

# Vaccine Hesitancy Unmasked: Unraveling Its Enigmatic Threads

Zulfkar Qadrie<sup>1</sup>, Mohd Altaf Dar<sup>2</sup>, Mudasir Maqbool<sup>3\*</sup> , Afshana Qadir<sup>4</sup> and Irfat Ara<sup>5</sup>

<sup>1</sup>Department of Pharmacology, Government Medical College Baramulla, Jammu and Kashmir, India; <sup>2</sup>Department of Pharmacology, CT Institute of Pharmaceutical Sciences, PTU, Jalandhar, Punjab, India; <sup>3</sup>Department of Pharmaceutical Sciences, University of Kashmir, Hazratbal, Jammu and Kashmir, India; <sup>4</sup>Government Nursing College, Baramulla, Jammu and Kashmir, India; <sup>5</sup>Regional Research Institute of Unani Medicine, University of Kashmir, Hazratbal, Jammu and Kashmir, India

\*Correspondence to: Mudasir Maqbool, Department of Pharmaceutical Sciences, University of Kashmir, Hazratbal, Jammu and Kashmir, India. ORCID: <https://orcid.org/0000-0002-9036-008X>. Tel: +91-9797240145, E-mail: [bhatmudasir92@gmail.com](mailto:bhatmudasir92@gmail.com)

Citation of this article: Qadrie Z, Dar MA, Maqbool M, Qadir A, Ara I. Vaccine Hesitancy Unmasked: Unraveling Its Enigmatic Threads. *Nat Cell Sci* 2023;1(2):80–87. doi: 10.61474/ncs.2023.00009.

## Abstract

Vaccine hesitancy poses a critical challenge to global public health, hindering efforts to achieve widespread immunization and combat infectious diseases. The present study delves into the multifaceted nature of vaccine hesitancy, aiming to unravel its enigmatic threads through a comprehensive analysis. Furthermore, the intricate interplay of factors that contribute to vaccine hesitancy, which range from socio-cultural, economic, and political dimensions, to cognitive biases and misinformation dissemination, was explored. The socio-cultural lens examines how historical experiences, cultural beliefs, and community dynamics influence vaccine acceptance. Economic factors, including access and affordability, were scrutinized for their impact on vaccine hesitancy at individual and societal levels. The present study also delves into the role of political landscapes and policy decisions in shaping the public perception of vaccines. Cognitive biases, which have rooted through psychological mechanisms, were scrutinized for their influence on decision-making processes for vaccination. Furthermore, the propagation of misinformation through various channels, including social media, was explored as a significant driver of vaccine hesitancy. Through synthesizing diverse perspectives and empirical evidence, the present study aims to provide a nuanced understanding of vaccine hesitancy. Such insights are crucial for designing targeted interventions, fostering public trust, and devising effective communication strategies to counteract vaccine hesitancy, and promote global health resilience.

**Keywords:** Vaccines; Public health; Immunity; Cultural beliefs; Hesitancy.

## Introduction

“Vaccine Hesitancy Unmasked” unravels the complex web of factors that contribute to hesitancy worldwide. By analyzing socio-cultural, economic, and political dimensions, the present study explores the historical contexts, cultural beliefs, and policy influences, along with cognitive biases, and the impact of misinformation. By untangling these threads, the present study aims to offer a nuanced understanding of the obstacles that hinder widespread immunization. This insight is essential for designing targeted interventions and communication strategies, playing a vital role in the global endeavor to address vaccine hesitancy, and strengthen public health resilience against infectious diseases. In the realm of public health, the issue of vaccine hesitancy has emerged as a multifaceted and intricate challenge. This phenomenon, which is characterized by the reluctance or refusal to undergo vaccination, despite the availability of vaccines, has garnered significant attention due to its profound impact on individual well-being, community immunity, and the broader public health infrastructure.<sup>1,2</sup> This comprehensive investigation

endeavors to delve deeply into the origins, manifestations, and potential remedies for vaccine hesitancy, shedding light on its complex nature, and the extensive repercussions it exerts on global health.<sup>2</sup>

## Origins and influences that shape vaccine hesitancy

The origins of vaccine hesitancy reside in a convergence of historical, cultural, psychological, and societal influences. The annals of vaccine history are marked by instances of controversy and perceived adverse effects, which have indelibly shaped public perception. Notably, the debunked association between the measles, mumps, and rubella (MMR) vaccine and autism stands as a prime example.<sup>1,3</sup> This episode propagated widespread skepticism and apprehension, leading to persistent doubts about the safety of vaccines. Cultural and religious beliefs are influential determinants of individual attitudes toward vaccination. Some cultural groups wholeheartedly embrace vaccines as protective measures

Received: August 24, 2023 | Revised: November 20, 2023 | Accepted: December 22, 2023 | Published online: December 30, 2023

for the greater community, while other groups harbor reservations driven by concerns over religious teachings, and the composition of vaccine ingredients. The digital era has amplified vaccine hesitancy through the proliferation of misinformation and disinformation. Social media platforms, which often lack robust fact-checking mechanisms, have evolved into breeding grounds for the dissemination of false narratives. Anecdotal accounts and unverified claims can swiftly overshadow empirical evidence, perpetuating uncertainty on vaccine safety and efficacy.<sup>4</sup>

