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Narrative Review of Vaccine Hesitancy Interventions

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ABSTRACT

Vaccine hesitancy remains a significant global public health challenge, contributing to delayed or refused vaccination despite the availability of safe and effective immunization services. This narrative review synthesizes evidence on interventions designed to address vaccine hesitancy across diverse populations and settings. Drawing on studies identified through PRISMA-informed search and appraisal processes, the review examines theoretical foundations, methodological approaches, and the effectiveness of behavioral, communication, community-based, policy, and digital interventions. Findings indicate that targeted health communication, motivational interviewing, reminder systems, and legislative mandates can improve vaccine uptake, though effectiveness varies across contexts and population groups. Community engagement and co-design strategies demonstrate promise in fostering trust and improving acceptance, while digital media campaigns offer wide reach in countering misinformation. However, substantial heterogeneity in study design, outcome measures, and theoretical application limits comparability and causal inference. Evidence gaps persist regarding underserved populations, low- and middle-income settings, and system-level equity-focused interventions. The review concludes that multi-component, context-sensitive strategies grounded in behavioral theory and supported by rigorous evaluation frameworks are essential for effectively addressing vaccine hesitancy and strengthening global immunization programs.

Keywords: Vaccine Hesitancy**,** Immunization Uptake**,** Public Health Interventions**,** Health Communication and Community Engagement.

INTRODUCTION

Vaccine hesitancy is a major global health threat identified by the WHO, delaying or refusing vaccinations despite their availability. Common determinants include confidence, convenience, complacency, religious beliefs, geographic barriers, and perceptions of vaccine risks [1]. Vaccine-preventable diseases remain widespread, particularly in the UK, USA, and India. Yet despite extensive communication efforts, hesitancy has gained attention worldwide [2]. Various strategies, including community activities, incentives, educational videos, testimonials, and media campaigns, have been piloted to address concerns, but no comprehensive synthesis exists to guide policy and program implementation. This review analyzes vaccine-hesitancy interventions tested globally, assessing effectiveness in raising uptake among populations with different levels of concern [3].

Conceptual Foundations of Vaccine Hesitancy

A robust theoretical foundation on vaccine hesitancy models provides a background for understanding the rationale and approaches adopted by the different interventions [4]. Several models have been proposed to underline the critical determinants of vaccine hesitancy. The Health Belief Model (HBM) explores perceptions of vaccine benefits and barriers; the Theory of Planned Behavior (TPB) emphasizes the importance of normative influences on intentions to comply with vaccination recommendations; and the Consolidated Framework for Implementation Research (CFIR) encompasses multiple factors that affect the uptake of new practices, such as vaccine uptake [5]. Such theoretical models highlight the complexity and multifactorial nature of vaccine hesitancy. Some common determinants cited across the literature include perceived risks of the vaccine, perceived importance in protecting oneself and the community, perceptions of trust, satisfaction with determinants of care, and religious beliefs [2]. These factors tend to group around wider socio-political and contextual themes, such as

cultural, social, economic, organizational, political, spatial, and digital. Such observation evidences the pressing need for a systems perspective to guide the development of innovative interventions [6]. Terminology used to describe vaccine hesitancy varies considerably. Rather than a distinct concept, vaccine hesitancy arises in a continuum of vaccination-related behaviors [2]. As such, it can be located between universal acceptance of vaccination, generally accompanied by an absence of dialogue surrounding the topic, and outright refusal [2]. In this perspective, vaccine hesitancy would represent qualified acceptance of vaccination, marked by an ongoing dialogue about the associated risks and benefits [1]. Given that vaccine hesitancy does not exclusively coincide with refusal or delay, it is important to distinguish associated behaviors: vaccination still takes place, albeit at the time of the individual's choosing. The uptake of the vaccine is additionally conditioned by access and availability of service [1]. Barriers to access do not represent hesitancy, and alleviation of relevant constraints typically permits commencement of the vaccination process. Nevertheless, access still constitutes a key antecedent determinant for decision-making concerning vaccination [7].

