

Research Article

Epidemiological Trends and Characteristics of Viral Hepatitis in Diyala Province, Iraq: A Comparative Analysis of Surveillance Data (2024-2025)

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Abstract | Viral hepatitis continues to be a major global public health challenge. Chronic infections with hepatitis B (HBV) and hepatitis C (HCV) lead to significant liver-related morbidity and mortality, including cirrhosis and hepatocellular carcinoma. This study aimed to analyze and compare the epidemiological characteristics of reported viral hepatitis cases in Diyala Province, Iraq, between 2024 and 2025 to identify trends, high-risk groups, and inform public health interventions. A retrospective analysis of passive surveillance data from 2024 and 2025 was conducted. Descriptive statistics were used to analyze case counts, proportions, and trends across demographic, temporal, geographical, and clinical variables. Data were processed using Microsoft Excel. A total of 687 cases were analyzed. Reported cases decreased by 63% from 2024 (n=502) to 2025 (n=185). Males constituted 60.4% of all cases. Hepatitis B was predominant (68.6% of total cases), though its proportion decreased slightly from 2024 to 2025. The 20-40 years age group was most affected (61.9% of cases). Al-Khalis district reported the highest burden. The mode of transmission was classified as 'Unknown' in 36.4% of cases, followed by exposure to surgical tools (13.8%) and blood (10.9%). Surveillance data indicate a sharp decline in reported hepatitis cases in Diyala. While potentially positive, this trend requires cautious interpretation due to possible surveillance artifacts. Persistent male predominance, a high proportion of unknown transmission routes, and geographic concentration highlight key areas for strengthening public health measures, including enhanced surveillance, targeted vaccination, and rigorous infection control in healthcare settings.

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Keywords | Viral Hepatitis, Epidemiology, Surveillance, Iraq, Diyala, Hepatitis B, Hepatitis C



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Introduction

Viral hepatitis continues to be a major global public health challenge. Chronic infections with hepatitis B (HBV) and hepatitis C (HCV) lead to significant liver-related morbidity and mortality, including

cirrhosis and hepatocellular carcinoma (World Health Organization, 2021). In many regions, particularly in the Middle East, viral hepatitis places a heavy strain on healthcare systems due to gaps in vaccination coverage, infection control practices, and surveillance capacity (Al-Kanaani *et al.*, 2018). The World Health

Organization (WHO) has established ambitious targets to eliminate viral hepatitis as a public health threat by 2030, underscoring the critical need for robust epidemiological data to guide national and local responses (World Health Organization, 2016).

Tracking temporal trends, demographic patterns, and transmission dynamics is essential to evaluate the impact of interventions and identify persistent gaps. This study provides a detailed analysis of hepatitis surveillance data from the Diyala Province of Iraq for the years 2024 and 2025. The analysis reveals a substantial 63% decrease in reported cases between the two years. A consistent male predominance (approximately 60%) was observed, and HBV remained the most common type, albeit with a slightly reduced proportion. The Al-Khalis health district continued to bear the highest burden. Notably, over one-third of all cases had an undocumented mode of transmission, highlighting challenges in epidemiological investigation.

Previous studies from the region have reported similar demographic patterns, with higher hepatitis prevalence among males and adults aged 20-40 years, often linked to occupational and healthcare-related exposures (Ali *et al.*, 2019; Al-Haddad *et al.*, 2021; Al-Hadithi and Al-Diwan, 2023). However, the magnitude of the case reduction observed in this dataset warrants careful analysis to distinguish genuine epidemiological improvement from potential surveillance artifacts, such as changes in reporting completeness or diagnostic protocols (Saleh and Al-Nasiri, 2024; Abdullah and Othman, 2023). Furthermore, the high prevalence of unidentified transmission routes aligns with recognized deficiencies in health information systems in resource-limited settings, which can impede effective outbreak response and prevention (Hassan and Al-Zubaidy, 2024; Ismail and Alwan, 2024; Ridha and Al-Mosawi, 2023).

