Chapter

Elimination of Hepatitis C in Turkey

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Abstract

This manuscript examines the epidemiological patterns, transmission routes, and genotypic distribution of hepatitis C virus (HCV) in Türkiye, highlighting national progress toward elimination targets set by the World Health Organization (WHO). The main objective is to evaluate the effectiveness of national screening, diagnostic, and treatment strategies, with a focus on the scale-up of direct-acting antiviral (DAA) therapies and their associated cost-effectiveness. Drawing on recent multicenter and population-based studies, the paper outlines the shifting prevalence of HCV genotypes, particularly among high-risk populations such as people who inject drugs (PWID), prisoners, and individuals undergoing hemodialysis. The analysis demonstrates that genotype 1b remains predominant, though genotype diversity is increasing due to migration and changing transmission dynamics. Findings reveal that despite improved availability of DAA treatments and health policy initiatives like the 2018–2023 National Viral Hepatitis Program, gaps persist in diagnostic follow-up and referral. The manuscript emphasizes the dual approach of micro- and macro-elimination, advocating for integrated care models, increased physician engagement, and enhanced awareness efforts. Projections suggest that achieving WHO goals is feasible in Türkiye if testing and treatment rates significantly improve. Ultimately, this study underscores the necessity of sustained political commitment, intersectoral collaboration, and targeted public-health interventions to reduce HCV-related morbidity and mortality by 2030.

Keywords: hepatitis C virus, genotypes, direct-acting antiviral drugs, cost-effectiveness analyses, Turkey

1. Introduction

Hepatitis C virus is a single-stranded RNA virus with 9600 bases in length. The genome encodes a polyprotein of approximately 3000 amino acid residues, which are processed post-translationally by host and viral proteases into ten structural and non-structural proteins. The latter encodes several enzymes that are required for protein processing and replication. HCV genome is needed for viral replication [1].

Chronic HCV infection remains a pressing public health concern in the United States, with an estimated 2.4 million individuals chronically infected. The disease imposes a considerable clinical and economic burden, necessitating prompt and effective responses. The introduction of DAAs has significantly transformed HCV

management, offering cure rates exceeding 95%, along with shorter, less toxic treatment regimens. Nevertheless, challenges such as high medication costs, limited insurance coverage, and health inequities hinder universal access to treatment. Many infections remain undiagnosed due to the asymptomatic nature of early HCV stages. Although the Centers for Disease Control and Prevention (CDC) recommends universal screening for adults and pregnant individuals, gaps in implementation persist. High-risk populations —including PWID, incarcerated individuals, and the uninsured—face persistent barriers to diagnosis and care. Reinfection among PWID highlights the need for comprehensive harm reduction, including needle exchange and opioid substitution programs. Achieving HCV elimination will require integrated, equity-driven strategies that expand screening, embed care within primary and correctional health services, and foster community engagement. Policy changes to reduce costs and improve access, combined with increased public funding and stakeholder collaboration, are critical to reducing national HCV prevalence and advancing toward eventual eradication [2].

Chronic HCV (cHCV) infection may remain clinically silent for decades before progressing to severe liver diseases, including cirrhosis and hepatocellular carcinoma (HCC). WHO reports estimate 80 (64–103) million global infections, with 80% undiagnosed and 93% untreated, largely due to asymptomatic presentation. Annually, HCV-related complications cause over 400,000 deaths worldwide [3–5].

Recent analyses suggest that the hepatitis C virus infects in excess of 3 million children worldwide. Contemporary antiviral regimens now attain sustained virological response rates above 95% in both pediatric and adult populations, bolstering confidence that the WHO's target of eliminating HCV by 2030 is realistically achievable [6].

Phylogenetic analyses have delineated the hepatitis C virus into seven primary genotypes encompassing 67 subtypes, with genotypes 1 and 3 collectively responsible for roughly one-third of all infections [5].

Globally, genotype 1 (GT1) was the most common (46%), followed by GT3 (22%), GT2 (13%), and GT4 (13%) [7]. Magri et al.'s meta-analysis of 23 investigations involving 11,419 Latin American PWID identified an HCV prevalence of 57%, while the United Nations Office on Drugs and Crime estimates a comparable global prevalence of roughly 50.2% among PWID [8]. Genotypes were searched in 720 patients, who were intravenous drug users with chronic HCV infection, and it was found that GT1a and GT3a were more common in the intravenous drug users (IVDUs) group [9]. A prospective multicenter study of 197 injection-drug users found GT3 most prevalent (44.1%), followed by GT1a (41.9%), 2 (5.1%), GT4, and GT1b (each 4.4%) [10].

A total of 412 HCV-RNA-positive patients were investigated for the distribution of HCV genotypes in the İstanbul University Medical School between 2013 and 2016. GT1 (82.5%) was the dominant genotype, followed by GT3 (10.7%), GT2 (4.6%), and GT4 (2.2%) [11]. A retrospective review of 558 patients treated at a single center in western Türkiye between 2005 and 2016 showed a marked predominance of GT1 (88.4%), with GT3 (5.2%), GT4 (2.9%), GT2 (2.1%), mixed infections (1.1%) and 5 (0.3%) occurring only sporadically [12]. An investigation conducted in Istanbul among 106 chronically HCV-infected patients revealed GT1b in 67% and GT3 in 16% of cases, respectively [13].

