

HIV and HCV Infection among Injecting Drug Users

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Abstract

Background: Human immunodeficiency virus (HIV) and hepatitis C virus (HCV) are the two blood-borne pathogens most commonly transmitted among injection drug users via multi-person use of syringes and other injection equipment. However, important differences exist in the epidemiology of HIV and HCV within different populations of intravenous drug users.

Methods: A literature review was carried out to summarize publications describing the epidemiology and natural history of HIV and HCV in injection drug users.

Results: Among injection drug users worldwide, HIV prevalence varies from < 5% to > 80%, with annual HIV incidence between < 1% and 50%. More consistency is shown in HCV prevalence (50–90%) and incidence (10–30% per year). Host, environmental and viral factors that favor rapid spread of HCV among IDUs suggest that HCV infection in a population of injection drug users may become endemic over a relatively short period of time. Lower transmission efficiency for HIV also indicates that its spread among injection drug users may be somewhat slower.

Conclusions: Successful efforts to prevent transmission of blood-borne viruses among IDUs typically result in risk reduction; however, no intervention has resulted in elimination of risk behavior. To reduce HIV transmission, risk reduction may be sufficient, whereas control of HCV may necessitate the use of injection practices that guarantee elimination of exposure to equipment contaminated with even small amounts of blood.

Key Words: Substance abuse, injection drug use, HIV, HCV, epidemiology.

BEFORE A PERSON injects psychoactive drugs, a small quantity of blood is drawn into the syringe to determine if the needle has been properly located in the vein. Even if the person then injects “all” of the blood and drug mixture from the syringe, a small residue of blood always remains in the needle and syringe; this residue may not be visible to the naked eye. If a second person then uses this same needle and syringe for an injection, any residue in the syringe and needle may be transferred into the second user. Blood residue may also contaminate shared equipment

used to prepare the drug for injection; the “cooker” used to heat and melt the drug into an injectable liquid and the “cotton” used to filter the drug as it is drawn into the syringe are two examples. There is substantial evidence that micro-transfusions occurring when injecting with a contaminated syringe can transmit blood-borne pathogens among drug injectors (1, 2). Although there is less direct evidence that sharing of other equipment may spread infections, the data indicate that this is probably the case (3, 4).

Hepatitis C virus (HCV) and human immunodeficiency virus (HIV) are the two pathogens most commonly transmitted by drug users through the multi-person use (“sharing”) of drug injection equipment (5, 6). These two pathogens are also likely to be responsible for the highest infectious disease morbidity and mortality rates among drug injectors worldwide. While both of these viruses can be transmitted through multi-person use of syringes and presumably via other drug injection equipment, there are important differences in the transmission dynamics of each virus within a population of injecting drug users (IDUs).

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Natural History and Epidemiology of HIV among IDUs

Persistent infection occurs in virtually all persons infected with HIV (7). The present data also indicate that, in the absence of effective treatment, the infection eventually results in an immunocompromised state which promotes opportunistic infections, certain malignancies and other fatal diseases (8–10). The length of time from initial infection to the development of severe immunodeficiency varies greatly among individuals (11). Epidemiologic studies have not shown that continuing to inject heroin or cocaine has any consistent effect on the rate of progression of HIV infection (12–15). However, it is conceivable that any actual effects of continued drug injection on disease progression are so modest as to be undetectable, and are statistically insignificant, even in large-scale epidemiological studies.

Over the last several years, there have been dramatic improvements in treatment of HIV infection. Highly active antiretroviral therapies (HAARTs) typically consist of three-drug combinations of antiretroviral agents, including reverse transcriptase inhibitors and protease inhibitors (16, 17). HAART can lead to suppression of viral replication and substantial increases in both the length and quality of life for HIV-infected persons (18–20). It is conceivable that by lowering HIV viral load in individual patients, HAART could also reduce the likelihood of HIV transmission to others in the event of blood exposure, but this has not been empirically determined (21).