## Role of healthcare providers in vaccine hesitancy

Vaccine hesitancy, which is a growing concern in public health, is influenced by a myriad of factors, and the role of healthcare providers is paramount in shaping public perceptions and decisions that pertain to immunization. One of the primary responsibilities of healthcare providers is effective communication. These serve as the trusted source of information for individuals who seek guidance on vaccines. Clear, transparent, and empathetic communication on the benefits and risks of vaccines remains crucial. Failure to provide accurate information may contribute to the spread of misinformation, and heighten vaccine hesitancy.<sup>5</sup> Beyond communication, the attitudes and practices of healthcare providers play a pivotal role. Their endorsement of vaccines and confidence in the immunization process would significantly impact public trust. Positive attitudes and practices can bolster vaccine acceptance, while any expression of doubt or hesitancy may have an opposite effect. Healthcare providers must lead by example, emphasizing the importance of vaccination through their own commitment to immunization.<sup>5,6</sup>

Cultural competence is another essential aspect of addressing vaccine hesitancy. Healthcare providers must be attuned to cultural nuances that influence beliefs and attitudes toward vaccines within diverse communities. Tailoring communication strategies to respect and incorporate these cultural differences is crucial in fostering understanding and acceptance. Recognizing and addressing individual concerns through patient-centered discussions is equally important, since a personalized approach can be more effective, when compared to a one-size-fits-all strategy. Systemic barriers within healthcare systems also contribute to vaccine hesitancy.<sup>6,7</sup> Limited access to vaccines, inconvenient clinic hours, and financial constraints can hinder individuals from getting vaccinated. Healthcare providers must advocate for policies and systemic changes that enhance vaccine accessibility, and address these structural challenges. By actively participating in advocacy efforts, healthcare providers can contribute to a more equitable and accessible immunization landscape.<sup>1</sup>

Professional education and training are ongoing necessities for healthcare providers. Staying informed on the latest scientific evidence, emerging vaccine technologies, and effective communication strategies is crucial. Continuous education empowers healthcare professionals to engage in informed discussions with hesitant individuals, address concerns, and counteract misinformation. By investing in the ongoing education of healthcare providers, the healthcare system can ensure a workforce that is well-equipped to navigate the evolving landscape of vaccine

hesitancy. Healthcare providers play a multifaceted role in vaccine hesitancy, from effective communication and positive endorsement, to cultural competence and advocacy for systemic improvement. Recognizing and addressing the complex interplay of these factors is essential for building public trust, enhancing vaccine acceptance, and ultimately, promoting the health and well-being of communities. A collaborative effort that involves healthcare providers, public health agencies, and the broader community is necessary to develop comprehensive strategies that address the root causes of vaccine hesitancy, and foster a more resilient immunization landscape.<sup>8</sup>

## Advantages of embracing vaccines across the population

Vaccine uptake in the general population offers a myriad of benefits that extend beyond individual health, contributing to community well-being and global public health efforts. First, vaccines are instrumental in preventing the spread of infectious diseases. By achieving high rates of vaccine coverage, communities can establish community immunity, protecting those who cannot be vaccinated, such as individuals with certain medical conditions or allergies. This indirect protection helps to curb the transmission of diseases within the population, ultimately leading to the decline in the overall incidence of infectious diseases.<sup>9</sup>

Second, widespread vaccine uptake is crucial for preventing outbreaks, and controlling epidemics. Diseases, such as measles and pertussis, which can lead to severe consequences, are kept at bay when a significant proportion of the population is immunized. This not only protects individuals from potentially serious illnesses, but also alleviates the burden on healthcare systems, and resources that would otherwise be strained during outbreaks. Furthermore, vaccines contribute to the reduction of healthcare costs. By preventing illness and complications associated to infectious diseases, vaccines help to minimize the economic burden on healthcare systems. Fewer hospitalizations, doctor visits, and treatments related to vaccine-preventable diseases result in cost savings for both individuals and societies. This, in turn, allows resources to be allocated more efficiently, and address other health needs and priorities.<sup>10</sup>

Vaccine uptake also plays a pivotal role in achieving global health security. As travel and international interactions increase, the risk of disease transmission across borders rises. High vaccine coverage contributes to global efforts in controlling and eradicating infectious diseases, fostering the collaboration between countries to ensure the health and safety of people worldwide. This interconnectedness underscores the importance of a coordinated, international approach to vaccination. In addition to its direct health benefits, vaccines contribute to overall societal well-being by supporting productivity and economic development. Healthy populations are more likely to participate in the workforce, contribute to economic growth, and build resilient communities. By preventing the burden of illnesses, vaccines help maintain a robust and active labor force, contributing to the social and economic stability of communities.<sup>11</sup>

Lastly, vaccines are essential tools in the prevention of long-term complications and disabilities associated to cer-

tain diseases. For example, vaccines, such as the human papillomavirus (HPV) vaccine, can prevent cervical cancer, while the influenza vaccine can help to protect against severe complications and mortality associated to seasonal flu. By preventing these long-term health consequences, vaccines contribute to a higher quality of life for individuals and communities.<sup>12</sup> The benefits of vaccine uptake in the general population extend far beyond individual health. These include the prevention of disease transmission, control of outbreaks, reduction of healthcare costs, contribution to global health security, support for economic development, and prevention of long-term health complications. Prioritizing and promoting vaccine uptake is a crucial component of public health strategies aimed at building healthier, more resilient communities.<sup>13</sup>