In a cohort of 385 Turkish patients with chronic hepatitis C, GT1—predominantly subtype 1b—represented 81.3% of infections, while GT2, 3, 4, and GT5 appeared only infrequently, a distribution consistent with prior reports [14].

According to data from 2013, the diagnosis rate in our country was below 20%, while the treatment rate remained under 1%. Seroprevalence study in the Turkish general population (n = 5460 persons), regarding hepatitis B virus (HBV) and HCV

infection, demonstrated that the prevalence of HBV and HCV was 4 and 1%, respectively [15]. HCV prevalence in Turkish pregnant women ranges from 0.2 to 2%. A 2018–2022 study (n = 259,875) found 0.5% seropositivity, 0.1% viremia; GT1 dominated in Turks, GT4 in foreigners ($p < 0.001$) [16].

Between 2014 and 2017, 152,596 individuals were screened for HCV at the Samsun Regional Training and Research Hospital. Anti-HCV positivity was 2.76%, with active infection at 2.05%, peaking in 2017 (3.64%). Genotype 1 predominated (89.86%), followed by GT3 (4.54%). Foreign nationals comprised 5.61% of seropositives and 1.37% of active infections [17].

There are several factors that influenced the changing of genotypes of HCV infection such as immigration, heavy tourist circulation, and commercial activity in the east, west, and southeast areas of Türkiye.

2. Transmission

HCV is transmitted through diverse mechanisms, notably transfusion of infected blood or blood products, intravenous drug injection, surgical or other invasive interventions, and body-modification practices such as piercing, tattooing, and circumcision.

In a cohort of 155 inpatients at the Addiction Center, anti-HCV serology and clinical profiles were examined according to opioid-specific versus polysubstance use disorders. Opioid use disorder was confirmed in 40% of participants, whereas 57.4% fulfilled criteria for polysubstance dependence. Anti-HCV-positive individuals displayed markedly greater frequencies of polysubstance use, injection-related practices (syringe use and sharing), self-inflicted injury, and body-modification procedures (tattooing/piercing) ($p = 0.02$, $p < 0.001$, $p < 0.001$, $p = 0.02$, and $p = 0.03$, respectively) [18].

A prospective survey at Izmir's Alcohol and Substance Abuse Treatment and Education Center (ASATEC) screened 478 outpatients—112 alcohol-dependent (23.4%), 322 substance-dependent (67.4%), and 44 with dual dependence (9.2%)—for HBV, HCV, and human immunodeficiency virus (HIV), noting injection-drug use in 16.5% and needle sharing in 9.8%. Anti-HCV antibodies were present in 9.6% of participants, with intravenous drug use, sharing of injection equipment, and ecstasy consumption independently associated with seropositivity [19].

The prevalence of anti-HCV positivity was found 0.7% in 448 patients who have received chemotherapy. This prevalence rate is similar to normal population's rate due to control of the blood samples before transfusion [20].

HCV prevalence in blood donors, who applied to Dicle University, Diyarbakır in between 2011 and 2015 years were found as follows: 0.35% in 2011, 0.34% in 2012, 0.29% in 2013, 0.23% in 2014 and 0.16% in 2015 ($p < 0.001$) [21].

Sexual transmission and, rarely, mother-to-child transmission are also among other modes of transmission.

3. Diagnosis

Accurate diagnosis of HCV infection is a critical step in the cascade of care and is foundational to achieving elimination goals. Diagnostic strategies have evolved significantly with advances in serological and molecular testing. The initial screening typically involves the detection of anti-HCV antibodies, followed by confirmatory testing using nucleic-acid amplification techniques (NAATs) to detect HCV-RNA and

establish active infection. These methods not only confirm ongoing viral replication but also guide subsequent clinical decision-making. Importantly, genotype determination, although less central in the era of pangenotypic therapies, remains relevant in regions where genotype-specific treatment regimens persist. Novel diagnostic algorithms increasingly emphasize streamlined, reflex testing approaches to reduce loss to follow-up and improve linkage to care. This section outlines the recommended diagnostic workflow, with particular attention to risk-based screening protocols and barriers to implementation within the Turkish healthcare context.

Assessment of suspected HCV relies on biochemical indicators of hepatocellular injury (alanine and aspartate aminotransferases (AST and ALT)), hepatic synthetic capacity (total bilirubin, serum albumin, prothrombin time, platelet count), and virological confirmation via anti-HCV antibody detection followed by HCV-RNA testing. To improve case finding, the joint American Association for the Study of Liver Diseases/the Infectious Diseases Society of America (AASLD/IDSA) guidelines recommend systematic screening of clearly defined high-risk populations [22].

A survey encompassing data from 100 countries determined that, in 2015, the global prevalence of active (viremic) HCV infection stood at roughly 1.0% (95% uncertainty interval 0.8–1.1%), representing an estimated 71.1 million (62.5–79.4 million) individuals with circulating HCV-RNA. Genotypic distribution showed a predominance of GT1 (44%) and GT3 (25%) among these infections [23].

A 2019 analysis encompassing 29 of the 30 the European Union (EU)/European Economic Area (EEA) member states placed the pooled prevalence of cHCV infection at 0.50%. Although overall levels were low, the heaviest disease burden lay in the eastern sub-region, and injection-drug use remained the dominant driver, accounting for approximately one-third of existing cases (35.76%, 95% credible interval (CrI): 33.07–38.60%), highlighting the disproportionate impact of people who inject drugs on the residual epidemic [24].

