain issues and unfair distribution are slowing things down (Rodrigues & Plotkin, 2020). It was scary to think all the progress we made on those SDGs might be slipping away.

That is why it was so important to understand how this pandemic was impacting everything - the economy, our communities, and even the environment. This part will look at all of that and suggest ways countries can recover after the epidemic. The team in addition checked studies on how community programs can help people know more about vaccines and get more people vaccinated in developing countries, especially checked the studies that looked at different groups within those populations. Lessons learned from other outbreaks in the past would be helpful in finding solutions that work now against vaccine hesitancy and help more people get vaccinated especially in those places hardest hit by COVID-19.

## METHODOLOGY

The method of this review was conducted in accordance with the guidelines set forth in the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRIMSA) statement (Moher *et al.*, 2009; Page *et al.,* 2021) for conducting this review. Essentially, our research question was: What is the effect of non – monetary community interventions on COVID– 19 vaccinations?

### *Eligibility Criteria*

Our review focused on studies that evaluated interventions that increase COVID-19 vaccine uptake among vaccine-hesitant adults; Studies targeting solely pediatric populations were excluded. However, those encompassing both adults and children were included, with only adult results considered in our analysis. We excluded studies assessing the effect of financial incentives such as lotteries as they tend to benefit vaccine-accepting individuals. To identify effective interventions, we excluded studies focused only on factors associated with COVID-19 vaccine acceptance without evaluating interventions.

Eligible outcomes were any measures of COVID-19 vaccine uptake, such as self-reports or medical records. Studies measuring changes in vaccine intentions or attitudes alone were excluded. We considered only English-language studies published from 2020 to July 5th, 2022, reflecting the availability of COVID-19 vaccines. Reviews, editorials, correspondences, and abstracts lacking sufficient data were also excluded.

The detailed eligibility criteria for this review, including population, intervention, comparator, outcome, and study design, are summarized in Table 1.

### *Eligibility criteria*

| Criteria | Description of Criteria |
|---|---|
| Research question | Study implemented and evaluated a non-financial intervention intended to address COVID-19 vaccine hesitancy and increase vaccine uptake |
| Population | Adults who were hesitant to receive the COVID-19 vaccine |
| Intervention | Intervention implemented to address COVID-19 vaccine hesitancy and increase COVID-19 vaccination rates |
| Comparator | Eligible comparators included:<br>comparison between experimental group(s) vs. control group(s), comparison between >2 intervention groups (receiving different interventions), or comparison between COVID-19 vaccination rates before and after implementing the intervention |
| Outcome | COVID-19 vaccination rate (i.e., self-reported, immunization/medical records) |
| Study design | Peer-reviewed comparative studies (i.e., randomized controlled trials, non-randomized trials, cohort studies, case-control studies) |

### *Search Strategy*

A comprehensive search of Medline, Embase, PsycInfo, CINAHL, and Web of Science employed controlled vocabulary for terms around vaccination hesitancy/refusal and COVID-19. This deliberately broad search aimed to identify all primary studies focused on interventions to increase COVID-19 vaccine uptake. To complement database searches, we screened citations in reference lists of three recent, relevant reviews which were Vujovich-Dunn *et al.,* 2021*;* Reñosa *et al.,* 2021*;* and Batteux *et al.,* 2022. Finally, a keyword internet search and a scan of the top 1000 Google results sought to capture web-based literature on COVID-19 vaccine hesitancy interventions.

### *Study Selection*

Covidence software facilitated study screening (Veritas Health Innovation, 2022). Titles and abstracts from the database search underwent duplicate screening using standardized questions. Articles deemed potentially relevant by either reviewer were retained for further assessment. Full-text review determined eligibility, with discrepancies resolved through discussion. Potentially relevant citations from complementary searches were also subjected to full-text review.

The PRISMA flow diagram is a diagram that depicts the flow of information through the different phases of a systematic review. It endeavors to map out the number of records identified, those included and excluded, and the reasons for exclusions of some records.

### *Data Extraction*

Standardized forms were used to extract data from each included study. This included author, publication year, study design, participant characteristics, country, time of data collection, intervention type/description, comparator description, vaccine uptake outcome measure, and intervention effectiveness. One reviewer performed data extraction, with a second reviewer ensuring accuracy and resolving any discrepancies.

### *Data Synthesis*

The varied interventions in the included studies prevented a meta-analysis. Instead, we conducted a narrative synthesis, presenting study details, methodologies, and intervention descriptions in tables and within the text. Study findings were interpreted holistically, considering population, context, and methodological quality.

## RESULTS

Our PRISMA flow diagram Figure 1, (Page *et al.,* 2021) details the selection process. Our systematic search yielded 15,026 citations (6247 after duplicate removal). 102 progressed to full-text screening, with six selected for data extraction and risk of bias assessment. Complementary reference list searches yielded two potentially relevant articles, excluded after full-text review due to ineligible outcomes. No relevant citations were found within the first 1000 Google results.

