

Global Prevention and Public Health Strategies for the Elimination of Hepatitis C

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Abstract

Hepatitis C virus (HCV) remains a critical driver of chronic liver disease, cirrhosis, and hepatocellular carcinoma globally. Following the advent of highly effective pangenotypic direct-acting antivirals (DAAs) capable of curing over 95% of infections, the World Health Organization (WHO) established a mandate to eliminate viral hepatitis as a major public health threat by 2030. Achieving this goal requires a reduction of 90% in new chronic infections and a 65% reduction in mortality relative to 2015 baselines. This review synthesizes the human epidemiological burden, primary prevention modalities, innovative diagnostic approaches, and public health frameworks necessary to bridge the gap between treatment capacity and real-world implementation. Despite a highly effective biomedical cure, systemic challenges persist, including low diagnosis rates, high medication costs, and limited micro-elimination coverage among marginalized populations such as people who inject drugs (PWID) and incarcerated individuals. This article outlines successful international strategies, including decentralized screening and integrated harm reduction, and frames the steps required to transition from disease control to population-level eradication.

Keywords:

Hepatitis C Virus; Public Health; Harm Reduction; Direct-Acting Antivirals; Disease Elimination; Preventive Medicine.

Introduction

Hepatitis C virus (HCV) is an enveloped, single-stranded RNA virus primarily transmitted via parenteral contact with infectious blood or bodily fluids (Fleurence et al., 2025). Since its initial discovery and characterization, it has evolved from an unidentifiable post-transfusion risk factor into one of the most comprehensively understood and treatable chronic viral pathogens in medical history (Kuo et al., 1989). Despite the availability of curative medical

interventions, the global burden remains vast. Approaching the World Health Organization's (WHO) 2030 deadline for viral hepatitis elimination, approximately 58 million individuals globally continue to live with chronic HCV, resulting in roughly 290,000 deaths annually due to progressive liver pathologies like cirrhosis and hepatocellular carcinoma (HCC) (Fleurence et al., 2025; Hellard et al., 2019).

The therapeutic paradigm of HCV underwent a structural revolution in 2014 with the emergence of all-oral, interferon-free direct-acting antivirals (DAAs) (Toma, 2025). Modern pangenotypic regimens, such as sofosbuvir/velpatasvir and glecaprevir/pibrentasvir, demonstrate sustained virologic response (SVR) rates exceeding 95% across all genotypes with minimal side effects and brief treatment durations of 8 to 12 weeks (Di Marco et al., 2022; Toma, 2025). This clinical efficacy shifted the public health perspective from mitigation to global elimination (WHO, 2016). The WHO targets call for a 90% reduction in incident cases, a 65% reduction in hepatitis-related mortality, and the treatment of 80% of eligible individuals by 2030 (Di Marco et al., 2022).

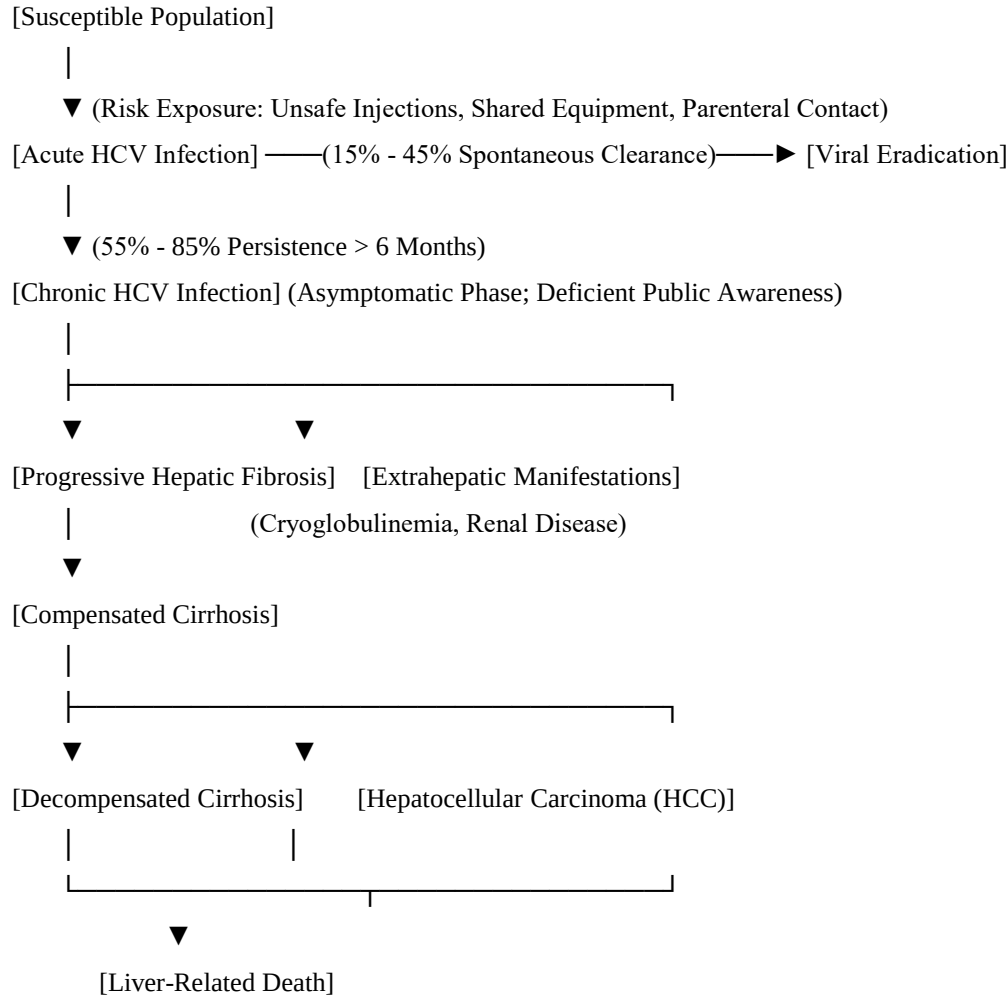
However, translating clinical efficacy into public health elimination has exposed deep implementation gaps within the global health sector strategy. Globally, only a minority of individuals living with chronic HCV have been diagnosed, and an even smaller percentage have initiated therapy (Toma, 2025). Marginalized populations—such as people who inject drugs (PWID), incarcerated populations, and individuals in low- and middle-income countries (LMICs)—experience disproportionate barriers to care cascade progression (Akiyama et al., 2021; Grebely et al., 2019; Millman et al., 2017). This review evaluates current public health prevention strategies, evaluates diagnostic and therapeutic innovations, outlines micro-elimination models, and analyzes the systemic hurdles that must be cleared to eliminate HCV as a global health threat.

