



Commentary

Can hepatitis C be eradicated in the United States?

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ABSTRACT

The advent of highly effective antiviral regimens will make the eradication of hepatitis C in high-income countries such as the United States technically feasible. But eradicating hepatitis C will require escalating our response to the epidemic in key domains, including surveillance and epidemiology, prevention, screening, care and treatment, policy, research, and advocacy. Surveillance must be nimble enough to quickly assess the magnitude of new transmission patterns as they emerge. Basic prevention strategies – community-based outreach and education, testing and counseling, and access to sterile injection equipment and opioid substitution therapies – must be scaled up and adapted to target groups in which new epidemics are emerging. All adults should be screened for hepatitis C, but special efforts must focus on groups with increased prevalence through community outreach and rapid testing. Government, industry, and payers must work together to assure full access to health services and antiviral drugs for everyone who is infected. Access to the new regimens must not be compromised by excessively high prices or arbitrary payer restrictions. Partnerships must be forged between hepatitis providers and programs that serve people who inject illicit drugs. Healthcare providers and systems, especially primary care practitioners, need education and training in treating hepatitis C and caring for substance-using populations. Services must be provided to the disadvantaged and stigmatized members of society who bear a disproportionate burden of the epidemic. Environments must be created where people who use drugs can receive prevention and treatment services without shame or stigma. Action is needed to end the policy of mass incarceration of people who use drugs, reduce the stigma associated with substance use, support the human rights of people who use drugs, expand social safety net services for the poor and the homeless, remove the legal barriers to hepatitis C prevention, and build public health infrastructure to reach, engage, and serve marginalized populations. Governments must take action to bring about these changes. Public health agencies must work with penal institutions to provide prevention and treatment services, including antiviral therapy, to those in need in jails and prisons or on probation or parole. Research is needed to guide efforts in each of these domains. Strong and sustained political advocacy will be needed to build and sustain support for these measures. Leadership must be provided by physicians, scientists, and the public health community in partnership with community advocates and people living with or at risk for hepatitis C. Eliminating hepatitis C from the United States is possible, but will require a sustained national commitment to reach, test, treat, cure, and prevent every case. With strong political leadership, societal commitment, and community support, hepatitis C can be eradicated in the United States. If this is to happen in our lifetimes, the time for action is now. This article forms part of a symposium in *Antiviral Research* on “Hepatitis C: next steps toward global eradication.”

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The appearance on the horizon of all-oral antiviral regimens that appear to be capable of eliminating infection with the

hepatitis C virus (HCV) in as many as 90% or more of patients in as little as 8–12 weeks has raised the question of whether HCV can be eradicated in high-income countries (Thomas, 2013; Hellard et al., 2014; Grebely and Dore, 2014). The pinnacle of public health achievements, disease eradication has a great appeal to donors, policymakers, and public health workers. It can also provide economic benefits, strengthen public health capacity to address other health conditions, and advance the humanitarian aims of social justice and health equity (Dowdle and Cochi, 2011).

Abbreviations: HCV, hepatitis C virus; PWID, people who inject drugs; PWUD, people who use drugs.

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But while newer therapies could bring the eradication of hepatitis C within reach, efforts to accomplish this goal face a number of significant hurdles. Hepatitis C has a long asymptomatic period that may last decades, during which diagnosis will not occur without widespread screening and the virus may be unwittingly transmitted to other persons. Most infected people are unaware of their infection. Treatment is costly, insurance coverage uncertain, and few clinicians have experience with the newest regimens. There is no robust natural immunity, and extensive efforts to develop a vaccine have yet to bear fruit. While effective prevention measures exist, they have not been widely applied, and where they have, they have not been sufficiently effective to stop all ongoing transmission. Disease progression is slow, which can forestall a sense of urgency. And the populations most affected by the epidemic are burdened by severe stigma and social marginalization, which handicaps the implementation of preventive and therapeutic services for them. In an era of extreme privatization of wealth (Stiglitz, 2012), funding is scant for public health initiatives, or any programs that benefit public well-being, and the need to provide services to marginalized populations in particular has difficulty gaining traction.

None of these obstacles, by itself, is insurmountable. Vaccines, for example, were critical for eliminating smallpox and polio from the United States and for ongoing efforts to eliminate measles, mumps, and rubella. But of the six adult infectious diseases targeted for eradication or elimination by the World Health Organization, vaccines are lacking for five. Cases of guinea worm, in fact, are down from an estimated 3.5 million in 1986 to 148 cases in 2013 despite the lack of either a vaccine or curative drug therapy. Hepatitis C meets a number of the established criteria for eradication to be technically feasible (Cochi and Dowdle, 2011; Hopkins, 2013):

- there is no non-human reservoir, and the organism cannot amplify in the environment;
- there are simple and accurate diagnostic tools;
- there are practical interventions to interrupt transmission; and
- the infection can, in most cases, be cleared from the host.

If the cost of treatment is not prohibitive, existing prevention measures are scaled up where needed, and screening can be widely implemented, eradication is technically feasible.

But meeting the prerequisites for eradication will demand escalation of our response to the hepatitis C epidemic in a number of critical dimensions, including public health initiatives, clinical interventions, public policy changes, and social and political action. The hepatitis C epidemic spans a diversity of groups: people with health insurance and those without coverage; those who are no longer at risk of transmitting or reacquiring HCV and those who continue to engage in risk behavior; those with the resources to address their infection and those facing more pressing priorities. If eradication is to be achieved, it will require societal and political commitment to vigorously engaging the full range of affected groups and populations. A successful eradication initiative requires not only biologically effective interventions, but considered attention to what has been described as the “human element” – political

leadership, cultural attitudes, societal commitment, and community support (Dowdle and Cochi, 2011).

This article outlines key steps that can be taken to accomplish the elimination of hepatitis C in the United States. Defined broadly as the absence of disease in a particular population (Dowdle and Cochi, 2011; Cochi and Dowdle, 2011), eradication requires preventing both the transmission of infection and progression to clinical disease among those already infected. (Although eradication is sometimes defined, technically, as the reduction of disease incidence to zero worldwide, definitions vary (Dowdle and Cochi, 2011; Cochi and Dowdle, 2011), and here we use it interchangeably with elimination, to mean ending the epidemic in a single country). The article highlights action needed to enhance epidemic control efforts in six domains:

- Surveillance and epidemiology (Table 1).
- Prevention (Table 2).
- Testing (Table 3).
- Care and treatment (Table 4).
- Social policy (Table 5), and
- Research (Table 6).

Each of the measures discussed has demonstrated effectiveness in certain settings or contexts but needs to be scaled up to effect eradication of the epidemic. Some of the measures will be more difficult to implement than others, and some may not be feasible in the near term. But none is beyond the grasp of a nation that has, in times of need, marshaled prodigious resources in pursuit of its goals.