The rates of HIV prevalence and incidence vary greatly among IDUs throughout the world (22). There are many populations of IDUs where HIV has not yet been introduced (23). In other regions, HIV in IDUs has stabilized at a relatively low prevalence (less than 5%) (24–28); incidence is also typically low in these settings, with rates of 1/100 person-years at risk or less (29, 30). There are also examples of IDU populations (e.g., Bangkok and Amsterdam) where seroprevalence appears to have stabilized at high levels, from 20–50% (31–33); under these conditions, HIV incidence is generally in the range of 4–8 per 100 person-years at risk (34, 35). Finally, there are some populations (China, Myanmar, and northeast India) in which HIV has infected a majority of IDUs (80% or more) (36, 37), and incidence rates may be 10/100 person-years at risk or higher (38, 39). Rapid dissemination of HIV appears to be most common in populations

in which there is little or no awareness of the threat or consequences of HIV. Documented historical examples of the rapid spread of HIV include New York City and Edinburgh; in each case, a shift from very low or no HIV infection in IDUs to moderate (20–40%) prevalence occurred over a period of six months to two years (40, 41). These early experiences, together with more recent examples, suggest that low HIV-seroprevalence patterns can change abruptly.

Variability in HIV incidence and prevalence rates among different populations of IDUs appears to be due to multiple factors, including: how long HIV has been present in the local population; the underlying frequency of risk behaviors; existing “mixing patterns” among local IDUs; and the extent to which public health and community leaders have implemented effective HIV-prevention programs. Understanding this variability and implementing suitable HIV-prevention programs are the two current, pressing challenges in controlling the transmission of HIV among IDUs.

Natural History and Epidemiology of HCV among IDUs

Hepatitis C virus infection becomes persistent in 70–80% of cases, as determined by persistently abnormal serum enzymes and/or viremia (HCV-RNA) (42). In a study of 43 IDUs in whom recent infection was observed, viral persistence was noted in 86%, after an average follow-up of six years (43). Persistent infection is believed to occur as a result of rapid genetic mutation of HCV and immune escape (44). Reinfection with the same or a different strain of HCV has been demonstrated experimentally in chimpanzees and observed to occur in humans with repeated exposure to HCV (45, 46). Thus, in the majority of cases, the immune response to HCV confers no protection against the development of chronic infection (47).

Following infection, 25–50% of IDUs develop acute hepatitis, with only one-half of symptomatic patients manifesting jaundice. More than 60% of persistent infections result in chronic liver disease; cirrhosis or chronic active hepatitis occurs within several years after infection in most (40–70%) of these cases (48). Persistent HCV infection is also associated with hepatocellular carcinoma (HCC) (49, 50). Few natural history studies have been carried out to determine whether ongoing drug use influences the course of persistent HCV infection (51). However, alcohol use is consistently associated with more rapid progression and greater severity of liver disease

in patients with HCV infection (52). HCV-genotype may also affect the course of the disease (53).

At present, alpha-interferon alone or in combination with Ribavirin is the only drug licensed for treatment of HCV infection (54). Early trials indicated that alpha-interferon treatment resulted in a sustained virological response (viral clearance six months post-treatment) in only 20% of cases (54); the combination of Ribavirin with interferon treatment raised the response level to approximately 40% (55). Protease inhibitors are also being evaluated as a treatment for HCV infection (56).

Studies of the prevalence of HCV infection carried out in IDU populations where drug injection has become endemic, support the hypothesis of rapid penetration. Compared to the epidemiology of HIV, there is relatively little heterogeneity in anti-HCV seroprevalence. Seroprevalence has been reported in a fairly narrow range, of 50–95% (57). The incidence of HCV infection in IDUs previously seronegative for HCV-antibody (anti-HCV) is generally 10–100 times higher than HIV incidence in the same group, in the range of 10–30% per year (57). These studies include 9% per year in Rome (58), 12% in Geneva (59), 17% in Seattle (60), and 38% in Australia (61).

