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Prevalence of hepatitis b and c among patients with tuberculosis during the COVID-19 pandemic era and war: challenges, systemic risks and epidemiology prognosis (analytical literature review)

Tuberculosis (TB) and viral hepatitis B (HBV) and C (HCV) remain a pressing global health problem. According to WHO, in 2023, approximately 296 million people will be living with chronic HBV infection, and 58 million with chronic HCV infection. Patients with TB are at increased risk of co-infection with viral hepatitis, which complicates treatment due to the increased risk of hepatotoxicity of anti-TB drugs.

The literature review analyzed current data on the prevalence of markers of viral hepatitis B and C among patients with tuberculosis. Global, European and Ukrainian co-infection rates, as well as risk factors for their occurrence, were considered. Systematic reviews and meta-analyses (2015–2025) indicate an increased prevalence of HBV and HCV among TB patients compared to the general population, especially in groups with high social risk and among people with HIV infection. The presence of HBV or HCV is associated with an increased risk of drug-induced liver injury during anti-TB therapy, highlighting the need for early screening and personalized patient management.

The military actions in Ukraine have created additional risks for the spread of infectious diseases. Before the start of the full-scale war, Ukraine was already among the countries with a high burden of multidrug-resistant TB. The war led to the destruction of the medical infrastructure, interruption of treatment of patients with TB and chronic viral hepatitis, large-scale internal and external migration of the population, and a decrease in coverage of preventive programs. And the interruption of anti-TB therapy increases the risk of developing drug-resistant forms of TB, while interrupted HCV treatment can lead to the progression of liver fibrosis.

Current international data (2020–2024) confirm that co-infection of viral hepatitis B and C with tuberculosis is a common and clinically significant problem, especially in Europe. Mandatory screening for HBsAg and anti-HCV before starting anti-tuberculosis treatment is pathogenetically justified and appropriate for timely stratification of the risk of developing hepatotoxic reactions. Management of patients with combined pathology requires a multidisciplinary approach involving phthisiologists, infectious disease specialists and gastroenterologists, as well as regular laboratory monitoring of the functional state of the liver. Given the relevance of the problem for Ukraine, including the Transcarpathian region, it is advisable to further conduct regional epidemiological studies to clarify the prevalence of co-infection and optimize clinical algorithms for patient management.

Key words: tuberculosis (TB), hepatitis B (HBV), hepatitis C (HCV), COVID-19, war in Ukraine.

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Поширеність гепатиту В та С серед пацієнтів з туберкульозом в епоху пандемії COVID-19 та війни: виклики, системні ризики та епідеміологічний прогноз (аналітичний огляд літератури)

Туберкульоз (ТБ) та вірусний гепатит В (HBV) та С (HCV) залишаються актуальною глобальною проблемою охорони здоров'я. За даними ВООЗ, у 2023 році приблизно 296 мільйонів людей житимуть з хронічною інфекцією HBV, а 58 мільйонів – з хронічною інфекцією HCV. Пацієнти з туберкульозом мають підвищений ризик коінфекції вірусним гепатитом, що ускладнює лікування через підвищений ризик гепатотоксичності протитуберкульозних препаратів.

В огляді літератури проаналізовано поточні дані про поширеність маркерів вірусного гепатиту В та С серед пацієнтів з туберкульозом. Були розглянуті світові, європейські та українські показники коінфекції, а також фактори ризику їх виникнення. Систематичні огляди та метааналізи (2015–2025) вказують на підвищену поширеність HBV та HCV серед пацієнтів з туберкульозом порівняно із загальною популяцією, особливо в групах з високим соціальним ризиком та серед людей з ВІЛ-інфекцією. Наявність HBV або HCV пов'язана з підвищеним ризиком медикаментозного ураження печінки під час протитуберкульозної терапії, що підкреслює необхідність раннього скринінгу та персоналізованого ведення пацієнтів.