Of 1000 individuals with anti-HCV seropositivity presenting to Dicle University (Diyarbakır), 78.5% underwent confirmatory HCV-RNA testing, and 54.8% were found viraemic. Among those with detectable RNA, 72.8% commenced direct-acting antiviral therapy within a median of 91 days (range 42–178.5), reflecting significantly faster and broader treatment uptake than that reported in comparable teaching and research hospitals ($p < 0.001$) [25].

Kaya S. documented a marked reduction in hepatitis C virus prevalence among hemodialysis recipients, falling from 31.4 to 51% in 2008 to 7.5% among the 55,890 patients undergoing dialysis in 2014 [26, 27].

Among 360 incarcerated individuals, HCV prevalence was 0.5%, whereas anti-HCV seropositivity occurred in just 0.06% of the 9709 pregnant women screened in Erzurum, eastern Türkiye [28].

Hepatitis C virus is transmitted with marked efficiency through shared injecting paraphernalia, as reflected by the 51.9% infection rate documented among 4694 individuals who inject drugs illicitly [29].

4. Screening recommendations from the AASLD/IDSA and the CDC*

4.1 General recommendations

- One-time, routine, opt-out HCV testing is recommended for all persons aged 18 years or older [22].

- One-time screening for persons younger than 18 years should be performed in the setting of behaviors, exposures, and conditions associated with increased risk for HCV infection.
- One-time screening of pregnant women is recommended unless risk factors indicate additional testing.
- Annual HCV testing is recommended for PWID and for HIV-seropositive men who have unprotected sex with men. Periodic testing should be offered to other persons with ongoing risk factors for exposure to HCV.

4.2 Risk-defining behaviors

- Injection of psychoactive substances at any point in life, even a single episode.
- Non-medical intranasal administration of illicit drugs.

4.3 Risk-defining exposures

- Previous or ongoing long-term hemodialysis.
- Percutaneous or parenteral contact with blood in unregulated settings.
- Occupational needle-stick, sharps injury, or mucosal contact with blood from an HCV-positive. Source among healthcare, emergency-response, and public-safety personnel.
- Birth to a mother infected with HCV.
- Receipt of blood products or solid-organ transplants in persons who:

  were later notified that the donor had HCV infection,

  underwent transfusion or transplantation before July 1992,

  received clotting-factor concentrates manufactured before 1987, or

  experienced incarceration at any time.

4.4 Other populations that should be screened

Persons with HIV infection, persons planning to initiate preexposure prophylaxis for HIV.

People with unexplained chronic liver disease and chronic hepatitis, including elevated ALT levels.

Solid-organ donors (deceased and living).

*Adapted from section on testing and linkage to care at http://hcvguidelines.org.

Limited awareness within the healthcare system means that individuals who screen anti-HCV positive often neither receive confirmatory HCV-RNA testing nor are referred to a specialist or tertiary care. This treatment gap poses a major obstacle to the successful elimination of HCV [30].

Diagnosis and treatment rates vary significantly between countries. A hospital-based investigation at Bülent Ecevit University in Zonguldak screened 63,963 individuals for anti-HCV antibodies, revealing a 2.0% seropositivity rate. Confirmatory nucleic-acid testing was undertaken for 647 of these antibody-positive patients (48.8%), with active viremia detected in 212 cases (32.7%). Notably, only 66 viremic patients (29.7%) received antiviral therapy, highlighting a substantial diagnostic-to-treatment gap that must be bridged to advance HCV elimination [31].

Current guidelines stipulate that persons with a positive anti-HCV screen should immediately undergo confirmatory HCV-RNA testing and, if viraemia is detected, be directed to genotype assessment or specialist evaluation for antiviral management.

Yehia B.R. et al. conducted a systematic review that screened 9581 records, assessed 117 full texts, and distilled the evidence to 10 eligible studies, yielding an estimated 3.5 million individuals with chronic HCV in the United States. Within this cohort, only half had been diagnosed, and successive steps of the care cascade dwindled to 43% accessing outpatient care, 27% receiving RNA confirmation, 16% initiating therapy, and a mere 9% achieving sustained virological response [32].

5. Treatment

An effective prophylactic vaccine for hepatitis C virus has yet to be developed; however, the introduction of direct-acting antivirals (DAAs) in 2013 transformed therapeutic prospects. These agents now enable virological eradication in most treated individuals. Evidence shows that a low baseline viral load and preserved renal function independently predict a rapid virological response—undetectable HCV-RNA within 4 weeks of therapy—in chronic infection [33].

All DAAs were approved in Türkiye after 2016, and sustained virological response exceeded 95% in many studies [34–39]. Under the general health insurance scheme, DAA therapy is dispensed to eligible citizens without out-of-pocket expense. These regimens reliably secure sustained virological response, enhance hepatic function, and substantially lessen progression to cirrhosis, related complications, and hepatocellular carcinoma. Persisting high-risk practices—particularly ongoing substance use—can facilitate reinfection, highlighting the need for structured patient education and sustained behavior-modification support.

The term *"macro-elimination"* of HCV infection refers to achieving significant, large-scale reductions in the prevalence and transmission of HCV within an entire country or region. It is a public-health milestone, signifying that a country has made substantial progress in controlling the disease, though it may not imply complete eradication. There are several key characteristics of macro-elimination:

a. *Reduction in prevalence* – a major decrease in the number of people infected with HCV within the population, often measured by national surveys or health system data.

b. *Widespread treatment access* – ensuring that the majority of those diagnosed with HCV are treated with highly effective antiviral therapies, such as DAAs, which can cure the infection in most cases.

c. *Prevention measures* – implementation of harm-reduction strategies to prevent new infections, such as:

Needle exchange programs.