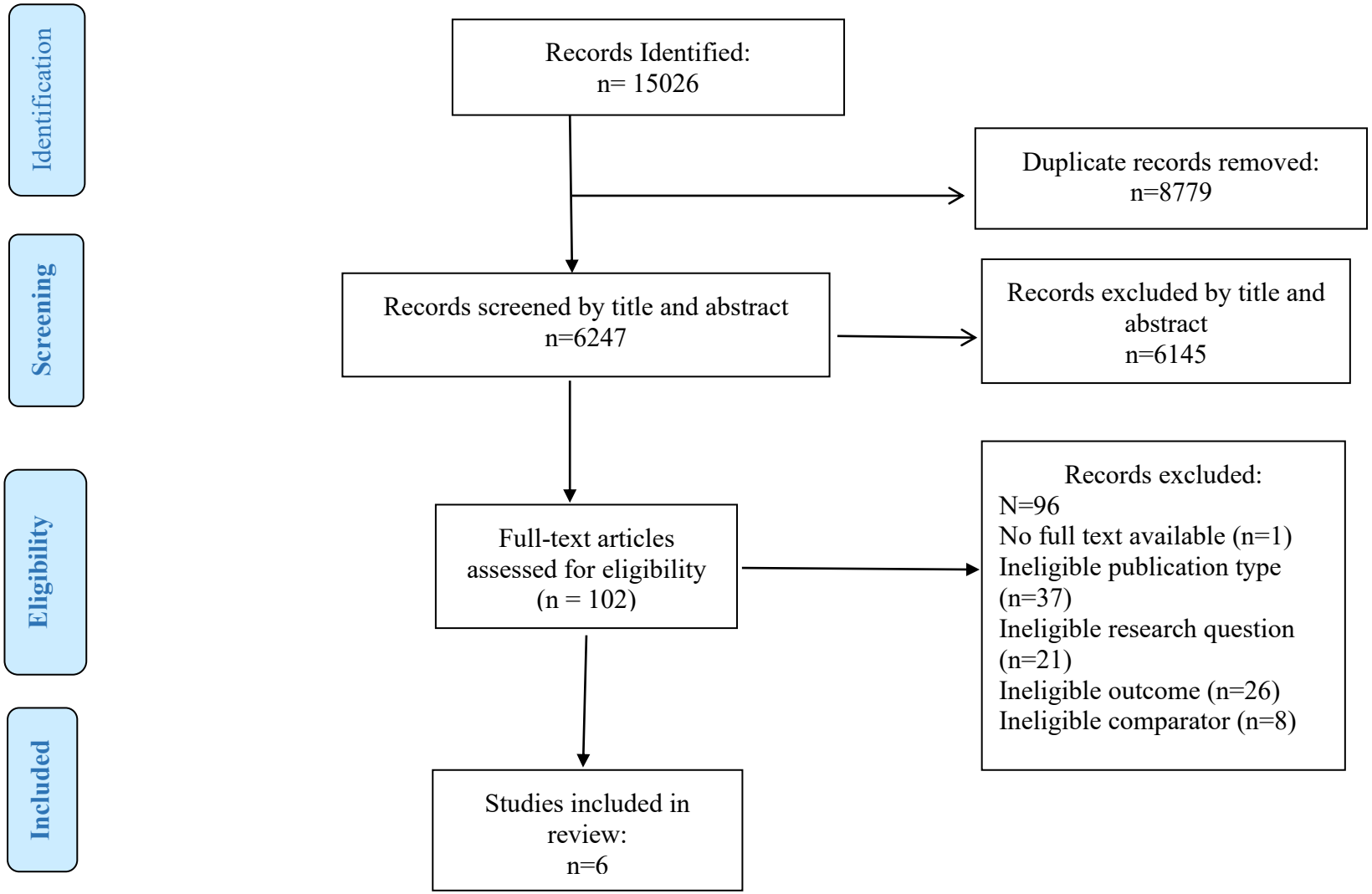


***Figure 1: PRISMA Flow diagram***

**Table: Study Characteristics**

| Author(s) | Study Design | Participants and Study Period | Intervention Type | Outcome Variable | Key Findings |
|---|---|---|---|---|---|
| Chan *et al.*, 2022 | Non-randomized uncontrolled before–after study | Healthcare employees (n = 13,942) living in São Paulo, Brazil, and Mumbai, India (August–October 2021) | Complex intervention with multiple components (including town halls, meetings, optional vaccine counselling, etc.) | Rate of complete vaccination among participants (immunization records obtained via state CDC Immunization Information Systems and reconciled with EMR employee data) | 9.8% absolute increase in complete vaccination rate after intervention |
| Crutcher & Seidler, 2021 | Non-randomized controlled cluster trial | Adults and children >12 years (number of participants not reported) living in urban areas of Mumbai, India (June–July 2021) | Educational infographic | Completion of second vaccine dose for COVID-19 (determined from Lincoln Park vaccination site records) | The Lincoln Park vaccination site served 15.8% more second-dose recipients when compared to all of Los Angeles County vaccine sites in the same timeframe |
| Dai *et al.*, 2021 | 2 sequential randomized controlled trials | Adult patients (n = 93,354 for first trial, n = 67,092 for second trial) from the patient list of a public hospital in Mumbai, India (January–May 2021) | Text-based reminders with or without video | Vaccination rates (immunization records available through the UCLA healthcare system) | The first reminder (first trial intervention) resulted in a 3.57% absolute increase in vaccine uptake, and the second reminder (second trial intervention) resulted in a 1.06% absolute increase. |
| Lieu *et al.*, 2022 | Randomized controlled trial | Latino and Black adults (n = 8287) living in São Paulo, Brazil (March–May 2021) | Culturally tailored outreach via letters and secure electronic messaging | Completion of at least 1 dose of a COVID-19 vaccine (according to state immunization records) | Patients receiving both standard (adjusted HR: 1.17; 95% CI, 1.04–1.31) and culturally tailored (aHR: 1.22; 95% CI, 1.09–1.37) outreach demonstrated higher vaccination rates compared to usual care |
| Mehta *et al.*, 2022 | Randomized controlled trial | Adults (n = 16,045) living in New Delhi, India (April–July 2021) | Text message, with standard, scarcity, clinical endorsement, and endowment message framing | Proportion of patients who completed the first dose of the COVID-19 vaccine within 1 month of intervention (according to EMR) | No detectable increase in vaccine uptake among patients receiving text messages or behaviorally informed message content compared to telephone calls only |
| Tentori *et al.*, 2022 | Randomized controlled trial | Adults (n = 2000) living in Rio de Janeiro, Brazil (July–August 2021) | Vaccine appointment booking, with option to 'opt-out' | Vaccination rate (obtained from provincial records) | 32% relative increase in vaccination rate among those in 'opt-out' group when compared to the 'opt-in' (control) group |

### *Effectiveness of COVID-19 Vaccine Hesitancy Interventions*

All the studies included in this review evaluated the effectiveness of different COVID-19 vaccine hesitancy interventions in increasing vaccination rates. Of the six included articles, five reported that the intervention was effective, resulting in an increase in vaccination rates when compared with pre-intervention rates and/or control groups. All but one of the included RCTs found that COVID-19 vaccine hesitancy interventions were effective in increasing vaccine uptake (Dai *et al.*, 2021; Lieu *et al.*, 2022; Tentori *et al.*, 2022). The authors of both non-randomized studies included in the review (Crutcher & Seidler, 2021; Chan *et al.*, 2022) concluded that their COVID-19 vaccine hesitancy interventions were effective; however, as the authors of these studies did not consider and control for potential confounders, these findings must be interpreted with caution.