Methodological Considerations in Intervention Studies

Various frameworks guide vaccine-hesitancy research. This synthesis follows a PRISMA-compliant process for systematic reviews [1]. Searches for peer-reviewed English-language studies, unrestricted by date, extracted articles on vaccination interventions targeting parents, caregivers, and the general population across child, adolescent, and adult vaccination schedules[8]. Opinion pieces, surveys solely assessing vaccine-hesitancy levels, studies focused exclusively on vaccine supply, and articles lacking direct intervention implementation were excluded [2]. Three reviewers rated the risk of bias using appropriate tools from the Cochrane Collaboration, National Institutes of Health, Effective Public Health Practice Project, and Campbell Collaboration [2]. This synthesis pools population-wide and targeted interventions. Common themes include modes (e.g., deliberative engagement, community-based participatory research, coalitions, community action teams, multiple-context outreach, birth cohorts) and tools (e.g., funding diversity, legislative strategies, customized approaches, relevant delivery sites)[9]. Theoretical influences and iterative, flexible approaches reflect practical implementation or community engagement models. Heterogeneity in study designs, vaccines, and determinants prompts per-category effect-size or outcome-report selection. As articulated by the Evidence and Gap Map framework, evidence quality varies by intervention type and implementation phase [10]. Studies inform measles–mumps–rubella, human papillomavirus, diphtheria, tetanus pertussis, seasonal influenza, and childhood vaccinations; the influence of other factors on COVID-19-vaccination uptake predominates [11].

Behavioral and Communication Interventions

Vaccine hesitancy interventions often focus on changing individual behavior and improving communication techniques [1]. Because information dissemination is critical to intervention success, the approach taken to convey messages is fundamental. Targeted communities or groups receive vaccination invitations based on modelling studies or direct evidence [12]. Addressing vaccine (mis)information through public health messaging is a major effort worldwide. Available messaging strategies are analysed, and vaccine and health messaging clarify the importance of vaccination regarding the individual, family, and community [2]. Stronger vaccine health messages elicit greater willingness to vaccinate than weak health messages [13]. Motivational interviewing, coupled with vaccine-dedicated video clips, promotes understanding of vaccination importance with longer half-life effects on the same [1]. Health behaviour theories, such as the health belief model, theory of planned behaviour, and social cognitive theory, are employed in messages [1]. Framing, a commonly used strategy to convey risks and preventive behaviour messages, relates a health risk to a vaccine undergoing approval [2]. Delivery mode influences intervention effectiveness; mass or social media, online platforms, Internet of Things devices, pamphlets, rural health functionaries, and field worker visits are channels for intervention [14]. Delivery by peer, family, and kin shows promise. In-person vaccination outreach with relatable, available persons is encouraged [3]. Delivery is via individual, group, in-person, and distance modes. In-person vaccinations with relatable characters are suitable; media and distance modes are appropriate where vaccination is difficult. Several independent studies measured the impact on adherence and attitude [15]. The number and type of vaccine receive increase. Nonhedonic quality of life rises among nonvaccinated students. Willingness rises for the curriculum, vocational, and conquest vaccines. Heterogeneity varies across vaccines; inoculation rate remains negative for some. Limitations comprise audience and delivery specification, targeting co-design, post-pandemic contextual change, material, and educational format [3].

Community Engagement and Trust-Building Strategies

Engagement strategies that actively involve communities in the planning, design, and implementation of immunization interventions have gained prominence as a means of enhancing vaccine uptake [1]. Such approaches are based on the premise that efforts to address vaccine hesitancy must be context-specific and must build on existing social norms, values, and practices within the community [16]. Therefore, stakeholders should engage communities to understand how the local context influences decisions concerning vaccination and to identify opportunities for adapting immunization interventions and practices to make them more acceptable. A review of

vaccine-associated educational initiatives implemented in various countries concluded that programs founded on collaboration with community members or the co-design of training materials led to similar or greater improvements in vaccination uptake than did conventional interventions [1]. Community co-design can encompass collaboration with local authorities (e.g., village chiefs) as well as efforts to identify and incorporate local champions who can facilitate outreach and communication [17]. Community engagement strategies not only contribute to a better understanding of a community's context but also foster trust and credibility between implementers and the community [3]. Trust-building activities often focus on transparent communication about vaccine-provisioning processes, supply and accountability mechanisms, and potential points of failure (e.g., stockouts) within the health system. Participation in dialogue sessions can address concerns and empower members of the community to act on their own needs or advocate within the health system. Vaccination co-design processes can enhance service adoption, and many countries have introduced culturally-responsive approaches founded on comprehensive initial assessments of the local context [18].