Військові дії в Україні створили додаткові ризики поширення інфекційних захворювань. Ще до початку повномасштабної війни Україна вже була серед країн з високим тягарем мультирезистентного туберкульозу. Війна призвела до руйнування медичної інфраструктури, переривання лікування пацієнтів з туберкульозом та хронічним вірусним гепатитом, масштабної внутрішньої та зовнішньої міграції населення, а також зменшення охоплення профілактичними програмами. А переривання протитуберкульозної терапії підвищує ризик розвитку медикаментозно-резистентних форм туберкульозу, тоді як перерване лікування HCV може призвести до прогресування фіброзу печінки.

Поточні міжнародні дані (2020–2024) підтверджують, що коінфекція вірусних гепатитів В та С з туберкульозом є поширеною та клінічно значущою проблемою, особливо в Європі. Обов'язковий скринінг на HBsAg та анти-HCV перед початком протитуберкульозного лікування є патогенетично виправданим та доцільним для своєчасної стратифікації ризику розвитку гепатотоксичних реакцій. Ведення пацієнтів з поєднаною патологією вимагає мультидисциплінарного підходу за участю фтизіатрів, інфекціоністів та гастроентерологів, а також регулярного лабораторного контролю функціонального стану печінки. Враховуючи актуальність проблеми для України, зокрема Закарпатської області, доцільно подальше проведення регіональних епідеміологічних досліджень для уточнення поширеності коінфекції та оптимізації клінічних алгоритмів ведення пацієнтів.

Ключові слова: туберкульоз (ТБ), гепатит В (ВГВ), гепатит С (ВГС), COVID-19, війна в Україні.

Introduction. Tuberculosis (TB) and viral hepatitis B (HBV) and C (HCV) remain a pressing global health problem. According to WHO, in 2023, approximately 296 million people will be living with chronic HBV infection, and 58 million with chronic HCV infection [1]. Patients with TB are at increased risk of co-infection with viral hepatitis, which complicates treatment due to the increased risk of hepatotoxicity of anti-TB drugs.

Current meta-analyses (2015–2025) show that the prevalence of HBV among TB patients is on average 5.8%, and HCV – 10.3% in the world, and in the European Region, according to WHO, the prevalence of HCV reaches 17.5% [2;5]. In Ukraine, among TB patients ≈15% of patients with HCV markers are noted [3;4].

Graphical dynamics of the literature (2015–2025) demonstrates a trend towards increased attention to the problem of co-infection and stabilization of estimates of HBV/HCV prevalence among TB patients. Objective was to identify the prevalence of markers of viral hepatitis B and C among tuberculosis patients, analyze global, European and Ukrainian data, and assess the clinical significance of co-infection for patient management.

Methods. To prepare the review, a systematic review of the literature was used, including international and national publications from 2015 to 2025, available in PubMed, Scopus, Web of Science and official reports of the WHO and the Center for Public Health of Ukraine. Systematic reviews, meta-analyses and cohort studies containing data on serological markers (HBsAg, anti-HCV), the frequency of co-infection and clinical outcomes for TB patients were analyzed. For clarity, graphs of literature dynamics and comparison of HBV and HCV (2015–2025) were constructed, illustrating changes in prevalence and regional differences.

Results and Discussion. Hepatitis B (HBV) and hepatitis C (HCV) are global health problems that cause chronic liver damage, cirrhosis, and hepatocellular carcinoma [5]. Tuberculosis (TB) remains one of the leading causes of death from infectious diseases worldwide [6]. The combination of TB with HBV or HCV is clinically significant due

to the mutual influence on the course of the disease and treatment outcomes.

The prevalence of HBV and HCV among TB patients is higher than in the general population, which is associated with common risk factors (socioeconomic vulnerability, injecting drug use, HIV infection, alcoholism, migration) [7]. Meta-analyses show that the presence of HBV or HCV in TB patients is associated with reduced success of anti-TB therapy and an increased risk of hepatotoxic reactions [8].