Safe blood transfusion practices.

Education about transmission risks.

Vaccination for hepatitis A and B (to reduce co-infections).

Screening and Early Diagnosis.

Scaling up screening efforts to identify HCV infections early, especially in high-risk populations, and linking them to care.

d. *Impact on public health* – reduced mortality and morbidity associated with HCV-related complications, such as liver cirrhosis and hepatocellular carcinoma.

5.1 Difference between micro- and macro-elimination

Micro-Elimination focuses on specific groups (people who inject drugs, incarcerated individuals, or certain geographic areas) as a step toward broader elimination goals. Macro-Elimination encompasses the entire country or region and reflects national-scale achievements.

5.2 Challenges in achieving macro-elimination

- Insufficient funding for health programs.
- Limited access to diagnostic and treatment resources.
- Stigma and lack of awareness about HCV.
- Barriers in reaching high-risk and underserved populations.

In summary, macro-elimination of HCV in a country reflects a substantial and measurable reduction in the disease's public health burden, signifying progress toward the goal of global HCV elimination, as outlined by the WHO.

Micro-elimination approach focuses on targeting specific populations or geographic areas with high hepatitis C burden and applying tailored strategies to eliminate the virus at a smaller scale, often within communities or regions. Micro-elimination for HCV has some advantages compared to total eradication strategies, such as:

1. *Targeting high-risk groups*: Identifying populations at higher risk of HCV infection, such as PWID, prisoners, or individuals with a history of blood transfusions, or immunosuppressed patients.

2. *Screening and diagnosis*: Early detection and diagnosing individuals within targeted groups was mentioned in **Table 1** to improve treatment outcomes and reduce transmission.

a. Base 2017 scenario						
	2015	2016	2017 and 2018	2018	2019	≥2020
Treated	4200	5600	10,200	9500	8800	5600
Newly diagnosed	5500	5500	5500	5500	5500	5500
Fibrosis stage	≥F0	≥F3	≥F1	≥F1	≥F1	≥F1
Treated age	15–79	15–79	15–79	15–79	15–79	15–79
SVR	49%	97%	99%	99%	99%	99%
b. Increased treatment scenario						
	2015	2016	2017 & 2018	2019	2020–2024	≥2025
Treated	4200	5600	10,200	11,000	11,000	11,000
Newly diagnosed	5500	5500	5500	5500	5500	5500
Fibrosis stage	≥F0	≥F3	≥F1	≥F0	≥F0	≥F0
Treated age	15–79	15–79	15–79	15–79	15–79	15–79
SVR	49%	97%	99%	99%	99%	99%
c. WHO targets scenario						
	2015	2016	2017 & 2018	2019	2021–2024	≥2025
Treated	4200	5600	10,200	15,000	16,000	16,000
Newly diagnosed	5500	5500	5500	6000	18,000	18,000
Fibrosis stage	≥F0	≥F3	≥F1	≥F1	≥F0	≥F0
Treated age	15–79	15–79	15–79	15–79	15–79	15–79
SVR	49%	97%	99%	99%	99%	99%

Table 1.
Estimations used to model the burden of HCV in Türkiye [40].

3. *Access to treatment*: Ensuring accessibility to DAAs, which offer highly effective treatment for HCV.

4. *Collaboration*: Engaging with stakeholders, including healthcare providers, policymakers, and community leaders, to create a coordinated effort in eliminating HCV.

5. *Sustainability and monitoring*: Implementing strategies that are sustainable over time, with regular monitoring to assess progress and adapt the approach as needed.

6. *Public-health initiatives*: Raising awareness, reducing stigma, and integrating HCV elimination into broader health strategies are fundamental to success.

7. *Tailored national plans*: Effective micro-elimination demands that national programs be tailored to the distinct epidemiological profiles, economic capacities, and sociocultural contexts of individual countries. Realizing the WHO target of removing HCV as a public-health threat by 2030 will therefore depend on coordinated engagement among policymakers, healthcare professionals, and

the wider community. Sustained financial commitment, methodical innovation, and an explicit emphasis on equity are essential to ensure that at-risk populations are fully served. The strategies proposed here outline a feasible pathway toward European HCV elimination and issue a compelling call for unified action in pursuit of a hepatitis-free future [41, 42].

The critical role of the micro-elimination approach in overcoming the barriers to achieving the WHO's 2030 HCV elimination targets. Micro-elimination, which focuses on specific high-risk populations, offers a pragmatic and cost-effective alternative to nationwide efforts, particularly in settings where full-scale elimination programs are not yet feasible. The case study of Iceland serves as a compelling example, showcasing how a targeted and well-coordinated intervention can yield significant public-health outcomes in a relatively short timeframe. Key strengths of micro-elimination include emphasis on multi-stakeholder collaboration, tailored interventions, and harm-reduction measures such as needle exchange programs and opioid substitution therapy. These components not only reduce HCV transmission but also foster broader health benefits within marginalized populations [41]. The micro-elimination strategy aims to make significant progress toward the global goal of HCV eradication by focusing efforts on specific, manageable targets, ultimately leading to the wider goal of global elimination [41].