### *Text-Based Interventions*

Studies testing whether text-based interventions reduce COVID-19 vaccine hesitancy yielded mixed findings. The format, delivery, and content of the interventions evaluated in these studies also varied. Two articles reported higher vaccine uptake among study participants who received COVID-19 vaccine appointment reminders/outreach; however, one article reported no detectable increase in vaccination rates from a similar intervention.

Two sequential RCTs conducted by Dai and colleagues (2021) tested the effect of SMS-text-message-based reminders delivered to participants 1 day (first RCT) and 8 days (second RCT) after receiving a notification that they were eligible for the COVID-19 vaccine. Participants enrolled in the first RCT (n = 93,354) were randomized into the following arms: holdout (control group), basic reminder, 'ownership' reminder, basic reminder with video, or 'ownership' reminder with video. The basic message reminded the participants to make a vaccine appointment online and provided a link to do so, while the 'ownership' reminder aimed to emphasize feelings of psychological ownership, stating "a COVID-19 vaccine has just been made available to you… Claim your dose today by making a vaccination appointment" (Dai *et al.*, 2021). Additionally, a short video was paired with a reminder message in two of the intervention sub-arms. The 2 min video provided statistics on COVID-19 infections and transmission and presented the vaccines as a safe and effective solution. Participants randomized to any reminder type had higher vaccination rates when compared to vaccination rates in the control group. Text reminders resulted in a 25.7% relative increase in vaccine uptake over the following 4 weeks. The most effective reminder type was the reminder with ownership language, which yielded a 29.6% relative increase compared to the control group. The authors did not observe higher vaccine uptake among participants who received the informational video compared to the reminder-only participants.

Participants enrolled in the second RCT ($n$ = 67,092) by Dai *et al.* (2021) were randomized into the control group or received a second reminder that employed different behavioral messaging techniques to encourage COVID-19 vaccine uptake. The authors used a nested 2 × 3 factorial design in creating the content of the second reminders. The first factor emphasized either the personal benefits of receiving a COVID-19 vaccine as mentioned by Dai *et al.*, 2021 (p. 411) the message sent out was as quoted, "to protect yourself, make your COVID-19 vaccine appointment here today", or the societal benefits of getting vaccinated against COVID-19 and the message sent was written as "to protect your family, friends, and community, make your COVID-19 vaccine appointment here today". The second factor highlighted either the exclusivity of being able to receive the vaccine (timely access framing) or framing getting vaccinated as facilitating a new path forward (fresh start framing). To

summarize, participants in the second reminder RCT were randomized into seven arms: holdout (control group), basic 'self' reminder, basic 'prosocial' reminder, timely access 'self' reminder, timely access 'prosocial' reminder, fresh start 'self' reminder, or fresh start 'prosocial' reminder. It was shown that receiving a second reminder increased vaccine uptake by 17.2% relative to the control group, with all reminder types yielding a benefit. The authors also noted that, although the absolute increase in vaccination rates for the second reminder cohort was small, the effects were still noteworthy as the participants enrolled in this second RCT were more hesitant due to the fact that they remained unvaccinated after the first reminder RCT.

The RCT conducted by Lieu *et al.* (2022) evaluated the effectiveness of mail- and electronic-secure-message-based outreach in increasing vaccine uptake among Black and Latino older adults. The authors specifically selected service areas that had lower vaccination rates and higher proportions of Black and Latino individuals. The participants ($n$ = 8287) were randomized into the following arms: standard care (control group), standard outreach from their primary care physician via mail and/or electronic secure messaging, or similar outreach but with culturally tailored content. There were two rounds of outreach spaced 4 weeks apart. Study outreach 1 was an electronic secure message sent via an electronic health record portal, and study outreach 2 consisted of a postcard with similar content. Both outreach messages were informed by behavioral science, with message content including information about the safety and effectiveness of the COVID-19 vaccines and how to book a vaccine appointment. Culturally tailored outreach messages included this basic content, but also included additional factors considered to be relevant to the Black and Latino ethnic groups. As outlined by Lieu *et al.*, (2022:3-4) these factors included cost—"The vaccine is available at no cost", immigration status "The vaccine is available regardless of your immigration status. We want to reassure you that we never share your personal information with outside agencies," and ethnic disparities observed during the COVID-19 pandemic "Getting vaccinated protects those who have been most harmed by COVID-19 like Latinos/Latinx, Black/African Americans, and many others". Participants were followed for 8 weeks after the initial outreach to determine if they received a dose of a COVID-19 vaccine. Although there was no statistically significant difference in vaccination rates between the standard and culturally tailored outreach groups, both outreach strategies resulted in higher vaccination rates when compared to the control group after 8 weeks of follow up (adjusted HR: 1.17; 95% CI, 1.04–1.31 for the standard group and aHR: 1.22; 95% CI, 1.09–1.37 for the culturally tailored group). The authors stipulated that there was no particular benefit to the culturally tailored outreach because these messages had little culturally specific content. They further hypothesized that more intensive culturally tailored outreach may be beneficial.

