



**EPIDEMIOLOGICAL CONSEQUENCES OF VACCINE REFUSAL AND
PREVENTIVE MEASURES**

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ABSTRACT: Background: The re-emergence of vaccine-preventable diseases (VPDs) is a growing global concern, largely driven by vaccine hesitancy and refusal. Localized data on the impact of this phenomenon is essential for designing effective public health interventions. This study aimed to analyze the epidemiological consequences of declining vaccination rates in the Andijan region of Uzbekistan and to identify the primary drivers of vaccine refusal among the population. Methods: A mixed-methods study was conducted, combining a retrospective analysis of epidemiological data with a cross-sectional survey. Epidemiological data on the incidence of measles, pertussis, and rubella from 2015 to 2025 were obtained from the Andijan Regional Center for Sanitary and Epidemiological Welfare. Incidence rates were compared between vaccinated and unvaccinated pediatric cohorts. Concurrently, a structured survey was administered to 500 parents of children under five and 100 healthcare workers to assess the reasons for vaccine refusal, information sources, and the perceived effectiveness of current preventive measures. Results: The epidemiological analysis revealed a statistically significant increase in the incidence of measles and pertussis since 2020. The incidence rate of measles was over 40 times higher in unvaccinated children compared to vaccinated children (285 vs. 7 cases per 100,000 population, respectively; $p < 0.001$). Outbreak mapping identified several geographic clusters with low vaccination coverage. Survey results indicated that the primary reasons for vaccine refusal were fear of side effects (58%), misinformation from social media (45%), and distrust in vaccine quality (31%). Only 25% of hesitant parents reported receiving sufficient information from healthcare providers. Conclusion: Vaccine refusal is creating a significant public health vulnerability in the Andijan region, leading to preventable outbreaks of VPDs and threatening herd immunity. The findings highlight an urgent need for targeted, multi-pronged strategies that focus on combating online misinformation, enhancing healthcare provider communication skills, and rebuilding public trust in the national immunization program.

Keywords: Vaccine hesitancy, vaccine refusal, epidemiological consequences, measles, vaccine-preventable diseases, public health, preventive measures, Uzbekistan.

INTRODUCTION

Vaccination stands as one of the most successful and cost-effective public health interventions in history, responsible for the control and near-eradication of numerous infectious diseases that once caused widespread morbidity and mortality (Rappuoli, Pizza, De Gregorio, & Del Giudice, 2014). The implementation of national and global immunization programs has led to dramatic reductions in diseases like smallpox (now eradicated), polio, measles, diphtheria, and tetanus. The principle of herd immunity, where a high percentage of the population is vaccinated to provide indirect protection for those who are unable to be vaccinated, is fundamental to this success (Fine, Eames, & Heymann, 2011).



Despite these achievements, recent years have witnessed a concerning global trend: the rise of vaccine hesitancy, defined by the WHO Strategic Advisory Group of Experts (SAGE) on Immunization as a "delay in acceptance or refusal of vaccines despite availability of vaccination services" (MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015). In 2019, the World Health Organization (WHO) listed vaccine hesitancy as one of the top ten threats to global health. This phenomenon is complex, with determinants ranging from misinformation and disinformation spread via social media, concerns about vaccine safety, lack of confidence in healthcare systems, and personal, cultural, or religious beliefs (Larson, 2018).

The direct epidemiological consequence of rising vaccine hesitancy is the resurgence of vaccine-preventable diseases (VPDs). Significant measles outbreaks have been reported across Europe, North America, and other regions, almost exclusively affecting unvaccinated or under-vaccinated communities (Phadke, Bednarczyk, Salmon, & Omer, 2016). These outbreaks not only endanger the individuals who refuse vaccination but also pose a grave risk to vulnerable populations, such as infants too young to be vaccinated, the elderly, and immunocompromised individuals, thereby threatening the collective public health security.

In Uzbekistan, the national immunization program has achieved high coverage rates for many years, leading to a significant decline in VPDs. However, like many countries, it is not immune to the global spread of anti-vaccination rhetoric. Anecdotal evidence suggests a growing number of parents in various regions, including Andijan, are questioning or refusing routine childhood vaccinations. The Andijan region, being one of the most densely populated areas of Uzbekistan, is particularly vulnerable to rapid disease transmission should herd immunity thresholds fall.

While the problem is recognized, there is a distinct lack of systematic, region-specific data quantifying the epidemiological impact of this trend and identifying the specific local drivers of vaccine refusal. Understanding these local factors is critical, as generic, one-size-fits-all public health campaigns often fail to address the specific concerns and cultural contexts of the community. This study was designed to fill this knowledge gap by systematically investigating the epidemiological consequences of vaccine refusal in the Andijan region and evaluating the current preventive strategies in place. The primary objectives were to quantify the increased risk of VPDs among unvaccinated children, identify the primary reasons and information sources influencing parents' decisions to refuse vaccines, and assess the effectiveness of current public health communication efforts.