1. Epidemiology and surveillance

Control of any epidemic must begin with an understanding of the scope of the problem and its location in time, place, and person. National surveillance data provide estimates of HCV prevalence and incidence in the mainstream U.S. population (Centers for Disease Control and Prevention, 2011), but hepatitis C is concentrated in marginalized groups who are poorly represented in existing data (Edlin, 2011). Prevalence rates among the homeless and the incarcerated are many times higher than the national average (Edlin, 2011). National prevalence estimates, however, are derived from a household survey that simply excludes people who are homeless or incarcerated from the sampling frame (Denniston et al., 2014). Even among the housed, the survey samples people who inject drugs (PWID) only if they willingly roll up their sleeves to have blood drawn by researchers – researchers from the same Federal government that dispenses harsh policies and punishments for drug users (Edlin, 2011). This underestimates HCV prevalence, which is elevated severalfold (Armstrong et al., 2006) among the 24 million (Substance Abuse and Mental Health Services Administration, 2012) Americans who use illicit drugs by any route and as high as 70–90% (Tseng et al., 2007; Nelson et al., 2011) among the 1.5–2.0 million (Mathers et al., 2008; Tempalski et al., 2013) who use drugs by injection. Incidence estimates are also underestimated. They are derived from reports of

Table 1

Steps needed to eradicate hepatitis C in the United States: epidemiology and surveillance.

A national surveillance system must be fully resourced to carry out the following functions on a national scale. Sporadic epidemiologic investigations have identified areas of ongoing transmission but their full scope remains unknown.

- Assess and monitor HCV incidence in high-risk populations, including emerging epidemics in young people who use prescription opioids, sexually active HIV-infected men who have sex with men, and persons receiving unsafe injections in medical settings
- Identify new outbreaks and emerging epidemics and quickly assess the magnitude of new transmission patterns as they emerge
- Assess and monitor HCV prevalence in high-risk populations, including the homeless, persons incarcerated in prisons and jails, people who use illicit drugs

Table 2

Steps needed to eradicate hepatitis C in the United States: prevention.

The following steps must be implemented nationwide to stop HCV transmission:

- Scale-up evidence-based prevention interventions to help arrest the transmission of HCV among the high-risk population of people who inject drugs (PWID). These include:
 - Community-based outreach and education, testing and counseling, and linkage to care
 - Access to sterile syringes and injection equipment through community-based needle and syringe programs and pharmacy sales or physician prescription
 - Supervised drug consumption rooms to provide a safety-net environment where the harmful consequences of drug use, including bacterial and viral infections and overdose, can be minimized
 - Access to effective treatment for substance use for all who need it, including opioid substitution (methadone or buprenorphine) or heroin maintenance treatment
 - Expand prevention activities to emphasize the importance of cookers and other injection equipment in addition to syringes as fomites for HCV transmission
 - Involve PWID in development of programs and messages to reduce HCV transmission
 - Engage young people who use illicit drugs (PWUD) with education and prevention messages before they initiate injection
 - Design and implement special targeted prevention efforts for new emerging epidemics quickly as they arise (for example, in young adults using prescription opioids, sexually active HIV-infected men who have sex with men, and patients receiving unsafe injections in medical settings)
 - Require all healthcare facilities to document adherence to appropriate precautions to prevent bloodborne virus transmission, especially ambulatory surgery centers and facilities using multidose medication vials
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symptomatic acute hepatitis cases, reflecting transmission rates in the population of people who have access to health care, have nothing to fear from the authorities, feel ill when they contract HCV infection, and visit a doctor when they feel ill (Edlin, 2011). PWID, however, rarely experience symptoms during acute HCV infections and, when they do, even more rarely visit physicians (Edlin, 2011). Three new epidemics of hepatitis C have emerged in the United States in recent years, in young people who use pharmaceutical opioids for nonmedical purposes (Office of HIV/AIDS and Infectious Disease Policy, 2013), sexually active HIV-infected men who have sex with men (Yaphe et al., 2012), and persons receiving unsafe injections in medical settings (Thompson et al., 2009; Perz et al., 2010). None registered in national HCV incidence estimates.

Accurate HCV prevalence and incidence estimates are critical for assessing the magnitude of the pandemic, designing and targeting public health interventions, allocating resources, and planning for future health care needs. Robust measures of prevalence and incidence that are sensitive to the segments of the epidemic in persons in marginalized groups must be developed (Table 1). Accurate data on hidden populations, such as people using pharmaceutical opioids, who are increasingly turning to heroin injection, can only be obtained through targeted outreach to those populations. These same outreach efforts can then be used to provide prevention, testing, and treatment services (Centers for Disease Control and Prevention, 2012). But viral hepatitis epidemiology and surveillance in the United States is hamstrung by meager funding (Edlin, 2011). A national viral hepatitis surveillance system is needed that is nimble enough to respond to emerging epidemics and quickly assess the magnitude of new transmission patterns as they emerge (Hanan et al., 2011).

2. Prevention

Whatever the full extent of the epidemic, basic prevention strategies must be implemented now (Table 2). Advances in

antiviral treatment notwithstanding, hepatitis C will not come under control without vigorous efforts to stem the tide of new infections that are fueling the epidemic. Fortunately, extensive field experience has been gained with interventions that have substantial, albeit less than complete, effectiveness (Edlin, 2011; Hagan et al., 2011; Van Den Berg et al., 2007; Abdul-Quader et al., 2013). Most HCV transmission occurs through the use of contaminated injection equipment during illicit drug use. Evidence-based interventions implemented in many urban areas in the U.S. starting in the 1980s provided PWID with the information and the means to avoid acquiring and transmitting infection with the human immunodeficiency virus (HIV) – including community-based outreach and education, HIV testing and counseling, and access to sterile syringes through community-based needle and syringe programs. In locations where these interventions were implemented, PWID markedly reduced their transmission of both HIV and HCV (Tseng et al., 2007; Mehta et al., 2011). HCV transmission rates were far higher than those for HIV to begin with, because HCV is tenfold more transmissible than HIV (Kwon et al., 2009); prevalence rates among PWID (hence the likelihood of encountering another person with the infection) are often tenfold higher (Tseng et al., 2007); and HCV survives and is transmissible on other drug preparation equipment in addition to syringes (Doerrbecker et al., 2013; Paintsil et al., 2014). HCV incidence rates remain unacceptably high, especially in young PWID (Thorpe et al., 2002; Garfein et al., 1998; Hagan et al., 1999; Hahn et al., 2002). Still, incidence among PWID fell from 15–20% per month in the 1980s (Lorvick et al., 2001; Garfein et al., 1996) to 10–25% per year (Thorpe et al., 2002; Garfein et al., 1998; Hagan et al., 1999; Hahn et al., 2002) after these HIV prevention interventions were introduced (Edlin, 2011; Tseng et al., 2007). This represents a reduction in transmission by an order of magnitude – a dramatic public health success story by any measure.

But even these partially effective interventions are not available in many locations and are poorly funded where they do exist.

Table 3

Steps needed to eradicate hepatitis C in the United States: testing.

The following steps are needed to identify all persons with hepatitis C:

- Provide hepatitis C testing to populations with an elevated prevalence (See Table 7)
 - Economic evidence supports at least one-time screening of the entire adult population age 20–69 years (Coffin et al., 2012)
 - Provide testing in community settings, homeless services, correctional facilities, and other criminal justice settings in addition to health facilities
 - Provide hepatitis C testing wherever HIV testing is available
 - Use strategies proven effective for HIV testing such as low-threshold testing and financial incentives in marginalized high-risk populations
 - Provide targeted testing in populations where emerging epidemics are identified or suspected
 - All persons testing positive for HCV antibodies should be offered RNA testing to determine whether they have chronic hepatitis C or not.
 - Use risk-based algorithms: start with direct viral (eg HCV RNA) tests in high-risk persons; use antibody tests followed by RNA testing of antibody-positives in persons believed to be at lower risk
 - Repeat testing regularly in persons at ongoing risk to detect new infections as they occur for purposes of treatment and surveillance
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Table 4
Steps needed to eradicate hepatitis C in the United States: access to care and antiviral treatment.

