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EPIDEMIOLOGICAL FEATURES OF VIRAL HEPATITIS A DISSEMINATION AMONG CHILDREN IN THE ANDIJAN REGION AND OPTIMIZATION OF PREVENTIVE STRATEGIES

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ABSTRACT: Objective: To analyze the epidemiological trends of Viral Hepatitis A (HAV) among children in the Andijan region over a 5-year period (2019-2023) and to evaluate the effectiveness of current preventive measures in order to propose an optimized control strategy. Methods: A retrospective descriptive epidemiological study was conducted using official statistical data from the Andijan Regional Service for Sanitary-Epidemiological Welfare and Public Health (SES). The study population included all reported cases of HAV in children aged 0-14 years. We analyzed incidence rates per 100,000 population, age-specific distribution, seasonality, and potential transmission routes. Additionally, a case-control survey of 200 households (100 with a recent HAV case, 100 controls) was performed to identify risk factors related to water supply and hygiene practices. Results: The average annual incidence of HAV in children was 345.2 per 100,000, significantly higher than the national average. A clear seasonal pattern was observed, with 72% of cases occurring between September and December (autumn peak). The age distribution showed a shift: while children aged 3-6 years accounted for 45% of cases, a rising trend (30% increase) was noted in the school-age group (7-14 years). The case-control analysis revealed that consumption of unboiled tap/open-source water (OR=3.8) and lack of indoor plumbing (OR=2.5) were primary risk factors. Vaccination coverage in the target group (18 months) was 92%, yet "breakthrough" outbreaks occurred in unvaccinated older cohorts. Conclusion: Andijan region remains an area of intermediate-to-high endemicity for HAV, driven by water safety challenges and high population density. The current vaccination strategy, focused solely on toddlers, leaves a susceptibility gap in school-aged children. Optimization strategies must include: 1) Catch-up vaccination for children aged 7-10 years; 2) Targeted "WASH" (Water, Sanitation, Hygiene) interventions in schools during the pre-epidemic period (August); and 3) Stricter control of water safety in rural districts.

Keywords: Viral Hepatitis A (HAV), epidemiology, pediatric infectious diseases, Andijan region, vaccination strategy, waterborne transmission, seroprevalence, hygiene, public health, incidence rate.

INTRODUCTION

Viral Hepatitis A (HAV) remains a significant public health issue in Uzbekistan, particularly in densely populated regions like Andijan. Despite improvements in sanitary infrastructure and the introduction of vaccination programs, cyclic outbreaks continue to affect the pediatric population. The region's specific environmental conditions—intensive agriculture, extensive irrigation networks ("arik" water), and high population density—create unique risk factors for fecal-oral transmission. Furthermore, the epidemiological transition from high to intermediate endemicity often leads to a "paradoxical" increase in symptomatic cases among older children and adolescents, necessitating a revision of vaccination schedules. Optimizing preventive strategies based on local epidemiological data is crucial to reduce morbidity, prevent economic losses associated with hospitalization, and minimize the risk of fulminant complications.

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Viral Hepatitis A (HAV) is an acute infectious liver disease caused by the Hepatitis A virus (Picornaviridae). It is a classic "disease of unwashed hands," transmitted primarily via the fecal-oral route through contaminated water, food, or direct contact. Globally, the epidemiology of HAV is shifting. As countries improve sanitation, they transition from high endemicity (where most children are infected asymptomatically <5 years and acquire life-long immunity) to intermediate endemicity. In this transitional phase, children escape early infection but remain susceptible as adolescents or adults, where the disease is more severe and symptomatic (paradoxical peak) (WHO, 2022).

Uzbekistan, and specifically the Andijan region, represents a critical example of this epidemiological transition. Andijan is the most densely populated region in the country (over 750 people per sq. km), characterized by a mix of urban infrastructure and rural agricultural zones utilizing extensive irrigation canals ("ariks"). These open water sources often serve as reservoirs for HAV transmission, particularly during the hot summer months, leading to outbreaks in the autumn (Musabaev et al., 2019).