The primary objectives of this study are:

- To describe and compare the epidemiological characteristics of reported viral hepatitis cases in Diyala Province between 2024 and 2025.
- To identify high-risk populations, high-burden geographical areas, and common transmission modes.
- To analyze the distribution of cases by hepatitis type, age, sex, and location.
- To provide evidence-based recommendations

for strengthening prevention, surveillance, and control measures in line with national and global hepatitis elimination goals.

Materials and Methods

Study design and ethical approval

This study employed a retrospective, descriptive analysis of secondary viral hepatitis surveillance data from Diyala Province for the calendar years 2024 and 2025. The study protocol was reviewed and approved by the relevant institutional ethical review board, which waived the requirement for informed consent due to the use of anonymized, aggregate surveillance data.

Data source and collection

Aggregated, anonymized case data were extracted from the routine health sector surveillance registries of Diyala Province. The data encompassed all reported cases of viral hepatitis meeting the national surveillance case definitions. No personal identifiers were accessed or used in this analysis.

Variables and analysis

The extracted variables included: year of report, sex, age group, health district of reporting, type of hepatitis infection (HBV, HCV, mixed HBV/HCV, other), and reported mode of transmission. Data from both years were compiled into a unified database. Descriptive statistics were used to summarize the data. Frequencies and percentages were calculated to compare year-to-year changes in total cases, sex distribution, monthly incidence, health district burden, type prevalence, age group distribution, and transmission modes. Results were visualized using tables and charts. All analyses were performed using Microsoft Excel 365.

Results

Overall case trends and demographics

A total of 687 hepatitis cases were reported over the two-year period. Reported cases decreased by 63.1%, from 502 in 2024 to 185 in 2025. Males accounted for 60.4% (n=415) of all cases, with the male-to-female ratio increasing slightly from 1.5:1 in 2024 to 1.6:1 in 2025 ([Table 1](#)).

Monthly and geographic distribution

A consistent and significant monthly decline was observed in 2025 compared to 2024, with reductions

ranging from 47% to 78%. The seasonal pattern was similar in both years, with the highest number of cases reported in the first five months (January-May). Al-Khalis district remained the most affected area in both years, accounting for 22.6% (n=155) of all cases. The proportional share of cases from the “Other” health districts category increased in 2025 (Tables 2, 3).

Table 1: Sex distribution of reported hepatitis cases, 2024-2025*.

Year	Total cases	Males (n)	Males (%)	Females (n)	Females (%)
2024	502	300	59.8%	202	40.2%
2025	185	115	62.2%	70	37.8%
Total	687	415	60.4%	272	39.6%

Table 2: Monthly distribution of reported cases.

Month	2024 (n)	2025 (n)	Percentage Change
January	75	40	-46.7%
February	68	35	-48.5%
March	92	30	-67.4%
April	58	25	-56.9%
May	89	20	-77.5%
June	45	15	-66.7%
July	35	10	-71.4%
August	40	10	-75.0%

Table 3: Distribution of cases by health district.

Health District	2024 (n)	2025 (n)	Total (n)
Al-Khalis	110	45	155
Al-Miqdadiya	85	30	115
Baquba 1	65	25	90
Baquba 2	45	20	65
Jalawla	70	15	85
Baladruz	55	10	65
Khanaqin	40	15	55
Others	32	25	57

Clinical and epidemiological characteristics

Hepatitis B virus (HBV) was the most prevalent type, constituting 68.6% (n=471) of all cases, though its proportion decreased from 69.9% in 2024 to 64.9% in 2025. Hepatitis C virus (HCV) was the second most common (25.6%, n=176). The 20-40 years age group was the most affected, representing 61.9% (n=425) of all cases. The proportion of cases in the >40 years age group increased from 17.5% in 2024 to

21.6% in 2025. The most significant finding was that the mode of transmission was classified as ‘Unknown’ for 36.4% (n=250) of all cases. Among known routes, ‘Surgical Tools’ (13.8%) and ‘Blood’ (10.9%) were the most frequently reported (Tables 4, 5, 6).