Policy and Health System Interventions

Vaccine mandates, system-level access interventions, provider incentives, and reminder/recall procedures constitute an important but under-explored class of interventions aimed at influencing population-level immunization uptake [2]. Vaccine mandates specify that certain vaccines must be received in order to participate in specific activities, such as school attendance, and are intended to increase uptake while also contributing to broader community-level protection through herd immunity [1]. System-level access interventions are policies that seek to facilitate vaccination by removing systemic barriers to access. Such approaches include expanding the range of qualifying health professionals authorized to administer vaccines and providing vaccines at no cost or where their cost constitutes only a small percentage of the expected income for a certain procedure [3]. System-level provider incentives reward providers for meeting or exceeding prescribed vaccination goals across their patient populations. Reminder/recall systems provide automated targeted messages to individuals who are due or overdue for vaccination through the medium of their choice (SMS, email, telephone call) at regularly prescribed intervals [19]. The effects of such policy-level interventions on overall vaccination rates appear at least partially determined by population characteristics such as geographic region, sex, income, and religion; thus, careful consideration of potential equity-related impacts is warranted[1]. Vaccine-mandate policies at the national and local levels have been associated with a net increase in vaccination rates, with mandates for school attendance consistently producing the largest positive effect across studies [20]. However, although mandated vaccines for school attendance match positively with homologous immunization models from the World Health Organization, analysis indicates that specific targeted coverage can meet herd immunity thresholds even in the absence of mandates, limiting the likely influence of emerging school-vaccination mandates. Beyond legislation requiring vaccination to gain licenses to engage in specific activities, limited country-level analysis exists of vaccine mandates and overall coverage trends at the national, regional, and global levels [21].

Digital and Media-Based Approaches

Vaccine hesitancy remains a global health threat [2]. Digital and media approaches encompass online campaigns to enhance knowledge, counter misinformation, and prompt consultations with health professionals [3]. Direct engagement with the public occurs via video clips, infographics, social media posts, and chatbots; health announcements, crisis response, and disinformation correction are other applications of such approaches. Evidence from 34 studies demonstrates extensive reach, moderate-to-high engagement levels, substantial reductions in misinformation exposure, and positive impacts on vaccination intentions [1].

Equity, Access, and Contextual Moderators

Vaccine-hesitant individuals who might otherwise accept vaccination exhibit different patterns of hesitancy than those who refuse immunization outright [2]. In contrast, child vaccination campaigns in many low- and middle-income countries where demand is high but supply is lacking encounter no hesitancy at the population level, although subgroups still persist [1]. Such stages of decision-making receive a modicum of attention in the vaccine literature. Many of the interventions fall short of interacting with widespread community-level activity, yet this absence reflects the context of the interventions under study [22]. Moreover, when campaigns lack the capacity to engage on a community-level basis, the recruitment of prominent local figures to lend endorsement within the economic and political structures underpinning the dominant supply-side paradigm receives greater emphasis. Decision-makers within such environments rarely engage with the notions of vaccination dissemination set forth in the literature [2].

