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Seroprevalence of Measles, Mumps, Rubella, and Varicella-Zoster Virus Among People Living with HIV in Türkiye

Türkiye'de HIV ile Yaşayan Bireylerde Kızamık, Kabakulak, Kızamıkçık ve Varisella-Zoster Seroprevalansı

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Abstract

Introduction: Infections caused by measles, mumps, rubella (MMR), and varicella-zoster virus (VZV) can lead to severe illness and complications among people living with human immunodeficiency virus (HIV). This study aimed to evaluate the seroprevalence of MMR and VZV among people living with HIV and provide data to support proactive immunization strategies.

Materials and Methods: This retrospective cross-sectional study included adults living with HIV who were followed up at the infectious diseases and clinical microbiology outpatient clinic between October 2020 and December 2025. Demographic characteristics, baseline $CD4^+$ T-cell counts, and MMR and VZV immunoglobulin G serology results were assessed. Vaccination indications were evaluated according to current guideline recommendations.

Results: A total of 206 patients were included in the study. Of these, 91.3% were male, and the median age was 34 years. Seronegativity rates were 16.8% for measles, 12.9% for mumps, 9.1% for rubella, and 3.4% for VZV. An indication for MMR vaccination was identified in 27.2% of patients, whereas 3.4% had an indication for VZV vaccination. Seronegativity increased with age for rubella but decreased with age for the other viruses.

Conclusion: A substantial immunity gap for MMR persists among people living with HIV, whereas VZV seropositivity remains high. Assessment of serological immunity and vaccination of eligible patients should be integral components of HIV care.

Keywords: HIV, measles, mumps, rubella, varicella-zoster virus

Öz

Giriş: Kızamık, kabakulak, kızamıkçık (MMR) ve varisella-zoster virüsü (VZV) enfeksiyonları HIV ile yaşayan bireylerde ciddi hastalık ve komplikasyonlara yol açabilir. Bu çalışma, HIV ile yaşayan kişilerde MMR ve VZV seroprevalansını değerlendirmeyi ve proaktif aşılama stratejilerini destekleyebilecek veriler sağlamayı amaçlamıştır.

Gereç ve Yöntem: Bu retrospektif kesitsel çalışmaya Ekim 2020-Aralık 2025 arasında enfeksiyon hastalıkları ve klinik mikrobiyoloji polikliniğinde takip edilen erişkin HIV pozitif hastalar dahil edildi. Demografik veriler, başlangıç $CD4^+$ T-hücre sayıları ve MMR ile VZV immünoglobulin G sonuçları incelendi. Aşılama endikasyonları güncel kılavuzlara göre belirlendi.

Bulgular: Toplam 206 hasta değerlendirildi; %91,3'ü erkekti ve medyan yaş 34 yıl idi. Seronegatiflik oranları kızamık için %16,8, kabakulak için %12,9, kızamıkçık için %9,1 ve VZV için %3,4 bulundu. Hastaların %27,2'sinde MMR, %3,4'ünde VZV aşı endikasyonu vardı. Kızamıkçık seronegatifliği yaşla artarken, diğer virüslerde azaldı.

Sonuç: HIV ile yaşayan bireylerde MMR için belirgin bağışıklık eksikliği sürmektedir, buna karşın VZV seropozitifliği yüksektir. Bağışıklık durumunun değerlendirilmesi ve uygun hastalarda aşılama HIV bakımının temel bir parçası olmalıdır.

Anahtar Kelimeler: HIV, kızamık, kabakulak, kızamıkçık, suçiçeği-zona virüsü

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Introduction

With the introduction of antiretroviral therapy, the life expectancy and quality of life of people living with human immunodeficiency virus (HIV) have improved significantly[1,2]. However, the immunosuppressive effects of HIV infection may increase susceptibility to vaccine-preventable infections and result in more severe clinical manifestations of these infections[3,4]. Several studies have demonstrated that people living with HIV have lower seropositivity rates for measles, mumps, rubella (MMR), and varicella-zoster virus (VZV) [5,6]. Accordingly, the European AIDS Clinical Society (EACS) guidelines recommend a proactive approach to screening and vaccination among people living with HIV[7].

In Türkiye, data on serological immunity to these vaccine-preventable infections among people living with HIV are limited. Therefore, this study aimed to evaluate the seroprevalence of MMR and VZV among people living with HIV, identify individuals eligible for vaccination, and contribute to the development of proactive immunization strategies.