## The diverse spectrum of hesitancy

Vaccine hesitancy encompasses a spectrum of attitudes and behaviors, rather than conforming to a singular archetype. On one end, individuals may exhibit mild hesitancy, expressing reservations on specific vaccines, their constituents, or potential side effects. These concerns frequently find their roots in misinformation and anecdotal anecdotes. At the opposite end of the spectrum lies outright vaccine refusal, which is characterized by the adamant rejection of all vaccines.<sup>2</sup> This extreme stance is often rooted in deeply held convictions, distrust of pharmaceutical enterprises and governmental agencies, and the pervasive skepticism towards medical interventions. Between these polarities exist a diverse array of perspectives. Some individuals engage in selective vaccination, opting to receive specific vaccines, while declining others based on perceived risk-benefit calculations. Socioeconomic factors, access to healthcare, and cultural norms all contribute to the intricate decision-making process.<sup>14</sup>

## Exploring factors that influence beliefs in the healthcare system and unpacking the vaccine side

Beliefs within the healthcare system are multifaceted, and shaped by a myriad of factors that influence the perceptions, attitudes and decisions of individuals. Concurrently, discussions surrounding vaccine side effects remain pivotal, since this impacts public trust and acceptance. This exploration delves into the intricate landscape of factors that influence beliefs in the healthcare system, emphasizing the need for transparent communication, cultural sensitivity, and improved access. Simultaneously, this unravels the complexities that surround vaccine side effects, focusing on the importance of risk-benefit analysis, transparency in information dissemination, and robust monitoring systems.<sup>15</sup> Beliefs within the healthcare system are influenced by a dynamic interplay of factors, including communication, cultural influences, access to healthcare, quality of care, and educational outreach. Navigating these influences require a comprehensive and patient-centered approach that prioritizes transparency, inclusivity, and equitable access to healthcare. Simultaneously, understanding and addressing concerns related to vaccine side effects demand a nuanced strategy,

with focus on risk-benefit analysis, transparent information dissemination, robust monitoring systems, media literacy, and proactive public health campaigns. By recognizing and actively addressing these multifaceted aspects, healthcare providers and public health authorities can foster an environment that promotes trust, informed decision-making, and widespread acceptance of crucial preventive measures, such as vaccines.<sup>16</sup>

## Factors that influence beliefs in the healthcare system

### Communication and trust

Effective communication lies at the heart of positive healthcare experiences. Patients form their beliefs based on interactions with healthcare providers, emphasizing the importance of transparent, empathetic, and clear communication. Trust is a delicate element within the healthcare system, and this is nurtured through open dialogue. Patients who feel heard, respected, and well-informed are more likely to develop trust in healthcare recommendations, including those related to vaccinations.<sup>16,17</sup>

### Cultural and societal influences

Cultural and societal factors exert a significant influence on healthcare beliefs. The diverse fabric of societies bring forth various perspectives on health, illness, and healthcare practices. Historical events, community attitudes, and cultural norms all contribute to shaping individual beliefs. Recognizing and respecting these diverse influences is essential in fostering a healthcare environment that is sensitive to different belief systems, thereby promoting inclusivity and trust.<sup>18</sup>

### Access to healthcare

Beliefs in the healthcare system are intricately linked to accessibility. Disparities in access based on socioeconomic factors can lead to skepticism or mistrust. Individuals with limited access to healthcare services may feel disconnected from the system, impacting their beliefs on its efficacy. Addressing these disparities by improving healthcare accessibility ensures that a broader segment of the population can positively engage with the healthcare system.<sup>19</sup>

### Quality of care

The quality of healthcare received significantly shapes an individual's beliefs. Positive experiences, effective treatments, and compassionate care contribute to favorable perceptions. Conversely, instances of suboptimal care, misdiagnosis, or inadequate attention can erode trust. Focusing on delivering high-quality care across diverse populations is crucial in fostering positive beliefs and attitudes toward the healthcare system.<sup>20</sup>

### Educational outreach

Education plays a pivotal role in shaping beliefs on healthcare. Comprehensive and accessible health education programs contribute to informed decision-making. Healthcare providers and public health initiatives must prioritize educational outreach, ensuring that individuals are equipped with

accurate information on preventive measures, including vaccinations. Education empowers individuals to make choices aligned with their health priorities and values.<sup>20</sup>

## Vaccine side effects

### *Transparency of information*

An essential aspect of navigating beliefs on vaccines revolves around the transparency of information on its potential side effects. Individuals must have access to clear, accurate, and easily understandable details on risks associated to vaccination. Transparency builds trust, and enables individuals to make informed decisions on their health. Healthcare providers play a central role in ensuring that information on vaccine side effects is communicated in a manner that is accessible and comprehensible to diverse audiences.<sup>21</sup>

### *Risk-benefit analysis*

Understanding the concept of risk-benefit analysis is crucial in the context of vaccine side effects. Every medical intervention, including vaccines, carries some level of risk. However, these risks are often minimal, when compared to the potential benefits of preventing severe diseases. Healthcare providers must effectively communicate this balance, emphasizing that the benefits of vaccination outweigh the risks for both individuals and the broader community. A nuanced understanding of risk-benefit analysis empower individuals to make decisions based on the comprehensive evaluation of its potential outcomes.<sup>22</sup>