Main Review

1. Epidemiology and Transmission Dynamics

The global distribution of HCV is characterized by significant regional variation. Estimates show the highest viremic prevalence rates in the Eastern Mediterranean (2.3%) and European (1.5%) regions, contrasting with lower rates (less than 1%) across the Americas and the Western Pacific (Di Marco et al., 2022). In specific countries such as Egypt, Georgia, and Mongolia, past medical practices, unsafe therapeutic injections, or localized systemic transmission led to baseline historical prevalences exceeding 4% to 6% (Di Marco et al., 2022).

Transmission dynamics are primarily driven by percutaneous exposure to blood. In high-income nations, injection drug use via shared needles, syringes, and ancillary preparation equipment accounts for most incident infections (Grebely et al., 2019; Smith et al., 2012). Conversely, in many LMICs, healthcare-associated transmission via improperly sterilized equipment, unsafe blood transfusions, and multiplex medical procedures remains an active contributor to incidence (WHO, 2016). Secondary routes of transmission include vertical (mother-to-child) transmission, occurring in 4% to 7% of pregnancies among HCV-monoinfected women, and sexual transmission, which is largely confined to HIV-positive men who have sex with men (MSM) (Benova et al., 2014; Platt L. et al., 2016).



The clinical progression of chronic HCV complicates public health screening. Following initial infection, up to 45% of healthy young individuals achieve spontaneous viral clearance within six months due to robust innate and adaptive immune responses (Dai, 2025). The remaining 55% to 85% develop chronic HCV infection, which remains largely asymptomatic for decades (Dai, 2025; Smith et al., 2012). Because infected individuals frequently "look and feel healthy," more than half of the global pool of chronic cases remains undiagnosed, functioning as an unaddressed reservoir for ongoing horizontal transmission (Dai, 2025; Millman et al., 2017). Left untreated, chronic viremia initiates progressive hepatic inflammation and fibrogenesis, leading over 40–50 years to cirrhosis, hepatic decompensation, and an elevated relative risk for primary liver malignancies (Smith et al., 2012).

2. Primary Prevention and Harm Reduction Frameworks

Because there is no effective prophylactic vaccine for HCV due to the virus's hypervariable genomic profile and rapid mutational escape mechanisms, primary prevention relies entirely on behavioral and structural interventions (Di Marco et al., 2022). Within public health frameworks, harm reduction represents the cornerstone for breaking transmission chains among high-risk cohorts.

Point-of-Care (POC) and Decentralized Diagnostics

To reach marginalized or geographically isolated populations, point-of-care rapid diagnostic tests (RDTs) using fingerprick whole blood or oral fluid provide results in under 30 minutes at room temperature (O' Kane & Hathorn, 2023). Furthermore, the validation of Dried Blood Spot (DBS) sampling allows non-specialized personnel to collect capillary blood samples in community harm-reduction hubs, which are then shipped to centralized laboratories for molecular testing, bypassing the need for standard venipuncture infrastructure (O' Kane & Hathorn, 2023).