Materials and Methods

This retrospective cross-sectional study included all adults living with HIV who were followed up at the Infectious Diseases and Clinical Microbiology outpatient clinic of University of Health Sciences Türkiye, Konya City Hospital between October 1, 2020, and December 31, 2025. Demographic data, including age, sex, education level, and route of HIV transmission, were recorded. Clinical and laboratory variables included baseline $CD4^+$ T-cell count, baseline CD4 percentage, and serological markers for measles immunoglobulin G (IgG), mumps IgG, rubella IgG, and VZV IgG, which were obtained from patient records.

Because measles, mumps, and rubella vaccines are administered as a combined MMR vaccine in Türkiye, MMR immunity was assessed collectively. Patients were considered to have an indication for MMR vaccination if seronegativity was detected for at least one available MMR serological marker (measles, mumps, or rubella IgG). Similarly, patients with a negative available VZV IgG result were considered to have an indication for varicella vaccination. Because serological testing was performed as part of routine clinical practice, complete serological data were not available for all patients. Therefore, vaccination indications were determined based on the available serological results, and unavailable serological results were not considered when determining vaccination indications.

The serological markers were analyzed using enzyme-based immunoassay methods. HIV infection was defined as reactivity in an HIV type 1/2 (HIV-1/2) antigen/antibody assay and was subsequently confirmed using a rapid supplemental test performed at a central public health laboratory (Geenius HIV-1/2 Supplemental Assay, Bio-Rad Laboratories, Redmond, WA, USA).

This study was approved by the University of Health Sciences Türkiye, Konya City Hospital Clinical Research Ethics Committee (approval number: 2026/89; April 13, 2026) and was conducted in accordance with the Declaration of Helsinki. Given the retrospective cross-sectional design of the study, written informed consent was not obtained from the patients.

Statistical Analysis

Continuous variables were presented as means ± standard deviations or medians with interquartile ranges (IQRs; 25^{th}-75^{th} percentiles). As the continuous variables did not follow a normal distribution according to the Shapiro-Wilk test, nonparametric methods were used. Categorical variables were presented as frequencies and percentages. For between-group comparisons, the Mann-Whitney U test was used for non-normally distributed continuous variables, and the chi-square test was used for categorical variables. Statistical analyses were performed using IBM SPSS Statistics version 26.0 (IBM Corp., Chicago, IL, USA), and a p value <0.05 was considered statistically significant.

Results

During the study period, 206 patients with HIV infection were identified from the outpatient clinic records. Of these patients, 188 (91.3%) were male, and the median age was 34 years (IQR, 27-44 years). The distribution of HIV transmission routes in the study population was as follows: heterosexual contact, 107 (51.9%); men who have sex with men (MSM), 29 (14.1%); intravenous drug use, 3 (1.5%); and unknown, 67 (32.5%). The median CD4+ T-cell count was 447 cells/mm^3 (IQR, 301-627 cells/mm^3), and the median CD4 percentage was 19.6% (IQR, 14.6%-27.0%) (Table 1).

Measles serology was available for 190 patients (92.2%), mumps serology for 124 patients (60.2%), rubella serology for 198 patients (96.1%), and VZV serology for 179 patients (86.9%). Seropositivity rates were 83.2% for measles, 87.1% for mumps, 90.9% for rubella, and 96.6% for VZV (Table 1). Accordingly, seronegativity was observed in 16.8% of patients for measles, 12.9% for mumps, 9.1% for rubella, and 3.4% for VZV. Regarding the combined MMR vaccine, seronegativity to at least one available MMR component was detected in 27.2% of patients (56/206) based on the available serological results.

Table 1. Demographic characteristics, HIV transmission routes, serological results, and laboratory parameters of people living with HIV included in the study (n = 206).