HBV infection can reduce the likelihood of successful completion of TB treatment by approximately 20%, while HCV can reduce it by up to 30–35% [8]. The main reason is the increased hepatotoxicity of anti-TB drugs (isoniazid, rifampicin, pyrazinamide), which requires careful monitoring of liver function and individualization of therapy [9].

The COVID-19 pandemic has significantly impacted global TB and viral hepatitis control programs. According to the World Health Organization, in 2020–2022, there was a decrease in the detection of new TB cases due to overloading of health systems and limited access to health services [6]. The pandemic has led to a reduction in TB and viral hepatitis screening programs [10], interruption of treatment due to lockdowns and mobility restrictions [10], and a decrease in HBV vaccination in a number of regions [11].

In addition to organizational factors, immunological aspects are important. Treatment of severe COVID-19 with immunomodulators or glucocorticosteroids may contribute to the reactivation of latent TB or HBV [12]. This is especially true for patients with concomitant chronic infections.

In countries with a high burden of TB, the pandemic has actually rolled back progress in disease control for several years [6].

The military actions in Ukraine have created additional risks for the spread of infectious diseases. Before the start of the full-scale war, Ukraine was already among the countries with a high burden of multidrug-resistant TB [13]. The war led to the destruction of the medical infrastructure, interruption of treatment of patients with TB and chronic viral hepatitis, large-scale internal and external migration of the population, and a decrease in coverage of preventive programs [13;14]. And the interruption of anti-TB therapy increases the risk of developing drug-resistant forms of TB, while interrupted HCV treatment can lead to the progression of liver fibrosis [8]. The combination of war and pandemic created a synergistic negative effect: weakened health systems, economic instability and psychosocial stress increased the spread of infections [14]. The comorbidity of TB and viral hepatitis is closely linked to poverty, limited access to health care and stigmatization of patients [7]. In the context of pandemics and wars, these factors are exacerbated, leading to late diagnosis and more complex clinical forms.

Hepatitis B and C viruses remain among the leading causes of chronic liver disease worldwide. At the same time, tuberculosis continues to be one of the most common infectious diseases, creating a significant intersection of risk populations. A meta-analysis that included 94,936 patients with tuberculosis in different regions of the world showed that the prevalence of HBsAg among TB patients is 5.8% and anti-HCV is 10.3%, which is higher than the general population [2]. The highest HBsAg rates among TB patients were observed in the African region (7.8%), while the highest HCV prevalence among TB patients was observed in the European region (up to 17.5%) [2]. A systematic review and, in particular, Ayele et al. [2] demonstrated that the prevalence of HBsAg among patients with tuberculosis is on average 5.8%, and anti-HCV is 10.3%, which is higher than the corresponding rates in the general population. A subsequent modern meta-analysis by Olaru et al. [5] confirmed the persistence of this trend and indicated pronounced regional differences, with the highest HCV rates in the European region. Thus, the current data are consistent with previous studies, confirming a consistently increased level of co-infection. European studies confirm that HBV/HCV co-infection significantly increases the risk of developing drug-induced liver damage during anti-tuberculosis therapy, which requires mandatory screening before starting treatment [2]. According to generalized results [2;5], in the European region the frequency of HCV among TB patients can reach 17.5%, which is one of the highest rates in the world. This is explained by the high concentration of risk groups (injecting drug users, HIV patients, people with a history of transfusions before the introduction of screening of donor blood). The study by Wong et al. [15] demonstrated that chronic HBV significantly increases the risk of drug-induced liver damage during anti-TB therapy, which is of particular clinical importance for countries with an average prevalence of HBV. Thus, in Europe the problem has not only an epidemiological but also a pharmacological dimension. In Ukraine, the prevalence of HCV markers in the adult population reaches about 5%, and HBV – about 1.5% [3]. At the same time, among patients with tuberculosis, the frequency of HCV is approximately 15% [4], which exceeds the national average. This indicates the concentration of co-infection precisely in groups with an increased socio-medical risk.