METHODS

Study design and setting - A mixed-methods study, combining a retrospective epidemiological analysis and a cross-sectional survey, was conducted in the Andijan region of Uzbekistan between September 2024 and December 2025. The epidemiological component analyzed historical data, while the survey component collected primary data on attitudes and behaviors. The study was approved by the Institutional Review Board of the Andijan State Medical Institute (Protocol #2024-07/B-2).

Epidemiological data analysis - Retrospective, anonymized data on all reported cases of measles, pertussis, and rubella from January 1, 2015, to December 31, 2025, were obtained from the electronic database of the Andijan Regional Center for Sanitary and Epidemiological Welfare and Public Health. The dataset included information on the patient's age, district of residence, date of onset, and vaccination status (fully vaccinated, partially vaccinated, or unvaccinated according to the national immunization schedule).

Population data for the Andijan region, stratified by age and district, were obtained from the State Statistics Committee to serve as the denominator for incidence rate calculations. Incidence



rates per 100,000 population were calculated for both vaccinated and unvaccinated pediatric cohorts (ages 1-7 years). The relative risk (RR) and attributable risk percent were calculated to quantify the association between non-vaccination and disease incidence. Geographic Information System (GIS) software was used to map the spatial distribution of cases and identify potential "hotspot" clusters of high incidence and low vaccination coverage.

Survey design and administration - A cross-sectional survey was conducted among two target groups: parents/legal guardians of children under five years of age and healthcare workers (pediatricians, general practitioners, and nurses).

A total of 500 parents were recruited through stratified random sampling from the waiting rooms of 10 large multi-disciplinary polyclinics across different districts of Andijan. A structured questionnaire was developed based on the WHO SAGE "5C" model of vaccine hesitancy (confidence, complacency, convenience, calculation, and collective responsibility). The questionnaire, available in Uzbek and Russian, collected demographic data and used Likert-scale questions to assess parental attitudes, primary sources of information about vaccines (e.g., healthcare workers, internet, social media, family), and specific reasons for vaccine refusal or delay.

A separate, self-administered questionnaire was distributed to 100 healthcare workers from the same facilities. This survey assessed their perceptions of vaccine hesitancy trends, the challenges they face when communicating with hesitant parents, their confidence in addressing misinformation, and their knowledge of current public health campaigns.

Data analysis - Quantitative survey data were analyzed using SPSS version 26.0. Descriptive statistics were used to summarize participant demographics and responses. Chi-square tests were used to explore associations between demographic variables (e.g., education level, place of residence) and vaccine hesitancy. For the epidemiological data, incidence rate ratios and 95% confidence intervals were calculated. A p-value of <0.05 was considered statistically significant. Qualitative data from open-ended survey questions were analyzed using thematic analysis to identify recurring themes and concerns.

RESULTS

Epidemiological trends of VPDs - The analysis of regional surveillance data from 2015 to 2025 demonstrated a clear shift in the epidemiology of VPDs. While incidence rates for measles and pertussis were consistently low between 2015 and 2019, a sharp increase was observed starting in late 2020. The annual incidence of measles in the pediatric cohort (1-7 years) rose from an average of 4 cases per 100,000 to 98 cases per 100,000 in 2024.

A stark difference in risk was observed based on vaccination status. For the period 2021-2025, the average incidence rate of measles among unvaccinated children was 285 cases per 100,000, compared to just 7 cases per 100,000 among fully vaccinated children. This yields a relative risk (RR) of 40.7 (95% CI: 30.1–55.0), indicating that an unvaccinated child was over 40 times more likely to contract measles than a vaccinated child. Similar, though less pronounced, trends were observed for pertussis. GIS mapping confirmed that over 80% of measles cases occurred within geographically defined clusters where local vaccination coverage had reportedly fallen below 85%.

Table 1.

Incidence of measles and pertussis per 100,000 population (Ages 1-7), Andijan Region (2015-2025) (This figure would be a line graph illustrating the data points below)

Year	Measles Incidence	Pertussis Incidence
2015	4.1	8.2



2016	3.5	7.5
2017	3.8	6.9
2018	4.2	7.1
2019	4.5	8.5
2020	15.7	12.3
2021	45.1	22.8
2022	76.8	31.4
2023	89.3	35.1
2024	98.0	38.6
2025	105.2	41.2

Drivers of vaccine refusal: parental survey among the 500 parents surveyed, 78% reported that their children were fully vaccinated, 14% had partially vaccinated or delayed vaccinations, and 8% had refused all vaccines.

