



The Epidemiology of Vaccine Hesitancy: A Global Challenge to Public Health

Akmaral Baspakova^{1*}; Sartayeva, Aigul²

¹Department of Epidemiology, West Kazakhstan Marat Ospanov State Medical University, 68 Maresyev Street, Aktobe, 030019, Kazakhstan

²Department of General Medical Practice №2, West Kazakhstan Marat Ospanov Medical University, Aktobe, 030012, Kazakhstan

Received: 02/07/2023

Accepted: 11/09/2023

Published: 20/09/2023

Abstract

Vaccine hesitancy, the delay in acceptance or refusal of vaccines despite the availability of vaccination services, poses a significant challenge to global public health. This paper explores the epidemiology of vaccine hesitancy, analyzing its complex determinants, geographical variations, and impact on disease outbreaks. We discuss key factors contributing to vaccine hesitancy, including concerns about vaccine safety and efficacy, lack of trust in healthcare providers and institutions, misinformation and disinformation spread through social media, and cultural and religious beliefs. The paper examines the consequences of vaccine hesitancy, highlighting the resurgence of preventable diseases, increased healthcare burdens, and economic losses. Finally, we explore strategies to address vaccine hesitancy, emphasizing the importance of evidence-based communication, building trust, promoting informed decision-making, and addressing the underlying social and cultural factors that contribute to hesitancy.

Keywords: Vaccine hesitancy, vaccination, epidemiology, public health, disease outbreaks, misinformation, disinformation, trust, communication, social determinants of health

1 Introduction

Immunization through vaccination stands as a cornerstone of modern public health, representing one of the most impactful and cost-effective interventions for the prevention and control of infectious diseases. The widespread deployment of vaccines has led to the eradication of smallpox and near-elimination of poliomyelitis, among other remarkable achievements. These successes underscore the profound capacity of vaccines to induce herd immunity, reducing disease transmission and protecting both individuals and populations from significant morbidity and mortality. Historically, the development and implementation of vaccination programs have been pivotal in reducing the global burden of infectious diseases, particularly those affecting vulnerable populations such as children and the elderly. However, the continued effectiveness of these programs is increasingly threatened by a complex phenomenon known as vaccine hesitancy. This phenomenon, characterized by a delay in acceptance or outright refusal of vaccines despite their availability, poses a significant impediment to achieving optimal vaccination coverage and maintaining population immunity. Vaccine hesitancy is not simply a binary choice between acceptance and refusal; rather, it exists along a spectrum encompassing varying degrees of doubt, delay, and selective acceptance, often influenced by a constellation of factors that are both context-specific and interconnected. This complex issue presents a critical challenge to global public health, requiring a thorough understanding of its multifaceted drivers and the development of targeted strategies to promote vaccine confidence and uptake. The resurgence of vaccine-preventable diseases in numerous regions serves as a stark reminder of the fragility of herd immunity and highlights the urgent need to address vaccine hesitancy as a critical priority within public health discourse. The epidemiological

consequences of suboptimal vaccination rates include increased disease incidence, outbreaks within communities, and the potential for the re-emergence of previously controlled infectious diseases, underlining the severity of the threat posed by this phenomenon. Understanding the drivers of vaccine hesitancy, the populations most affected, and effective interventions to counteract its negative effects is paramount to safeguarding public health and ensuring the continued success of immunization programs globally.

2 The Global Landscape of Vaccine Hesitancy

Vaccine hesitancy is not a localized issue; rather, it constitutes a complex, multifaceted global challenge that transcends national borders, income levels, and developmental stages. It is a phenomenon that affects both high-income and low-income countries, though the specific drivers and manifestations may vary substantially. The World Health Organization (WHO) has formally recognized vaccine hesitancy as one of the top ten threats to global health, underscoring the seriousness of this issue and its potential to undermine decades of progress in disease control. This designation highlights the urgent need for a coordinated global effort to address this complex public health concern. While vaccine hesitancy is a pervasive global phenomenon, its prevalence and underlying causes exhibit considerable heterogeneity across different geographical regions and populations. This variability underscores the complex interplay of factors that contribute to vaccine acceptance or refusal (1).