Variables	
Age (year)	
Mean ± SD	36.6 ± 11.5
Median (IQR)	34 (27–44)
Male, n (%)	188 (91.3%)
Educational status, n (%)	
Primary school	18 (20.5%)
Secondary (middle) school	22 (25%)
High school	22 (25%)
University	26 (29.5%)
HIV transmission route, n (%)	
Heterosexual contact	107 (51.9%)
MSM	29 (14.1%)
IVDU	3 (1.5%)
Unknown	67 (32.5%)
Seropositivity, n (%)	
Measles IgG	158/190 (83.2%)
Mumps IgG	108/124 (87.1%)
Rubella IgG	180/198 (90.9%)
Varicella IgG	173/179 (96.6%)
Laboratory parameters, median (IQR)	
CD4 count (cells/mm^3)	447 (301–627)
CD4 percentage, median (%)	19.6 (14.6–27)

Educational status information was available for 88 patients. HIV, human immunodeficiency virus; IgG, immunoglobulin G; IQR, interquartile range; IVDU, intravenous drug use; MSM, men who have sex with men; SD, standard deviation.

These patients were considered to have an indication for MMR vaccination. The distribution of these patients is shown in Figure 1.

Among patients with an indication for MMR vaccination, 89.3% (50 of 56) had a baseline CD4+ T-cell count ≥200 cells/μL, and all patients with an indication for VZV vaccination (6 patients) had a CD4+ T-cell count ≥200 cells/μL, indicating immunological eligibility for vaccination at the time of presentation.

Among the 14 women of reproductive age (18-49 years), rubella IgG antibodies were negative in 4 (28.6%); 3 of these 4 patients had adequate baseline CD4+ T-cell counts (CD4+ ≥200 cells/μL) for vaccination.

In addition, MMR and VZV serostatuses were analyzed according to the patients' sociodemographic and clinical characteristics. Bivariate analysis showed no significant differences between groups in terms of sex, education level, MSM status, CD4+ T-cell count, or CD4 percentage. Rubella seronegativity increased with advancing age, whereas seronegativity for the other viruses decreased with age. These associations were statistically significant for all viruses except mumps ($p < 0.05$) (Table 2). The distribution of MMR and VZV IgG antibody positivity and negativity according to patients' birth years is shown in Figure 2.

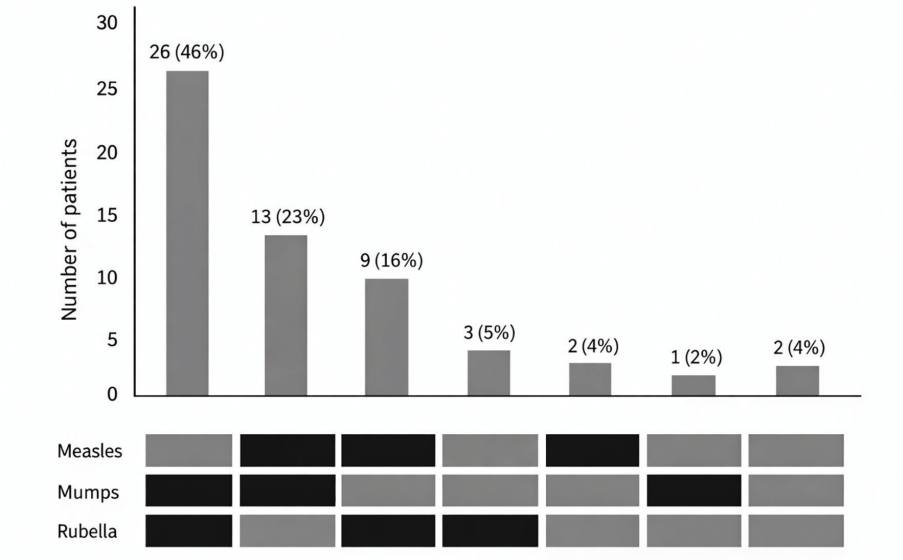

Figure 1. Distribution of the 56 patients (27.2%) identified as having an indication for measles, mumps, and rubella (MMR) vaccination based on the available serological results. Gray squares indicate IgG seronegativity for the corresponding MMR component. IgG, immunoglobulin G.

Table 2. Comparison of demographic and clinical characteristics according to MMR and varicella IgG serostatus in people living with HIV.