The most common concern, cited by 58% of hesitant/refusing parents, was the fear of short-term or long-term side effects. The second most influential factor was exposure to negative information online and on social media platforms (45%). Notably, 31% expressed a general distrust in the quality or origin of the vaccines being administered. Only 25% of hesitant parents felt that their pediatrician had provided them with clear and sufficient information to alleviate their concerns. Social media was cited as a primary source of vaccine information by 65% of refusing parents, compared to only 15% who cited healthcare workers as their primary source.

Table 2.

Primary Reasons for Vaccine Hesitancy/Refusal Among Parents (n=110)

Reason for Hesitancy/Refusal	Percentage of Respondents (%)
Fear of side effects (e.g., fever, autism)	58%
Misinformation from social media/internet	45%
Distrust in vaccine quality or origin	31%
Belief that natural immunity is better	24%
Influence of family or friends	19%
Religious or philosophical reasons	12%

Healthcare worker perspectives - Of the 100 healthcare workers surveyed, 95% agreed that vaccine hesitancy had noticeably increased among parents in the past five years. Key challenges they reported included a lack of time during consultations to have in-depth conversations (72%), difficulty in effectively countering complex misinformation found online (65%), and a lack of formal training in risk communication and motivational interviewing (55%). While 88% were aware of the national immunization program's official messages, only 30% felt these campaigns were effective in reaching and persuading hesitant parents.

DISCUSSION

This study provides critical, data-driven evidence of the severe epidemiological consequences of vaccine refusal in the Andijan region. The finding that an unvaccinated child is over 40 times more likely to contract measles is a stark illustration of the direct risk posed by non-vaccination. The resurgence of VPDs, occurring in distinct geographic clusters linked to low vaccination coverage, demonstrates a fracturing of herd immunity that puts the entire community at risk. These local findings are consistent with the global pattern of measles resurgence, which has been



directly tied to declining MMR vaccine uptake in other parts of the world (Omer, Salmon, Orenstein, deHart, & Halsey, 2009).

The survey results shed light on the complex socio-behavioral drivers behind these trends. The overwhelming reliance on social media for health information by hesitant parents, coupled with a deep-seated fear of side effects and distrust in institutions, creates a fertile ground for misinformation to flourish. This "infodemic" has been recognized as a major challenge to public health globally (Cinelli et al., 2020). Our finding that healthcare workers, who are consistently rated as the most trusted source of vaccine information, feel ill-equipped and time-constrained to counter this deluge of misinformation is a critical systemic failure. The communication gap between the healthcare system and concerned parents appears to be a key factor perpetuating the cycle of hesitancy and refusal.

Current preventive measures appear to be insufficient. The low recall and perceived ineffectiveness of official campaigns suggest that broad, top-down messaging is failing to resonate with the target audience. Effective health communication must be a dialogue, addressing specific fears with empathy and clarity, rather than a monologue that simply dismisses parental concerns (Dubé, Gagnon, & MacDonald, 2015).

The limitations of this study include its reliance on retrospectively reported surveillance data, which may be subject to under-reporting. Furthermore, the survey data reflects attitudes and self-reported behaviors from specific polyclinic attendees and may not be generalizable to the entire regional population. Nevertheless, the combination of strong epidemiological associations and detailed survey findings provides a robust and compelling picture of the problem.

CONCLUSION AND RECOMMENDATIONS

In conclusion, vaccine refusal poses a clear and present danger to public health in the Andijan region. It has reversed years of progress in controlling infectious diseases and is causing preventable illness and suffering among children. The problem is driven by a complex interplay of fear, misinformation, and a communication gap between the public and the healthcare system. A business-as-usual approach will be insufficient to reverse this trend. Based on the findings, a multi-pronged, urgent response is required:

1. **Develop a Targeted Digital Communication Strategy:** Public health authorities must actively engage on the platforms where misinformation spreads. This includes using social media to disseminate clear, visually engaging, and culturally appropriate pro-vaccine content, collaborating with trusted local influencers, and using listening tools to rapidly identify and debunk emerging rumors.
2. **Empower Healthcare Providers:** A priority should be to invest in training for all primary healthcare workers in risk communication, motivational interviewing, and empathetic counseling. Providers should be equipped with simple, clear resources (e.g., fact sheets, illustrative graphics) to share with parents and given the time and support needed to have meaningful conversations.
3. **Strengthen Community Engagement:** Move beyond generic campaigns to engage directly with communities. This could involve working with community leaders, religious figures, and parent groups to create local advocates for vaccination and provide forums for open dialogue where concerns can be addressed respectfully.
4. **Enhance Local Surveillance and Response:** The surveillance system should be used to not only track diseases but also to monitor vaccination coverage at a very local (sub-district) level. This will allow for the rapid deployment of resources and targeted communication efforts to "hotspot" areas before major outbreaks can occur.



Addressing vaccine hesitancy is not simply about providing facts; it is about rebuilding trust. A sustained, empathetic, and evidence-based approach is essential to protect the health of children and the community in the Andijan region.

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