There are many factors suggesting that, in a population of IDUs, a pattern of endemic HCV infection tends to develop over a relatively short period of time. Indeed, host, viral and environmental factors that determine transmission patterns of infectious diseases all seem to favor rapid spread of HCV among IDUs (62). Viral factors that facilitate HCV dissemination include the relatively high efficiency of HCV transmission via blood exposure; studies of needlestick exposures to contaminated syringes in health-care settings show that HCV transmission occurs in 3% of such exposures vs. 0.3% for HIV (63). As a result of the high levels of persistent infection in HCV-exposed individuals, there are large reservoirs of HCV-infectious IDUs in many regions of the world (57). The size of the reservoir of HCV infection may be a significant environmental factor affecting transmission dynamics, since it is related to the probability of contact with an infected individual. Host factors include behaviors that expose individuals to HCV, such as the shared use of drug preparation and injection equipment. Declines in these risk practices have been observed in the era of HIV/AIDS, and associated with reductions in HIV incidence (64). However, injection risk behavior has not been

eliminated (65–67), and sharing of drug preparation equipment such as drug cookers and filtration cotton, seems to persist in IDU populations because it is believed to be low risk in terms of HIV transmission (68). Thus, persistent risk behavior in IDUs, in combination with HCV viral and environmental factors that promote transmission, appears to be sufficient to facilitate the spread of HCV. One can imagine HCV spreading nearly unimpeded in a population of IDUs; such a scenario would also be possible for HIV, with some important differences. The lower transmission efficiency for HIV may impede its spread. Moreover, as a consequence of the lower HIV transmission efficiency, any reduction in syringe-sharing would be reflected in fewer HIV transmissions.

A vaccine against HCV infection might interrupt the chain of its transmission and reduce the number of new infections. However, some of the same problems exist as with HIV vaccine development. These include the existence of multiple strains and the high mutation rate of the HCV genome (69). While there is some current research to develop an HCV vaccine, the prospect of having such a vaccine in the immediate future is unlikely.

Comparison of HIV and HCV Prevention among IDUs

There have been more than fifteen years of efforts to prevent HIV infection among injecting drug users. To date, all efforts to prevent transmission of HIV and other blood-borne viruses among IDUs have led to risk reduction without total risk elimination. The extent of risk reduction appears to have been sufficient to significantly decrease HIV transmission among IDUs in many different areas (25, 70). And in some cities, low HIV prevalence has been maintained for more than five years. There is also new evidence that risk reduction programs may be able to “reverse” high seroprevalence HIV epidemics, such as the HIV epidemic among IDUs in New York City (64).

In contrast, awareness of the problem of HCV infection in IDUs arose only recently (71). At present, there is only one published study showing that a risk reduction program (needle exchange) was associated with reduced HCV infection in IDUs (72). Other studies have reported that neither drug treatment (73) nor needle exchange (58) had any effect on HCV incidence. Moreover, there is no evidence on a community level that risk reduction programs can

control HCV within a population of IDUs. Indeed, there are no known populations where HCV prevalence has remained at less than 5% for any considerable period of time. The reasons for this are not fully understood, and direct comparisons of HIV and HCV incidence in IDU samples has not provided an explanation (29, 32, 59–61). Thus, HCV control may be far more difficult to achieve than HIV control in a community of IDUs, and HCV prevention may be viewed as a relatively high standard against which public health prevention programs may measure themselves.

Summary

Throughout the fifteen years of HIV prevention efforts, there have been notable successes in terms of individual IDUs who did not become infected, in terms of prevention programs that were effective with large numbers of IDUs, and in terms of populations of IDUs in which both prevalence and incidence rates have remained very low. There are also many areas of the world where HIV is spreading very rapidly among drug injectors. The greatest problem in those areas may be the failure of public officials to implement prevention programs of known effectiveness.

In contrast, programs that explicitly attempt to reduce HCV transmission among IDUs have only existed a few years. To date, there have been few documented successes in reducing HCV transmission. Programs that can effectively control HIV transmission appear to be less effective against HCV, and a new generation of prevention efforts may be needed to control HCV transmission. This may be a formidable challenge, requiring greater resources in terms of outreach education, and distribution or exchange of sterile syringes and other drug injection equipment among IDUs. However, it is quite likely that HCV prevention efforts will benefit considerably from previous successes in developing and implementing programs to control HIV transmission among IDUs. Finally, HIV and HCV are but two blood-borne pathogens for which injecting drug users are at high risk. The lessons learned in HIV prevention and to be learned in HCV prevention must be kept in mind for future, as yet unrecognized, blood-borne infectious diseases.

Acknowledgments

This work was supported by NIH grants 1R01 DA 08023 and 1R01 DA 03574.

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