Variables	Measles IgG (–) (n = 32)	Measles IgG (+) (n = 158)	p	Mumps IgG (–) (n = 16)	Mumps IgG (+) (n = 108)	p	Rubella IgG (–) (n = 18)	Rubella IgG (+) (n = 180)	p	Varicella IgG (–) (n = 6)	Varicella IgG (+) (n = 173)	p
Male n (%)	28 (87.5)	148 (93.7)	0.260	16 (100)	100 (92.6)	0.595	15 (83.3)	167 (92.8)	0.166	5 (83.3)	160 (92.5)	0.391
Age (year) (median, IQR)	27 (23-29.8)	38 (27.8-46)	**<0.001**	29 (26-42.5)	35.5 (27-44.8)	0.252	43.5 (34.5-52.5)	33 (27-43)	**0.008**	25 (22.3-31.8)	34 (27-44)	**0.026**
MSM, n (%)	5/16 (31.3)	22/92 (23.9)	0.540	3/12 (25)	16/57 (28.1)	1.000	1/7 (14.3)	26/104 (25)	1.000	1/3 (33.3)	24/73 (24.7)	1.000
CD4 count (cells/mm^3)	446 (288-638)	447 (301-626)	0.973	319 (263-703)	419 (279-562)	0.635	340 (180–604)	462 (323-636)	0.173	334 (274-566)	448 (311-622)	0.438
CD4 percentage (%)	21.1 (13.6-30.8)	18.4 (14.6-25.9)	0.227	18.7 (9.8-26.4)	18.4 (14.6-25.9)	0.465	17 (8.8–29.2)	19.8 (14.8-27.2)	0.703	19.7 (16.3-21.5)	19.1 (14.5-27)	0.874
Educational status, n (%)			0.744			0.595			0.782			0.629
Primary school	2 (14.3)	14 (20.6)		1 (10)	8 (19.1)		2 (25)	16 (20.5)		0 (0)	16 (20.8)	
Secondary school	3 (21.4)	17 (25)		3 (30)	10 (23.8)		1 (12.5)	19 (24.4)		0 (0)	20 (26)	
High school	5 (35.7)	15 (22.1)		2 (20)	14 (33.3)		3 (37.5)	19 (24.4)		1 (50)	19 (24.7)	
University	4 (28.6)	22 (32.4)		4 (40)	10 (23.8)		2 (25)	24 (30.8)		1 (50)	22 (28.6)	

HIV, human immunodeficiency virus; IgG, immunoglobulin G; IQR, interquartile range; SD, standard deviation; MSM, men who have sex with men; MMR, measles, mumps, and rubella.