### *Monitoring and reporting*

Rigorous monitoring of vaccine safety is paramount for maintaining public confidence. Continuous surveillance of adverse events, prompt reporting mechanisms, and transparent communication on the monitoring process contribute to the proactive approach in addressing concerns related to vaccine side effects. Robust monitoring systems not only enhances the safety profile of vaccines, but also demonstrates a commitment to ongoing evaluation and improvement in public health practices.<sup>23</sup>

### *Media influence and misinformation*

The influence of media in shaping public perceptions cannot be understated. Addressing vaccine side effects require navigating through the complex landscape of media influence, and combating misinformation. Healthcare providers and public health agencies must actively engage with the media to ensure accurate and balanced reporting. Efforts to counter misinformation, both online and offline, are essential in fostering an environment where individuals can make informed decisions based on reliable information.<sup>24</sup>

### *Public health campaigns*

Proactive public health campaigns play a vital role in shaping beliefs on vaccine side effects. Well-designed campaigns that emphasize the safety and efficacy of vaccines can provide clear information on its potential side effects, and highlight the benefits of vaccination, contributing to a positive narrative. Furthermore, engaging in public discourse through various channels can help to counteract

vaccine hesitancy, and build confidence in immunization programs.<sup>25</sup>

## Impact on public health and societal implications

The consequences of vaccine hesitancy extend beyond individual choices, significantly affecting both personal and public health outcomes. Among the most concerning consequences is the erosion of community immunity, which is a phenomenon wherein a substantial segment of the population becomes immune to a disease, consequently safeguarding those who cannot be vaccinated due to medical constraints.<sup>26</sup> As vaccine coverage rates dwindle due to hesitancy, community immunity diminishes, rendering communities more susceptible to outbreaks of vaccine-preventable illnesses. Diseases, such as measles, pertussis, and other formerly controlled afflictions, have resurged in various regions, posing threats to unvaccinated individuals, and placing undue strain on healthcare systems. Furthermore, vaccine hesitancy exacerbates health disparities, particularly within marginalized communities. The limited access to reliable information, healthcare resources, and immunization services disproportionately affects vulnerable populations, culminating in inequitable health outcomes.<sup>27</sup>

## Strategies to address vaccine hesitancy

Effectively addressing vaccine hesitancy necessitates a comprehensive approach that acknowledges the diverse origins and manifestations of this challenge.<sup>28</sup> A range of strategies holds promise in confronting this complex issue.

### *Education and communication*

Dispensing accurate, evidence-based information on vaccines is a foundational step. Health authorities and healthcare professionals must embark on transparent communication campaigns that confront prevalent misconceptions and concerns.<sup>29</sup>

### *Cultural competence*

Recognizing and respecting cultural and religious beliefs that are tied to vaccines is imperative. Tailoring information that resonates within diverse cultural contexts would foster increased acceptance.<sup>30</sup>

### *Engagement of healthcare providers*

Healthcare professionals play a pivotal role in establishing trust and addressing patient anxieties. Open and empathetic communication can counteract misinformation and instill confidence.<sup>31</sup>

### *Community involvement*

Collaborating with community leaders, influencers, and local organizations can facilitate the dissemination of accurate information, and address specific concerns within distinct communities.<sup>32</sup>

### *Promoting digital literacy*

In the age of information overload, cultivating critical thinking



skills and digital literacy can empower individuals to discern credible sources from misinformation.<sup>33</sup>

### Policy measures

In selected instances, policy interventions, such as the elimination of non-medical exemptions for vaccines in school settings, can bolster vaccination rates.<sup>34</sup>

### Research and vigilance

Continuous monitoring of vaccine coverage rates and public attitudes would enable informed interventions, and timely response to emerging trends in hesitancy.<sup>35</sup>

## Role of health literacy and vaccine literacy in determining compliance to vaccination

In the global pursuit of public health, vaccination stands as a cornerstone for disease prevention and control. However, the success of vaccination programs is intricately tied to the level of health literacy and vaccine literacy within communities. Health literacy encompasses the ability to access, understand, and apply health information, while vaccine literacy specifically relates to understanding the importance, safety, and efficacy of vaccines. Health literacy and vaccine literacy are indispensable determinants of vaccination compliance. As the world faces ongoing and emerging health challenges, the importance of empowering individuals with the knowledge to make informed decisions on vaccination cannot be overstated. Efforts to improve health and vaccine literacy must be comprehensive, addressing the diverse needs of populations, and fostering a sense of trust and confidence in public health measures. By investing in education and communication strategies that enhance health and vaccine literacy, societies can build a foundation for stronger, more resilient public health systems, and ensure the success of vaccination programs in safeguarding global well-being.<sup>36,37</sup>

Health literacy serves as the foundation upon which individuals make informed decisions on their health, including vaccination. In populations with low health literacy, there is a heightened risk of misinformation, misinterpretation of health-related information, and overall poor health outcomes.<sup>38–41</sup> In the context of vaccination, individuals with limited health literacy may struggle to comprehend the benefits and risks associated to vaccines, leading to hesitancy or refusal. Understanding vaccination schedules, recognizing potential side effects, and comprehending the broader societal benefits of immunization are all aspects of health literacy that significantly impact vaccination compliance. Effective communication strategies tailored for diverse literacy levels are imperative to ensure that individuals can make informed decisions on their own health, and their communities.<sup>41–47</sup>

## The 5C model of vaccine hesitancy

Vaccine hesitancy, which is a growing concern in global public health, can be effectively understood through the lens of the 5C model. This model identifies five key factors that influence an individual's decision to accept or refuse vaccinations: confidence, complacency, convenience, communication, and calculation.<sup>47–51</sup>