Esmael et al. [16] pointed out the impact of multiple co-infection and proved that the presence of HIV significantly increases the risk of detecting HBV/HCV in patients with tuberculosis, forming a three-component co-infection (TB/HIV/HBV or TB/HIV/HCV), which significantly complicates treatment. Naderi et al. [17] confirmed that dual viral co-infection (HBV + HCV) in TB patients is associated with more frequent biochemical signs of hepatocellular damage and the need to modify therapeutic regimens. In addition, the integrated “Test and Treat” approaches described by Beard et al. (2024) [18] prove the effectiveness of active screening for viral hepatitis in risk groups, which is also relevant for TB patients. The results of various meta-analyses (2015–2023) demonstrate a consistently increased prevalence of HBV/HCV among tuberculosis patients. The prevalence of HBV and HCV markers in patients with tuberculosis varies significantly depending on socio-economic conditions, the structure of risk groups (e.g., injection drug use, HIV co-infection, prison conditions), and the level of coverage of screening programs. This diversity makes it difficult to transfer research results from one region to another and requires caution when interpreting international data in a national context. Most published studies are observational in nature, which limits the

ability to establish causal relationships. Often, only serological tests (HBsAg, anti-HCV) are used without confirmation of active viral replication by PCR, which may lead to an overestimation of the frequency of active infection and influence clinical conclusions.

Currently, Ukraine lacks large-scale cohort studies with a clear analysis of hepatotoxicity depending on HBV/HCV status. Data on hepatitis B and C in Transcarpathia. According to the Transcarpathian Regional Center for Disease Control and Prevention (as of the first quarter of 2025), 2,748 people were tested for viral hepatitis. 396 cases of hepatitis B and 479 cases of hepatitis C were detected. 477 patients with chronic hepatitis B and 92 with hepatitis C were treated. This is general data for the region, but it is not specifically divided by tuberculosis patients – that is, statistics on how many people have combined infections (tuberculosis + hepatitis B or C) in Transcarpathia are currently not publicly available in open sources. The incidence of tuberculosis in the region has been decreasing in recent years; one of the indicators in 2025 was about 16.1 cases per 100,000 population. This is a separate statistics for tuberculosis; it does not include data on simultaneous hepatitis infections. Scientific studies at the global level (not specifically for Transcarpathia) have shown that people with tuberculosis often have viral hepatitis; the global frequency of positive tests for HBV among TB patients is approximately ~5–6%, and for HCV – ~10%. This means that patients with tuberculosis are at higher risk of having HBV or HCV than the general population, but specific indicators depend on the region, population and level of testing coverage.

The co-existence of tuberculosis and viral hepatitis complicates both diagnosis and therapy, since some anti-tuberculosis drugs have a hepatotoxic effect, and viral hepatitis itself causes liver damage, which can reduce the tolerability of treatment and increase the risk of complications. Such patients usually require comprehensive medical supervision and careful monitoring of the liver during therapy [19;20;21].

Graph of the literature dynamics of HBV/HCV prevalence among tuberculosis patients by studies from 2015 to 2025 based on available sources (Fig. 1). The data visualize how scientific estimates (in percentages) of the percentage of HCV among TB patients have changed in several key works.

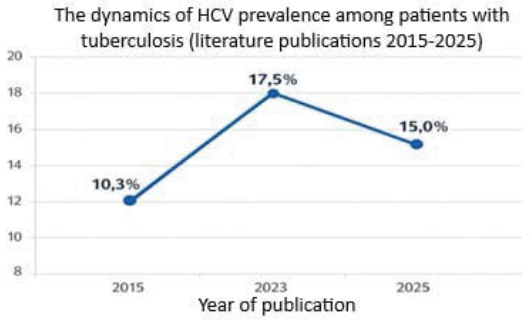

Fig. 1 The dynamics of HBV/HCV prevalence among tuberculosis patients according to studies from 2015 to 2025 based on published sources.

