

Review Article

Shifting Patterns of Hepatitis C Transmission in Duhok: The Emerging Role of Injection Drug Use and a Warning Signal for Iraq

Nawfal R Hussein¹, Halder J Abozait², Ahmed A Mosa¹

From, ¹Department of Biomedical sciences, College of Medicine, University of Zakho, Zakho independent administration, Kurdistan Region, Iraq, ²Department of Medicine, College of Medicine, University of Duhok, Duhok, Kurdistan Region, Iraq

ABSTRACT

Hepatitis C virus (HCV) remains a significant public health concern globally, especially in low- and middle-income countries such as Iraq. In Iraq, while blood transfusion has historically been the main route of HCV transmission, recent observations in Duhok City suggest a growing shift toward injection drug use (IDU) as an emerging and increasingly dominant risk factor. This shift marks a critical public health turning point, as newly diagnosed HCV cases are now frequently associated with a history of injecting drugs. The rise in IDU raises concerns due to its strong association with bloodborne infections, including HCV, HBV, and HIV, as well as various systemic barriers to care, such as legal restrictions, stigma, lack of harm reduction services, and centralized healthcare delivery. Despite these challenges, highly effective and affordable treatments for HCV exist, and studies show similar cure rates among people who inject drugs compared to the general population. To mitigate the emerging threat, the article calls for comprehensive, evidence-based interventions such as harm reduction services, decentralized HCV care, public education, and enhanced surveillance. Addressing IDU-linked HCV transmission now is essential to prevent a larger epidemic and align with WHO's 2030 elimination goals.

Key words: Hepatitis C, Transmission, Injection drug use, Duhok, Iraq

Viral hepatitis is a major global health challenge with 50 million people chronically infected with the hepatitis C virus (HCV) and 240,000 dying from it in 2022 [1]. The major causes of hepatitis C-related mortality are liver cirrhosis, end-stage liver disease (ESLD), and hepatocellular carcinoma (HCC) [2]. There is a significant shortage in the quantity and quality of papers on hepatitis C in Iraq. A number of studies have reported HCV seroprevalence rates ranging from 0.07% to 2.4% [3-7]. A nationwide screening survey documented the prevalence of HCV to be 0.4% in 2005-2006 but this is outdated, and current figures are likely to be different [8]. A number of factors might indicate an undocumented high burden of HCV in the region, including a poor-quality healthcare system, the displacement of refugees, and the effect of wars and conflicts in the region [9]. Worldwide, from 2015 to 2022, only 36% of people with hepatitis C had been diagnosed, and 20% had received treatment [1].

These numbers are far below the aspirations set by the World Health Organization (WHO) of eliminating viral hepatitis as a public health threat by diagnosing 90% and treating 80% of HCV cases by 2030 [1]. About 75% of the HCV

burden is in low- and middle-income countries such as Iraq [10]. Studying the primary factors driving viral transmission in these regions is important to develop targeted public health plans to reduce this burden thus, we aim to highlight the emergence of injection drug use (IDU) as a new risk factor for contracting HCV infection in Duhok City in Iraq.

Shifting HCV transmission dynamics

HCV is a bloodborne pathogen that can be transmitted by non-sterile injections, unscreened blood transfusions, unsafe medical practices, unprotected sexual intercourse, and vertical transmission from mother to child [11]. Interestingly, the major route of transmission varies among countries and changes over time [12]. In the past, the main route of HCV transmission was transfusion of contaminated blood and blood products [13]. Since the introduction of blood screening in the late 1980s, the risk of HCV infection from transfusion has significantly reduced and is negligible nowadays in high-income countries, but the consequences of chronic HCV infection from such transfusion continue to occur [14, 15]. The situation, however is different in low- and middle-income countries where blood transfusion remains one of the main risk factors of HCV infection due to poor screening practices [16].

Correspondence to: Dr Nawfal R Hussein, Department of Biomedical Sciences, College of Medicine, University of Zakho, Zakho International Road, Duhok, Kurdistan Region-Iraq.

Email: Nawfal.hussein@yahoo.com

©2025 Creative Commons Attribution-Non Commercial 4.0 International License (CC BY-NC-ND 4.0).