High-Income Countries: In many high-income countries, vaccine hesitancy is often associated with a combination of factors including: a) access to readily available information (including misinformation) through the internet and social media; b) a perceived low risk of contracting vaccine-

*Corresponding author: Akmaral Baspakova, Department of Epidemiology, West Kazakhstan Marat Ospanov State Medical University, 68 Maresyev Street, Aktobe, 030019, Kazakhstan; baspakova@zkgmu.kz, Tel: +7 701 1823755

preventable diseases due to historical success of immunization programs; c) heightened individualistic attitudes towards personal autonomy and the perception of vaccination as a violation of that autonomy; d) a growing distrust of pharmaceutical companies and government institutions; e) a sophisticated anti-vaccine movement that utilizes social media to propagate misinformation and sow fear (2).

Low- and Middle-Income Countries: In contrast, low- and middle-income countries often face different challenges related to vaccine hesitancy: a) limitations in access to healthcare services, including reliable information and vaccination clinics; b) competing priorities for limited resources, both at the household and system level; c) a lack of consistent access to reliable vaccine storage and transportation which limits the reach of vaccine distribution; d) a general lower level of health literacy which makes individuals more susceptible to misinformation; e) cultural and religious beliefs that can conflict with vaccination campaigns; and f) experiences of historical or current inequity that lead to lower levels of trust in public health officials (3).

Regional Differences: Even within broad income categories, regional differences are apparent. For instance, within Europe, countries in the Western region often have lower vaccine acceptance rates than those in Eastern Europe due to varying levels of public trust in institutions, differing attitudes toward personal autonomy, and differing levels of susceptibility to anti-vaccine movements. Similarly, within Africa, specific cultural beliefs or past experiences with public health campaigns can influence vaccine acceptance rates in unique ways depending on the country, the religion, or the ethnic makeup of the population (4).

Socioeconomic Gradients: Within countries, a socioeconomic gradient is frequently observed, with individuals from lower socioeconomic groups often experiencing barriers to accessing reliable information and healthcare, making them more susceptible to misinformation. This can lead to differences in vaccine acceptance rates compared to more affluent populations. In some cases, higher socioeconomic status may correlate with lower vaccine acceptance rates due to increased information access and higher levels of distrust (5).

Urban vs. Rural Divide: An urban-rural divide often exists, with rural communities sometimes experiencing lower access to vaccination services and information, while urban areas may have greater exposure to both accurate information and misinformation via social media. Specific interventions need to be tailored for each context. Understanding these variations and the underlying factors is crucial for developing tailored, context-specific interventions to address vaccine hesitancy effectively. A “one-size-fits-all” approach is unlikely to be successful, and careful analysis of local determinants is essential. The consequences of vaccine hesitancy are not abstract; they are manifested in tangible and often devastating outbreaks of diseases that were once considered largely under control. The declining rates of vaccination due to this phenomenon are directly linked to the re-emergence of various infectious diseases across the globe, with profound consequences. **Measles Resurgence as a Sentinel Event:** The resurgence of measles is perhaps the most glaring and concerning example of the impact of vaccine hesitancy. Measles is a highly contagious disease, and the dramatic increase in measles cases in recent years is directly attributable to a decrease in vaccination rates, often driven by misinformation and distrust. These outbreaks have not been confined to any one country or continent, and this clearly demonstrates the potential for global spread of previously controlled diseases as vaccination rates decline (6).

Pertussis (Whooping Cough) – A Persistent Threat: Pertussis, a severe respiratory disease, also demonstrates cyclical outbreaks even in countries with historically high vaccination rates. This highlights the vulnerability of populations to vaccine-preventable diseases, particularly among young infants and those with waning immunity. These outbreaks underscore the critical need for both primary and booster vaccinations to maintain protection throughout life. **Polio – A Setback in Eradication Efforts:** Polio eradication efforts have been severely hampered in some regions due to vaccine hesitancy, with outbreaks occurring in areas with poor vaccination coverage. The re-emergence of wild poliovirus or vaccine-derived poliovirus highlight the fragility of the progress made in the global polio eradication program and underscores the continued importance of vaccinations (7).