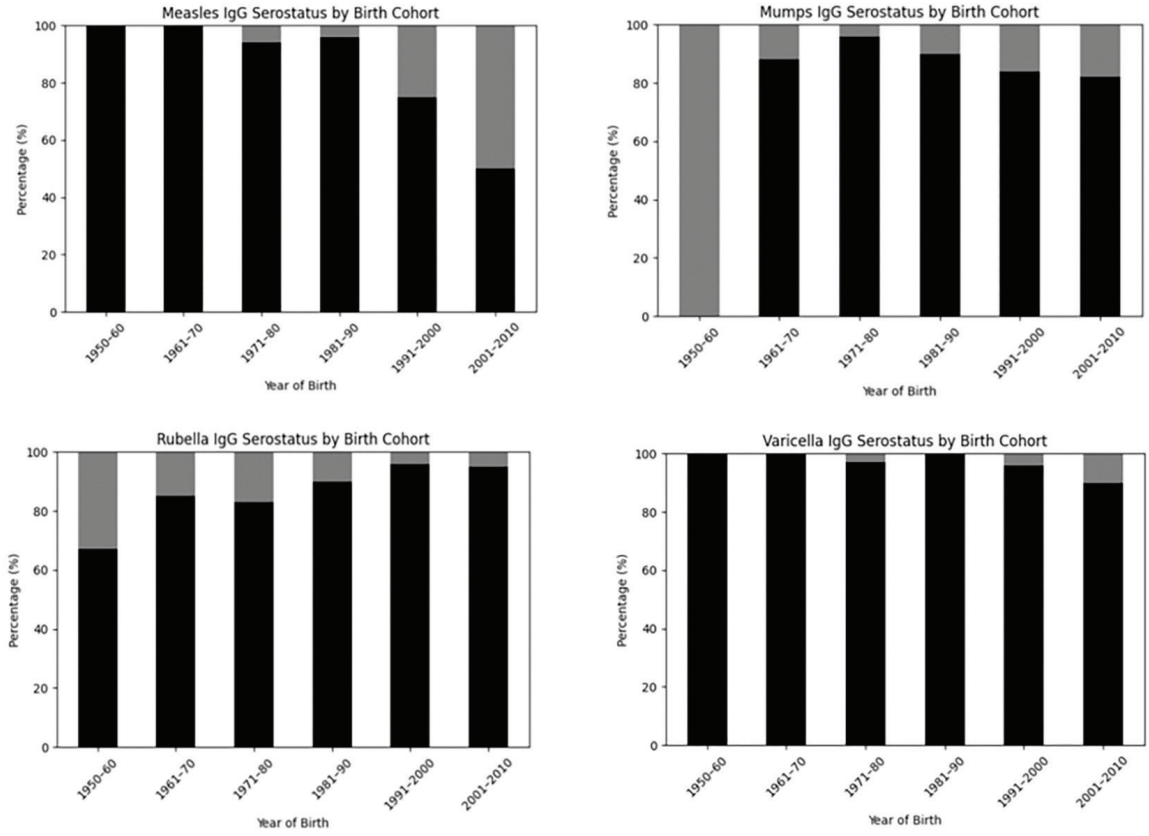

Figure 2. Distribution of MMR and varicella IgG serostatus according to birth cohorts among people living with HIV. Black bars represent IgG-positive individuals, whereas gray bars indicate IgG-negative individuals. MMR, measles, mumps, and rubella; IgG, immunoglobulin G; HIV, human immunodeficiency virus.

Discussion

In this study, the serostatus of MMR and varicella was evaluated in an adult cohort of people living with HIV in Türkiye. We found that 27.2% of patients were susceptible to at least one infection preventable by the MMR vaccine, and 3.4% were susceptible to VZV. The EACS guidelines and the Advisory Committee on Immunization Practices recommend serological assessment of immunity to MMR and VZV in people living with HIV and vaccination of patients without evidence of immunity who have a CD4+ T-cell count ≥200 cells/mm^3 or a CD4 percentage ≥15%[7,8]. In our study, approximately 90% of patients with an indication for MMR vaccination and all patients with an indication for VZV vaccination had CD4$^+$ T-cell counts appropriate for vaccination at the time of presentation, indicating that immunization strategies are generally clinically feasible.

In Türkiye, measles vaccination was included in the national immunization program in 1970; a second dose was introduced for first-grade schoolchildren in 1998, and in 2006, the combined MMR vaccine was incorporated into routine immunization following the addition of mumps and rubella vaccines to the national immunization program[9]. Nevertheless, following migration movements associated with the civil war in Syria in 2011, increases in measles cases and periodic outbreaks have been reported in Türkiye, as in many European countries[3,6,9,10]. This epidemiological change makes the assessment of measles susceptibility even more important, particularly in populations with limited immune protection. In our study, measles seronegativity among people living with HIV was 16.8%. This rate is considerably higher than those reported in HIV cohorts from European countries such as Germany (3.2%)[6], France (4.6%)[11], and the United Kingdom (7%)[3]. However, it is similar to the rate reported in a multicenter HIV cohort from Türkiye (18%)[12]. Considering that measles is associated with a more severe clinical course and increased mortality in individuals with T-cell immunodeficiency[13], this high susceptibility to measles among people living with HIV in our country represents an important public health risk.

Our study also demonstrated a statistically significant association between age and measles serostatus. According to the birth cohort analysis, measles seronegativity was 0% among patients born between 1950 and 1960, whereas this rate progressively increased in subsequent birth cohorts, reaching 50% among those born between 2001 and 2010. This finding may be explained by stronger and more durable immunity among individuals in older birth cohorts, who were more likely to have acquired immunity through natural infection, whereas in younger cohorts, vaccine-induced immunity may wane over time or the primary vaccine response may be insufficient[14,15]. Similarly, previous studies have reported higher measles seropositivity among older age groups and increased susceptibility among younger adults living with HIV[3,6,9-11].