The following steps are needed to assure that all persons with chronic hepatitis C are offered antiviral therapy:

- Create collaborative action among government, industry, and payers to assure full access to antiviral drugs for all who need them, regardless of insurance coverage or ability to pay
- Educate and train primary care providers and healthcare systems in treating hepatitis C and caring for stigmatized populations including PWID
- Build public health infrastructure where PWID can receive multidisciplinary health services (including prevention and care) without fear of shame or stigma, with the following characteristics:
 - Comprehensive and continuing primary and specialty medical care, treatment for substance use, mental health services, case management, overdose prevention, peer support, and social services
 - Location in primary care health facilities, substance use treatment facilities, prisons and jails, and community-based facilities that provide services to homeless persons and persons who use illicit drugs
 - Improved linkage between testing and care
 - Stable, adequate funding through dedicated funding streams or health insurance coverage
- Develop best-practice guidelines for harm reduction and evidence-based behavioral strategies to provide expert, nonjudgmental care to persons who use illicit drugs
- Create collaboration and cross-training between providers with expertise in hepatitis C treatment and those who provide services to PWID

Needle and syringe programs reach only a fraction of people who inject illicit drugs. They operate in 166 U.S. cities, but most are severely constrained by meager funding and 20 states have no programs at all ([amfAR Foundation for AIDS Research, 2013](#)). The number and capacity of these programs must be expanded to the scale required to impact upon hepatitis C transmission. To accomplish this, two major obstacles must be removed: the absence of meaningful Federal funding for viral hepatitis prevention ([Edlin, 2011](#)) and the Congressional ban on using Federal funds for syringe exchange or distribution.

Needle and syringe programs should adopt low-threshold policies to maximize accessibility and reject restrictions that have sometimes been adopted, such as limitations on the number of syringes provided to each individual, or efforts to prevent clients from distributing the sterile syringes to other people in their community ([World Health Organization, 2007](#); [Strike et al., 2013](#)). These policies undermine the objective of making sterile syringes as available as possible to those who need them. Low dead-space syringes, such as insulin syringes with permanently attached needles, are optimal, since the volume of blood trapped, which may be transferred to another person if the syringe is reused, can be reduced as much as 40-fold ([Zule et al., 2013](#); [World Health Organization, 2012](#)).

But needle and syringe programs, while critically important, will never be able to reach everyone who inject illicit drugs.

Pharmacies, on the other hand, reach into nearly every neighborhood, urban, suburban, and rural, and are often open long hours. A mix of Federal, state, and local laws and regulations, designed to prevent access to sterile syringes for illicit drug use, are now known to accelerate the spread of HIV and HCV ([Gostin et al., 1997](#); [Burriss et al., 2002](#)). By selling syringes without restriction, pharmacists can provide not only lifesaving access to sterile syringes to people who inject drugs in every community, but also vital information about safe injection technique and referrals for hepatitis testing and treatment and treatment for substance use ([Fuller et al., 2007](#); [Crawford et al., 2013](#)). Where syringes still require prescription by law, physicians can prescribe them and provide the same lifesaving benefits ([Rich et al., 2004](#)).

But syringes are only part of the picture. Substantial evidence indicates that HCV is often transmitted through the use of not just contaminated syringes, but other injection equipment, such as cookers – containers used to dissolve drugs in water – cottons used to filter the drug solution, and water used to dissolve the drugs ([Thorpe et al., 2002](#); [Hahn et al., 2002](#); [Hagan et al., 2001](#)). Thus, increasing the effectiveness of efforts to prevent HCV transmission will require expanding their focus beyond syringes to emphasize the need to avoid sharing cookers and other injection equipment as well.

While illicit opioid injection may begin for a variety of reasons, once dependence ensues, continued use is often driven by the need

Table 5
Structural interventions needed to eradicate hepatitis C in the United States.

The following structural changes are needed to address social determinants of hepatitis C:

- Replace repressive and punitive criminal justice interventions (criminalization and incarceration) with public health approaches to reducing the harm of licit and illicit substance use
- End the ban on use of Federal funds for syringe access services
- Repeal laws and regulations that prohibit distribution of sterile injection equipment
- Reduce the stigmatization that demonizes and vilifies persons with unhealthy behaviors
- Create public health and healthcare infrastructure with the ability to:
 - reach, engage, and impact marginalized populations
 - respond to new epidemics as they emerge
 - reverse the deleterious effects of stigma and discrimination by providing respectful HCV prevention and treatment services
 - generate resources and public awareness and support
- Provide universal access to hepatitis C prevention and treatment services to all persons living in the United States (ideally through nationwide universal health care)
- Assure the human rights of all people without regard to licit or illicit substance use
- Expand the social safety net to allow people facing poverty, homelessness, unemployment, mental illness, problematic substance use, ethnic discrimination, or other forms of social disadvantage to achieve greater well-being
- Train law enforcement and correctional personnel in harm reduction principles and practice
- Provide HCV prevention, testing and treatment services in criminal justice settings, including jails, prisons, probation, and parole
- Extend the scope of the responsibility of public health departments to include incarcerated populations
- Create a national action plan incorporating public health, public safety, academic, healthcare, industry, and community stakeholders, and sufficient resources, to prevent and treat hepatitis C
- Sufficient funding for all of the above
- Sustained political/societal will (at all levels from the community to the national government) for the above
- Sustained political advocacy to motivate the above

Table 6

Research needed to eradicate hepatitis C in the United States.

Research on the following problems is needed to support hepatitis C eradication efforts:

- Improve the effectiveness of prevention interventions to more effectively help people at risk reduce their risk and interrupt transmission
- Improve viral testing technologies to more quickly, more cheaply, and less invasively ascertain current infection status
- Develop testing technology to detect acute HCV infection for purposes of treatment and surveillance
- Continue development of shorter, more effective, and less toxic antiviral treatments for all patient groups, including “difficult-to-treat” groups such as those with cirrhosis, African American ethnicity, or prior unsuccessful treatment attempts
- Examine the effectiveness of antiviral regimens in real-world populations, including those with medical and psychiatric comorbidity, poverty, obesity, and alcohol and illicit substance use
- Prioritize the development of interventions that can more effectively engage and retain infected persons in care
- Better define the roles of integrated multidisciplinary services, integrated care, case management, patient navigation, and peer interventions to support access to, acceptance of, and adherence to antiviral therapy
- Develop programs to provide antiviral therapy to persons who inject illicit drugs and assess the real-world effectiveness of these programs
- Develop simplified, straightforward regimens that primary care practitioners can use safely and effectively without elaborate training and without elaborate requirements for patient selection, characterization, or monitoring for viral response or side effects or the need to tailor regimens according to patient characteristics (such as viral genotype, viral load, host genotype, prior treatment response, patient ethnicity, liver disease stage, etc.)
- Investigate interactions between antiviral agents and drugs used to treat mental health conditions and substance use and determine best practices for managing them
- Determine optimal treatment regimens for acute HCV infection
- Develop an effective preventive vaccine

to prevent opioid withdrawal. Opioid substitution therapies such as methadone and buprenorphine, prescribed for the treatment of opioid dependence, are among the most effective known medical treatments for any condition (McLellan et al., 2000; Gerstein and Harwood, 1990). Yet we have failed to make them available to the vast majority of people who need them (Institute of Medicine, 2006). Expanding access to these therapies can dramatically reduce illicit drug injection in the riskiest of circumstances, when opioid use is needed to stave off withdrawal symptoms, and allow PWID to reduce the spread of HIV and HCV infection (Gowing et al., 2011).