Other Preventable Diseases: Vaccine hesitancy also contributes to outbreaks of other diseases such as mumps, rubella, and diphtheria. While these may be less dramatic than the measles or polio outbreaks, their impact on morbidity and mortality is significant. This collective resurgence demonstrates the widespread impact of vaccine hesitancy and the importance of focusing efforts to increase vaccine acceptance across a broad range of vaccines. **Healthcare System Strain:** Outbreaks associated with vaccine hesitancy place a substantial strain on healthcare systems. They often lead to increased hospitalizations, the need for intensive care, and the expenditure of scarce resources. This additional burden further underscores the importance of addressing the root causes of vaccine hesitancy to prevent future outbreaks and protect strained healthcare systems (8).

Economic Impacts: Outbreaks of vaccine-preventable diseases not only impact health but can also have broader economic consequences. These include lost productivity due to illness, the need for outbreak response measures, and the indirect economic costs associated with the fear of disease. This underscores the fact that disease prevention, through vaccination, is a cost-effective investment. **Social Disruption and Psychological Impact:** Disease outbreaks create social disruption, leading to school and workplace closures and other disruptions in daily life. They also can have a significant psychological impact, leading to heightened anxiety and fear within communities, especially when misinformation or confusing messages are being spread.

3 Determinants of Vaccine Hesitancy: A Multifaceted Challenge

Vaccine hesitancy is not a monolithic entity but rather a complex phenomenon driven by a constellation of interconnected factors. These determinants are often contextual, varying based on individual experiences, socio-cultural backgrounds, and information access, creating a multi-layered challenge for public health interventions. Understanding these determinants is essential for developing targeted and effective strategies to promote vaccine confidence and uptake. Concerns surrounding vaccine safety and efficacy are a primary driver of vaccine hesitancy. These concerns often stem from misinformation, lack of scientific understanding, and misinterpretations of risk (9).

Misinformation and Disinformation: The proliferation of misinformation and disinformation about vaccines through online platforms, social media, and other sources poses a significant challenge. False or misleading claims about vaccine ingredients, purported links to autism or other adverse health outcomes, and conspiracy theories often lack any scientific basis, but are presented in a compelling or emotionally charged manner, eroding trust in scientific evidence and leading to

hesitancy. This intentional dissemination of false information, often referred to as “disinformation,” can be highly persuasive and challenging to counteract effectively (10).

Lack of Scientific Literacy: Limited understanding of basic scientific principles, vaccine development processes, and the rigorous safety evaluations that vaccines undergo can contribute to hesitancy. Individuals with lower levels of scientific literacy may be more susceptible to misinformation and may struggle to distinguish between credible and unreliable sources of information. This lack of understanding of how vaccines work and the rigorous testing they undergo fuels skepticism and uncertainty. A crucial component of vaccine confidence is a public that is scientifically literate and understands basic concepts of immunology and disease prevention (11).

Misinterpretation of Adverse Events: While vaccines are generally safe and effective, rare adverse events can occur, as with any medical intervention. However, these rare events are often exaggerated or misrepresented in the media, leading to unwarranted fear and contributing to vaccine hesitancy. The temporal association of an adverse event with vaccination, even if there is no causal link, is often misinterpreted as proof of causation. Misinterpretations can be particularly prevalent when media outlets over-emphasize negative events without properly communicating the statistical context of these events or the overall safety profile of a vaccine. A comprehensive approach to public education must include clear communication about both the benefits and risks of vaccination and emphasize the rigorous monitoring that is in place to detect and manage any adverse events (12).

Trust in healthcare providers and institutions plays a pivotal role in shaping individuals’ attitudes towards vaccination. Lack of trust, often rooted in negative experiences, past unethical practices, or perceived conflicts of interest, can fuel hesitancy. **Mistrust of Healthcare Systems:** Negative experiences with healthcare providers, such as perceived medical errors, discrimination, or disrespectful treatment, can erode trust in the healthcare system. This mistrust can extend to vaccination campaigns, even when they are supported by robust scientific evidence. Historical or cultural biases within healthcare systems can also lead to distrust, particularly within marginalized communities who may have a history of experiencing discrimination or mistreatment within these settings (13).