4. Secondary Prevention: "Treatment as Prevention" (TasP)

The paradigm of Secondary Prevention has been redefined by the concept of Treatment as Prevention (TasP). By utilizing highly effective DAA regimens to rapidly eliminate the viral reservoir in actively transmitting populations, clinicians achieve a dual benefit: individual clinical cure and the immediate reduction of onward horizontal transmission risk (Hellard et al., 2019).

Table 1: Evolution of Hepatitis C Treatment: From the Interferon Era to the Direct-Acting Antiviral (DAA) Era

Component	Historical Paradigm (Interferon Era)	Current Public Health Standard (DAA Era)
Regimen Composition	Pegylated Interferon-alpha + Ribavirin	All-oral Pangenotypic DAAs (e.g., SOF/VEL)
Treatment Duration	24 to 48 weeks	8 to 12 weeks
Cure Rate (SVR)	~40% – 50%, genotype-dependent	>95% across all viral genotypes
Tolerability Profile	Severe toxicities (anemia, depression, cytopenias)	Highly tolerable, minor self-limiting side effects
Prescription Access	Restricted to tertiary academic subspecialists	Decentralized to primary care and community hubs
Public Health	Individual tertiary mitigation for	Secondary prevention via "Treatment as

Function	advanced disease	Prevention" (TasP)
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Mathematical modeling and real-world implementations show that prioritizing DAA delivery to individuals with high transmission potential, such as active PWID, can yield rapid drops in community-wide prevalence, offsetting initial pharmaceutical spending through reduced long-term healthcare utilization (Hellard et al., 2019).

5. Micro-Elimination Frameworks and Global Implementations

Rather than waiting for top-down macroeconomic health system overhauls, public health authorities have increasingly adopted "micro-elimination" strategies. These frameworks break down national targets into manageable subpopulations defined by specific risk profiles, institutional settings, or geographic areas (Cooke et al., 2019).

- **Incarcerated Populations:** Correctional facilities experience an elevated prevalence of HCV relative to general communities, driven by overlapping risk behaviors (Dolan et al., 2016). Implementing opt-out universal screening frameworks at intake, coupled with direct in-facility DAA therapy, turns prisons into public health intervention hubs that help break outside transmission networks upon re-entry (Akiyama et al., 2021).
- **The Georgian National Elimination Program:** Initiated in 2015 as the world's first comprehensive nationwide elimination project, Georgia combined multi-sector screening across hospitals, harm reduction centers, and prisons with specialized pharmaceutical partnerships (Handanagic et al., 2023). By 2022, Georgia had screened approximately 80% of its adult population, curing over 80,000 viremic individuals and reducing its total active chronic reservoir by more than 65% (Handanagic et al., 2023).
- **Decentralization in Rwanda:** Rwanda became a leader in sub-Saharan Africa by decentralizing HCV care from tertiary hospitals down to local primary health clinics (Handanagic et al., 2023). Through rapid diagnostic integration and training non-specialist primary care physicians, the country completed its baseline goal of screening 7 million individuals, demonstrating that elimination models can succeed within resource-constrained infrastructures (Handanagic et al., 2023).

6. Persistent Structural Barriers to 2030 Targets

Despite a highly effective biomedical cure and proven implementation frameworks, global progress remains uneven and faces substantial structural headwinds (Fleurence et al., 2025).

Diagnostic and Treatment Costs

Although generic competition has driven the cost of an 8-to-12-week DAA course down to under \$100 in several low-income countries via voluntary licensing agreements, costs remain high in many high- and middle-income

nations (Millman et al., 2017). Third-party payer restrictions, specialized prior-authorization hurdles, and budgetary caps within regional health programs continue to delay immediate treatment initiation (Millman et al., 2017).

Stigma and Systematic Marginalization

HCV is heavily concentrated within socially marginalized cohorts who experience systemic stigma within healthcare networks, including PWID, sex workers, and homeless populations (Fleurence et al., 2025). This stigma discourages healthcare-seeking behaviors and undermines care retention. Additionally, criminalization of injection drug possession in various jurisdictions drives these populations away from testing centers, increasing the risk of late-stage clinical presentations and continued horizontal transmission (Akiyama et al., 2021).

Conclusion

The global elimination of Hepatitis C as a major public health threat is technically achievable but remains an implementation challenge rather than a biomedical one. The development of short-course, pangenotypic direct-acting antivirals has provided a highly effective cure for individual patients. However, eliminating the virus at a population level requires scaling up public health strategies that address the entire care cascade.

Moving forward, national programs must prioritize structural harm reduction efforts, remove institutional barriers to treatment access, and transition from specialized hospital-based care to decentralized, community-led health models. Bridging these diagnostic and political gaps is essential for public health sectors to meet the WHO 2030 targets and achieve global HCV elimination.

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