Although there is no strong evidence that mumps or rubella infections have a more severe clinical course in people living with HIV, rubella infection during pregnancy may result in serious fetal and neonatal complications; therefore, maintaining rubella immunity remains clinically and epidemiologically important for women living with HIV[4]. In our study, 12.9% of adults living with HIV were seronegative for mumps, and 9.1% were seronegative for rubella. Furthermore, 28.6% of women of reproductive age were seronegative for rubella, which is noteworthy. This rate is higher than those reported in cohorts of HIV-positive women of reproductive age from Iran (17.3%)[4], Austria (18.2%)[16], and Germany (9%)[6]. However, because the number of female patients in our study was limited, these comparisons should be interpreted with caution. In our cohort, unlike the other three viruses, rubella seronegativity increased with advancing age. A similar trend was observed in another HIV cohort from Türkiye, although the association did not reach statistical significance[12]. In contrast, a cohort from Germany showed decreasing seronegativity with increasing age[6]. These differences may be attributable to historical variations in vaccination schedules, vaccination coverage rates, and the circulation of natural infection between countries.

It is well known that VZV infections, related complications, and mortality occur more frequently among people living with HIV[17,18]. In our study, VZV seropositivity was detected in 96.6% of patients. Since the varicella vaccine was incorporated into the national immunization program in Türkiye in 2013[19], the high seropositivity observed in our adult cohort is likely attributable primarily to a history of natural infection rather than vaccination. Nevertheless, although seropositivity indicates protection against varicella infection, VZV reactivation and its associated clinical manifestations cannot be completely excluded in people living with HIV because of impaired cellular immunity[20,21].

Study Limitations

This study has some limitations. First, the single-center, retrospective design may limit the generalizability of the findings. Furthermore, because serological tests were performed as part of routine clinical practice, complete MMR serological data were not available for all patients. Therefore, indications for MMR vaccination were determined based on the available serological results, and the reported prevalence may have underestimated the true prevalence. In addition, reliable data on the vaccination history of most patients were unavailable. Therefore, seronegativity cannot be attributed

solely to a lack of vaccination; it may also reflect waning vaccine-induced immunity, primary vaccine failure, or HIV-related immune dysfunction. However, this study was not designed to determine the underlying causes of seronegativity but rather to evaluate serological immunity to MMR and VZV among people living with HIV.

Despite these limitations, this study has important strengths. First, it is one of the few studies evaluating both MMR and VZV immunity among people living with HIV in Türkiye. Second, it includes a large adult cohort spanning multiple birth cohorts, providing valuable epidemiological insights into the national context.

Conclusion

In conclusion, our study demonstrates an immunity gap for MMR components among adults living with HIV, whereas VZV seropositivity remains high. These findings support the need for systematic assessment of immunity to vaccine-preventable infections as part of HIV care and vaccination of eligible patients in accordance with current guidelines.

Ethics Committee Approval: This study was approved by the University of Health Sciences Türkiye, Konya City Hospital Clinical Research Ethics Committee (approval number: 2026/89; April 13, 2026) and was conducted in accordance with the Declaration of Helsinki.

Informed Consent: Given the retrospective cross-sectional design of the study, written informed consent was not obtained from the patients.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.R.T., Y.G., Concept: M.R.T., Y.G., Design: M.R.T., Y.G., Data Collection or Processing: M.R.T., Y.G., Analysis or Interpretation: M.R.T., Y.G., Literature Search: M.R.T., Y.G., Writing: M.R.T., Y.G.

Conflict of Interest: No conflict of interest was declared by the authors.