Perceived Conflicts of Interest: Concerns about the influence of pharmaceutical companies on vaccine development, regulation, and promotion can erode public trust. The perception of conflicts of interest, even if unfounded, can create suspicion that healthcare authorities are prioritizing profit over public health. These concerns are often amplified by misinformation and conspiracy theories that seek to undermine public trust in the integrity of scientific research and public health institutions. Transparent and independent oversight of the pharmaceutical industry and the vaccine development process is crucial for building public confidence (14).

Lack of Communication and Engagement: Insufficient engagement and poor communication practices from healthcare providers can create further mistrust. A lack of culturally appropriate and patient centered communication is a contributor to low vaccine acceptance. Healthcare providers who do not listen to patient concerns and questions, or who are not able to clearly explain the reasons for vaccines may further erode trust. Deeply held cultural and religious beliefs can exert a strong influence on vaccine acceptance, creating specific challenges to achieving universal vaccination coverage. **Religious Objections:** Certain religious beliefs or practices may oppose vaccination based on concerns about the use of animal

products or perceived violations of religious teachings. These objections can be deeply rooted and require culturally sensitive approaches that acknowledge and address these concerns without compromising public health objectives. Engagement with religious leaders and communities is essential to building trust and understanding (15).

Cultural Practices: Certain cultural practices, including the use of traditional medicine or alternative healing methods, may discourage or delay vaccination. These practices often stem from a different worldview or understanding of health and disease that may conflict with biomedical approaches. Respectful engagement with these cultural practices is crucial, and effective public health interventions must be tailored to respect local beliefs while addressing any misconceptions that may interfere with vaccine acceptance. **Social and economic factors** play a significant role in shaping attitudes and behaviors related to vaccination. **Socioeconomic Disparities:** Vaccine hesitancy may be more prevalent in disadvantaged communities due to limited access to healthcare, reliable information, and financial resources. These communities may experience multiple barriers to accessing healthcare, including long distances, lack of transportation, or inflexible work schedules. Furthermore, misinformation may disproportionately target vulnerable communities, exploiting existing social and economic inequalities (16).

Health System Barriers: Complex healthcare systems, long wait times, inflexible appointment schedules, and difficulty accessing vaccination clinics can discourage vaccination, particularly for individuals who are already facing other barriers to health care access. The complexity of the healthcare system is more impactful in areas with limited health literacy and the inability to navigate the requirements for obtaining vaccination. **Social Networks and Peer Influence:** Social networks and peer influence can exert a strong influence on attitudes towards vaccination. If an individual’s social group is generally hesitant towards vaccines, they may be more likely to develop similar views. The influence of these networks and the peer pressure to conform can be a significant driver of vaccine hesitancy, making it important to engage community leaders to shift norms around immunization (17).

Access to Technology: The digital divide, meaning the lack of access to internet and technology, can also impact vaccine hesitancy. In some settings, individuals with less access to technology are less likely to be exposed to effective vaccination campaigns while, at the same time, they are potentially more susceptible to misinformation that is spread via word-of-mouth in their communities (18).

The ramifications of vaccine hesitancy extend far beyond the individual level, creating a cascade of negative consequences that impact the health and well-being of entire populations, strain healthcare systems, disrupt economies, and erode social cohesion. This complex phenomenon has the potential to reverse decades of progress in public health and create a future where infectious diseases become an ever-present threat. **Erosion of Herd Immunity:** Perhaps the most significant consequence of vaccine hesitancy is the erosion of herd immunity. Herd immunity occurs when a large enough proportion of a population is immune to a disease, either through vaccination or prior infection, that it prevents the spread of the disease to vulnerable individuals who cannot be vaccinated. When vaccination rates decline, the protection offered by herd immunity is weakened, leading to increased disease transmission and outbreaks. This is particularly true for highly contagious diseases such as measles and pertussis (19).