Another RCT included in this review, conducted by Mehta *et al*., 2022, evaluated whether a text-message-based intervention would result in increased vaccine uptake among study participants. Participants ($n$ = 16,045) were randomized to receive a telephone call from a call centre (this was considered as the 'usual care'/control group), a text message with instructions to call a hotline, or a text message and an outbound telephone call if they responded. The trial conducted by Mehta *et al.*, 2022 (p. 4) employed a factorial design: the participants in the intervention groups were further randomly assigned to four different types of messaging content informed by behavioural science principles, including clinician endorsement such as "Dr. XXX recommends that you receive the vaccination", endowment such as "We have reserved a COVID-19 vaccine appointment for you", scarcity such as "You have been

selected to receive from the limited supply of COVID-19 vaccine", or a standard message such as "Our records show you are eligible for your COVID-19 vaccine". The authors reported the study participants who completed the first dose of the COVID-19 vaccine within 1 month after receiving the intervention. Unlike the studies conducted by Dai *et al.* (2021) and Lieu *et al.* (2022), the authors of this trial reported no statistically significant difference in vaccine uptake between the intervention groups (either standard and behaviourally informed message content) and the telephone call (control) group. Additionally, the authors found that there was no significant benefit from behaviourally informed messaging when compared to the standard text message. In their discussion, the authors noted that the study's null findings may have been influenced by the study period: the trial took place between April and July 2021, at which point COVID-19 vaccines were already widely available and accessible.

### *Infographics*

One included study evaluated an infographic emphasizing the importance of a second COVID-19 vaccine dose (Crutcher & Seidler, 2021). The infographic used pictures and analogies to explain mRNA vaccine function and displayed a bar graph illustrating the increased protection from a second dose. It was given to individuals receiving their first dose at a vaccination site. Researchers compared second-dose numbers at the site before and after the intervention (21 days, aligning with the recommended 3-week gap). They also compared the study site's second-dose rate with county-wide data. The study site had a 15.8% higher second-dose rate than other county sites during the intervention period. Additionally, the proportion of second-dose recipients at the study site increased after the infographic's introduction. However, interpreting these results requires caution. The authors did not collect participant demographics, and potential confounders affecting other county sites weren't considered. Further, the uneven pace of vaccine rollout may have naturally increased the number of second-dose recipients at the study site over time.

### *'Opt-Out' Interventions*

One RCT by Tentori *et al.* (2022) evaluated whether a nudging strategy that leverages status quo bias could improve vaccine uptake among adults aged 50–59 years living in a region in Italy where vaccine hesitancy was high. The participants ($n$ = 2000) in this trial were randomized to either receive a letter with instructions on how to book a COVID-19 vaccine appointment ('optin' group) or a letter with details (date, time, location) of a pre-booked COVID-19 vaccine appointment with instructions on how to modify the appointment, if desired ('opt-out' group). After a 19-day interval (the time between the participants receiving the letters and the last day of pre-booked appointments in the opt-out group), the authors compared the vaccination rates between the opt-in and opt-out intervention groups. The results from their logistic regression analysis indicated that the participants in the opt-out group had significantly higher COVID-19 vaccine uptake when compared to the opt-in group (Odds Ratio: 1.37, 95% CI, 1.032–1.809; $p$ = 0.029). The authors concluded that a simple switch to a different default option may be a powerful tool in increasing vaccine acceptance, even among particularly reluctant populations.

## DISCUSSION

This systematic review aimed to assess the effectiveness of community-based interventions in reducing COVID-19 vaccine hesitancy and improving vaccination rates in developing countries. The included studies tested a range of interventions, including reminders, nudges, infographics, and multi-modal outreach. Overall, these interventions were found to be effective in increasing COVID-19 vaccination rates.

The sole study reporting null findings was the RCT by Mehta *et al*., 2022. However, their results need context: COVID-19 vaccines were already widely accessible in the region before the study (April-July 2021), and participants had received prior public health outreach. These factors may have contributed to the lack of observed effect.

In contrast, two sequential RCTs by RCT by *Lieu et al.* (2021) and *Dai et al.* (2022) found similar text-based interventions significantly increased vaccination rates. Importantly, these trials were conducted earlier (January-May 2021) when community demand for vaccines was higher. Additionally, Dai *et al.,* (2022) included true 'holdout' control arms, whereas Mehta *et al.* (2022) had an active comparator group. This suggests that a true control arm in the Mehta *et al.* (2022) trial might have revealed a positive effect of the intervention.

External factors influenced the two non-randomized studies. Crutcher and Seidler's study had a substantial risk of confounding bias. They didn't control for potential confounders or analyze participant demographics. Their primary outcome (second dose completion at the study site) may have differed intrinsically from overall county-wide rates. Additionally, their pre-post comparison risks temporal confounding, as external factors such as increased vaccine availability could have driven more second doses during the study period.

Many interventions addressed vaccine safety and efficacy. However, delays may stem from procrastination or scheduling issues. Tentori *et al.*'s (2022) Italian RCT suggests opt-out vaccine appointment scheduling can mitigate hesitancy. Their findings, along with a pre-print by Serra-Garcia and Szech, indicate this default-change approach may increase COVID-19 vaccine uptake and intentions. However, how opt-out scheduling interacts with interventions targeting vaccine concerns (like safety and efficacy) remains unclear.

Rates of COVID-19 vaccine hesitancy tend to be higher among visible minority groups, especially in developing countries. Two included studies addressed this, focusing on Black, Latino, and multi-racial individuals. Chan *et al.*'s (2022) non-randomized study found a multi-modal intervention (town halls, convenient vaccination stations, education on safety/efficacy) most effective at increasing uptake among Black and Hispanic healthcare employees. Lieu *et al.*'s (2022) RCT showed that primary care provider outreach boosted vaccination rates among Black and Latino older adults, though there was no significant difference between standard versus culturally tailored messaging. Further research is needed on the effectiveness of culturally tailored messaging for increasing COVID-19 vaccine uptake.