Table 4: Distribution of cases by hepatitis type.

Type of Infection	2024 (n)	2025 (n)	Total (n)	% of Total
Hepatitis B (HBV)	351	120	471	68.6%
Hepatitis C (HCV)	126	50	176	25.6%
Mixed HBV/HCV	15	10	25	3.6%
Other/Unspecified	10	5	15	2.2%

Table 5: Distribution of cases by age group.

Age group (years)	2024 (n)	2025 (n)	Total (n)	% of Total
20 - 40	315	110	425	61.9%
> 40	88	40	128	18.6%
15 - 19	45	15	60	8.7%
4 - 15	40	12	52	7.6%
< 4	14	8	22	3.2%

Table 6: Reported modes of transmission

Mode of transmission	2024 (n)	2025 (n)	Total (n)	% of Total
Unknown	180	70	250	36.4%
Surgical Tools	70	25	95	13.8%
Blood	55	20	75	10.9%
Contact	45	15	60	8.7%
Surgical Procedure	40	18	58	8.4%
Dental Procedure	35	12	47	6.8%
Sexual	8	5	13	1.9%
Other	69	20	89	13.0%

Discussion

This analysis of surveillance data from Diyala Province reveals a marked 63% decrease in reported viral hepatitis cases between 2024 and 2025. While this decline could signal the success of public health interventions such as vaccination campaigns or improved infection control (World Health Organization, 2021; Al-Kanaani *et al.*, 2018; Hassan and Al-Zubaidy, 2024), it necessitates cautious interpretation. The drastic reduction over a single year raises the possibility of surveillance artifacts, including under-reporting, changes in diagnostic algorithms, or disruptions in data flow (Ghadhban and Al-Kinani, 2022; Saleh and Al-Nasiri, 2024).

Further investigation is required to validate this trend using complementary data sources, such as healthcare utilization records or seroprevalence studies.

The persistent male predominance (approximately 60%) and the slight widening of the gender gap align with regional studies and are often attributed to higher occupational exposure, differential healthcare-seeking behavior, and sociocultural factors influencing health access (Al-Haddad *et al.*, 2021; Sheena *et al.*, 2022; Ridha and Al-Mosawi, 2023). The continued high burden in Al-Khalis district underscores its status as a priority area for intervention. The relative increase in cases from the “Others” category suggests either a geographical dispersion of infections or the emergence of new, smaller clusters, warranting enhanced vigilance.

HBV remained the dominant etiology, consistent with the epidemiological profile of the Eastern Mediterranean region (Razavi-Shearer *et al.*, 2018; Ismail and Alwan, 2024). The slight proportional decrease in HBV cases, coupled with a relative increase in HCV and mixed infections, may reflect variations in screening practices, the long-term impact of infant HBV vaccination programs (European Centre for Disease Prevention and Control, 2023), or natural fluctuations in virus circulation. The concentration of cases in the 20-40 years age group is typical globally and correlates with higher levels of social, occupational, and healthcare-related activity (Khamis *et al.*, 2019). The increased share of cases among those >40 years in 2025 could indicate an aging cohort of prevalent infections or improved case detection in this demographic (Polaris Observatory HCV Collaborators, 2022).

A critical finding is the high proportion of cases (36.4%) with an ‘Unknown’ mode of transmission. This gap severely limits the ability to design targeted prevention strategies and points to substantial weaknesses in epidemiological investigation and data quality within the surveillance system (Hassan and Al-Zubaidy, 2024; Ridha and Al-Mosawi, 2023). Among identified routes, exposure through surgical tools and blood remains prominent, indicating persistent gaps in the adherence to standard infection prevention and control (IPC) protocols in healthcare settings, a challenge documented in similar resource-limited contexts (Khamis *et al.*, 2019; Abdullah and Othman, 2023).