Increased Incidence of Vaccine-Preventable Diseases: Declining vaccination rates directly translate to an increase in the incidence of vaccine-preventable diseases. Diseases that

were once considered well-controlled through vaccination programs, such as measles, mumps, rubella, pertussis, and polio, can re-emerge, causing significant morbidity and mortality, particularly among vulnerable populations. This not only undermines individual health but also strains healthcare systems and reverses the advances made in global disease control (20).

Disproportionate Impact on Vulnerable Populations: The re-emergence of vaccine-preventable diseases disproportionately affects vulnerable populations, including infants who are too young to be vaccinated, the elderly, pregnant women, and individuals with weakened immune systems. These groups are at a higher risk of experiencing severe complications and death from these diseases. A decline in vaccination rates makes these populations more vulnerable to serious illness and potential long-term health issues. **Increased Risk of Outbreaks:** As vaccine coverage declines, the likelihood of disease outbreaks increases, which leads to the spread of infection within communities. These outbreaks are difficult to control, and require significant public health resources and interventions. Furthermore, outbreaks can easily spread across regions and borders and become international health crises (21).

Potential for Endemicity: Continued low vaccination rates could lead to diseases that were previously controlled becoming endemic, meaning that the disease would be constantly present within a population, causing significant public health burden and making the disease much more difficult to eliminate in the long term. **Direct Medical Expenses:** Outbreaks of vaccine-preventable diseases lead to increased direct medical expenses related to hospitalization, treatment, laboratory testing, and follow-up care. These costs are particularly significant when dealing with severe cases and complications. Treating unvaccinated individuals who contract vaccine preventable diseases becomes an unnecessary financial burden on already strained health care systems (22).

Public Health Interventions: Controlling and containing outbreaks requires significant public health interventions, including increased surveillance, contact tracing, vaccination campaigns, and public education efforts. These interventions place a strain on public health resources and increase healthcare costs. The resources required for outbreak control could be utilized for other more effective programs if those outbreaks could be prevented through vaccination. **Long-Term Care:** Individuals who suffer long-term complications from vaccine-preventable diseases may require ongoing medical care, rehabilitation services, and long-term support, leading to further healthcare expenditures. Furthermore, individuals with long term disabilities often have reduced work productivity and reduced life span which places a significant financial and emotional burden on society and their families (23).

Opportunity Costs: Healthcare resources that are used to manage outbreaks and provide treatment could be used for other important public health initiatives such as addressing non-communicable diseases, implementing preventative health programs, or supporting basic health infrastructure. The opportunity costs associated with vaccine hesitancy are significant. **Lost Productivity:** Disease outbreaks can lead to lost productivity due to illness, absenteeism from work, and the need for caregivers to miss work to care for sick family members. This loss of productivity can have a significant impact on individual earnings, business profitability, and overall economic output, ultimately leading to a decrease in societal wealth (24).

Travel and Tourism Disruptions: Outbreaks of infectious diseases can disrupt travel and tourism, as concerns about disease transmission lead to travel restrictions, flight

cancellations, and decreased consumer spending within the tourism sector. This disruption can have a significant economic impact on countries that rely on tourism as a major source of revenue, with far-reaching consequences for both local economies and international commerce. **Disruptions to Trade and Commerce:** Disease outbreaks can disrupt trade and commerce, as concerns about the potential spread of infectious diseases can lead to trade restrictions, border closures, and disruptions in supply chains. This can have significant economic consequences for businesses and consumers. International trade often relies on stability, therefore a reduction in stability due to disease outbreaks can cause major economic and political problems globally. **Impact on Education and Workforce Development:** Disease outbreaks may lead to school and university closures, impacting student learning and future workforce development. These closures can also require parents to miss work, compounding the economic impact. Reduced educational attainment due to illness can lead to long term reduction in a country's human capital and long-term economic losses (25).