### Confidence

Confidence in vaccines is fundamental to acceptance. This reflects trust in the safety, efficacy, and necessity of immunizations. Factors, such as misinformation, concerns about the side effects, and distrust in healthcare systems can erode this confidence. Addressing confidence issues require transparent communication from healthcare providers, and concerted efforts to combat vaccine misinformation through accessible and culturally sensitive public health campaigns.<sup>52</sup>

### Complacency

Complacency arises when individuals perceive a low risk of vaccine-preventable diseases, which is often due to successful past vaccination efforts or low disease prevalence. This can lead to underestimating the importance of maintaining vaccination schedules. Combatting complacency involves emphasizing the ongoing threat of vaccine-preventable diseases in public health messaging, as well as actively recommending and reminding individuals of the necessity of vaccinations.<sup>53</sup>

### Convenience

Access to vaccination services is a critical determinant of vaccine uptake. Convenience relates to the ease with which individuals can access vaccines, considering factors, such as time, location and cost. In order to improve convenience, healthcare systems must expand vaccination services, offer flexible hours, and reduce financial barriers. Mobile vaccination units, workplace programs, and integration into routine healthcare appointments can enhance accessibility, particularly for vulnerable populations.<sup>54</sup>

### Communication and calculation

Effective communication is pivotal in addressing vaccine hesitancy. Clear, accurate, and culturally sensitive communication strategies are essential to dispel myths, and build understanding. Calculation involves individuals who weigh the perceived risks and benefits of vaccination. Healthcare providers play a crucial role in addressing calculation-related hesitancy by engaging in open conversations, providing evidence-based information, and empathizing with individual perspectives.<sup>55</sup>

The 5C model provides a comprehensive framework for understanding the intricate factors that contribute to vaccine hesitancy. By simultaneously addressing confidence, complacency, convenience, communication and calculation, public health efforts can develop targeted interventions that enhance vaccine acceptance, and contribute to a broader culture of trust and informed decision-making.<sup>56,57</sup>

## Conclusion

Vaccine hesitancy is a multidimensional challenge intertwined with historical legacies, cultural dynamics, psychological biases, and the rapid propagation of misinformation. Its repercussions extend beyond personal choices, affecting the broader landscape of community health, disease prevalence, and healthcare systems. By delving into the origins and manifestations of vaccine hesitancy, and executing evidence-based strategies, societies can endeavor to rebuild

trust in vaccines, fortify public health defenses, and cultivate a healthier future for all. In the pursuit of comprehending the intricacies of vaccine hesitancy, fostering informed decision-making and ensuring equitable access to immunization stands as essential endeavors for the global health community. A comprehensive curriculum for healthcare professionals should be developed to address vaccine hesitancy. Focus should be given to understanding hesitancy factors, honing communication skills, debunking myths, promoting cultural competence, introducing collaborative decision-making models, and providing practical applications. Emphasis should be given to continual professional development, in order to ensure ongoing proficiency in navigating vaccine-related discussions, and building trust within diverse communities.

## Acknowledgments

The authors would like to acknowledge the support and expertise provided by all co-authors. Their insights have greatly enriched the content of the article. Special appreciation is owed to the corresponding author for the leadership and coordination throughout the collaborative process. Lastly, the authors would like to convey their appreciation to the reviewers for the constructive feedback, which significantly enhanced the quality and rigor of the review. This collaborative effort has resulted in a comprehensive and insightful contribution to the scientific community.

## Funding

None.

## Conflict of interest

The authors have no conflicts of interest to declare.

## Author contributions

ZQ: conceptualization, methodology, data curation, and preparation of the original draft; MAD: investigation, formal analysis, visualization, and meticulous review and editing; MM: software, validation, formal analysis, and thorough review and editing, which enhanced the overall quality of the manuscript; AQ: resources, project administration, supervision, and detailed review and editing; IA: conceptualization, original draft preparation, review and editing, and provided crucial supervision throughout the research process. All authors have critically reviewed and approved the final manuscript, underscoring the collaborative nature of the work, and ensuring its comprehensive and well-structured research output.