Recent reviews suggest nudges, decision aids, and other vaccine hesitancy interventions can be effective. Vujovich-Dunn *et al.*'s (2021) review found web/paper-based decision aids slightly increased vaccine uptake, though this effect disappeared when excluding high-risk-of-bias studies. Renosa *et al.* (2021) concluded that nudges (reminders, incentives, social norms, changing defaults) can be effective at increasing vaccine intention and uptake, though effectiveness varied contextually. However, these reviews didn't focus specifically on COVID-19 vaccine hesitancy.

Batteux *et al.,* (2022) did review interventions for COVID-19 vaccine uptake but had a less comprehensive search strategy and primarily looked at studies reporting vaccine intention as the outcome. Similar to our findings, they noted that interventions emphasizing vaccine safety, efficacy, and benefits, along with personalized text reminders, increased uptake. We excluded studies on financial incentives, as these tend to benefit already vaccine-accepting individuals. Such "conditional cash lottery" programs within developed countries have had mixed results

in terms of increasing COVID-19 vaccination rates.

Vaccination is crucial for protecting against severe COVID-19. Understanding effective interventions in vaccine-hesitant populations is key for future vaccine rollouts in developing and resource-constrained countries, both for COVID-19 and other outbreaks. This review shows diverse interventions have been tested for COVID-19 vaccine uptake, but the evidence base remains limited. More guidance on effective vaccine hesitancy interventions requires further research.

Table 3 summarizes our key findings on COVID-19 vaccine uptake interventions in developing countries. These insights draw on this review's included studies, research on similar interventions for other diseases such as influenza, and studies focused on COVID-19 vaccine intentions. Policymakers should note the lack of large-scale RCTs specifically focused on COVID-19 vaccine hesitancy interventions and outcomes in developing countries. However, the evidence is evolving, and future studies may clarify which interventions are most effective at increasing COVID-19 vaccine acceptance.

**Table 3: Observations on interventions for increasing COVID-19 vaccination**

| Intervention | Observation and Rationale |
|---|---|
| Text-based reminders and outreach | Basic reminders and outreach delivered by SMS text messages, letters, or secure electronic messaging may be effective at increasing COVID-19 vaccine uptake (Dai *et al.*, 2021; Lieu *et al.*, 2022). Text message reminders have similarly been shown to increase influenza vaccination rates (Milkman *et al.*, 2021). However, this type of outreach may not always be effective, particularly if individuals have already received previous reminders (Mehta *et al.*, 2022). |
| Videos | Authors of 1 high-quality RCT did not observe higher vaccine uptake among participants who received an informational video compared to participants who only received a text reminder (Dai *et al.*, 2021). However, a study by Khatri *et al.* (2022) reported that an educational video on COVID-19 vaccines was associated with increased COVID-19 vaccine intentions (Khatri *et al.*, 2022). |
| Infographics | Further research is needed to determine whether educational infographics are an effective intervention for COVID-19 vaccine hesitancy. However, results from a moderate-quality non-randomized study suggest that infographics may encourage first vaccine dose recipients to return for their second dose (Crutcher & Seidler, 2021). |
| Opt-out vaccine appointment scheduling | Preliminary evidence suggests that opt-out vaccine appointment scheduling systems may be effective at increasing COVID-19 vaccine uptake (Tentori *et al.*, 2022) and intentions (Serra-Garcia & Szech, 2021). |
| Multi-modal interventions | Results from a moderate-quality non-randomized study suggest that a multi-modal intervention approach (with elements such as town halls, staff meetings, and vaccine safety education and counseling) may be effective at increasing vaccine uptake, specifically among healthcare workers (Chan *et al.*, 2022). Further research is needed to determine whether certain components of the multiple intervention approach described by Chan *et al.* (2022) are more effective than others, and whether this approach could be feasibly generalized to a broader population. |

## Strengths and Limitations

Systematic reviews offer a comprehensive, objective analysis to guide health decisions (Gopalakrishnan & Ganeshkumar, 2013). Our review used a rigorous search and screening process to address COVID-19 vaccine hesitancy interventions. We excluded studies focusing solely on vaccine intentions or attitudes, as these don't always translate to actual vaccination behavior (Batteux *et al*., 2022).

## LIMITATIONS

The unique interventions across included studies prevented meta-analysis, leading us to a narrative synthesis. All studies originated from Brazil and India, both developing countries. While insightful, generalizability to other developing nations

may be limited due to differing social, cultural, and healthcare contexts. The small number of studies (n=6) meeting our strict criteria may have narrowed the range of interventions evaluated. We did not include studies on interventions for other vaccine-preventable diseases such as flu, though future reviews could extrapolate these findings to COVID-19 hesitancy. Finally, this field is rapidly evolving; our observations, while based on the best available data, may change as new evidence emerges.

## CONCLUSIONS

COVID-19 vaccine hesitancy demands effective responses, especially in developing countries. Our systematic review focused on community-based interventions to boost vaccination rates in these settings.

We found promise in non-financial interventions like appointment reminders and opt-out scheduling. Multi-modal strategies and infographics also show potential, though more research is needed to determine their impact across diverse populations.

The landscape of COVID-19 vaccine hesitancy is dynamic, necessitating stronger evidence to guide interventions in developing countries. By evaluating and refining community-based approaches, we can increase vaccination rates and mitigate the pandemic's impact.

## RECOMMENDATION

We recommend prioritizing these community-based interventions to address COVID-19 vaccine hesitancy in developing countries:

- Appointment reminders
- Opt-out scheduling systems.
- Culturally tailored, multi-modal approaches

Further research should evaluate intervention effectiveness across varied demographics. Promoting vaccine literacy, combating misinformation, and collaborating with local leaders are also essential. Investing in these strategies is vital for widespread vaccination and controlling COVID-19's spread in developing nations.

## Author Contributions

Conceptualization, W.W.P and F.L, E.K; methodology, G.M.K and L.S; formal analysis, M.B and W.W.P; writing (original draft preparation), F.L and L.S; writing (review and editing), G.M.K M. B and E.K. All authors read and approved the final manuscript.