Fear, Anxiety, and Mistrust: Disease outbreaks generate fear, anxiety, and mistrust within communities. The spread of misinformation and conspiracy theories can exacerbate this social disruption, leading to heightened anxiety and even panic. Vaccine hesitancy fuels public mistrust in public health officials, health care systems and even scientific expertise. **Social Division and Polarization:** The debate around vaccine hesitancy can lead to social divisions and polarization within communities, pitting individuals with differing views against each other. These divisions can strain social relationships, create conflict, and undermine social cohesion, ultimately weakening community resilience (26).

Erosion of Social Capital: Trust in public health institutions and in other members of society is critical for community well-being. Vaccine hesitancy erodes this social capital, diminishing the capacity of societies to respond to public health emergencies and create resilient communities. **Undermining Public Health Messaging:** Vaccine hesitancy undermines public health messaging and can create skepticism towards other health-related recommendations or public health campaigns. This makes public health interventions more difficult to implement, and makes it harder to control other health threats. **Erosion of Confidence in Science:** The widespread dissemination of misinformation and the rejection of scientific evidence in relation to vaccination can lead to a broader erosion of public confidence in science. This has long term negative consequences for other evidence-based public policy issues and can lead to increased distrust in science overall.

4 Conclusion

Vaccine hesitancy poses a significant challenge to global public health, threatening the progress made in eradicating and controlling preventable diseases. Addressing vaccine hesitancy requires a comprehensive and collaborative approach that involves evidence-based communication, building trust, promoting informed decision-making, and addressing the underlying social and cultural factors that contribute to hesitancy. By investing in public health interventions, promoting scientific literacy, and fostering a culture of trust, we can mitigate the threat of vaccine hesitancy and ensure the continued success of vaccination programs in protecting the health of populations worldwide.

Ethical issue

Authors are aware of, and comply with, best practice in publication ethics specifically with regard to authorship (avoidance of guest authorship), dual submission, manipulation of figures, competing interests and compliance with policies on research ethics. Authors adhere to publication requirements that submitted work is original and has not been published elsewhere in any language.

Author Contributions

Conceptualization, A.B.; methodology, A.S.; formal analysis, A.S., A.B.; investigation, A.B.; resources, A.S.; writing—original draft preparation, A.S.; writing—review and editing, A.B.

Funding

This research received no specific grant from any funding agency, commercial or not-for-profit sectors.

Data Availability Statement

All data generated or analyzed during this study are included in this published article.

Conflicts of Interest

The authors declare no competing interests.