In recent years, new outbreaks of hepatitis C have emerged among young people who begin using pharmaceutical opioids and then shift to injecting heroin, which is cheaper and easier to obtain (Office of HIV/AIDS and Infectious Disease Policy, 2013). Targeted outreach to these new at-risk populations will be needed to bring prevention tools and messages to them – ideally before the transition to injection occurs. The same methods and principles that have enabled effective prevention with other marginalized at-risk groups must be used – respect, cultural competence, tolerance, avoidance of judgment, and the full collaboration of affected communities in defining and implementing needed interventions, to ensure that they are credible, relevant, and effective (International Network of People Who Use Drugs, 2008; Jürgens, 2008; Hunt et al., 2010; Leicht et al., 2011; Potts, 2008; World Health Organization, 1986).

All HCV prevention interventions must be developed in partnership with members of the affected communities, because they can provide extensive information about the context in which injection and risk behavior occurs, inform how such risk has been and can be mitigated, provide input regarding how messages may be received, and assess the relevance of risk-reduction strategies. Productive partnership with affected communities requires respect, non-judgment, cultural competence, and the willingness to learn from PWID. Professionals have expertise in disease and treatment, but PWID are the experts on their lives, their social norms and networks, the drugs they use and how they use them, the messages that will be credible, the changes that are achievable, and the interventions that will be effective (O’Mara-Eves et al., 2013; Institute of Medicine, 2013). Community-based coalitions (Albert et al., 2011; Brason et al., 2013) and interventions using successful indigenous strategies of PWID who have remained uninfected (Mateu-Gelabert et al., 2014) show promise, as do peer interventions, which empower the same indigenous networks through which drugs and information about drug use are transmitted to pass along information and strategies for reducing disease

transmission (Crawford and Bath, 2013). Separate programs may be needed for older and younger clients, whose needs may vary. Multicomponent interventions are needed, to take maximum advantage of all effective prevention modalities (Degenhardt et al., 2010; Harris et al., 2012; Birkhead et al., 2007), and should involve strategic alliances between public health agencies and community institutions including community-based organizations, substance use treatment programs, community-based and specialty health facilities, homeless/housing services, adolescent health and services programs, emergency medical facilities, law enforcement, and criminal justice, to maximize engagement with populations at risk. Primary care providers, for example, can interrupt HCV transmission by screening for opioid addiction and providing information, access to sterile syringes, hepatitis C education, testing, and treatment, and treatment for opioid addiction to those who need it (Bowman et al., 2013). Adherence by physicians to evidence-based opioid prescribing guidance can also help reduce opioid addiction (Coffin and Banta-Green, 2014).

Much can be learned from outside the United States. Supervised drug consumption rooms, operating in at least 63 cities in 9 countries on 3 continents, provide an environment where the harmful consequences of drug use, including bacterial and viral infections and overdose, can be minimized (Hedrich et al., 2010; Schatz and Nougier, 2012; Marshall et al., 2011). Implementing them in the United States would require political support, and possibly legislative reform (Beletsky et al., 2008). Heroin maintenance treatment, an evidence-based therapy available in five European countries, provides a safe and effective alternative for people for whom methadone proves ineffective (Oviedo-Joekes et al., 2009; Ferri et al., 2011; Strang et al., 2012).

Finally, scores of viral hepatitis outbreaks have been documented due to improper procedures in U.S. healthcare facilities, especially in ambulatory surgery centers, often involving the use of multidose medication vials (Thompson et al., 2009; Perz et al., 2010). Undoubtedly hundreds more instances of transmission have gone undetected or have not been subjected to careful investigation. Systematic surveillance, monitoring, and remediation of these practices are needed.

3. Testing

Among the most important prevention strategies, hepatitis C testing is also a necessary prerequisite for identifying infected people so they can be engaged in care and treatment for their infection (Table 3). As many as 75% of people with hepatitis C in the US are unaware of their infection (Institute of Medicine,

2010; Smith et al., 2012). HCV antibodies can be detected using a highly sensitive and specific enzyme immunoassay test, and a rapid test that can be performed on a fingerstick blood specimen has been approved by FDA. Both the Centers for Disease Control and Prevention and the U.S. Preventive Services Task Force now agree that all people born between 1945 and 1965 should be tested at least once to detect unsuspected HCV infection (Smith et al., 2012; Moyer, 2013). Widespread implementation of this recommendation by public health programs and healthcare systems will be required to maximize the benefits. Electronic health records can be leveraged to facilitate or even automate this, using alerts or bulk or standing orders. But while birth cohort testing is expected to identify 75% of undiagnosed HCV infections, the remaining 25% are in other age groups and will be unaffected by this strategy. Consequently, other groups with an increased prevalence of HCV infection must also be offered screening (Table 7). Indeed, there is enough economic evidence to justify at least one-time screening of the entire adult population aged 20–69 (Coffin et al., 2012), which would greatly simplify implementation of the necessary screening.

Hepatitis C disproportionately affects marginalized groups, however, of whom many will be missed by these efforts in healthcare facilities because they are not engaged in health care. Strategies that have been used to promote HIV testing in marginalized high-risk populations, such as low-threshold testing in community-based venues, and financial incentives, can be employed to increase the detection of HCV infections. Opportunistic strategies can maximize efficiencies; for example, with a minimal investment of resources and infrastructure, an HCV test could be added whenever HIV testing is performed, in clinical or community-based settings.

Targeted outreach to high-risk populations is particularly important. In such populations several alternative testing algorithms may be helpful. In groups with a high prevalence of HCV antibodies, such as PWID, testing initially with a viral antigen

or RNA test – either as a reflex when an antibody test is positive, or by omitting the antibody test entirely – can shorten the process of determining a person's infection status by avoiding the need to obtain a second sample, and consequently reduce loss to follow-up. Direct viral testing, if repeated at frequent intervals (e.g., every 3 months), can also detect new acute infections in high-risk persons during the “window period” before antibodies have developed, maximizing the opportunity to prevent not only chronic infection but also secondary transmission. Treatment during the acute phase of infection can be shorter and more effective than during the chronic phase, although regimens using the newer antiviral drugs remain to be determined. Economic analysis is needed to ascertain the cost-effectiveness of this strategy.