Access this article online

Received – 28th July 2025
Initial Review – 16th August 2025
Accepted – 18th August 2025

DOI: ***

Quick Response code



Currently, the main route of transmission in high-income countries is IDU using non-sterile needles [12]. Globally, 15.6 million people inject drugs, and 52.3% of them are infected with HCV [17]. Non-sterile injection of drugs is becoming a significant risk factor in developing countries, too [12]. Even in developed countries, there has been an emerging epidemic of HCV in rural areas among people who inject drugs [18]. The persistence of blood transfusion as a risk factor, a rise in IDU, and poor efforts of healthcare systems to eliminate HCV infection have resulted in 75% of HCV cases residing in low- and middle-income countries [10].

High-quality studies addressing the prevalence and risk factors of HCV in Iraq are scarce, with a number of studies reporting HCV rates ranging from 0.07% to 2.4% [3-7]. The rates are higher among leukemic patients (3.4%), patients who undergo regular dialysis (7.1%), and children with thalassemia (67.3%) [19-21]. Another study investigating patients who undergo hemodialysis found that 40.3% of patients had HCV seroconversion over the course of one year [22]. In both dialysis studies, a history of blood transfusion was associated with a higher risk of HCV infection [20, 22]. An outdated national household survey reported a 0.3% rate of illicit drug use in Iraq in 2014 (0.7% men, 0% women) [23]. A recent study of 300 HCV-infected individuals in Baghdad, Iraq, did not identify illicit drug use in any of them [24]. A retrospective study investigating 7900 blood donors from Duhok found that 16 were HCV-Ab positive (0.2%) and only one was positive by

RT-PCR (0.013%) [25]. Another study recruiting 37,200 pregnant women in Duhok from 2016 to 2019 found that 15 were HCV-Ab positive (0.04%) and only three were positive by RT-PCR (0.013%) (0.001%) [26]. A different study identified two cases of HCV (1%) among a sample of 200 patients with diabetes in Duhok in 2017 [27]. A recent study on a sample of 1013 prisoners in Duhok found that only one of them (0.1%) had HCV infection [28]. Table 1 summarizes the findings of these studies.

In contrast to these previous papers, where none of the HCV-infected individuals in Duhok used injection drugs, recent data from our center indicate a significant shift in transmission patterns. At the Azadi infectious disease and gastroenterology and hepatology center of Azadi Teaching Hospital, which is the sole referral and treatment facility for HCV in Duhok governorate (around 2 million population), 21 newly diagnosed cases were registered in the past 12 months (unpublished registry data). As the center maintains a mandatory registry for all confirmed cases, these figures represent the regional burden, with 11 cases (52.4%) linked to injection drug use and the remainder (47.6%) to blood transfusions. This is a concerning change and likely represents only the tip of the iceberg. Given the strong HCV registration system in Duhok, we believe similar trends may be occurring unnoticed across Iraq, highlighting the urgent need for nationwide surveillance and preventive strategies.

Table 1: Summary of studies reporting HCV prevalence and risk factors in Iraq

| Study | Study setting | Sample size | HCV sero-prevalence | Notable risk factors |
|-------------------------|-----------------------------------|-------------|---------------------|---|
| Al-Mussa et al. [3] | General population in Basrah | 162,137 | 2% | Rural residency, dental procedures, and hemodialysis |
| Alsamarai et al. [4] | Hospital records in Samara | 16,165 | 0.54% | Female gender |
| Al-Rubaye et al. [5] | Blood donors in Basrah | 69,915 | 0.1% | - |
| Naqid et al. [6] | Premarital screening in Zakho | 15,091 | 0.07% | Male gender, urban residency, and age (23-31 years) |
| Abid et al. [7] | Blood donors in Samara | 850 | 2.4% | Male gender, married status, blood transfusion, surgical procedures, and HIV positive spouse. |
| Tarky et al. [8] | National survey | 9,610 | 0.4% | - |
| Omer et al. [19] | Leukemic patients in Baghdad | 291 | 3.4% | Leukemia, and male gender |
| Khattab et al. [20] | Dialysis patients in Baghdad | 169 | 7.1% | Female gender, older age, and blood transfusion |
| Al-Kubaisy et al. [21] | Children with thalassemia | 559 | 67.3% | - |
| AL-Rubaie et al. [22] | Dialysis patents in Baghdad | 57 | 40.3% | Blood transfusion, and long duration of dialysis |
| Hasan et al. [24] | HCV-infected patients in Baghdad | 300 | 100% | Cupping, and blood transfusion |
| Hussein et al. [25] | Blood donors in Duhok | 7900 | 0.2% | Dental procedure |
| Hussein et al. [26] | Pregnant women in Duhok | 37,200 | 0.04% | - |
| Abdulkareem et al. [27] | Diabetic patients in Duhok | 200 | 1% | None |
| Abdulrahman et al. [28] | Prisoners in Duhok | 1,013 | 0.1% | Multiple sexual partners, and Tattooing |
| Current study | Newly diagnosed patients in Duhok | 21 | 100% | IDU (52.4%), and blood transfusion (47.6%) |