One of the major challenges in HCV elimination is that, despite the detection of anti-HCV positivity in patients through various studies conducted for different reasons, HCV-RNA testing is often not requested, and these patients are not referred to the appropriate specialists or tertiary care hospitals. A retrospective review of the electronic laboratory records at Hitit University Erol Olcok Training and Research Hospital identified 121,492 anti-HCV determinations. Anti-HCV seropositivity was observed in 891 individuals (0.81%). Among these, HCV-RNA analysis documented active viremia in 147 cases (16.5%) and excluded it in 389 (43.7%). Alarmingly, 355 seropositive patients (39.8%) were never evaluated for HCV-RNA, underscoring a substantial gap in the diagnostic cascade (**Figure 1**) [43].

In a cohort study involving 306 individuals with untreated HCV, researchers examined repercussions for occupational efficiency, routine functioning, healthcare consumption, associated expenditures, and health-related quality of life (HRQoL). Compared with matched controls, participants exhibited significantly greater work impairment (26 vs. 15%; $p < 0.001$), translating into average annual productivity losses of US$10,316 per employed patient versus US$5469. Overall healthcare utilization was higher as well, with mean all-cause costs reaching US$22,818 per patient each year, compared with US$15,362 for controls ($p < 0.001$). HRQoL indices and activity scores likewise confirmed significantly poorer outcomes among the untreated HCV group [44].

Razavi and co-workers predicted that, under the treatment practices in place in 2013, overall HCV prevalence would stabilize or modestly decline across the countries analyzed. In contrast, the burden of advanced liver disease was projected to escalate markedly, with compensated cirrhosis increasing by about 40%, decompensated cirrhosis by 60%, and liver-related mortality by roughly 70% [45].

Enhancing national capacity for HCV testing and therapy can markedly diminish the infection's clinical and societal burden. Modeling suggests that elimination targets will necessitate a three- to fivefold expansion in diagnostic coverage and/or treatment uptake, making investment in public-health infrastructure and workforce expertise imperative. If only therapeutic potency improves, reductions of approximately 5% in

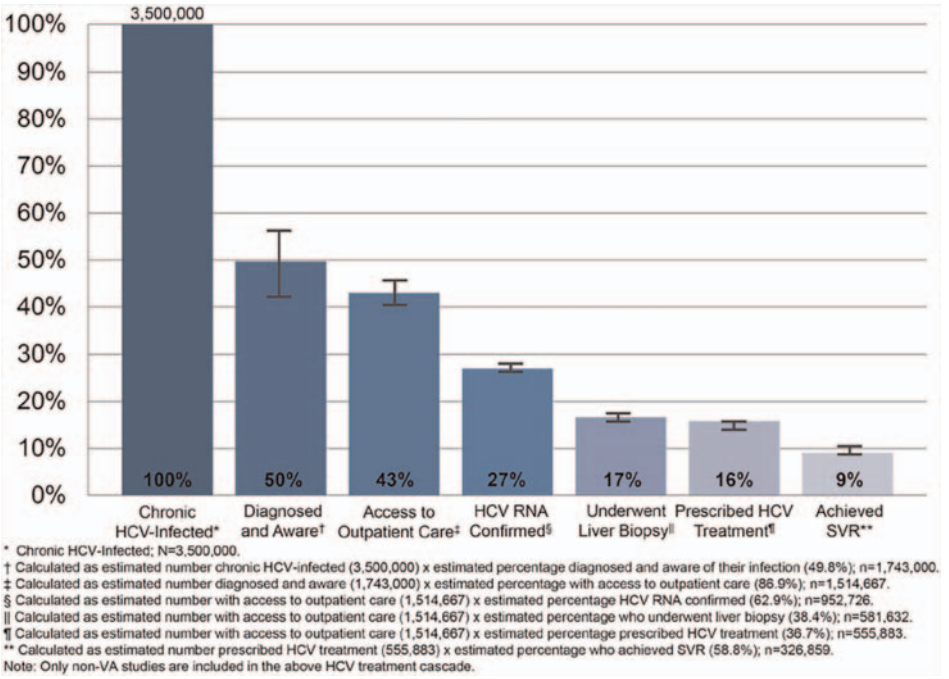

Figure 1.
Treatment cascade for people with chronic HCV infection, prevalence estimates with 95% confidence intervals [32].

viremia, HCC, liver-related mortality, and cirrhosis would be realized by 2030. Conversely, coupling broader access with higher efficacy is projected to yield a 20% drop in viremia, a 25% decline in HCC and liver-related deaths, and a 25–30% decrease in both compensated and decompensated cirrhosis over the same period [46].

Achieving the eradication of viral hepatitis demands a paradigm shift from individual case management toward an integrated population-level framework that prioritizes coordinated public-health measures. Central to this framework are the systematic disruption of transmission chains through comprehensive immunization programs, robust preventive initiatives, and universal access to effective antiviral therapies.

Responding to this imperative, the WHO adopted the Global Health Sector Strategy (GHSS) on viral hepatitis in 2016. This strategy presents a bold vision to eliminate viral hepatitis as a public-health threat by 2030, offering a detailed roadmap of priority prevention and treatment actions designed to fortify health systems within the broader pursuit of universal health coverage [47].

WHO has set ambitious goals for HCV elimination by 2030, including an 80% reduction in new infections and a 65% decrease in HCV-related mortality. However, until now, most of the countries have not yet reached this target.