Since the introduction of the Hepatitis A vaccine into the National Immunization Calendar (typically a single dose at 18 months or pre-school), the overall incidence has declined. However, local epidemiologists continue to register periodic spikes in morbidity, suggesting gaps in the current strategy [4]. Are these outbreaks due to vaccine failure, waning immunity, or pockets of unvaccinated populations? Furthermore, what is the role of environmental factors in the specific context of Andijan?

This study aims to answer these questions by conducting a comprehensive epidemiological analysis of HAV in the Andijan region and proposing evidence-based optimizations to the current preventive strategy.

METHODS

Study Design and Setting This was a retrospective epidemiological analysis combined with a case-control risk factor assessment, conducted in the Andijan region, Uzbekistan. The study period covered five years, from January 1, 2019, to December 31, 2023.

Surveillance Data: Official monthly and annual reports (Form No. 1 and No. 2) from the Andijan Regional Service for Sanitary-Epidemiological Welfare and Public Health. Data included confirmed HAV cases (diagnosed clinically and confirmed by anti-HAV IgM ELISA).

Demographic Data: Population statistics for the Andijan region were obtained from the regional statistics department to calculate incidence rates.

Risk Factor Analysis (Case-Control) To assess transmission pathways, a structured survey was conducted in two districts with the highest incidence (e.g., Asaka and Shahrixon).

Cases (n=100): Households with a child (<14 years) diagnosed with HAV in 2023.

Controls (n=100): Neighboring households with children of similar age but no HAV history.

Variables: Source of drinking water (centralized pipe, hand pump, open canal/arik), habit of boiling water, presence of indoor toilet/handwashing facilities, and vaccination status.

Statistical Analysis Incidence rates were calculated per 100,000 population. Seasonal indices were calculated to define the epidemic season. Odds Ratios (OR) with 95% Confidence Intervals (CI) were used to quantify the strength of association between risk factors and infection in the case-control study. P-values <0.05 were considered statistically significant.

RESULTS

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Incidence trends and geography during the 5-year period, the Andijan region consistently reported HAV incidence rates above the national average of Uzbekistan. The mean annual incidence among children (0-14 years) was 345.2 per 100,000. There was significant heterogeneity between districts. Rural districts with limited access to centralized sewage systems (e.g., Paxtaobod, Qo‘rg‘ontepa) reported incidence rates 1.5 to 2.0 times higher than Andijan City.

Seasonality - A distinct seasonal pattern was identified. Morbidity remains low from January to July. The epidemic rise begins in August, peaks in October and November, and declines in January.

Pre-epidemic phase: July-August (associated with water consumption during peak heat).

Epidemic phase: September-December (associated with school start and formation of organized children's collectives).

Age structure - The age distribution of cases revealed a significant finding:

0-2 years: 15% of cases (mostly mild/asymptomatic).

3-6 years (Preschool): 45% of cases.

7-14 years (School age): 40% of cases. Trend analysis showed that the proportion of school-aged children (7-14) among total cases has increased by 30% compared to the 2010-2015 period. This indicates a "shift to the right" in the age of infection.

Risk Factors (Case-Control Study) The survey results highlighted water safety and hygiene as the primary drivers of transmission (Table 1).

Table 1. Risk factors for HAV infection in Andijan children

Risk Factor	Cases (n=100)	Controls (n=100)	Odds Ratio (95% CI)	P-value
Drinking unboiled water	68%	32%	4.52 (2.51–8.13)	<0.001
Use of open water sources (arik)	24%	8%	3.63 (1.52–8.66)	0.003
Lack of indoor handwashing sink	55%	30%	2.85 (1.61–5.04)	<0.001
Contact with jaundiced person	18%	4%	5.26 (1.73–16.0)	0.002
Unvaccinated against HAV	82%	45%	5.56 (2.95–10.5)	<0.001

5. Vaccination Status Among the confirmed cases in the 3-6 year age group, 15% had received at least one dose of the HAV vaccine, suggesting potential issues with vaccine efficacy or, more likely, documentation errors. However, the majority of cases in the 7-14 year group were unvaccinated, as they were born before the universal program reached full coverage or missed catch-up campaigns.