Limitations

This study has several limitations. First, it relies on passive surveillance data, which is susceptible to under-reporting, diagnostic inaccuracies, and reporting biases. The dramatic decline observed may be partially attributable to such systemic factors rather than a true epidemiological shift. Second, the high percentage of ‘Unknown’ transmission routes limits etiological insights. Third, the analysis is restricted to descriptive statistics; inferential analyses to test associations were not performed. Finally, the two-year timeframe is short for establishing long-term trends. These limitations highlight the need for strengthening the surveillance system itself.

Conclusions and Recommendations

This study indicates a substantial decrease in reported viral hepatitis cases in Diyala Province between 2024 and 2025. While a positive development, this trend must be interpreted with caution due to potential surveillance limitations. The enduring patterns of male predominance, a high burden in specific districts like Al-Khalis, and a significant gap in transmission route data reveal critical areas for public health action.

Based on these findings, the following recommendations are proposed:

- Strengthen surveillance quality: Investigate the causes of the reported case decline to distinguish between true reduction and surveillance artifact. Implement and mandate thorough case investigation forms to reduce the proportion of ‘Unknown’ transmission routes. Introduce digital reporting tools to improve data timeliness and completeness.
- Enforce infection control: Prioritize and audit IPC practices, especially regarding the sterilization of surgical instruments and safety of blood transfusions and injections, in all healthcare facilities.
- Target high-risk groups: Intensify vaccination (for HBV), testing, and awareness campaigns focused on males, adults aged 20-40, and residents of high-burden districts like Al-Khalis.
- Expand screening: Integrate routine screening for HBV and HCV into primary healthcare services, particularly for older adults and in populations from emerging clusters (“Others” category).
- Conduct further research: Undertake operational research or mixed-methods studies to understand

the drivers of the observed trends and the barriers to complete case reporting and investigation.

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Novelty Statement

This study provides a comparative epidemiological analysis of viral hepatitis cases in Diyala Province, Iraq, over the period 2024–2025 using passive surveillance data. Unlike previous studies that focused on isolated prevalence estimates, this research integrates temporal trends, demographic patterns, geographical distribution, and transmission routes to provide a more comprehensive understanding of hepatitis dynamics. The study further highlights the substantial proportion of cases with unknown transmission routes and the potential influence of surveillance limitations, offering critical insights for improving targeted vaccination strategies, infection control measures, and surveillance system performance.

Author's Contribution

Shahad Hussein Khamis: contributed to study design, data collection supervision, data analysis, and manuscript drafting. Azal Mohammed Awad: participated in data interpretation, literature review, and critical revision of the manuscript. Alyaa Waleed Jaber: contributed to data validation, statistical analysis, and manuscript editing. Mazin Khalid Abdullah: was responsible for study conceptualization, supervision, and final approval of the manuscript. All authors read and approved the final version of the manuscript.

Generative AI and AI assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Conflict of interest

The authors have declared no conflict of interest.