Grebely and co-authors underscore that meeting elimination targets depends heavily on prioritizing PWID, a population bearing the highest risk of HCV propagation. Although pangenotypic DAAs have transformed therapeutic prospects, uptake among PWID is hindered by drug costs, fragmented service delivery, and limited accessibility. The authors therefore call for a substantial scale-up of Harm Reduction Strategies—most notably comprehensive needle-and-syringe programs and

widespread opioid substitution therapy (OST)—as indispensable components for curbing new HCV infections [48].

Improving testing and diagnosis: Timely detection of HCV among PWID is indispensable for elimination, yet testing uptake remains suboptimal because this population has limited contact with conventional healthcare services. Current evidence advocates scaling up point-of-care diagnostics and community-centered screening to improve case finding. Overcoming entrenched stigma and structural barriers requires policy frameworks that embed PWID within mainstream health systems instead of perpetuating their marginalization.

Community-based interventions: Engaging communities and peer-led interventions can help bridge the gap between healthcare providers and PWID, facilitating treatment uptake and adherence. Eliminating HCV among PWID by 2030 is an achievable goal but requires a comprehensive and multi-sectoral approach. Increasing access to treatment, strengthening harm reduction programs, and securing policy support are essential to success. This strategy is a valuable guide for policymakers, public-health professionals, and healthcare providers, emphasizing the importance of an inclusive and evidence-based strategy to combat HCV in vulnerable populations [48].

PWID often experiences stigma, discrimination, and criminalization, which hinder their ability to access healthcare. A lack of healthcare provider's willingness to treat PWID further limits treatment opportunities. Fragmented healthcare systems make it difficult for PWID to navigate effectively. Many PWID remain undiagnosed due to limited access to testing and insufficient engagement with healthcare services. Traditional healthcare settings may not be suitable or accessible for PWID. Delays in diagnosis result in missed opportunities for early intervention. DAAs have revolutionized HCV treatment, but access remains inconsistent. Restrictive treatment policies, financial barriers, and adherence concerns contribute to suboptimal treatment outcomes. Some healthcare providers hesitate to prescribe DAAs to PWID due to misconceptions about adherence and reinfection risks. Effective harm reduction measures, such as needle exchange programs and OST, are not widely implemented in some regions. Limited integration of HCV treatment into harm reduction services reduces overall effectiveness in preventing new infections. Implementing community-based testing, rapid diagnostic tools, and peer-led outreach programs can enhance early detection and engagement. A decentralized, low-threshold approach can improve treatment uptake and retention. Increasing access to OST, syringe distribution, and supervised injection facilities can prevent new infections and facilitate engagement in HCV care. Decriminalization of drug use, training healthcare providers, and reducing restrictive treatment guidelines are essential for improving access. It is very important to highlight that eliminating HCV among PWID by 2030 is feasible but requires a comprehensive, multi-sectoral approach that prioritizes harm reduction, healthcare integration, and policy reforms [49].

Feld J.J. and colleagues argue that micro-elimination—precision interventions directed at high-risk cohorts such as PWID, prisoners, and other marginalized groups—offers the most tangible path toward global HCV eradication. Central to their analysis is the expansion of population-level screening and rapid linkage to care, steps that accelerate diagnosis, curtail transmission, and avert advanced liver disease. The review further contends that durable success depends on robust policy frameworks and sustained financial commitment, underpinned by coordinated action among clinicians, public-health officials, and community stakeholders. Drawing on international case studies, the authors distill transferable lessons that can guide jurisdictions pursuing comparable objectives. Collectively, their findings reinforce that targeted

strategies, efficient care pathways, and strong political will are indispensable to achieving—and maintaining—HCV elimination [50].

The Global Health Sector Strategy on Viral Hepatitis (2016–2021) aims to provide a roadmap for eliminating viral hepatitis as a public-health threat by 2030, aligning with the WHO's broader Sustainable Development Goals (SDGs) [51]. Key components of the strategy include:

Vision: A global landscape in which the propagation of viral hepatitis has been effectively interrupted, and every individual affected by the infection can obtain affordable, high-quality preventive, diagnostic, and therapeutic services.

Goal: To reduce new infections by 90% and hepatitis-related deaths by 65% by 2030, compared to 2015 levels.

5.3 Strategic directions

1. *Information for focused action*: Strengthen surveillance and monitoring systems to generate accurate data on the hepatitis burden and track progress.

2. *Interventions for impact*: Scale-up evidence-based prevention measures, including vaccination (for hepatitis B), harm reduction for people who inject drugs, and safe medical practices.

3. *Delivering for equity*: Expand equitable access to hepatitis testing, treatment, and care, with a focus on high-risk and marginalized populations.

4. *Financing for sustainability*: Mobilize domestic and international funding to ensure sustainable hepatitis programs.

5. *Innovation for acceleration*: Invest in research and innovation to develop new diagnostic tools, treatments, and vaccines.

6. Key targets by 2020

- *90% of infants* receive a hepatitis B vaccine within 24 hours of birth.
- *100% of blood donations* are screened for hepatitis.
- *50% of people living with hepatitis B or C* are diagnosed.
- *75% of those diagnosed with hepatitis B or C* have access to appropriate treatment.

7. Guiding principles

- *Universal health coverage (UHC)*: Integrating hepatitis services into national health systems.
- *Equity and human rights*: Prioritizing vulnerable and underserved populations.
- *Public-health approach*: Implementing cost-effective, scalable interventions.

This strategy underscores the critical need for global collaboration, national leadership, and innovative solutions to achieve the elimination of viral hepatitis as a public-health threat by 2030.