## References

- [1] Dubé E, Laberge C, Guay M, Bramadat P, Roy R, Bettinger J. Vaccine hesitancy: an overview. *Hum Vaccin Immunother* 2013;9(8):1763–1773. doi:10.4161/hv.24657, PMID:23584253.
- [2] MacDonald NE; SAGE Working Group on Vaccine Hesitancy. Vaccine hesitancy: Definition, scope and determinants. *Vaccine* 2015; 33(34):4161–4164. doi:10.1016/j.vaccine.2015.04.036, PMID:25896383.
- [3] Dror AA, Eisenbach N, Taiber S, Morozov NG, Mizrahi M, Zigron A, *et al.* Vaccine hesitancy: the next challenge in the fight against COVID-19. *Eur J Epidemiol* 2020;35(8):775–779. doi:10.1007/s10654-020-00671-y, PMID:32785815.
- [4] Troiano G, Nardi A. Vaccine hesitancy in the era of COVID-19. *Public Health* 2021;194:245–251. doi:10.1016/j.puhe.2021.02.025, PMID:33965796.
- [5] Paterson P, Meurice F, Stanberry LR, Glismann S, Rosenthal SL, Larson HJ. Vaccine hesitancy and healthcare providers. *Vaccine* 2016;34(52):6700–6706. doi:10.1016/j.vaccine.2016.10.042, PMID:27810314.
- [6] Dubé E. Addressing vaccine hesitancy: the crucial role of healthcare providers. *Clin Microbiol Infect* 2017;23(5):279–280. doi:10.1016/j.cmi.2016.11.007, PMID:27851999.
- [7] Elbarazi I, Al-Hamad S, Alfalasi S, Aldaheri R, Dubé E, Alsuwaidi AR. Exploring vaccine hesitancy among healthcare providers in the United Arab Emirates: a qualitative study. *Hum Vaccin Immunother* 2021;17(7):2018–2025. doi:10.1080/21645515.2020.1855953, PMID:33369524.
- [8] Huang D, Ganti L, Graham EW, Shah D, Aleksandrovskiy I, Al-Bassam M, *et al.* COVID-19 Vaccine Hesitancy Among Healthcare Providers. *Health Psychol Res* 2022;10(3):34218. doi:10.52965/001c.34218, PMID:35774910.
- [9] Näsman A, Du J, Dalianis T. A global epidemic increase of an HPV-induced tonsil and tongue base cancer - potential benefit from a pan-gender use of HPV vaccine. *J Intern Med* 2020;287(2):134–152. doi:10.1111/joim.13010, PMID:31733108.
- [10] Leung AK, Koh B, Lua VY, Liu JH, Choi SY, Lee IC, Lee M, Lin MH, Hodgetts D, Chen SX. The role of cosmopolitan orientation in COVID-19-related attitudes: perceived threats and opportunities, vaccination willingness, and support for collective containment efforts. *Curr Psychol* 2023. doi:10.1007/s12144-023-05039-5.
- [11] Goldberg R. Vaccine Liability in the Light of Covid-19: A Defence of Risk-Benefit. *Med Law Rev* 2022;30(2):243–267. doi:10.1093/medlaw/fwab053, PMID:35026000.
- [12] Mercadante AR, Law AV. Will they, or Won't they? Examining patients' vaccine intention for flu and COVID-19 using the Health Belief Model. *Res Social Adm Pharm* 2021;17(9):1596–1605. doi:10.1016/j.sapharm.2020.12.012, PMID:33431259.
- [13] Gulumbe BH, Shehu A, Abdulrahim A, Emmerson P, Lawan KA. Advancing Malaria eradication efforts: Nigeria and Ghana embrace the Oxford Malaria vaccine as a beacon of hope. *Journal of Global Health Science*. *J Glob Health Sci* 2023;Aug5:e13. doi:10.35500/jghs.2023.5.e13.
- [14] Swed S, Alibrahim H, Bohsas H, Shoib S, Hasan MM, Motawea KR, *et al.* Parents' acceptance to vaccinate children against COVID-19: A Syrian online survey. *Front Public Health* 2022;10:955362. doi:10.3389/fpubh.2022.955362, PMID:36311581.
- [15] Davies B, Olivier J, Amponsah-Dacosta E. Health Systems Determinants of Delivery and Uptake of Maternal Vaccines in Low- and Middle-Income Countries: A Qualitative Systematic Review. *Vaccines (Basel)* 2023;11(4):869. doi:10.3390/vaccines11040869, PMID:37112781.
- [16] Herzog R, Álvarez-Pasquin MJ, Díaz C, Del Barrio JL, Estrada JM, Gil Á. Are healthcare workers' intentions to vaccinate related to their knowledge, beliefs and attitudes? A systematic review. *BMC Public Health* 2013;13:154. doi:10.1186/1471-2458-13-154, PMID:23421987.
- [17] Mosadeghrad AM. Factors influencing healthcare service quality. *Int J Health Policy Manag* 2014;3(2):77–89. doi:10.15171/ijhpm.2014.65, PMID:25114946.
- [18] Jin J, Sklar GE, Min Sen Oh V, Chuen Li S. Factors affecting therapeutic compliance: A review from the patient's perspective. *Ther Clin Risk Manag* 2008;4(1):269–286. doi:10.2147/tcrm.s1458, PMID:18728716.
- [19] Musheke M, Bond V, Merten S. Individual and contextual factors influencing patient attrition from antiretroviral therapy care in an urban community of Lusaka, Zambia. *J Int AIDS Soc* 2012;15(Suppl 1):17366. doi:10.7448/IAS.15.3.17366, PMID:22713354.
- [20] Ford ME, Vernon SW, Havstad SL, Thomas SA, Davis SD. Factors influencing behavioral intention regarding prostate cancer screening among older African-American men. *J Natl Med Assoc* 2006;98(4):505–514. PMID:16623062.