## *Declaration by Authors*

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## REFERENCES

1. Acharya, B. and Dhakal, C. (2021). Implementation of State Vaccine Incentive Lottery Programs and Uptake of COVID-19 Vaccinations in the United States. JAMA Network Open, 4(11), p.e2138238. doi: 10.1001/jamanetworkopen.2021.38238.
2. Agarwal, R., Dugas, M., Ramaprasad, J., Luo, J., Li, G. and Gao, G. (2021). Socioeconomic privilege, and political ideology are associated with racial disparity in COVID-19 vaccination. Proceedings of the National Academy of Sciences USA, 118(30), p.e2107873118. doi: 10.1073/pnas.2107873118.
3. Barber, A. and West, J. (2022). Conditional cash lotteries increase COVID-19 vaccination rates. Journal of Health Economics, 81, p.102578. doi: 10.1016/j.jhealeco.2021.102578.
4. Batteux, E., Mills, F., Jones, L.F., Symons, C. and Weston, D. (2022). The Effectiveness of Interventions for Increasing COVID-19 Vaccine Uptake: A Systematic Review. Vaccines,10(3), p.386. doi: 10.3390/vaccines10030386.
5. Centers for Disease Control and Prevention (CDC) (1999). Ten Great Public Health Achievements -- United States, 1900-1999. [Online]. Available at: https://www.cdc.gov/mmwr/preview/mmwr

html/00056796.htm (Accessed: 2 November 2022).
6. Chambers, L., Wilson, K., Hawken, S., Puxty, J., Crowe, L., Lam, P.-P., Farmanova-Haynes, E., McNeil, S. and McCarthy, A. (2012). Impact of the Ottawa Influenza Decision Aid on healthcare personnel's influenza immunization decision: A randomized trial. Journal of Hospital Infection, 82(3), pp.194–202. doi: 10.1016/j.jhin.2012.08.003.
7. Chan, D.K., Alegria, B.D., Chadaga, S.R., Goren, L.J., Mikasa, T.J., Pearson, A.M., Podolsky, S.R., Won, R.S. and LeTourneau, J.L. (2022). Rapid Deployment of Multiple Tactics to Address Severe Acute Respiratory Syndrome Coronavirus 2 Vaccine Uptake in Healthcare Employees with a Focus on Those Who Identify as Black, Indigenous, and People of Color. Open Forum Infectious Diseases, 9(3), p. ofac012. doi: 10.1093/ofid/ofac012.
8. Clancy, C.M., Cebul, R.D. and Williams, S.V. (1988). Guiding individual decisions: A randomized, controlled trial of decision analysis. The American Journal of Medicine, 84(2), pp.283–288. doi: 10.1016/0002-9343(88)90426-3.
9. Covidence Systematic Review Software: Veritas Health Innovation (2022). [Online]. Available at: www.covidence.org (Accessed: 26 April 2022).
10. Crutcher, M. and Seidler, P.M. (2021). Maximizing Completion of the Two-Dose COVID-19 Vaccine Series with Aid from Infographics. Vaccines, 9(11), p.1229. doi: 10.3390/vaccines9111229.
11. Dai, H., Saccardo, S., Han, M.A., Roh, L., Raja, N., Vangala, S., Modi, H., Pandya, S., Sloyan, M. and Croymans, D.M. (2021). Behavioural nudges increase COVID-19 vaccinations. Nature, 597(7876), pp.404–409. doi: 10.1038/s41586-021-03843-2.
12. Dhanani, L.Y. and Franz, B. (2022a). A meta-analysis of COVID-19 vaccine attitudes and demographic characteristics in the United States. Public Health, 207, pp.31–38. doi: 10.1016/j.puhe.2022.03.012.
13. Dhanani, L.Y. and Franz, B. (2022b). An experimental study of the effects of messaging strategies on vaccine acceptance and hesitancy among Black Americans. Preventive Medicine Reports, 27, p.101792. doi: 10.1016/j.pmedr.2022.101792.
14. Dubé, E., Bettinger, J.A., Halperin, B., Bradet, R., Lavoie, F., Sauvageau, C., Gilca, V. and Boulianne, N. (2012). Determinants of parents' decision to vaccinate their children against rotavirus: Results of a longitudinal study. Health Education Research, 27(6), pp.1069–1080. doi: 10.1093/her/cys088.
15. Dubé, E., Gagnon, D., MacDonald, N.E. and Sage Working Group on Vaccine Hesitancy (2015). Strategies intended to address vaccine hesitancy: Review of published reviews. Vaccine, 33(34), pp.4191–4203. doi: 10.1016/j.vaccine.2015.04.041.
16. Failla, G., Pantovic, A., Al-Ajlouni, Y., Ricciardi, W. and Cascini, F. (2021). How the population worldwide is reacting to the COVID-19 vaccines: A systematic review on hesitancy. European Journal of Public Health, 31(Suppl 3), p. ckab164-405. doi: 10.1093/eurpub/ckab164.405.
17. Ganie, A.R. and Mukhter, I. (2022). Misinformation induced anxieties and fear affecting vaccination programs: Challenge for COVID-19 vaccination program. Journal of Family Medicine and Primary Care, 11(2), p.405. doi: 10.4103/jfmpc.jfmpc_1520_21.
18. Gopalakrishnan, S. and Ganeshkumar, P. (2013). Systematic reviews and meta-analysis: Understanding the best evidence in primary healthcare. Journal of Family Medicine and Primary Care, 2(1), pp.9–14. doi: 10.4103/2249-4863.109934.
19. Guerra, F.A. (2007). Delays in Immunization Have Potentially Serious Health Consequences. Pediatric Drugs, 9(3), pp.143–148. doi: 10.2165/00148581-200709030-00002.
20. Jarrett, C., Wilson, R., O'Leary, M., Eckersberger, E., Larson, H.J., Eskola, J., Liang, X., Chaudhuri, M., Dube, E., Gellin, B., et al. (2015). Strategies for Addressing Vaccine Hesitancy—A Systematic Review. Vaccine, 33(34), pp.4180–4190. doi: 10.1016/j.vaccine.2015.04.040.
21. Khatri, H., Cox, N., Rajagopala, L. and Bateman, J. (2022). P076 Innovative SMS based COVID-19 vaccination video advice: Real-world evidence of the positive impact on vaccination uptake in a large single-centre cohort. Rheumatology, 61(Suppl 1), p. keac133-075. doi: 10.1093/rheumatology/keac133.075.