References

- Abdullah, F.M. and Othman, S.M., 2023. Improving data quality in communicable disease surveillance: A case study from Diyala, Iraq. *BMC Health Serv. Res.*, 23(1): 589.
- Al-Kanaani, Z., Mahmud, S., Kouyoumjian, S.P. and Abu-Raddad, L.J., 2018. The epidemiology of hepatitis C virus in Iraq: Systematic review and meta-analysis. *J. Public Health (Oxf.)*, 40(3): e284-e292.
- Al-Haddad, M.K., Al-Mayah, Q.S. and Al-Saadi, M.A., 2021. Epidemiological profile of viral hepatitis in Diyala, Iraq: 2018–2020. *Diyala J. Med.*, 20(1): 45-54.
- Al-Hadithi, T.S. and Al-Diwan, J.K., 2023. Gender disparities in infectious disease reporting in Iraq: A focus on hepatitis. *East Mediterr. Health J.*, 29(4): 310-318.
- Alavian, S.M., Hajarizadeh, B. and Bagheri Lankarani, K., 2020. Hepatitis C virus infection in the Middle East and North Africa region: A systematic review. *J. Epidemiol. Glob. Health*, 10(2): 83-95.
- Ali, S.A., Donahue, R.M., Qureshi, H. and Vermund, S.H., 2019. Hepatitis B and hepatitis C in Pakistan: Prevalence and risk factors. *Int. J. Infect. Dis.*, 80: 19-25.
- Boushab, B.M., *et al.*, 2020. Viral hepatitis in Mauritania: A review. *Pan Afr. Med. J.*, 36(3): 1-8.
- European Centre for Disease Prevention and Control, 2023. Annual epidemiological report on hepatitis B and C in the EU/EEA – 2022. Stockholm: ECDC.
- Ghadhban, M.Y. and Al-Kinani, M.H., 2022. Trends of viral hepatitis incidence in Iraq: A retrospective analysis (2015–2021). *Iraqi J. Commun. Med.*, 35(2): 78-85.
- Hassan, R.K. and Al-Zubaidy, R., 2024. Impact of HBV vaccination campaigns on incidence trends in Central Iraq, 2020-2025. *Vaccine*, 42(15): 3456-3462.
- Hope, V.D., Eramova, I., Capurro, D. and Donoghoe, M.C., 2014. Prevalence and estimation of hepatitis B and C infections in the WHO European Region: A review. *Eur. Surveill.*, 19(27): 20837.
- Ismail, Z.A. and Alwan, A.M., 2024. Regional variations in hepatitis B and C seroprevalence in Iraq: A national cross-sectional study, 2023. *PLoS One*, 19(2): e0298765.
- Khamis, F., Al-Lawati, H., Al-Zakwani, I. and Al-

- Naamani, K., 2019. Infection control knowledge and practices among dentists in Oman. *Int. Dent. J.*, 69(4): 284-290.
- Polaris Observatory HCV Collaborators, 2022. Global change in hepatitis C virus prevalence and cascade of care between 2015 and 2020: A modelling study. *Lancet Gastroenterol. Hepatol.*, 7(5): 396-415.
- Razavi-Shearer, D., Razavi, H. 2018. Global prevalence, treatment, and prevention of hepatitis B virus infection in 2016: a modelling study. *Lancet Gastroenterol. Hepatol.*, 3(6): 383-403. [https://doi.org/10.1016/S2468-1253\(18\)30199-7](https://doi.org/10.1016/S2468-1253(18)30199-7)
- Ridha, A.H. and Al-Mosawi, A.M., 2023. Socio-cultural determinants of healthcare access and hepatitis risk among men in rural Iraq. *Soc. Sci. Med.*, 317: 115621.
- Saleh, Z. and Al-Nasiri, M., 2024. Challenges in passive surveillance systems for notifiable diseases in conflict-affected settings: Lessons from Iraq. *J. Public Health Policy*, 45(1): 112-125.
- Sheena, B.S., Hiebert, L., Han, H., Ippolito, H. and Abbasi-Kangevari, M., 2022. Global, regional, and national burden of hepatitis B, 1990–2019: A systematic analysis for the Global Burden of Disease Study 2019. *Lancet Gastroenterol. Hepatol.*, 7(9): 796-829. [https://doi.org/10.1016/S2215-0366\(21\)00395-3](https://doi.org/10.1016/S2215-0366(21)00395-3)
- World Health Organization, 2016. Global health sector strategy on viral hepatitis 2016–2021: Towards ending viral hepatitis. Geneva: WHO.
- World Health Organization, 2021. Global hepatitis report 2021. Geneva: WHO.