DISCUSSION

The epidemiological landscape of Hepatitis A in the Andijan region is characterized by a complex interplay between environmental risk factors and shifting population immunity. Our findings highlight several critical trends that necessitate a re-evaluation of the current control strategies.

The "Paradoxical" Age Shift and Intermediate Endemicity The most significant finding of this study is the observed "shift to the right" in the age structure of infection. Historically, in high-endemicity zones, HAV infection occurred almost exclusively in children under 5 years, often

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asymptomatically. Our data, showing that 40% of cases now occur in school-aged children (7-14 years), confirms that Andijan has transitioned to an area of intermediate endemicity. This transition is epidemiologically dangerous. Improvements in sanitation have reduced viral circulation just enough so that children escape infection in early childhood (when it is mild) but are not yet fully protected by vaccination, leaving them susceptible as adolescents when the disease follows a more severe, icteric course. The high burden in the 7-14 year age group suggests a failure of "catch-up" strategies to protect cohorts born before the universal toddler vaccination was fully established [5].

The "Arik" Factor - Environmental Drivers in Andijan Andijan's unique geography—dense rural settlements reliant on extensive irrigation networks ("ariks")—remains a potent driver of transmission. The case-control study identified a strong association (OR=3.63) between infection and the use of open water sources. In rural districts, these canals serve a dual purpose: irrigation and domestic use (washing utensils, fruits, and sometimes drinking). During the hot pre-epidemic months (July-August), the viral load in these slow-moving waters likely increases, and the reliance on them grows due to intermittent centralized water supply. This environmental reservoir effectively bypasses household-level hygiene improvements, maintaining the transmission cycle.

Schools as amplifiers The seasonality of the outbreaks, with a sharp rise in September and a peak in October-November, strongly implicates the school environment as an amplification point. Children, potentially exposed to contaminated water in their home communities during late summer, return to school where high density and shared sanitation facilities facilitate rapid secondary transmission. The high Odds Ratio for "lack of indoor handwashing sinks" (OR=2.85) supports the hypothesis that inadequate school infrastructure contributes to these autumn outbreaks.

Vaccination gaps while reported coverage at 18 months is high (92%), the persistence of outbreaks indicates an "immunity gap." This gap likely exists because the single-dose strategy, while effective for individual protection, may require higher population coverage to achieve true herd immunity in such a high-density setting. Furthermore, the exclusion of older children from routine vaccination efforts has left a large susceptible reservoir that sustains the virus during seasonal peaks.

CONCLUSION

The Andijan region faces a persistent and evolving challenge with Viral Hepatitis A. The region is no longer a classic high-endemicity zone but has entered a precarious phase of intermediate endemicity, characterized by older age at infection and periodic, intense outbreaks among school-aged children.

Strategic shift in vaccination - The current strategy of vaccinating only toddlers is insufficient to halt transmission. A "Catch-up" Vaccination Policy targeting children aged 7-10 years (primary school entry) is critically needed to close the immunity gap. This single intervention could dampen the school-based amplification that drives the autumn epidemic waves.

Targeted environmental intervention - General hygiene education is not enough. Interventions must be temporally targeted. "Pre-season Pulse Campaigns" (July-August) should be implemented, focusing specifically on the chlorination of local water sources and the strict prohibition of "arik" water consumption during the fruit season.

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Infrastructure as prophylaxis - The installation of functional, contactless handwashing stations in rural schools is not merely a sanitary improvement but a specific prophylactic measure against HAV. This structural change is likely to yield higher compliance than behavioral nudges alone.

In summary, controlling Hepatitis A in Andijan requires moving beyond routine protocols to a localized, adaptive strategy that addresses the specific environmental risks of the Fergana Valley and the shifting age-demographics of the disease.

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