4. Care

Once infected people are identified, they must be engaged in care in order to benefit from newly approved regimens that now offer high rates of cure (Table 4). The development of therapies capable of clearing infection in 80%–90% or more of patients is perhaps the most powerful tool for the elimination of hepatitis C. Interferon-free regimens, now in clinical trials, under review at FDA, or already approved (Pawlotsky, 2014; Lange et al., 2014), promise to reduce the barriers to eradication even further. Currently, many patients diagnosed with hepatitis C do not undergo therapy (Kramer et al., 2012; North et al., 2013). There are a variety of reasons for this, but the barriers posed by interferon therapy account for many of them. Interferon's daunting side effects include distressing flu-like symptoms, severe cytopenias, and neuropsychiatric sequelae ranging from insomnia and irritability to life-threatening depression. Patients with a history of psychiatric illness or heavy alcohol or illicit substance use are often judged ineligible for treatment. Managing the side effects is complicated enough that treatment is generally only prescribed by specialists, and remuneration is limited enough that many specialists are unenthusiastic about treating large numbers of patients.

These barriers will diminish if interferon is eliminated from the picture. Newer regimens now in development offer the prospect of curing 95%–100% of patients with interferon-free therapy in as little as six weeks (Kohli et al., 2014). More than a dozen interferon-free regimens are in clinical trials (Pawlotsky, 2014; Lange et al., 2014). But while drawbacks to these regimens will be much fewer, some will still remain, including drug-drug interactions, the risk of antiviral drug resistance, and what are likely to be very high costs for the drugs. Moreover, while generous health insurance plans will likely pay for these therapies, millions of Americans lack coverage. The Affordable Care Act promises to decrease this number substantially, but not to zero. Those who remain without insurance will be those socially and economically disenfranchised groups in whom hepatitis C is disproportionately prevalent.

Thus, while newer therapies will make it possible to eliminate hepatitis C in the more advantaged, eradication will require assuring access to care for those less fortunate. This will necessitate (a) adequate insurance coverage, (b) sufficient numbers of clinicians prepared to prescribe and monitor therapy, (c) affordable drug regimens, and (d) sufficient support services to enable patients to manage the therapies. Sufficient resources, both organizational and financial, will need to be committed to assure that the new regimens are accessible to all those affected by the epidemic. Hepatitis C cannot be eradicated if millions remain without access to health care. Case management, patient navigation, and peer support programs can help assure that patients prescribed the new regimens will be able to adhere, complete, and benefit from them. Reinfection rates in PWID achieving SVRs have been low to date, when patients have been thoroughly educated and have access to the means to avoid reinfection (Aspinall et al., 2013), but rigorous

Table 7
Groups that should be screened for hepatitis C.*

Persons in the following groups, which have an elevated prevalence of HCV infection, should be considered for hepatitis C screening

Persons with the following medical conditions or treatments

- Diabetes or hypertension
- Human immunodeficiency virus infection
- Long-term hemodialysis
- Blood transfusion, blood products, or an organ or tissue transplant before July 1992
- Elevated levels of liver enzymes in blood

Persons with the following exposures

- Percutaneous or mucosal exposures to HCV-infected or -unknown blood
- Children born to HCV-positive mothers
- Unsafe medical injections or procedures, tattoos, or piercings
- History of ever injecting illicit drugs

Persons with the following social, demographic, or behavioral risk factors

- History of noninjected drug use, especially crack or intranasal cocaine
- History of heavy alcohol consumption
- History of mental illness
- Lack of a college degree, and especially <12 years of education
- Lack of health insurance
- Income below 2 times the Federal poverty threshold, and especially persons living in poverty
- Homelessness or a history of homelessness
- Incarceration or a history of incarceration
- ≥ 10 lifetime sexual partners, and especially ≥ 20 lifetime sexual partners
- Sex before age 18
- Birth in high-prevalence countries
- Birth between 1945 and 1965
- African American ethnicity
- Male sex

* Economic evidence supports at least one-time screening of the entire adult population aged 20–69 years (Coffin et al., 2012), which would greatly simplify implementation of the necessary screening.

prevention services will be needed to be sure this remains the case. Access to sterile injection equipment must be unencumbered.

Struggles between drug makers and payers over the prices of the new drugs for hepatitis C have emerged as a major threat to access, especially for vulnerable patients. Drug makers have set prices high, and some payers, especially Medicaid programs, have begun denying or restricting access. Thus, just as the new regimens are poised to bring about sharp reductions in morbidity and mortality, they are likely to sharpen disparities between advantaged and disadvantaged populations. If we are to eradicate hepatitis C, everyone who needs hepatitis C treatment must have access to it. Rationing therapy means allowing people at risk of progression to continue to die and those at risk of transmitting to continue to spread the infection. Rationing means telling patients that a safe and effective cure is available, but because of the price they must wait until their liver is severely damaged before they can receive it. This is not an acceptable policy. The drugs are inexpensive to produce (Hill et al., 2014) and it would be irresponsible to let the epidemic continue to spread while they sit on the shelf. Payers and drug makers must come together and agree on a workable solution to allow everyone who needs access to the cure to have it. Patients must not be fodder for price wars between multibillion-dollar organizations, each pursuing its own financial interest. They must not be allowed to die of an easily curable disease, hostage to a financial struggle between drug makers and payers. Pharma, government, and private payers are capable of finding a way to make the drugs available to everyone who needs them. At this watershed moment in the epidemic, there is no excuse not to do so. It would be a perverse outcome, a shameful indictment of our public health and healthcare systems, if just at the moment that we have the tools to eradicate this scourge, the structure of medication financing in our country were to foil our ability to use them. Affordable pricing will assure the largest possible market for the drugs, a win–win arrangement. Government, industry, and payers must work together to reach agreements to assure full access to antiviral drugs for all who need them (Editorial, 2014).

5. Social determinants of hepatitis C

Eradication of hepatitis C in mainstream society faces substantial challenges. Drug regimens must be developed that are safe, tolerable, convenient, and effective. Prices must be negotiated that payers will be able and willing to afford. Enough practitioners must be found and trained to prescribe them to millions of infected persons. Iatrogenic transmission in healthcare settings must be identified and interrupted.

But strong social forces are at work to overcome these challenges. Pharmaceutical companies are mounting vigorous drug development efforts and are eager to support educational programs for a broad clinician workforce. New regimens in development will be less toxic and less complex to prescribe. The proliferation of competing regimens could drive prices into the affordable range. And the Affordable Care Act will extend health insurance coverage to millions of Americans.

But while these developments will help millions of Americans with hepatitis C who have jobs, doctors, and health insurance, the epidemic cannot be stopped, let alone eradicated, without attacking its core. Hepatitis C is concentrated among people disadvantaged by poverty, unemployment, homelessness, substance use, lack of health insurance and access to health services, ethnic discrimination, and the epidemic of incarceration (Table 7) (Edlin, 2011,2013; Armstrong et al., 2006; Edlin, 2005; Stepanova et al., 2011). Each of these conditions presents obstacles to the prevention and treatment of hepatitis C. The core of the HCV epidemic

– where most ongoing transmission is occurring – is among PWID. Eradicating hepatitis C will require the political and social willingness to provide services to these disadvantaged and often stigmatized members of society.

Key public policies and social forces in the United States, however, pose substantial barriers to hepatitis C eradication in these groups. These include (1) the arrest, prosecution, and incarceration of people who use drugs (PWUD), (2) restrictions on safety net services for PWUD, (3) restrictions on public health measures that would stem the spread of infectious diseases such as HCV and HIV infections among PWID, (4) the dismantling of the social safety net that provides opportunities for people grappling with poverty, homelessness, incarceration, and substance use to improve their health and well-being, and (5) social stigma—the demonization of drugs and people who use them.