Critical Synthesis of Intervention Effectiveness

In a comprehensive review of vaccine hesitancy interventions, Singh et al. (2022) found that uptake increased by 0.04% to 84.6% after health education and promotion interventions, by 11% to 12% after legislative mandates, by approximately 3% after shortage-based campaigns, and by 7% to 16% after transportation assistance measures [1]. Community engagement co-design strategies sometimes achieved greater effectiveness than conventional approaches, but methodological limitations hindered general conclusions [1]. The included studies exhibited

considerable limitations. Many employed single-arm pretest-posttest designs, undermining causal inference and the robustness of observed trends. Formal theory was often absent despite the complex determinants of vaccine-hesitant behaviour. Communications or health literacy strategies and community engagement approaches were common but rarely combined with broader systemic, political, or ethical frameworks [23]. The gap is particularly concerning given the salience of these topics in contemporary society. Consequently, there is a pressing need for additional intervention studies that engage with previously under-researched populations (such as young adults, migrant communities, and antivaccine individuals), settings (including urban and minority contexts), types (particularly concerning equity or access), and methodological paradigms that support causal inference. The deployment of multiple, standardised, or widely endorsed measures of both vaccine hesitancy and vaccine-related knowledge, together with a shared reporting framework, would usefully facilitate comparative analysis and integration across independent studies at different geographical or cultural locales [3]. Finally, building upon the emerging literature on implementation science, the further examination of the practical conditions and factors shaping the institutional uptake, incorporation, and sustainability of existing interventions would elucidate the determinants of behavioural change and the challenges involved in enacting equitable public-health measures [24].

Gaps, Limitations, and Future Research Directions

A few notable gaps and limitations exist in the literature on vaccine hesitancy interventions. First, some populations and contexts remain understudied [25]. For example, limited research specifically addresses vaccine hesitancy among Indigenous peoples (including First Nations, Métis, and Inuit in Canada), refugees, asylum seekers, displaced persons, and other migrant groups [2]. Much of the available scholarship derives from high-income countries, whereas research in low- and middle-income contexts is scarce, despite the challenge of vaccine hesitancy posed by social media [3]. Besides, certain intervention types, including policies (laws/mandates, subsidies, accessibility), multimedia (websites, radio/TV, and print), and other community engagement methods (community-owned strategies, community champions), remain largely unexplored [1]. Future studies would benefit from more rigorous designs and analyses [26]. Rather than relying solely on survey methodology or cross-sectional designs, non-experimental and experimental methods (randomized controlled trials, natural experiments, before-and-after studies) offer the possibility of greater internal validity. Alongside such designs, enhanced statistical analyses, including structural equation modeling and agent-based modeling, can illuminate mediating pathways and simulation effects. Scholars have also stressed the importance of harmonized outcome measures, standardized reporting guidelines, and the alignment of research strategies with implementation science. Standardized measures would enhance both comparability within and integration across studies, facilitate meta-analytic syntheses, and clarify the causal role of hesitancy in the decision to vaccinate [27]. The identification and evaluation of additional interventions through implementation research, along with the examination of barriers to and facilitators of intervention uptake and adherence, would further advance the field. Greater attention to the broader context of vaccine hesitancy, alongside continued prioritization of the topic, remains essential [28, 29].

CONCLUSION

Vaccination remains one of the most effective public health interventions for preventing infectious diseases and protecting both individuals and communities. Nevertheless, vaccine hesitancy continues to undermine immunization efforts worldwide. This review demonstrates that vaccine hesitancy is a complex, context-dependent phenomenon shaped by behavioral, social, cultural, and structural factors. Consequently, no single intervention is sufficient to address it across all populations. Evidence suggests that communication-based strategies, community engagement initiatives, digital outreach, and policy-level interventions can each contribute to improved vaccination uptake when appropriately tailored to local contexts. Approaches grounded in behavioral theory and supported by trusted community actors tend to achieve more sustainable outcomes. However, methodological limitations, inconsistent reporting standards, and insufficient research in marginalized populations and low-resource settings restrict the strength and generalizability of current findings. Future research should prioritize rigorous experimental designs, standardized outcome measures, and implementation-focused studies that examine how interventions function in real-world settings. Policymakers and public health practitioners should adopt integrated, multi-level strategies that combine education, trust-building, system-level accessibility improvements, and transparent governance. Strengthening these approaches will be essential for countering vaccine hesitancy, improving immunization coverage, and safeguarding global health.

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