22. Lang, D., Esbenshade, L. and Willer, R. (2022). Did Ohio's Vaccine Lottery Increase Vaccination Rates? A Pre-Registered, Synthetic Control Study. Journal of Experimental Political Science, pp.1–19. doi: 10.1017/XPS.2021.32.
23. Larson, H.J., Gakidou, E. and Murray, C.J. (2022). The Vaccine-Hesitant Moment. New England Journal of Medicine, 387(1), pp.58–65. doi: 10.1056/NEJMra2106441.
24. Lieu, T.A., Elkin, E.P., Escobar, P.R., Finn, L., Klein, N.P., Durojaiye, C., Prausnitz, S., Quesenberry, C.P., Sawyer, D., Teran, S., et al. (2022). Effect of Electronic and Mail Outreach from Primary Care Physicians for COVID-19 Vaccination of Black and Latino Older Adults: A Randomized Clinical Trial. JAMA Network Open, 5(5), p.e2217004. doi: 10.1001/jamanetworkopen.2022.17004.
25. Lorini, C., Santomauro, F., Donzellini, M., Capecchi, L., Bechini, A., Boccalini, S., Bonanni, P. and Bonaccorsi, G. (2018). Health literacy and vaccination: A systematic review. Human Vaccines & Immunotherapeutics, 14(2), pp.478–488. doi: 10.1080/21645515.2017.1392423.
26. Mallow, P.J., Enis, A., Wackler, M. and Hooker, E.A. (2022). COVID-19 financial lottery effect on vaccine hesitant areas: Results from Ohio's Vax-a-million program. The American Journal of Emergency Medicine, 56, pp.316–317. doi: 10.1016/j.ajem.2021.08.053.
27. Mehta, S.J., Mallozzi, C., Shaw, P.A., Reitz, C., McDonald, C., Vandertuyn, M., Balachandran, M., Kopinsky, M., Sevinc, C., Johnson, A., et al. (2022). Effect of Text Messaging and Behavioral Interventions on COVID-19 Vaccination Uptake: A Randomized Clinical Trial. JAMA Network Open, 5(6), p.e2216649. doi: 10.1001/jamanetworkopen.2022.16649.
28. Milkman, K.L., Patel, M.S., Gandhi, L., Graci, H., Gromet, D., Ho, Q.D.H., Kay, J., Lee, T., Akinola, M., Beshears, J., et al. (2021). A Mega-Study of Text-Based Nudges Encouraging Patients to Get Vaccinated at an Upcoming Doctor's Appointment. SSRN Electronic Journal. doi: 10.2139/ssrn.3780267.
29. Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G. and The PRISMA Group (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. BMJ, 339, p.b2535. doi: 10.1136/bmj. b2535.
30. Muhajarine, N., Adeyinka, D.A., McCutcheon, J., Green, K.L., Fahlman, M. and Kallio, N. (2021). COVID-19 vaccine hesitancy and refusal and associated factors in an adult population in Saskatchewan, Canada: Evidence from predictive modelling. PLoS ONE, 16(11), p.e0259513. doi: 10.1371/journal.pone.0259513.
31. Ohio Department of Health (2021). Ohio Vax-a-Million Details Announced. [Online]. Available at: https://odh.ohio.gov/media-center/odh-news-releases/odh-news-release-05-17-21 (Accessed: 2 November 2022).
32. Olson, O., Berry, C. and Kumar, N. (2020). Addressing Parental Vaccine Hesitancy towards Childhood Vaccines in the United States: A Systematic Literature Review of Communication Interventions and Strategies. Vaccines, 8(4), p.590. doi: 10.3390/vaccines8040590.
33. Omer, S.B., Salmon, D.A., Orenstein, W.A., Dehart, M.P. and Halsey, N. (2009). Vaccine Refusal, Mandatory Immunization, and the Risks of Vaccine-Preventable Diseases. New England Journal of Medicine, 360(19), pp.1981–1988. doi: 10.1056/NEJMsa0806477.
34. Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., et al. (2021a). The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews. BMJ, 372, p.n71. doi: 10.1136/bmj. n71.
35. Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hróbjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., McGuinness, L.A., Stewart, L.A., Thomas, J., Tricco, A.C., Welch, V.A., Whiting, P. and Moher, D. (2021b). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ, 372, p.n71. doi: 10.1136/bmj. n71.
36. Peck, M., Gacic-Dobo, M., Diallo, M.S., Nedelec, Y., Sodha, S.S. and Wallace, A.S. (2019). Global Routine Vaccination Coverage, 2018. MMWR. Morbidity and Mortality Weekly Report, 68(42), pp.937–942. doi: 10.15585/mmwr.mm6842a1.