In 2015, the first systematic reviews showed that the prevalence of HCV among patients with tuberculosis was approximately 10.3% based on data collected up to 2021. By 2023, this figure had increased to approximately 17.5% in some regions, especially in the WHO European Region [2]. In 2025, more recent large reviews suggest a slight decrease or stabilization of the prevalence at around 15%, with significant regional variability [5;22;23]. Comparative literature dynamics show increasing attention to the problem (Figure 2).

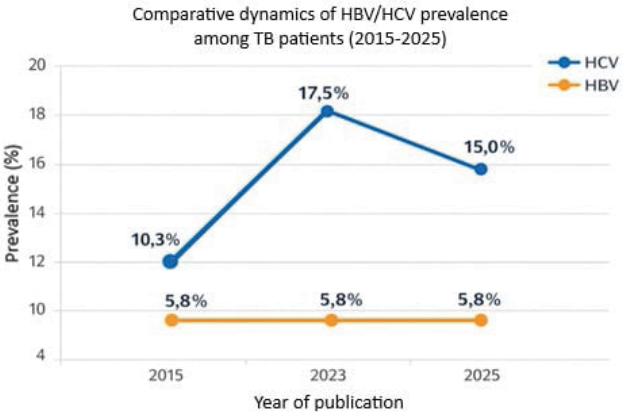

Fig. 2 Combined graph of literature dynamics of HBV and HCV among tuberculosis patients (2015–2025). Blue line – HCV (10.3% → 17.5% → 15%); Orange line – HBV (5.8% → 5.8% → 5.8%).

Since 2015, there has been an increase in the number of studies and systematic estimates of HCV prevalence among patients with tuberculosis, which has improved the accuracy and reliability of the data obtained. Analysis of regional studies (especially for 2023–2025) demonstrates significant variability in indicators depending on the geographical distribution and characteristics of risk groups. Recent meta-analyses indicate stabilization of indicators at a level that remains significantly higher compared to the general population [23].

Conclusions and prospects for further research. Many studies emphasize the importance of mandatory testing for HBV and HCV in patients with tuberculosis in order to timely detect co-infection and adjust treatment. Ukrainian doctors suggest screening for viral hepatitis in all patients with tuberculosis. The state has included hepatitis B and C in the national plan to combat infectious diseases along with tuberculosis and HIV.

Current international data (2020–2024) confirm that co-infection of viral hepatitis B and C with tuberculosis is a common and clinically significant problem, especially in Europe. Mandatory screening for HBsAg and anti-HCV before starting anti-tuberculosis treatment is pathogenetically justified and appropriate for timely stratification of the risk of developing hepatotoxic reactions. Management of patients with combined pathology requires a multidisciplinary approach involving phthisiologists, infectious disease specialists and gastroenterologists, as well as regular laboratory monitoring of the functional state of the liver. Given the relevance of the problem for Ukraine, including the Transcarpathian region, it is advisable to further conduct regional epidemiological studies to clarify the prevalence of co-infection and optimize clinical algorithms for patient management.

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Koval G.M. – idea, goal, final review of the article;

Vysochanska V.V. – collection of research material, analysis of the results obtained, preparation of the text of the article;

Yurik O.M. – collection of research material, analysis of the results obtained;

Derbak M.A. – idea, collection of research material.

BIBLIOGRAPHY

1. World Health Organization. Global hepatitis report 2023 [Electronic resource]. Geneva: WHO; 2023. Available from: https://www.who.int/publications/i/item/9789240091672

2. Ayele HT, Mourik MS, Debray TP, Bonten MJ. Isoniazid Prophylactic Therapy for the Prevention of Tuberculosis in HIV Infected Adults: A Systematic Review and Meta-Analysis of Randomized Trials. PLoS One. 2015 Nov 9;10(11):e0142290. doi: 10.1371/journal.pone.0142290. PMID: 26551023; PMCID: PMC4638336.