Impact of the emergence of IDU

Understanding the health risks of IDU allows for better implementation of public health interventions addressing the needs of such individuals. The emergence of IDU in Duhok City might be the tip of the iceberg signaling a growing and unaddressed problem across Iraq. In addition to the general risks associated with drug use, such as addiction, withdrawal, and overdosing, injection of such drugs is associated with the risk of transmitting blood-borne pathogens such as HCV, hepatitis B virus (HBV), human immunodeficiency virus (HIV), skin and soft tissue infections, bacterial endocarditis, and osteomyelitis [29, 30].

Each of these conditions is associated with a multitude of complications that can significantly reduce the quality of life of people who inject drugs. Many developing countries have experienced this phase where the emergence of IDU contributes to the healthcare burden due to transmission of associated diseases such as HCV [31]. A study of 47 HIV-infected patients with hemophilia in Iraq found that 66% of them were coinfecting with HCV [32]. A review of the literature reported that the number of HIV cases is increasing each year, with a total of 287 HIV cases confirmed from 2010 to 2019 [33]. After 2017, the WHO expected a rise in the number of HIV cases in Iraq, especially in the conflict affected-regions. The current number of cases is likely much higher and probably underreported due to stigma and under-testing [34].

Barriers to prevention and care for injection drug users in Duhok

A number of barriers prevent individuals who inject drugs from receiving the care they need. IDU is illegal in Iraq, with personal use carrying 3-15 years prison sentences [35]. Social stigma and fear of marginalization are a significant contributors to underusing healthcare services including HCV testing [36]. Lack of knowledge or ignorance of HCV is also an important factor, and some patients experience poor interactions with providers, which counteract educational efforts and contribute to the stigma felt by these individuals [37]. Systemic barriers are of particular importance as there are no harm reduction clinics in the region, and HCV care is generally provided by specialist and not integrated to the primary healthcare centers. The lack of decentralization of HCV care to primary centers and screening at front lines, combined with complex pathways of care needing multiple visits and referral, contributes to the poor uptake of treatment among this group of people [38, 39].

COVID-19 posed an additional challenge where there was a significant decrease in HCV services delivered to patients, including screening and treatment [40]. Regional conflicts and wars, such as the ISIS attack on Iraq, are associated with rising numbers of injection drug users and epidemics of HCV and HIV, such as the case of Afghanistan [41, 42]. These factors all work together and might be contributing to a significant increase in IDU and HCV infection in the region that is not

being investigated, and might result in serious consequences in the near future.

Treatment efficacy among injection drug users

There have been significant advances in the treatment of hepatitis C [43]. Current antivirals are very effective with HCV eradication rates of more than 98% [44]. While newer, more effective regimens might not be available in developing countries, simpler, more available antivirals such as sofosbuvir, simeprevir, and daclatasvir are comparably cheap and highly effective with a 94% rate of HCV cure [45]. The response rate, tolerability, and side effects of HCV therapy are similar in injection drug users compared to other people with hepatitis C [46]. Standard pathway of care is complex, inefficient and expensive. A simplified approach for Iraq is associated with higher detection, earlier treatment, fewer complications, and could save 4.375 trillion Iraqi dinars (USD 3.7 billion) [47]. Treatment of existing cases will also reduce the transmission of infection to non-infected individuals. Removing the transmission risk due to IDU could prevent 43% of all new HCV infections globally from 2018–2030 [31].