- [21] Pichitchaisopa N, Naenna T. Factors affecting the adoption of healthcare information technology. *EXCLI J* 2013;12:413–436. PMID: 26417235.
- [22] Tran BX, Boggiano VL, Nguyen LH, Latkin CA, Nguyen HLT, Tran TT, et al. Media representation of vaccine side effects and its impact on utilization of vaccination services in Vietnam. *Patient Prefer Adherence* 2018;12:1717–1728. doi:10.2147/PPA.S171362, PMID:30233151.
- [23] d’Onofrio A, Manfredi P. Vaccine demand driven by vaccine side effects: dynamic implications for SIR diseases. *J Theor Biol* 2010;264(2):237–252. doi:10.1016/j.jtbi.2010.02.007, PMID:20149801.
- [24] Sprent J, King C. COVID-19 vaccine side effects: The positives about feeling bad. *Sci Immunol* 2021;6(60):eabj9256. doi:10.1126/sciimmunol.abj9256, PMID:34158390.
- [25] Ganesan S, Al Ketbi LMB, Al Kaabi N, Al Mansoori M, Al Maskari NN, Al Shamsi MS, et al. Vaccine Side Effects Following COVID-19 Vaccination Among the Residents of the UAE-An Observational Study. *Front Public Health* 2022;10:876336. doi:10.3389/fpubh.2022.876336, PMID:35602146.
- [26] Soares P, Rocha JV, Moniz M, Gama A, Laires PA, Pedro AR, et al. Factors Associated with COVID-19 Vaccine Hesitancy. *Vaccines (Basel)* 2021;9(3):300. doi:10.3390/vaccines9030300, PMID:33810131.
- [27] Murphy J, Vallières F, Bentall RP, Shevlin M, McBride O, Hartman TK, et al. Psychological characteristics associated with COVID-19 vaccine hesitancy and resistance in Ireland and the United Kingdom. *Nat Commun* 2021;12(1):29. doi:10.1038/s41467-020-20226-9, PMID:33397962.
- [28] Larson HJ, Jarrett C, Eckersberger E, Smith DM, Paterson P. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007–2012. *Vaccine* 2014;32(19):2150–2159. doi:10.1016/j.vaccine.2014.01.081, PMID:24598724.
- [29] Puri N, Coomes EA, Haghbayan H, Gunaratne K. Social media and vaccine hesitancy: new updates for the era of COVID-19 and globalized infectious diseases. *Hum Vaccin Immunother* 2020;16(11):2586–2593. doi:10.1080/21645515.2020.1780846, PMID:32693678.
- [30] Salmon DA, Dudley MZ, Glanz JM, Omer SB. Vaccine hesitancy: Causes, consequences, and a call to action. *Vaccine* 2015;33(Suppl 4):D66–D71. doi:10.1016/j.vaccine.2015.09.035, PMID:26615171.
- [31] Kwok KO, Li KK, Wei WJ, Tang A, Wong SYS, Lee SS. Editor’s Choice: Influenza vaccine uptake, COVID-19 vaccination intention and vaccine hesitancy among nurses: A survey. *Int J Nurs Stud* 2021;114:103854. doi:10.1016/j.ijnurstu.2020.103854, PMID:33326864.
- [32] Robertson E, Reeve KS, Niedzwiedz CL, Moore J, Blake M, Green M, et al. Predictors of COVID-19 vaccine hesitancy in the UK household longitudinal study. *Brain Behav Immun* 2021;94:41–50. doi:10.1016/j.bbi.2021.03.008, PMID:33713824.
- [33] Dubé E, Vivion M, MacDonald NE. Vaccine hesitancy, vaccine refusal and the anti-vaccine movement: influence, impact and implications. *Expert Rev Vaccines* 2015;14(1):99–117. doi:10.1586/14760584.2015.964212, PMID:25373435.
- [34] Kricorian K, Civen R, Equils O. COVID-19 vaccine hesitancy: misinformation and perceptions of vaccine safety. *Hum Vaccin Immunother* 2022;18(1):1950504. doi:10.1080/21645515.2021.1950504, PMID:34325612.
- [35] Aw J, Seng JJB, Seah SSY, Low LL. COVID-19 Vaccine Hesitancy-A Scoping Review of Literature in High-Income Countries. *Vaccines (Basel)* 2021;9(8):900. doi:10.3390/vaccines9080900, PMID:34452026.
- [36] Lorini C, Del Riccio M, Zanobini P, Biasio RL, Bonanni P, Giorgetti D, et al. Vaccination as a social practice: towards a definition of personal, community, population, and organizational vaccine literacy. *BMC Public Health* 2023;23(1):1501. doi:10.1186/s12889-023-16437-6, PMID:37553624.
- [37] Sørensen K, Van den Broucke S, Pelikan JM, Fullam J, Doyle G, Slonska Z, et al. HLS-EU Consortium. Measuring health literacy in populations: illuminating the design and development process of the European Health Literacy Survey Questionnaire (HLS-EU-Q). *BMC Public Health* 2013;13:948. doi:10.1186/1471-2458-13-948, PMID:24112855.
- [38] Sørensen K, Van den Broucke S, Fullam J, Doyle G, Pelikan J, Slonska Z, et al. (HLS-EU) Consortium Health Literacy Project European. Health literacy and public health: a systematic review and integration of definitions and models. *BMC Public Health* 2012;12:80. doi:10.1186/1471-2458-12-80, PMID:22276600.
- [39] Amit Aharon A, Nehama H, Rishpon S, Baron-Epel O. Parents with high levels of communicative and critical health literacy are less likely to vaccinate their children. *Patient Educ Couns* 2017;100(4):768–775. doi:10.1016/j.pec.2016.11.016, PMID:27914735.