5.1. Structural interventions

These social forces that shape how diseases move through populations – stigma, discrimination, incarceration, poverty – the social determinants of health and disease – are called structural factors, because they are social structures that constrain risk and determine, or influence, who gets ill and who gets better (World Health Organization Commission on Social Determinants of Health, 2008; Centers for Disease Control and Prevention, 2010). Poverty, for example, promotes hepatitis C, as it does other diseases; Americans living in poverty have a ninefold increased risk of having hepatitis C (Armstrong et al., 2006). Homeless populations have HCV prevalences as high as 20 times the national population (Edlin, 2011; Gelberg et al., 2012; Beijer et al., 2012). The dismantling of the social safety net (Editorial Board, 2013a,b) increases the pressure on people with few resources, forcing them to address more urgent priorities than hepatitis C and reducing their reserves and resilience to resist harmful substance use.

Structural interventions target the social environment in which diseases such as hepatitis C thrive and spread. To eradicate hepatitis C, at least seven types of structural changes are needed: (1) ending the mass incarceration of people who use drugs, (2) reducing the stigma associated with substance use, (3) protecting the human rights of PWUD, (4) removing the legal barriers to hepatitis C prevention, (5) building public health infrastructure able to reach, engage, and serve marginalized populations, (6) expanding social safety net services for the poor and the homeless, and (7) sustained political advocacy to build and sustain support for these changes (Table 5).

5.2. Mass incarceration

For decades, the U.S. has pursued an aggressive policy of arresting and incarcerating its citizens who use illicit drugs, focusing especially on poor, minority communities (Alexander, 2010; Drucker, 2011). Millions of people, particularly people of color – and most especially poor, young, African American and Latino men – have been imprisoned, at a cost to the public of hundreds of billions of dollars (Travis et al., 2014; Count the Costs, 2013). Incarceration of people who use illicit drugs is a senseless policy, since about 9% of adults in the United States currently use illicit drugs; in fact, 125 million Americans have at some time used illegal drugs (Substance Abuse and Mental Health Services Administration, 2012). Imprisonment can be, and is, applied to only a small subset of drug users, and is focused particularly on those disadvantaged by racism and economic deprivation. This policy of mass incarceration destroys lives, decimates families, and ravages communities, weakening their cohesion and undermining their well-being (Clear, 2007; Wildeman and Western, 2010). It sets police in violent conflict with the communities they are tasked

to protect, creating a climate of fear, distrust, secrecy, and evasion that pervades everyday life (Goffman, 2014), and while it has had no measurable effect on reducing drug use, the criminalization of drugs has fostered the enrichment of a massive, international, criminally controlled illegal drug market, fueling corruption and violence worldwide (United Nations Office on Drugs and Crime, 2005; Nazario, 2014). But while the professed objective of this policy is to keep people from using illicit drugs, there is little evidence of a beneficial effect on either drug use or public safety. Portugal decriminalized all illicit drug use in 2001 and experienced no surge in illicit drug use but was able to implement a public health approach to reducing the harms of drug use (Moreira et al., 2011; Greenwald, 2009). In the U.S., which is now experiencing epidemic increases in the nonmedical use of both pharmaceutical opioids and heroin, illicit drugs are at least as plentiful, readily available, and widely used as ever (Fig. 1) (Substance Abuse and Mental Health Services Administration, 2012; Office of National Drug Control Policy, 2004; National Research Council, 2010; Global Commission on Drug Policy, 2011).

But apart from its impact or lack thereof on drug use, the policy of mass incarceration fuels the spread of diseases such as HIV and HCV (Global Commission on Drug Policy, 2012, 2013). It drives drug use and drug users underground, creating a climate of secrecy and mistrust in which disclosure of drug use to the authorities subjects people to the risk of severe punishment. Punishments for drug use in the United States are among the harshest in the developed world (Turner and Bunting, 2013; Subramanian and Shames, 2013; Mauer, 2003). Avoiding arrest and incarceration is an omnipresent priority for PWUD, taking precedence over the need for health services and the use of measures to prevent bloodborne infections such as HIV and HCV. Street-level policing disrupts the provision of services to PWUD, increasing risk behavior associated with infectious disease transmission and overdose. Police often harass people using syringe exchange services, confiscate their syringes, or arrest them for possession of syringes (Beletsky et al., 2011a, 2014). These practices increase risk behavior and fuel the spread of HIV and HCV (Wood et al., 2009; Kerr et al., 2005; Fitzgerald, 2005; Friedman et al., 2011).

Repressive drug policies extend beyond incarceration (Petersilia, 2003; Braman, 2004; Thompson, 2008). Once convicted, those found to have used drugs are often barred from ever receiving public services such as housing, education, and health insurance that would allow them opportunities to move away from harmful drug use and adopt healthier behaviors. Imprisonment, in effect, operates in a vicious cycle, punishing illness and poverty in ways that, in turn, generate further illness and poverty (Rich et al., 2014). Other policies, such as the Congressional ban on using Federal funds for syringe exchange, undermine public health efforts that could reduce the spread of HIV and HCV. Enacted by Congress to make illicit drug use more difficult, this ban has achieved no appreciable reduction in drug use but has crippled attempts to prevent the spread of bloodborne diseases such as HIV and HCV, and must be lifted to enable the eradication of hepatitis C. A web of laws and regulations restricts and criminalizes the possession, distribution and dispensing of needles and syringes that pharmacists and public health programs could otherwise provide to prevent bloodborne virus transmission (Gostin et al., 1997; Burris et al., 2002). These restrictions result in increased rates of equipment sharing, often exacerbated by the use of needle and syringe possession by police as evidence of criminality. These policies ensure that while illicit drugs are plentiful, sterile injection equipment is scarce – conditions that assure continued bloodborne virus transmission.

Recognizing that these repressive drug policies are ineffective, violate basic human rights, generate violence, and expose individuals and communities to unnecessary health risks, a growing international consensus has emerged, calling for a shift from repressive criminal justice measures to a public health approach to reducing the harms of illicit drug use (Global Commission on Drug Policy, 2013; United Nations Programme on HIV/AIDS (UNAIDS) and United Nations Office of the High Commissioner for Human Rights (UNHCR), 2006; Costa, 2008; United Nations Office on Drugs and Crime, 2008; United Nations Office on Drugs and Crime (UNODC), 2009; Wood et al., 2010; Grover, 2010; Insulza, 2013; Pugh et al., 2013; Editorial Board, 2014). Resolve will be needed, however, to translate these sentiments into action. Ending