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References

1. Teeraananchai S, Kerr SJ, Amin J, Ruxrungtham K, Law MG. Life expectancy of HIV-positive people after starting combination antiretroviral therapy: a meta-analysis. HIV Med. 2017;18(4):256-66.
2. de Boer-van der Kolk IM, Sprangers MA, Prins JM, Smit C, de Wolf F, Nieuwkerk PT. Health-related quality of life and survival among HIV-infected patients receiving highly active antiretroviral therapy: a study of patients in the AIDS Therapy Evaluation in the Netherlands (ATHENA) Cohort. Clin Infect Dis. 2010;50(2):255-63.
3. Molton J, Smith C, Chaytor S, Maple P, Brown K, Johnson M, Geretti AM. Seroprevalence of common vaccine-preventable viral infections in HIV-positive adults. J Infect. 2010;61:73-80.
4. Ghaderkhani S, SeyedAlinaghi S, Farhadi K, Abbasian L, Abdollahi A, Hasannezhad M, Dehghan Manshadi SA, Rajabi E. Serological status of measles, mumps, and rubella antibodies in HIV-positive women of childbearing age at a referral hospital in Iran. AIDS Res Ther. 2025;22(1):42.
5. Llenas-García J, Rubio R, Hernando A, Arrazola P, Pulido F. Do HIV-positive adult immigrants need to be screened for measles-mumps-rubella and varicella zoster virus immunization? AIDS Care. 2013;25(8):980-9.
6. Schwarze-Zander C, Draenert R, Lehmann C, Stecher M, Boesecke C, Sammet S, Wasmuth JC, Seybold U, Gillor D, Wieland U, Kümmerle T, Strassburg CP, Mankertz A, Eis-Hübinger AM, Jäger G, Fätkenheuer G, Bogner JR, Rockstroh JK, Vehreschild JJ. Measles, mumps, rubella and VZV: importance of serological testing of vaccine-preventable diseases in young adults living with HIV in Germany. Epidemiol Infect. 2017;145(2):236-44.
7. European AIDS Clinical Society (EACS). EACS Guidelines 2025 v13.0: immunisation in persons with HIV [Internet]. Brussels: EACS; 2025 [updated 2025 Oct 6; cited 2026 Feb 8]. Available from: https://eacs.sanfordguide.com/en/eacs-hiv/eacs-section4/vaccination.
8. Advisory Committee on Immunization Practices. Recommended adult immunization schedule by medical condition and other indications, United States, 2025 [Internet]. Atlanta (GA): Centers for Disease Control and Prevention; 2025 [updated 2025 Aug 7; cited 2026 Feb 8]. Available from: https://www.cdc.gov/vaccines/hcp/imz-schedules/adult-age.html.
9. Nayir T, Nazlıcan E, Şahin M, Kara F, Alp Meşe E. Effects of immunization program on morbidity and mortality rates of vaccine-preventable diseases in Turkey. Turk J Med Sci. 2020;50(8):1909-15.
10. Moss WJ, Griffin DE. Global measles elimination. Nat Rev Microbiol. 2006;4:900-8.
11. Lambert D, Dramé M, Rouger C, Brodard V, Nguyen Y, Berger JL, Kmiec I, Hentzien M, Lebrun D, Jaussaud R, Andreoletti L, Bani-Sadr F. High prevalence of measles seronegativity in adults with HIV infection born in the era of measles vaccination in Northern France. AIDS. 2015;29:241-3.
12. Candevir A, Kuşcu F, Yıldırım F, Kömür S, Şentürk GÇ, İnal AS, Eser F, Çetiner S, Kurtaran B, Taşova Y. Low immunity against vaccine preventable diseases in Turkish HIV cohort. Turk J Med Sci. 2021;51(5):2311-7.
13. Maldonado Y. Measles vaccine, HIV infection, and antiretroviral therapy--a window of opportunity. J Infect Dis. 2012;206(4):466-8.
14. Kontio M, Jokinen S, Paunio M, Peltola H, Davidkin I. Waning antibody levels and avidity: implications for MMR vaccine-induced protection. J Infect Dis. 2012;206(10):1542-8.
15. Strebel PM, Orenstein WA. Measles. N Engl J Med. 2019;381(4):349-57.
16. Grabmeier-Pfistershammer K, Poeppl W, Herkner H, Touzeau-Roemer V, Huschka E, Rieger A, Burgmann H. High need for MMR vaccination in HIV infected adults in Austria. Vaccine. 2014;32(45):6020-3.
17. Perronne C, Lazanas M, Leport C, Simon F, Salmon D, Dallot A, Vildé JL. Varicella in patients infected with the human immunodeficiency virus. Arch Dermatol. 1990;126(8):1033-6.
18. Gebo KA, Kalyani R, Moore RD, Polydefkis MJ. The incidence of, risk factors for, and sequelae of herpes zoster among HIV patients in the highly active antiretroviral therapy era. J Acquir Immune Defic Syndr. 2005;40(2):169-74.
19. Wolfson LJ, Daniels VJ, Pillsbury M, Kurugöl Z, Yardimci C, Kyle J, Dinleyici EC. Cost-effectiveness analysis of universal varicella vaccination in Turkey using a dynamic transmission model. PLoS One. 2019;14(8):e0220921.
20. Gnann JW Jr, Whitley RJ. Clinical practice. Herpes zoster. N Engl J Med. 2002;347(5):340-6.
21. Cohen JI. Clinical practice: Herpes zoster. N Engl J Med. 2013;369(3):255-63.