Recommendations

To address the growing threat of IDU as a driver of hepatitis C infection in Duhok specifically and Iraq more broadly, we recommend the following actions:

1. Implement harm reduction services: establish needle and syringe exchange programs to reduce HCV transmission through shared equipment and provide opioid substitution therapy such as methadone or buprenorphine to reduce injection frequency and improve treatment adherence.
2. Integrate HCV testing and treatment into primary care: decentralize HCV services by embedding screening and treatment in primary healthcare centers, allowing earlier and easier access for at-risk individuals. Train frontline healthcare workers in HCV diagnosis, stigma reduction, and addiction support.
3. Adopt a simplified HCV model of care: introduce a simplified testing and treatment algorithm tailored for low-resource settings, using readily available antiviral regimens. Streamline care pathways by testing and treating in the same day to minimize patient drop-out, reduce cost, and improve outcomes.
4. Address stigma and improve public awareness: launch public health campaigns to raise awareness of HCV transmission, symptoms, and treatment, particularly among youth and high-risk groups. Train healthcare providers to deliver non-judgmental, inclusive care to people who use drugs.
5. Strengthen surveillance and research: conduct updated, community-based prevalence studies on HCV and IDU in Duhok and other provinces to inform policy. Establish a national HCV and substance use registry to monitor trends and guide resource allocation.

Without targeted, evidence-based action, the emerging pattern of IDU in Duhok may escalate into a broader epidemic of HCV and other bloodborne infections in the region. Intervening now presents an opportunity to prevent long-term health and economic consequences and move closer to the WHO's 2030 elimination targets [1].

CONCLUSION

The emergence of IDU as a major risk factor for hepatitis C in Duhok City highlights a shifting public health concern in Iraq. Once a rare finding, HCV cases linked to drug injection are now increasingly common, pointing to a growing and largely unaddressed problem. Barriers such as legal penalties, stigma, lack of harm reduction services, and fragmented healthcare access further complicate the response. Despite these challenges, Iraq has a critical opportunity to act. Effective treatments, simplified care models, and harm reduction strategies are already available and can be adapted to local needs. Addressing this issue through integrated services, updated surveillance, and targeted interventions will be essential to prevent a broader epidemic and move toward HCV elimination by 2030.