8. HCV elimination plan in Türkiye

Türkiye's Viral Hepatitis Prevention and Control Programme for 2018–2023 was formally inaugurated on 12 September 2018 and subsequently circulated to all healthcare institutions, affiliated organizations, and other key stakeholders nationwide. The objectives of this program are as follows, using appropriate public-health approaches:

a. To reduce diseases, complications, and deaths caused by viral hepatitis.

b. To improve the care of viral hepatitis patients.

c. To mitigate the socioeconomic impact of viral hepatitis in community settings.

The strategies to be implemented within the program are as follows:

9. Increasing awareness

Awareness of viral infections is an important factor for the early diagnosis and early treatment of the diseases.

a. Disease burden of HCV infection in Türkiye.

b. Awareness of general population regarding HCV infection.

c. Awareness of risk groups.

d. Awareness of health providers, policymakers, communities, and family doctors:

   i. Enhancing immunization for hepatitis B and A.

   ii. Strengthening Viral Hepatitis surveillance.

   iii. Improving access to treatment.

   iv. Preventing mother-to-child transmission.

   v. Ensuring the safety of blood products.

   vi. Preventing Viral Hepatitis transmission among people who inject drugs.

   vii. Preventing healthcare-associated hepatitis.

10. Screening

a. Increasing the diagnostic rate of HCV infection.

b. To increase types of On-Site Survey Programs.

10.1 Mobile applications

a. Applications designed for smartphones or tablets.

b. Utilize device features such as GPS, camera and sensors.

c. Examples: Google Field Mapper, Survey123 (Esri), Fulcrum.

10.2 Geographic information system (GIS)-based survey programs

a. Used for map-based data collection and analysis.

b. Integrates field data with geographic coordinates.

c. Examples: QGIS, ArcGIS Field Maps.

10.3 Survey and form-based tools

a. Allow users to collect field data via standardized forms or surveys.

b. Examples: KoboToolbox, ODK Collect.

10.4 IoT-based systems

a. Collect real-time data from sensors or devices.

b. Common in sectors like environmental monitoring, energy or agriculture.

10.5 Inspection and monitoring tools

a. Used for health and safety audits, equipment maintenance or quality control.

b. Examples: iAuditor, Safety Culture.

11. Connection with the treatment

a. Integration between family health center and specialists' treatment.

b. Integration between health center and prisoner.

c. Integration between alcohol and substance addiction treatment center (AMATEM) and health systems.

d. Adding of HCV diagnosis on electronic medical record system.

12. Reaching the well qualified doctor

a. The role of family doctors as an observer.

b. The number of doctors who can prescribe direct antiviral agents.

c. Availability of treatment for patients with active HCV infection.

13. Reaching the drug (DAAs)

a. Contents of HCV treatment and special finance.

b. The agreement of reimbursement.

c. Availability of direct antiviral drugs.

14. Evaluation and monitoring

a. Existence of HCV patients records.

b. Reporting of new cases.

According to Turkey Viral Hepatitis Prevention and Control Program, three scenarios were planned.

a. Base 2017: At the beginning 271,000 viremic patients were estimated. Among them, 58,400 patients were diagnosed, and 10,200 patients were treated (**Figure 2**). By 2030 the total number of viremic infections would decline by 35%. The number of decompensated liver cirrhosis and hepatocellular carcinoma cases would decrease by 10–25% by the same year (**Figure 3**) [40].

b. Increased scenario: In this scenario improved diagnosis and improved treatment by DAAs were accepted. By 2030, the total number of viremic HCV patients would decrease by 50%; and liver-related deaths, prevalence of HCC, and prevalence of decompensated liver cirrhosis would decrease by 45–70% **(Table 1)** [40].

c. WHO scenario: WHO targets scenario, which meets the WHO Global Health Sector Strategy viral hepatitis targets a 65% reduction in mortality and 90% diagnosis rate of the infected population by 2030 (**Table 1**) [40]. The total number of viremic HCV infections would decrease by 80%; liver-related deaths, prevalence of HCC, and prevalence of decompensated cirrhosis would decrease by 80–85% (**Figure 3** and **Table 1**) [40].

While using an Excel-based disease progression model, the cost effectiveness of HCV was estimated using three scenarios. Base 2016, Increase Treatment and sustained virological response and WHO targets. The total cumulative direct and indirect cost between 2015 and 2030 for the WHO targets scenario was calculated. By applying the WHO targets scenario, the prevalence of HCV can be decreased by 80%,

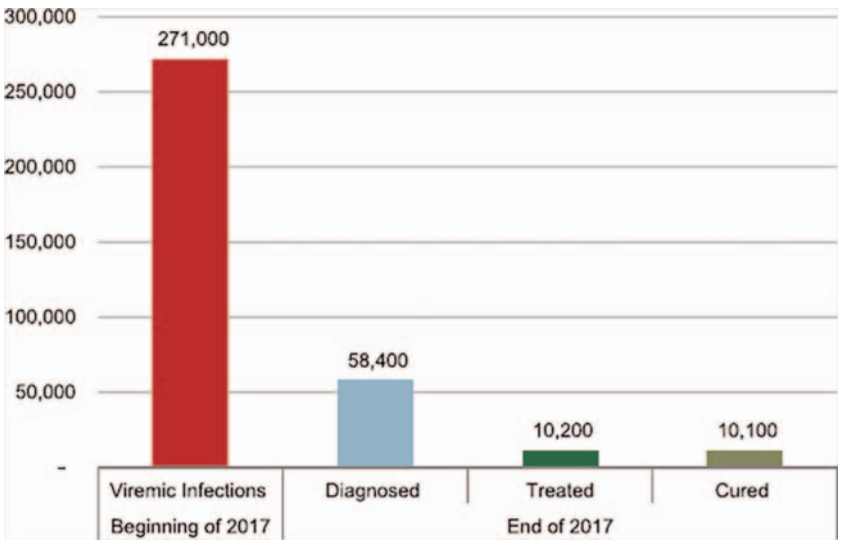

Figure 2.
The HCV cascade of care, including the total number of viremic infections, the number of diagnosed patients, and the number of patients treated and cured, in Türkiye in 2017 [40].