3. Центр громадського здоров'я МОЗ України. Оцінка поширеності вірусних гепатитів В і С в Україні, 2021 [Електронний ресурс]. Режим доступу: https://phc.org.ua

4. Центр громадського здоров'я МОЗ України. Дані щодо ко-інфекції туберкульоз/вірусний гепатит С, 2023 [Електронний ресурс]. Режим доступу: https://phc.org.ua

5. Olaru ID, Beliz Meier M, Mirzayev F, Prodanovic N, Kitchen PJ, Schumacher SG, Denkinger CM. Global prevalence of hepatitis B or hepatitis C infection among patients with tuberculosis disease: systematic review and meta-analysis. EClinicalMedicine. 2023 Apr 6;58:101938. doi: 10.1016/j.eclinm.2023.101938. PMID: 37090436; PMCID: PMC10113747.

6. Mostafavi E, Ebrahimi B, Doosti-Irani A, Mirzazadeh A. Prevalence of hepatitis B, hepatitis C, and tuberculosis among people living with HIV in Iran: a systematic review and meta-analysis. BMC Infect Dis. 2024 Aug 3;24(1):777. doi: 10.1186/s12879-024-09676-4. PMID: 39097724; PMCID: PMC11297631.

7. Marco MH, Ahmedov S, Castro KG. The global impact of COVID-19 on tuberculosis: A thematic scoping review, 2020-2023. PLOS Glob Public Health. 2024 Jul 3;4(7):e0003043. doi: 10.1371/journal.pgph.0003043. PMID: 38959278; PMCID: PMC11221697.

8. Sun T, Chi H, Wang J, Zheng Y, Zhu H, Zhao J, Zhou K, Chen M, Wang D, Tung TH, Xu J, Shen B. Effect of SARS-CoV-2 infection on liver function in patients with hepatitis B. BMC Infect Dis. 2024 Dec 18;24(1):1428. doi: 10.1186/s12879-024-10324-0. PMID: 39695950; PMCID: PMC11654415.

9. Wei X, Cai R, Wu X, Su Y, Lian S, Nan T, Ye X, Wei J. Risk of drug-induced liver injury in chronic hepatitis C and tuberculosis co- infection: a systematic review and meta- analysis. BMC Infect Dis. 2025 Nov 13;25(1):1566. doi: 10.1186/s12879-025-12005-y. PMID: 41233746; PMCID: PMC12613362.

10. Rajbhandari R, Nguyen VH, Knoble A, Fricker G, Chung RT. Advances in the management of hepatitis B. BMJ. 2025 Jun 3;389:e079579. doi: 10.1136/bmj-2024-079579. PMID: 40461178.

11. Mihai N, Olariu MC, Ganea OA, Adamescu AI, Molagic V, Aramă ȘS, Tilișcan C, Aramă V. Risk of Hepatitis B Virus Reactivation in COVID-19 Patients Receiving Immunosuppressive Treatment: A Prospective Study. J Clin Med. 2024 Oct 10;13(20):6032. doi: 10.3390/jcm13206032. PMID: 39457983; PMCID: PMC11508539.

12. Туберкульоз і вірусні гепатити: Подвійний виклик, єдине рішення. Центр громадського здоров'я України, 2025 (офіційний науково-популярний огляд https://phc.org.ua/news/tuberkuloz-i-virusni-gepatiti-podviyniy-viklik-edine-rishennya).

13. Чабан Т. В., Верба Н. В., Бочаров В. М., Ткач Л. В. Епідеміологічні особливості HBV-інфекції в Україні під час пандемії COVID-19 та воєнного стану (2015–2023). https://preventmed.com.ua/2024/01/15/materialy-konferenczyi-infekczijni-hvoroby-suchasnosti-etiologiya-epidemiologiya-diagnostyka-likuvannya-profilaktyka-biobezpeka-prysvyachenoyi-s-hhorichnym-chytannyam-pa/

14. Chaudhari M., Verma S., Deb S. Insights into molecular interplay in tuberculosis–COVID-19 co-infection via integrated multi-omics strategies. Multidisciplinary Scientific Journal 2025;8(4):41. https://doi.org/10.3390/j8040041