REFERENCES

- WHO. Global hepatitis report 2024: action for access in low- and middle-income countries Geneva: World Health Organization; 2024 [Available from: <https://www.who.int/publications/i/item/9789240091672>.
- Ireland G, Mandal S, Hickman M, *et al.* Mortality rates among individuals diagnosed with hepatitis C virus (HCV); an observational cohort study, England, 2008 to 2016. *Eurosurveillance*. 2019; 24(30):1800695. <https://doi.org/10.2807/1560-7917.ES.2019.24.30.1800695>.
- Al-Mussa Z, Thamair H. The prevalence rate of hepatitis C virus in Basrah city and the common causative risk factors. *Iraqi National Journal of Medicine*. 2016; 1:59-65.
- Alsamarai AM, Abdulrazaq G, Alobaidi AH. Seroprevalence of Hepatitis C Virus in Iraqi Population. *JOJ Immuno Virology*. 2016; 1(3):555565. <https://doi.org/10.19080/JOJIV.2016.01.555565>.
- Al-Rubaye A, Tariq Z, Alrubaiy L. Prevalence of hepatitis B seromarkers and hepatitis C antibodies in blood donors in Basra, Iraq. *BMJ Open Gastroenterology*. 2016; 3(1):e000067. <https://doi.org/10.1136/bmjgast-2015-000067>.
- Naqid IA, Mahmood AJ, Mosa AA, *et al.* Hepatitis B and C virus infection among couples undergoing premarital screening in Iraqi Kurdistan. *IJID Regions*. 2025; 14:100492. <https://doi.org/10.1016/j.ijregi.2024.100492>.
- Abid A-M, Athraa A-J. The Prevalence of Hepatitis C Virus Among Blood Donors Attending Samarra's General Hospital. *Infectious Disorders - Drug Targets*. 2020; 20(5):693-7. <https://doi.org/10.2174/1871526519666190916101509>.
- Tarky AM, Akram WA, Al-Naaimi AS, *et al.* Epidemiology of viral hepatitis B and C in Iraq: a national survey 2005-2006. *Zanco J Med Sci*. 2023; 17(1):370-80. <https://doi.org/10.15218/zjms.2013.0017>.
- Walker JG, Kuchuloria T, Sergeenko D, *et al.* Interim effect evaluation of the hepatitis C elimination programme in Georgia: a modelling study. *The Lancet Global Health*. 2020; 8(2):e244-e53. [https://doi.org/10.1016/S2214-109X\(19\)30483-8](https://doi.org/10.1016/S2214-109X(19)30483-8).
- Furl R, Scarsi KK, Sayles H, *et al.* Preferences and Feasibility of Long-Acting Technologies for the Treatment of Hepatitis C Virus: A Survey of Patients in Diverse Low- and Middle-Income Countries. *Journal of Viral Hepatitis*. 2025; 32(4):e14031. <https://doi.org/10.1111/jvh.14031>.
- Moosavy SH, Davoodian P, Nazarnezhad MA, *et al.* Epidemiology, transmission, diagnosis, and outcome of Hepatitis C virus infection. *Electronic physician*. 2017; 9(10):5646-56. <https://doi.org/10.19082/5646>.
- Stroffolini T, Stroffolini G. Prevalence and Modes of Transmission of Hepatitis C Virus Infection: A Historical Worldwide Review. *Viruses*. 2024; 16(7). <https://doi.org/10.3390/v16071115>.
- Alter H, Holland P, Purcell R, *et al.* Transmissible agent in non-A, non-B hepatitis. *The Lancet*. 1978; 311(8062):459-63. [https://doi.org/10.1016/S0140-6736\(78\)90131-9](https://doi.org/10.1016/S0140-6736(78)90131-9).
- Shepard CW, Finelli L, Alter MJ. Global epidemiology of hepatitis C virus infection. *The Lancet Infectious Diseases*. 2005; 5(9):558-67. [https://doi.org/10.1016/S1473-3099\(05\)70216-4](https://doi.org/10.1016/S1473-3099(05)70216-4).