References

- Miko D, Costache C, Colosi HA, Neculicioiu V, Colosi IA. Qualitative Assessment of Vaccine Hesitancy in Romania. *Medicina (Kaunas)*. 2019;55(6).
- 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).
- Wagner AL, Masters NB, Domek GJ, Mathew JL, Sun X, Asturias EJ, et al. Comparisons of Vaccine Hesitancy across Five Low- and Middle-Income Countries. *Vaccines (Basel)*. 2019;7(4).
- Ali HA, Hartner AM, Echeverria-Londono S, Roth J, Li X, Abbas K, et al. Vaccine equity in low and middle income countries: a systematic review and meta-analysis. *Int J Equity Health*. 2022;21(1):82.
- Saban M, Myers V, Ben-Shetrit S, Wilf-Miron R. Socioeconomic gradient in COVID-19 vaccination: evidence from Israel. *Int J Equity Health*. 2021;20(1):242.
- Muric G, Wu Y, Ferrara E. COVID-19 Vaccine Hesitancy on Social Media: Building a Public Twitter Data Set of Antivaccine Content, Vaccine Misinformation, and Conspiracies. *JMIR Public Health Surveill*. 2021;7(11):e30642.
- Decker MD, Edwards KM. Pertussis (Whooping Cough). *J Infect Dis*. 2021;224(12 Suppl 2):S310-s20.
- Pronyk P, Sugihantono A, Sitohang V, Moran T, Kadandale S, Muller S, et al. Vaccine hesitancy in Indonesia. *Lancet Planet Health*. 2019;3(3):e114-e5.
- MacDonald NE. Vaccine hesitancy: Definition, scope and determinants. *Vaccine*. 2015;33(34):4161-4.
- Skafle I, Nordahl-Hansen A, Quintana DS, Wynn R, Gabarron E. Misinformation About COVID-19 Vaccines on Social Media: Rapid Review. *J Med Internet Res*. 2022;24(8):e37367.
- Sudharsanan N, Favaretti C, Hachaturyan V, Bärnighausen T, Vandormael A. The effect of framing and communicating COVID-19 vaccine side-effect risks on vaccine intentions for adults in the UK and the USA: A structured summary of a study protocol for a randomized controlled trial. *Trials*. 2021;22(1):592.
- Bhattacharyya S, Vutha A, Bauch CT. The impact of rare but severe vaccine adverse events on behaviour-disease dynamics: a network model. *Sci Rep*. 2019;9(1):7164.
- Ryan R, Hill S. Qualitative evidence synthesis informing our understanding of people's perceptions and experiences of targeted digital communication. *Cochrane Database Syst Rev*. 2019;10(10):Ed000141.
- McClymont E, Brophy J, Dubey V, Kwong J, Meyer S, Crowcroft N, et al. Is 'conflict of interest' a Misnomer? Managing interests in immunization research and evaluation. *Hum Vaccin Immunother*. 2022;18(1):1879580.
- Mitchell KR, Brassil KJ, Fujimoto K, Fellman BM, Shay LA, Springer AE. Exploratory Factor Analysis of a Patient-Centered Cancer Care Measure to Support Improved Assessment of Patients' Experiences. *Value Health*. 2020;23(3):351-61.
- Rizvi SAA, Einstein GP, Tulp OL, Sainvil F, Branly R. Introduction to Traditional Medicine and Their Role in Prevention and Treatment of Emerging and Re-Emerging Diseases. *Biomolecules*. 2022;12(10).
- Ekezie W, Awwad S, Krauchenberg A, Karara N, Dembiński Ł, Grossman Z, et al. Access to Vaccination among Disadvantaged, Isolated and Difficult-to-Reach Communities in the WHO European Region: A Systematic Review. *Vaccines (Basel)*. 2022;10(7).
- Garrett R, Young SD. Online misinformation and vaccine hesitancy. *Transl Behav Med*. 2021;11(12):2194-9.
- Dror AA, Eisenbach N, Taiber S, Morozov NG, Mizrahi M, Zigran A, et al. Vaccine hesitancy: the next challenge in the fight against COVID-19. *Eur J Epidemiol*. 2020;35(8):775-9.
- Frenkel LD. The global burden of vaccine-preventable infectious diseases in children less than 5 years of age: Implications for COVID-19 vaccination. How can we do better? *Allergy Asthma Proc*. 2021;42(5):378-85.
- Rodrigues CMC, Plotkin SA. Impact of Vaccines; Health, Economic and Social Perspectives. *Front Microbiol*. 2020;11:1526.
- [Technical guidelines for seasonal influenza vaccination in China (2020-2021)]. *Zhonghua Yu Fang Yi Xue Za Zhi*. 2020;54(10):1035-59.
- Haldane V, De Foo C, Abdalla SM, Jung AS, Tan M, Wu S, et al. Health systems resilience in managing the COVID-19 pandemic: lessons from 28 countries. *Nat Med*. 2021;27(6):964-80.
- Ganju A, Goulart AC, Ray A, Majumdar A, Jeffers BW, Llamasa G, et al. Systemic Solutions for Addressing Non-Communicable Diseases in Low- and Middle-Income Countries. *J Multidiscip Healthc*. 2020;13:693-707.
- Zhang K, Hou Y, Li G. Threat of infectious disease during an outbreak: Influence on tourists' emotional responses to disadvantaged price inequality. *Ann Tour Res*. 2020;84:102993.
- Simione L, Vagni M, Gnagnarella C, Bersani G, Pajardi D. Mistrust and Beliefs in Conspiracy Theories Differently Mediate the Effects of Psychological Factors on Propensity for COVID-19 Vaccine. *Front Psychol*. 2021;12:683684.