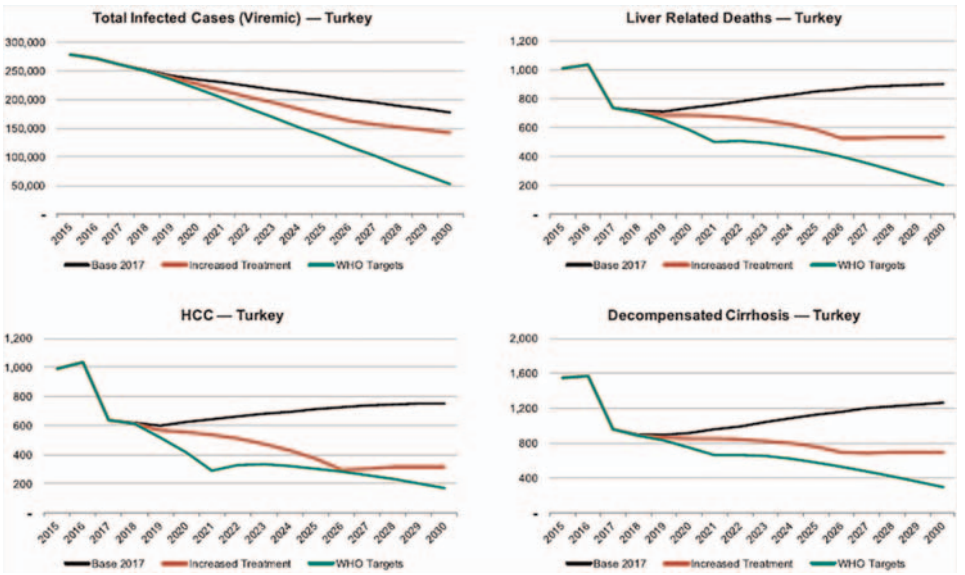

Figure 3.
Total infected cases, liver-related deaths, prevalent HCC, and prevalent decompensated cirrhosis in Turkey, 2015–2030 [40].

and the total number of liver-related deaths by 65% in 2030. If healthcare and indirect costs are taken into consideration, all scenarios would be cost-effective in Türkiye [52].

Approximately six in ten individuals living with HCV have never initiated antiviral therapy. Türkiye conducts close to 900 hepatic transplantations annually, achieving an overall success rate of nearly 85%. From the insurer's viewpoint and excluding

antiviral drug expenses, the mean yearly outlay per patient is estimated at US$446.83 for chronic hepatitis C without cirrhosis, US$577.56 for compensated cirrhosis, US $1984.39 for decompensated cirrhosis, US$2474.15 for hepatocellular carcinoma, and US$42,469.27 for liver transplantation [53].

Early diagnosis and treatment are crucial not only from the clinical perspective, but also from the cost perspective, as a more severe disease costs significantly more [54].

Family physicians can play a significant role in the eradication of HCV infection. Family physicians are in a unique position to contribute to early diagnosis, prevention, and treatment of HCV. They can help by:

1. *Screening*: Family physicians can routinely screen at-risk populations for HCV, which is key for early detection and reducing the spread of the infection.

2. *Education:* They can provide essential information about HCV transmission, prevention, and treatment options to patients, helping to raise awareness in the community.

3. *Referrals:* Family physicians can refer patients to specialists for further diagnosis and treatment, ensuring timely medical intervention.

4. *Treatment management*: With proper training and support, family physicians can be involved in managing antiviral therapy for HCV, particularly with DAAs, which have proven to be highly effective. By playing an active role in these areas, family physicians can help in the global efforts to eliminate HCV as a public-health threat [54].

15. Conclusions

Chronic HCV remains a formidable global health and economic challenge, with an estimated 71–80 million people infected worldwide. Untreated infection may persist silently for decades before cirrhosis, hepatic decompensation, or hepatocellular carcinoma emerge. Yet the landscape has shifted dramatically: pangenotypic direct-acting antivirals now deliver sustained virological response rates exceeding 95%, transforming cure from aspiration to routine expectation. Building on this therapeutic revolution, WHO's 2030 targets—an 80% reduction in new infections and a 65% decline in HCV-related mortality—are realistic milestones rather than distant ideals. Türkiye's Viral Hepatitis Prevention and Control Programme, initiated in 2018, illustrates both the feasibility and cost-effectiveness of scaling diagnosis and treatment. Continued progress will hinge on unwavering political commitment, robust financing, and close collaboration among clinicians, public-health professionals, policymakers, and affected communities. With sustained, coordinated action, HCV can be relegated from a silent epidemic to a controllable threat, offering a powerful model for infectious-disease elimination.

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