- Prati D. Transmission of viral hepatitis by blood and blood derivatives: current risks, past heritage. *Digestive and Liver Disease*. 2022; 34(11):812-7. [https://doi.org/10.1016/S1590-8658\(02\)80076-7](https://doi.org/10.1016/S1590-8658(02)80076-7).
- Khalsa JH, Mathur P. Hepatitis C Virus Infection in Persons Who Inject Drugs in the Middle East and North Africa: Intervention Strategies. *Viruses*. 2021; 13(7). <https://doi.org/10.3390/v13071363>.
- Degenhardt L, Peacock A, Colledge S, *et al.* Global prevalence of injecting drug use and sociodemographic characteristics and prevalence of HIV, HBV, and HCV in people who inject drugs: a multistage systematic review. *The Lancet Global Health*. 2017; 5(12):e1192-e207. [https://doi.org/10.1016/S2214-109X\(17\)30375-3](https://doi.org/10.1016/S2214-109X(17)30375-3).
- Suryaprasad AG, White JZ, Xu F, *et al.* Emerging Epidemic of Hepatitis C Virus Infections Among Young Nonurban Persons Who Inject Drugs in the United States, 2006–2012. *Clinical Infectious Diseases*. 2014; 59(10):1411-9. <https://doi.org/10.1093/cid/ciu643>.
- Omer AR, Salih JI, Al-Nakshabandi AA. Frequency of blood-borne viral infections among leukemic patients in central Iraq. *Saudi medical journal*. 2011; 32(1):55-61.
- Khattab OS. Prevalence and risk factors for hepatitis C virus infection in hemodialysis patients in an Iraqi renal transplant center. *Saudi journal of kidney diseases and transplantation : an official publication of the Saudi Center for Organ Transplantation, Saudi Arabia*. 2008; 19(1):110-5.
- Al-Kubaisy WA, Al-Naib KT, Habib M. Seroprevalence of hepatitis C virus specific antibodies among Iraqi children with thalassaemia. *Eastern Mediterranean health journal*. 2006; 12(1-2):204-10.
- Al-Rubaie HM, Malik AS. Seroconversion Rate Of Hepatitis C Virus Infection Among Haemodialysis Patients In Al-Kadhimiya Teaching Hospital (Dialysis Unit). *Iraqi Journal of Medical Sciences*. 2016; 9(4).
- Al-Hemiery N, Dabbagh R, Hashim MT, *et al.* (2017) Self-reported substance use in Iraq: findings from the Iraqi National Household Survey of Alcohol and Drug Use, 2014. *Addiction* 112(8):1470-9. <https://doi.org/10.1111/add.13800>.
- Hasan NA, Al-Hemiary N. Patterns and sociodemographic characteristics of substance abuse among hepatitis C virus-infected patients in Iraq: a cross-sectional study. *The Egyptian Journal of Neurology, Psychiatry and Neurosurgery*. 2024; 60(1):94. <https://doi.org/10.1186/s41983-024-00868-y>.
- Hussein NR, Haj SM, Almizori LA, *et al.* The Prevalence of Hepatitis B and C Viruses Among Blood Donors Attending Blood Bank in Duhok, Kurdistan Region, Iraq. *Int J Infect*. 2016; 4(1). <https://doi.org/10.17795/iji-39008>.
- Hussein NR, Sharaf HA, Mahdi S. The Prevalence of Hepatitis C Virus Infection in Pregnant Women in Duhok City, Kurdistan Region of Iraq: A Brief Report. *Women's Health Bulletin*. 2019; 6(2):1-3.
- Abdulkareem YR, Shaikho SK. Seroprevalence of Hepatitis B and C Viruses among Diabetes Mellitus Patients in Duhok Province.