15. Wong RJ, Rupp L, Lu M, Yang Z, Daida YG, Schmidt M, Boscarino JA, Gordon SC, Chitnis AS. Prevalence of hepatitis B virus (HBV) and latent tuberculosis co-infection and risk of drug-induced liver injury across two large HBV cohorts in the United States. J Viral Hepat. 2023 Jun;30(6):512-519. doi: 10.1111/jvh.13823. Epub 2023 Mar 6. PMID: 36843435.

16. Esmael A., Mpendo J., Kawoozo B., Keneema E., Nanvubya A., Ssetaala A., Okech B. Prevalence and risk factors of hepatitis B and C virus among tuberculosis and human immunodeficiency virus co-infected patients: systematic review and meta-analysis // Ecronicon. 2025. Available from: https://ecronicon.net/ecprm/prevalence-and-risk-factors-of-hepatitis-b-and-c-virus-among-tuberculosis-and-human-immune-deficiency

17. Naderi M, Hosseini SM, Soltani SA, Hamidi Sofiani V, Moradi A. The overlapping coinfection of hepatitis B virus and anti-hepatitis C virus antibody in tuberculosis patients: Unraveling co-infection patterns and clinical implications. SAGE Open Med. 2025 Sep 17;13:20503121251376150. doi: 10.1177/20503121251376150. PMID: 40980473; PMCID: PMC12446823.

18. Beard N, Hill A. Combined "Test and Treat" Campaigns for Human Immunodeficiency Virus, Hepatitis B, and Hepatitis C: A Systematic Review to Provide Evidence to Support World Health Organization Treatment Guidelines. Open Forum Infect Dis. 2024 Jan 11;11(2):ofad666. doi: 10.1093/ofid/ofad666. PMID: 38352158; PMCID: PMC10863549.

19. Feleke BE, Feleke TE, Adane WG, Girma A. Impacts of hepatitis B and hepatitis C co-infection with tuberculosis, a prospective cohort study. Virol J. 2020 Jul 23;17(1):113. doi: 10.1186/s12985-020-01385-z. PMID: 32703225; PMCID: PMC7376700.
20. Lomtadze N, Kupreishvili L, Salakaia A, Vashakidze S, Sharvadze L, Kempker RR, Magee MJ, del Rio C, Blumberg HM. Hepatitis C virus co-infection increases the risk of anti-tuberculosis drug-induced hepatotoxicity among patients with pulmonary tuberculosis. PLoS One. 2013 Dec 19;8(12):e83892. doi: 10.1371/journal.pone.0083892. PMID: 24367617; PMCID: PMC3868578.
21. Chen L, Bao D, Gu L, Gu Y, Zhou L, Gao Z, Huang Y. Co-infection with hepatitis B virus among tuberculosis patients is associated with poor outcomes during anti-tuberculosis treatment. BMC Infect Dis. 2018 Jul 3;18(1):295. doi: 10.1186/s12879-018-3192-8. PMID: 29970037; PMCID: PMC6029116.
22. Naderi M, Hosseini SM, Soltani SA, Hamidi Sofiani V, Moradi A. The overlapping coinfection of hepatitis B virus and anti-hepatitis C virus antibody in tuberculosis patients: Unraveling co-infection patterns and clinical implications. SAGE Open Med. 2025 Sep 17;13:20503121251376150. doi: 10.1177/20503121251376150. PMID: 40980473; PMCID: PMC12446823.
23. Wei X, Cai R, Wu X, Su Y, Lian S, Nan T, Ye X, Wei J. Risk of drug-induced liver injury in chronic hepatitis C and tuberculosis co- infection: a systematic review and meta- analysis. BMC Infect Dis. 2025 Nov 13;25(1):1566. doi: 10.1186/s12879-025-12005-y. PMID: 41233746; PMCID: PMC12613362.

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