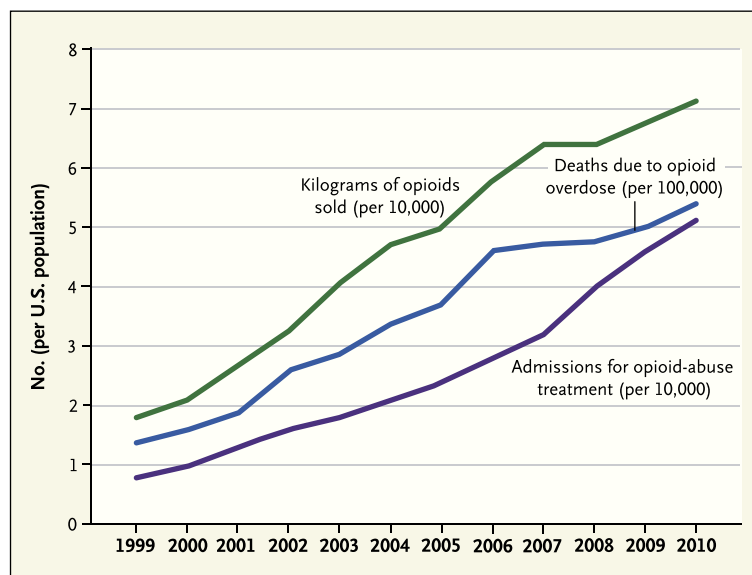


Fig. 1. Epidemic of Nonmedical Opioid Use, United States, 1999–2010. The United States experienced four- to sixfold increases in opioid sales, admissions for opioid-abuse treatment, and deaths due to opioid overdose from 1999 to 2010. While overdose deaths are highly visible, HCV infections resulting from the same epidemic are invisible, but if not detected and treated, can be just as lethal. Sources: Data are from the National Vital Statistics System of the Centers for Disease Control and Prevention, the Treatment Episode Data Set of the Substance Abuse and Mental Health Services Administration, and the Automation of Reports and Consolidated Orders System of the Drug Enforcement Administration. Reprinted with permission from Volkow ND et al. *N Engl J Med* 2014;370:2063–6.

punitive approaches to drug use would allow implementation of public health interventions capable of mitigating the harms of drug use, preventing the transmission of HCV, and providing curative treatment to interrupt transmission and reduce the burden of liver disease. At the same time, public health approaches are more likely than repressive criminal justice action to reduce harmful drug use itself.

5.3. Stigma

The criminalization of drug use amplifies, reinforces, and legitimizes stigma and discrimination associated with illicit drug use, which in turn are central drivers of the HCV epidemic. Stigma operates by triggering shame in the stigmatized and disgust in others (Goffman, 1963), strong emotions which overshadow other priorities such as enhancing health or reducing risk. Stigmatized individuals stand as “deeply discredited persons facing an unaccepting world” Goffman, 1963. Stigma and discrimination permeate nearly every aspect of the daily lives of PWUD – from relationships with family and friends, to employment opportunities, to individual mental health, and especially to medical care (Olsen and Sharfstein, 2014; Room, 2005).

Drug-related stigma has been largely normalized and is generally perceived as acceptable (Anderson and Ripullo, 1996; Simmonds and Coomber, 2009). In public discourse, users of illicit drugs are often portrayed as perpetrators of social ills (Duster, 1970; Musto, 1973; Reinarman and Levine, 1997). Drug use is seen as a moral failing, for which users are culpable, without regard for the conditions that lead people to problematic drug use and inhibit change (McLaughlin and Long, 1996). Rooted in moral judgment and fear, drug-related stigma creates a dynamic in which people who use drugs are held to high standards for all problems linked to their drug use despite a socially constructed and reinforced web of barriers to opportunities, resources and care. Stigma and shame rob PWUD of status and power and subject them to discrimination and injustice. The withdrawal of rights and withholding of needed services from drug users is normative in public policy in the United States.

Stigma is reinforced by beliefs and ideas (Link and Phelan, 2001). The belief that people who use drugs are less deserving of care, that PWUD are not interested in caring for their health and well-being, or simply that PWUD are too “difficult to reach” inhibit the development and implementation of programs to address the needs of this community (van Boekel et al., 2013; Merrill et al., 2002) – even though it has consistently been shown that when services are tailored appropriately and delivered with cultural competence and respect, PWUD are quite easy to reach (Flanagan and Hancock, 2010; Springer, 1992; Litwin et al., 2005). When given the necessary tools – primarily education and access to sterile injection equipment – PWUD promptly and dramatically reduced their HIV incidence rates, much more rapidly than have people at risk sexually (Kral et al., 2003). Yet most are denied even these basic interventions, and myths about their intransigence and irresponsibility persist (Beyrer et al., 2010).

Stigma amplifies the hepatitis C epidemic by impeding many kinds of activities needed for its eradication. It inhibits the development, implementation, and funding of programs to address the needs of PWID such as HCV prevention and treatment. It prevents PWID from accessing such programs. It keeps doctors, nurses, and pharmacists from objectively providing PWID with life-saving, specific information about how to avoid HCV infection beyond simply advising them not to use illicit drugs. It prevents PWID from disclosing their use to healthcare providers who could then offer prevention services, testing, and treatment. It inhibits PWID from objectively and thoughtfully planning rational strategies to avoid acquiring and transmitting HCV infection in their community.

And it keeps them from mobilizing to bring political pressure and demand attention to their rights and needs, which remain unmet and disregarded.

5.4. Public health infrastructure

Infrastructure, a critical prerequisite for disease eradication (Dowdle and Cochi, 2011; Dowdle, 2004), is also a powerful tool against stigma. Environments must be created where PWID can receive health services without fear of shame or stigma. The same programs can provide prevention, testing, and care. Treatment services must include comprehensive and continuing primary and specialty medical care, substance use treatment, and mental health services. Case management, social services, and programs such as peer support, HIV and HCV prevention, and overdose prevention can amplify their effectiveness. Programs are needed to reach PWID in primary care health facilities, substance use treatment facilities, prisons and jails, emergency rooms, and community-based facilities that provide services to homeless persons and persons who use illicit drugs. Fortunately, examples of successful programs abound (Aspinall et al., 2013; Edlin et al., 2007; Bruggmann and Litwin, 2013) but scaling them up will require stable, adequate funding either through dedicated funding streams or universal health insurance. Healthcare providers and systems, especially primary care practitioners, need education and training in both treating hepatitis C and caring for stigmatized, substance-using populations. Best practices need to be developed in the principles of harm reduction and motivational enhancement and the delivery of expert, nonjudgmental care to PWUD. Partnerships to bridge the divide between providers with expertise in hepatitis C treatment and programs that serve PWID – groups who rarely cross paths and even more rarely communicate – can foster the collaboration and cross-training needed to treat hepatitis C in PWID, and should be promoted and supported.

5.5. Law enforcement

Given their pervasive ability to promote or impede efforts to prevent HCV and HIV transmission, enlisting law enforcement in these efforts is critical. Training police officers in harm reduction can enlist them in support of disease prevention efforts, rather than undermining them (Beletsky et al., 2011b; Silverman et al., 2012; United Nations Office on Drugs and Crime, 2013). Drug courts have been widely implemented, offering treatment instead of incarceration for some persons arrested for drug offenses. But while treatment is certainly more beneficial than imprisonment, arrest records and convictions created by drug courts do lasting damage to people's future prospects for health and well-being (Cooper, 2007; Walsh, 2011; Drug Policy Alliance, 2011; Tiger, 2013). In Seattle, police, community members, and elected officials have collaborated to create a program that sends people found with drugs to community-based treatment and other support services without first arresting them (Satterberg et al., 2013; Satterberg, 2011).