- [40] Cadeddu C, Regazzi L, Bonaccorsi G, Rosano A, Unim B, Griebler R, et al. The Determinants of Vaccine Literacy in the Italian Population: Results from the Health Literacy Survey 2019. *Int J Environ Res Public Health* 2022;19(8):4429. doi:10.3390/ijerph19084429, PMID:35457297.
- [41] Castro-Sánchez E, Chang PWS, Vila-Candel R, Escobedo AA, Holmes AH. Health literacy and infectious diseases: why does it matter? *Int J Infect Dis* 2016;43:103–110. doi:10.1016/j.ijid.2015.12.019, PMID:26751238.
- [42] Castro-Sánchez E, Vila-Candel R, Soriano-Vidal FJ, Navarro-Illana E, Díez-Domingo J. Influence of health literacy on acceptance of influenza and pertussis vaccinations: a cross-sectional study among Spanish pregnant women. *BMJ Open* 2018;8(7):e022132. doi:10.1136/bmjopen-2018-022132, PMID:29982220.
- [43] Meppelink CS, Smit EG, Franssen ML, Diviani N. “I was Right about Vaccination”: Confirmation Bias and Health Literacy in Online Health Information Seeking. *J Health Commun* 2019;24(2):129–140. doi:10.1080/10810730.2019.1583701, PMID:30895889.
- [44] Biasio LR, Bonaccorsi G, Lorini C, Pecorelli S. Assessing COVID-19 vaccine literacy: a preliminary online survey. *Hum Vaccin Immunother* 2021;17(5):1304–1312. doi:10.1080/21645515.2020.1829315, PMID:33118868.
- [45] Albright AE, Allen RS. HPV Misconceptions Among College Students: The Role of Health Literacy. *J Community Health* 2018;43(6):1192–1200. doi:10.1007/s10900-018-0539-4, PMID:29922992.
- [46] Scott TL, Gazmararian JA, Williams MV, Baker DW. Health literacy and preventive health care use among Medicare enrollees in a managed care organization. *Med Care* 2002;40(5):395–404. doi:10.1097/00005650-200205000-00005, PMID:11961474.
- [47] Montagni I, Ouazzani-Touhami K, Mebarki A, Texier N, Schück S, Tzourio C, CONFINS group. Acceptance of a Covid-19 vaccine is associated with ability to detect fake news and health literacy. *J Public Health (Oxf)* 2021;43(4):695–702. doi:10.1093/pubmed/fdab028, PMID:33693905.
- [48] Rancher C, Moreland AD, Smith DW, Cornelison V, Schmidt MG, Boyle J, et al. Using the 5C model to understand COVID-19 vaccine hesitancy across a National and South Carolina sample. *J Psychiatr Res* 2023;160:180–186. doi:10.1016/j.jpsychires.2023.02.018, PMID:36809746.
- [49] Tostrud L, Thelen J, Palatnik A. Models of determinants of COVID-19 vaccine hesitancy in non-pregnant and pregnant population: Review of current literature. *Hum Vaccin Immunother* 2022;18(6):2138047. doi:10.1080/21645515.2022.2138047, PMID:36345571.
- [50] Alobwede SM, Kidzeru EB, Katoto PDMC, Lumngwena EN, Cooper S, Goliath R, et al. Influenza Vaccination Uptake and Hesitancy among Healthcare Workers in Early 2021 at the Start of the COVID-19 Vaccine Rollout in Cape Town, South Africa. *Vaccines (Basel)* 2022;10(8):1176. doi:10.3390/vaccines10081176, PMID:35893825.
- [51] Kattumana T. Trust, Vaccine Hesitancy, and the COVID-19 Pandemic: A Phenomenological Perspective. *Social Epistemology* 2022;36(5):641–55. doi:10.1080/02691728.2022.2115325.
- [52] Putri NP, Subramaniam G, Sivasamugham LA, Gopinathan S, Raman M, Hai ST. Understanding COVID-19 Vaccine Hesitancy among Tertiary Level Students in Malaysia Using the 5C Model-A Short Survey. *Journal of Liaquat University of Medical & Health Sciences* 2022;21(03):222–228. doi:10.22442/jlumhs.2022.00959.
- [53] Hossain MB, Alam MZ, Islam MS, Sultan S, Faysal MM, Rima S, et al. Health Belief Model, Theory of Planned Behavior, or Psychological Antecedents: What Predicts COVID-19 Vaccine Hesitancy Better Among the Bangladeshi Adults? *Front Public Health* 2021;9:711066. doi:10.3389/fpubh.2021.711066, PMID:34490193.
- [54] Zhao J, Or C. An examination of factors beyond the 5C Model in COVID-19 Vaccine Uptake Decisions. *Healthcare and Medical Devices* 2023;79:1. doi:10.54941/ahfe1003480.
- [55] Betsch C, Schmid P, Heinemeier D, Korn L, Holtmann C, Böhm R. Beyond confidence: Development of a measure assessing the 5C psycho-

- logical antecedents of vaccination. *PLoS One* 2018;13(12):e0208601. doi:10.1371/journal.pone.0208601, PMID:30532274.
- [56] Gendler Y, Ofri L. Investigating the Influence of Vaccine Literacy, Vaccine Perception and Vaccine Hesitancy on Israeli Parents' Acceptance of the COVID-19 Vaccine for Their Children: A Cross-Sectional Study. *Vaccines (Basel)* 2021;9(12):1391. doi:10.3390/vaccines9121391, PMID:34960137.
- [57] Eitze S, Heinemeier D, Schmid-Küpke NK, Betsch C, Vaccination60+ Study Group. Decreasing vaccine hesitancy with extended health knowledge: Evidence from a longitudinal randomized controlled trial. *Health Psychol* 2021;40(2):77–88. doi:10.1037/hea0001045, PMID:33475414.