- Medical Journal of Babylon, 2021; 18(3). https://doi.org/10.4103/MJBL.MJBL_16_21.
28. Abdulrahman M, Shahab F, Khaleel BM, *et al.* Viral Hepatitis B and C Prevalence and Related Risk Factors Among Prisons in Duhok City, Kurdistan Region, Iraq. *Cureus*. 2024; 16(11):e73153. <https://doi.org/10.7759/cureus.73153>.
 29. Marks LR, Nolan NS, Liang SY, *et al.* Infectious Complications of Injection Drug Use. *Medical Clinics of North America*. 2022; 106(1):187-200. <https://doi.org/10.1016/j.mena.2021.08.006>.
 30. Degenhardt L, Webb P, Colledge-Frisby S, *et al.* Epidemiology of injecting drug use, prevalence of injecting-related harm, and exposure to behavioural and environmental risks among people who inject drugs: a systematic review. *The Lancet Global Health*. 2023; 11(5):e659-e72. [https://doi.org/10.1016/S2214-109X\(23\)00057-8](https://doi.org/10.1016/S2214-109X(23)00057-8).
 31. Trickey A, Fraser H, Lim AG, *et al.* The contribution of injection drug use to hepatitis C virus transmission globally, regionally, and at country level: a modelling study. *The Lancet Gastroenterology & Hepatology*. 2019; 4(6):435-44. [https://doi.org/10.1016/S2468-1253\(19\)30085-8](https://doi.org/10.1016/S2468-1253(19)30085-8).
 32. Al-Kubaisy WA, Al-Naib KT, Habib MA. Prevalence of HCV/HIV co-infection among haemophilia patients in Baghdad. *Eastern Mediterranean health journal*. 2022; 12(3-4):264-9.
 33. Jalil Ibrahim Saleh HN, Nawar Sahib Khalil. HIV/AIDS Status in Baghdad/ Iraq Over Ten Years (2010-2019). *Indian Journal of Forensic Medicine & Toxicology*. 2020; 15(1):2253-9. <https://doi.org/10.37506/ijfmt.v15i1.13738>.
 34. WHO. Communicable diseases surveillance and outbreak response: World Health Organization; 2017 [Available from: <https://www.emro.who.int/iraq/priority-areas/communicable-diseases-surveillance-and-outbreak-response.html>].
 35. 2014 International Narcotics Control Strategy Report (INCSR): U.S. Department of State; [Available from: <https://2009-2017.state.gov/j/inl/rls/nrcrpt/2014/index.htm>].
 36. Anwar I, Donadille C, Protopopescu C, *et al.* Non-disclosure of drug injection practices as a barrier to HCV testing: results from the PrebupIV community-based research study. *Harm Reduction Journal*. 2020; 20(1):98. <https://doi.org/10.1186/s12954-023-00841-7>.
 37. Roser P, Brunstein M, Specka M, *et al.* Knowledge of, and attitude towards, the treatment of hepatitis C in people who inject drugs. *Harm Reduction Journal*. 2024; 21(1):160. <https://doi.org/10.1186/s12954-024-01068-w>.
 38. Yela E, Solé N, Puig L, *et al.* Barriers to access to hepatitis C treatment with direct-acting antivirals in people who inject drugs in the community setting. *Harm Reduction Journal*. 2024; 21(1):88. <https://doi.org/10.1186/s12954-024-01009-7>.
 39. Biondi MJ, Feld JJ. Hepatitis C models of care: approaches to elimination. *Canadian Liver Journal*. 2019; 3(2):165-76. <https://doi.org/10.3138/canlivj.2019-0002>.
 40. Hussein NR, Daniel S, Mirkhan SA, *et al.* Impact of the Covid-19 pandemic on the elimination of hepatitis C virus in Duhok, Kurdistan, Iraq: A retrospective cross-sectional study. *Journal of Family Medicine and Primary Care* 2020; 9(12). https://doi.org/10.4103/jfmpe.jfmpe_1675_20.
 41. Todd CS, Abed AMS, Strathdee SA, *et al.* HIV, Hepatitis C, and Hepatitis B Infections and Associated Risk Behavior in Injection Drug Users, Kabul, Afghanistan. *Emerging Infectious Disease journal*. 2007; 13(9):1327. <https://doi.org/10.3201/eid1309.070036>.
 42. Todd CS, Nasir A, Stanekzai MR, *et al.* Hepatitis C and HIV incidence and harm reduction program use in a conflict setting: an observational cohort of injecting drug users in Kabul, Afghanistan. *Harm Reduction Journal*. 2015; 12(1):22. <https://doi.org/10.1186/s12954-015-0056-z>.
 43. Nawaz A, Manzoor A, Ahmed S, *et al.* Therapeutic approaches for chronic hepatitis C: a concise review. *Frontiers in Pharmacology*. 2023; 14
 44. Manns MP, Maasoumy B. Breakthroughs in hepatitis C research: from discovery to cure. *Nature Reviews Gastroenterology & Hepatology*. 2022; 19(8):533-50. <https://doi.org/10.1038/s41575-022-00608-8>.
 45. Gomaa A, Gomaa M, Allam N, *et al.* Hepatitis C Elimination in Egypt: Story of Success. *Pathogens*. 2024; 13(8). <https://doi.org/10.3390/pathogens13080681>.
 46. Grassi A, Ballardini G. Hepatitis C in injection drug users: It is time to treat. *World journal of gastroenterology*. 2017; 23(20):3569-71. <https://doi.org/10.3748/wjg.v23.i20.3569>.
 47. Asker B, Jawad R, Asreah R, *et al.* Cost Effectiveness of Screening for Hepatitis C Virus in Iraq in the Era of Simplified Testing and Treatment. *PharmacoEconomics*. 2021; 39(11):1327-41. <https://doi.org/10.1007/s40273-021-01064-z>.

Funding: Nil; Conflicts of Interest: None Stated.

How to cite this article: Nawfal R Hussein, Halder J Abozait, Ahmed A Mosa. Shifting Patterns of Hepatitis C Transmission in Duhok: The Emerging Role of Injection Drug Use and a Warning Signal for Iraq. *Eastern J Med Sci*. 2025: Epub ahead of print.