5.6. Prisons and jails

So long as millions of Americans at high risk of hepatitis C are behind bars, penal institutions offer an unparalleled opportunity for HCV prevention and treatment (Allen et al., 2003; Cocoros et al., 2014; Rich et al., 2014). Millions of people pass through jails and prisons annually and a large proportion have hepatitis C or are at risk for it (Larney et al., 2013; McNamara et al., 2013; Hammett et al., 2002). Most of the barriers to reaching and engaging persons with prevention and treatment services in the community are absent in correctional settings, where providing these services is

cheaper and easier than in the community and couldn't be more practical (Edlin, 2011; Edlin and Carden, 2006; Spaulding et al., 2006; Iacomi et al., 2013). Since correctional agencies often lack the fiscal and professional resources to undertake public health initiatives, this will require collaboration between correctional and public health agencies (Klein et al., 2007) and extending the scope and mandate of public health agencies to include incarcerated populations.

5.7. Human rights

The Constitution of the World Health Organization states, "The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being," and "Governments have a responsibility for the health of their peoples which can be fulfilled only by the provision of adequate health and social measures" (World Health Organization, 1946). For PWUD, protection of the right to health requires that lifesaving needle and syringe access programs be available, that laws criminalizing the possession, distribution and dispensing of needles and syringes be repealed, and that treatment for life-threatening infections be provided in a manner that is accessible to those who need it (United Nations Programme on HIV/AIDS (UNAIDS) and United Nations Office of the High Commissioner for Human Rights (UNHCR), 2006; United Nations Office on Drugs and Crime (UNODC), 2009; Grover, 2010; UN Economic and Social Council, 2000). Thus, a national commitment to these measures is necessary for nations to ensure the human rights of PWUD. The recognition that the priorities of public health and human rights are aligned has led to a human rights-based approach to public health (Merrill et al., 2002). Governments are obligated to take action to ensure that all persons are accorded human rights (Jurgens et al., 2010; Gruskin et al., 2007). Policies that are likely to result in unnecessary morbidity and preventable mortality are breaches of governments' obligation to respect the right to health.

6. Research

Implementing the steps outlined above can have a major impact on the hepatitis C epidemic now (Tables 1–5). Still, much remains to be learned about how hepatitis C can best be controlled to further the goal of eradication. Research is needed to further each of the domains discussed above: epidemiology, surveillance, prevention, care, and structural interventions (Table 6). Methods are needed to quickly identify and engage groups experiencing emerging HCV epidemics to characterize the problem and provide prevention and treatment before uncontrolled transmission results. Research is needed to identify interventions that can effectively engage and retain PWID, among whom most new infections occur, in prevention and treatment services. Evidence-based interventions implemented to control HIV transmission among PWID effectively ended the era in which HCV infection was nearly inevitable within the first year of illicit drug injection, opening a window of several years that didn't exist before (Edlin, 2011; Tseng et al., 2007). But methods of reducing transmission further during that window are urgently needed.

Technological advances could address many of these challenges. Continued development of shorter, more effective, and less toxic antiviral regimens, already underway at a number of pharmaceutical companies, is needed. Attention will be needed to response rates in groups known to be less responsive to antiviral therapy, including patients with cirrhosis, African American ethnicity, and prior unsuccessful treatment attempts. Because sufficient specialists do not exist to meet the need, the barrier must be broken to move hepatitis C treatment into primary care (Brew et al., 2013).

Ideal regimens will be straightforward, without the need for the elaborate characterization of patients and detailed monitoring that characterized the first generation of HCV protease inhibitors. Drug-drug interactions must be well characterized, especially with drugs used to treat substance use and mental health conditions. Technologies capable of cheaply and rapidly identifying viral antigens or RNA during acute infection before the development of antibodies will facilitate recognition of groups sustaining new transmission, and identifying optimal regimens for the treatment of acute infection will maximize the potential to interrupt transmission and avert chronic infection. Protocols for pre- and post-exposure prophylaxis will further contribute to controlling transmission where it is greatest.

Still, answers are needed to a great many questions that will not be solved by technology. Much of this work must focus on PWID, the core of the hepatitis C epidemic (see Research Agenda, Supplementary Tables 1–7).

7. National action plan

A national action plan is needed to propel the action needed to bring about hepatitis C eradication. The plan must have the full collaboration of both health and law enforcement authorities in order to bring about the changes necessary for it to be effective. Conflicts between the public health and public safety functions of government, which often work at cross purposes, must be reconciled, so that fully coordinated efforts can be directed toward eradicating hepatitis C (Beletsky et al., 2011b; Silverman et al., 2012; United Nations Office on Drugs and Crime, 2013). Progress must be continuously assessed and monitored. Efforts must be sufficiently resourced to be effective. The U.S. Department of Health and Human Services has published a viral hepatitis action plan that contains scores of critical steps but provides no dollars for the control of viral hepatitis (U.S. Department of Health and Human Services, 2014). Controlling hepatitis C is likely to be cost-effective (Sadana and Blas, 2013; Chan et al., 2013), but investment of substantial funds will be necessary.

Scotland has set a superlative example for national action. That nation launched a vigorous National Hepatitis C Action Plan in 2006, emphasizing prevention, testing, treatment, care and support, and focusing particular efforts on delivering these services to PWID (The Scottish Government, 2008). The Scottish government committed £43 million to the effort, an amount corresponding to about \$4 billion for a country the size of the United States. The plan was based on an extensive evidence review, involved consultation with hundreds of stakeholders, adopted a multidisciplinary approach to hepatitis C prevention, diagnosis, and treatment, and has averted an estimated 3000 HCV infections (Hutchinson, 2013).

8. Advocacy

Strong and sustained advocacy will be necessary to propel movement toward the steps discussed in this article if hepatitis C is to be eradicated. Government action can provide critical support for needed structural changes (Sadana and Blas, 2013; Blas et al., 2008). Providing housing to homeless people, for example, is a critical intervention for disease prevention and health promotion (Doran et al., 2013). Creating programs to serve those in need can create a powerful momentum to reverse the effects of stigma, expanding options and opening doors to healthier behaviors (Sadana and Blas, 2013). But physicians, scientists, and the public health community must also provide leadership by partnering with community activists to advocate for social and policy change (Hanan et al., 2011; Downing et al., 2005; Gruen et al., 2006; Grace



Fig. 2. Elimination of Hepatitis C from the United States. This cartoon was drawn by Mike Luckovich to commemorate the 25th anniversary of the discovery of the hepatitis C virus. Great strides have been made against the hepatitis C epidemic, but further resolve will be needed to finish it off. The cartoon was commissioned by the Viral Hepatitis Action Coalition.

and Dennis, 2007; Farmer, 2013; Butkus et al., 2014). Principles of medical ethics require physicians to contribute to the betterment of the community's health and advocate for their access to health care (American Medical Association, 2001; Medical Professionalism Project, 2002).

9. Conclusion

Disease eradication initiatives can be powerful public health strategies. The establishment of an eradication goal can galvanize resolve, spur the commitment of resources, and focus efforts to achieve the goal. Efforts focused on a specific disease can provide broader benefits by improving health infrastructure and elevating the quality of care for other conditions as well, breaking vicious cycles of poverty and disease (Farmer, 2013). The elimination of hepatitis C from the United States is technically feasible, but it will require a sustained national commitment to reach, test, treat, cure, and prevent every case of hepatitis C. With strong, sustained political and social support and an active process of ongoing monitoring, evaluation, and innovation, it can be achieved. Much remains to be done if eradication of hepatitis C is to be accomplished in our lifetimes (Fig. 2). But if it is to be achieved, the time for action is now.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.antiviral.2014.07.015>.

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