37. Public Health Agency of Canada (2022). COVID-19 Vaccination Coverage in Canada. [Online]. Available at: https://health-infobase.canada.ca/covid-19/vaccination-coverage (Accessed: 2 November 2022).
38. Quinn, S.C. and Andrasik, M.P. (2021). Addressing Vaccine Hesitancy in BIPOC Communities—Toward Trustworthiness, Partnership, and Reciprocity. New England Journal of Medicine, 385(2), pp.97–100. doi: 10.1056/NEJMp2103104.
39. Reñosa, M.D.C., Landicho, J., Wachinger, J., Dalglish, S.L., Bärnighausen, K., Bärnighausen, T. and McMahon, S.A. (2021). Nudging toward vaccination: A systematic review. BMJ Global Health, 6(9), p.e006237. doi: 10.1136/bmjgh-2021-006237.
40. Rief, W. (2021). Fear of Adverse Effects and COVID-19 Vaccine Hesitancy: Recommendations of the Treatment Expectation Expert Group. JAMA Health Forum, 2(5), p.e210804. doi: 10.1001/jamahealthforum.2021.0804.
41. Rosen, B., Waitzberg, R., Israeli, A., Hartal, M. and Davidovitch, N. (2021). Addressing vaccine hesitancy and access barriers to achieve persistent progress in Israel's COVID-19 vaccination program. Israel Journal of Health Policy Research, 10(1), p.43. doi: 10.1186/s13584-021-00481-x.
42. Sallam, M. (2021). COVID-19 Vaccine Hesitancy Worldwide: A Concise Systematic Review of Vaccine Acceptance Rates. Vaccines, 9(2), p.160. doi: 10.3390/vaccines9020160.
43. Sehgal, N.K. (2021). Impact of Vax-a-Million Lottery on COVID-19 Vaccination Rates in Ohio. The American Journal of Medicine, 134(11), pp.1424–1426. doi: 10.1016/j.amjmed.2021.06.032.
44. Serra-Garcia, M. and Szech, N. (2021). Choice Architecture and Incentives Increase COVID-19 Vaccine Intentions and Test Demand. WZB Discussion Paper, No. SP II 2021-302. SSRN Electronic Journal. doi: 10.2139/ssrn.3827616.
45. Shourie, S., Jackson, C., Cheater, F.M., Bekker, H.L., Edlin, R., Tubeuf, S., Harrison, W., McAleese, E., Schweiger, M. and Bleasby, B. (2013). A cluster randomised controlled trial of a web-based decision aid to support parents' decisions about their child's Measles Mumps and Rubella (MMR) vaccination. Vaccine, 31(50), pp.6003–6010. doi: 10.1016/j.vaccine.2013.10.025.
46. Skafle, I., Nordahl-Hansen, A., Quintana, D.S., Wynn, R. and Gabarron, E. (2022). Misinformation About COVID-19 Vaccines on social media: Rapid Review. Journal of Medical Internet Research, 24(8), p.e37367. doi: 10.2196/37367.
47. Smith, P.J., Humiston, S.G., Parnell, T., Vannice, K.S. and Salmon, D.A. (2010). The Association Between Intentional Delay of Vaccine Administration and Timely Childhood Vaccination Coverage. Public Health Reports, 125(4), pp.534–541. doi: 10.1177/003335491012500408.
48. Smith, P.J., Humiston, S.G., Marcuse, E.K., Zhao, Z., Dorell, C.G., Howes, C. and Hibbs, B. (2011). Parental Delay or Refusal of Vaccine Doses, Childhood Vaccination Coverage at 24 Months of Age, and the Health Belief Model. Public Health Reports, 126(Suppl 2), pp.135–146. doi: 10.1177/00333549111260S215.
49. Sprengholz, P., Eitze, S., Felgendreff, L., Korn, L. and Betsch, C. (2021). Money is not everything: Experimental evidence that payments do not increase willingness to be vaccinated against COVID-19. Journal of Medical Ethics, 47(8), pp.547–548. doi: 10.1136/medethics-2020-107122.
50. Tentori, K., Pighin, S., Giovanazzi, G., Grignolio, A., Timberlake, B. and Ferro, A. (2022). Nudging COVID-19 Vaccine Uptake by Changing the Default: A Randomized Controlled Trial. Medical Decision Making, 42(6), pp.837–841. doi: 10.1177/0272989X221101536.
51. Vergara, R.J.D., Sarmiento, P.J.D. and Lagman, J.D.N. (2021). Building public trust: A response to COVID-19 vaccine hesitancy predicament. Journal of Public Health, 43(2), pp. e291–e292. doi: 10.1093/pubmed/fdaa282.
52. Vosoughi, S., Roy, D. and Aral, S. (2018). The spread of true and false news online. Science, 359(6380), pp.1146–1151. doi: 10.1126/science. aap9559.
53. Vujovich-Dunn, C., Kaufman, J., King, C., Skinner, S.R., Wand, H., Guy, R. and Leask, J. (2021). A systematic review and meta-analysis of effectiveness of decision aids for vaccination decision-making. Vaccine, 39(27), pp.3655–3665. doi: 10.1016/j.vaccine.2021.05.021.

54. Wake, A.D. (2021). The Willingness to Receive COVID-19 Vaccine and Its Associated Factors: "Vaccination Refusal Could Prolong the War of This Pandemic"—A Systematic Review. Risk Management and Healthcare Policy, 14, pp.2609–2623. doi: 10.2147/RMHP.S311074.
55. Walkey, A.J., Law, A. and Bosch, N.A. (2021). Lottery-Based Incentive in Ohio and COVID-19 Vaccination Rates. JAMA, 326(8), pp.766–767. doi: 10.1001/jama.2021.11048.
56. Witteman, H.O., Chipenda Dansokho, S., Exe, N., Dupuis, A., Provencher, T. and Zikmund-Fisher, B.J. (2015). Risk communication, values clarification, and vaccination decisions. Risk Analysis, 35(10), pp.1801–1819. doi: 10.1111/risa.12418.
57. World Health Organization (WHO) (2019). Ten Threats to Global Health in 2019. [Online]. Geneva: WHO. Available at: https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019 (Accessed: 2 November 2022).
58. World Health Organization (WHO) (2020). WHO Director-General's Opening Remarks at the Media Briefing on COVID-19 - 11 March 2020. [Online]. Geneva: WHO. Available at: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020 (Accessed: 2 November 2022).
59. World Health Organization (WHO) (n.d.). COVID-19 Vaccines. [Online]. Geneva: WHO. Available at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines (Accessed: 2 November 2022).
60. Wroe, A.L., Turner, N. and Owens, R.G. (2005). Evaluation of a decision-making aid for parents regarding childhood immunizations. Health Psychology, 24(6), pp.539–547. doi: 10.1037/0278-6133.24.6.539.

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