AIDScience Vol. 1, No. 16, December 13, 2001

The effectiveness of needle exchange programs: A review of the science and policy

Steffanie A. Strathdee[1] and David Vlahov[2]

[1]Department of Epidemiology, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, Maryland, United States.
[2]Joseph L. Mailman School of Public Health, Columbia University, New York, New York, United States.

Abstract

Needle exchange programs (NEPs) permit injection drug users (IDUs) to exchange potentially contaminated syringes for sterile ones, with the aim of decreasing the circulation of contaminated injection equipment and reducing the spread of blood-borne pathogens in the community. Since the first NEP was introduced in Amsterdam in 1984, at least 46 regions, countries, and territories reported having at least one NEP by December 2000. Surprisingly, only one-third of countries where HIV has been reported among IDUs and only 40% of countries where injection drug use is known to occur have introduced at least one NEP. There are also considerable variations in NEP availability and coverage within and between countries, and sometimes within states or cities. This review discusses the history, science, and politics surrounding the implementation and evaluation of NEPs in both developed and developing countries, and suggests alternative mechanisms to increase coverage of sterile syringes among IDUs. We also suggest areas for further research to guide future attempts at interventions that aim to reduce the global spread of blood-borne infections.

Introduction

Multiperson use of needles and syringes contributes to a considerable illness burden in both developed and developing countries. Use of nonsterile syringes can occur within the context of illicit drug injection and is associated with transmission of blood-borne pathogens, including HIV, hepatitis B virus (HBV) and hepatitis C virus (HCV), human T cell lymphotropic viruses, and even malaria. Syringe sharing, or even reuse of syringes by the same person, increases the risk of endocarditis, cellulitis, and abscesses.

From the public health perspective, it is important to ensure that persons who cannot or will not cease injection of illicit drugs are not at risk of these infections. In the United States alone, injection drug use accounts for approximately half of all new HIV infections annually, either directly through needle sharing between injection drug users (IDUs), or indirectly through sexual transmission among IDUs and their sexual partners (*1*). Although the incidence of vertical HIV transmission has decreased dramatically in developed countries since the advent of antiretroviral therapies offered to HIV-infected mothers, the majority of perinatally acquired HIV infections in North America can be traced back to a parent who was an IDU.

The urgency of providing IDUs with widespread access to sterile injection equipment is apparent on a global level when examining the link between initiation of injection and HIV infection (Table 1). In 1992, there were 80 countries, regions, and territories reporting injection drug use, of which 52 (65%) also reported HIV among IDUs. In 1999,

there were 134 such regions reporting injection drug use, of which 114, or 84%, reported HIV among IDUs (personal communication, Andrew Ball, 2001). In less than a decade, we have therefore witnessed nearly a 20% proportionate increase in the occurrence of HIV among countries reporting injection drug use, which underscores the need for prevention activities to start early before an epidemic takes hold.

The major types of interventions aimed at reducing drug-related harms are those based on outreach, drug treatment programs, network-oriented interventions, and needle-exchange programs (NEPs). Below, we discuss the history, science, and politics surrounding the implementation and evaluation of NEPs and other measures to expand syringe access. Readers interested in more general reviews of the other interventions mentioned here are referred to a number of excellent sources (*2*, *3*, *4*, *5*).

At NEPs, IDUs exchange potentially contaminated syringes for sterile ones, usually on a one-for-one basis. In doing so, NEPs aim to decrease the circulation of contaminated injection equipment, thereby reducing the spread of blood-borne pathogens in the community (*6*, *7*). Many NEPs provide other sterile equipment or paraphernalia that facilitates safer injection (e.g., cotton, cookers, water, and bleach). NEPs also act as a pivotal entry point for drug treatment and rehabilitation (*8*, *9*, *10*). Some NEPs also provide condoms, HIV testing and counseling, referrals to medical care, onsite screening for medical conditions such as sexually transmitted diseases (STDs) and TB, vaccines, abscess care, and multivitamins (Table 2). Although the usual modality for NEPs is one of a fixed store front or mobile van, some programs, such as the NEP in Bogota, Columbia, operate as a small group of outreach workers exchanging syringes from a backpack (personal communication, Timothy Ross, 2001).

The history of NEPs

The first NEP was introduced in Amsterdam, the Netherlands, in 1984 (*11*). The program, initiated by a drug-user organization, loosely translated as the Junkies' Union, was soon adopted by the Municipal Health Department of Amsterdam, where it became a cornerstone of HIV prevention activities among IDUs. Today in Amsterdam, IDUs can exchange syringes at 12 clinical settings, or "outposts," and a methadone bus that offers free HIV testing and counseling, methadone maintenance, and screening for STDs to Dutch citizens (*12*).

Since the mid-1980s, global expansion of NEPs has occurred in both developed and developing countries, despite many obstacles that will be discussed more fully below. In North America, the first NEPs were introduced in 1988, in Tacoma, Washington, and the Canadian cities of Vancouver, Toronto, and Montreal. In the United States, the introduction of NEPs was fostered by nongovernmental organizations such as the National AIDS Brigade and the North American Syringe Exchange Network, whereas in Canada NEPs were openly supported by the federal health minister. A needle exchange was implemented as early as 1995 in Katmandu, Nepal (*13*). The feasibility of NEPs has been assessed in Vietnam, where involvement from communities and ex-drug users were important aspects that affected acceptability (*14*). NEPs have even been introduced among the hill tribes of Northern Thailand (*15*) and in prison settings in Australia and Switzerland, where they have generally been well received (*16*, *17*).

As of December 2000, there were at least 46 regions, countries, and territories that reported having at least one NEP (Fig. 1). This suggests that only one-third of countries where HIV has been reported among IDUs and only 40% of countries where injection drug use is known to occur have introduced at least one NEP. There are also considerable variations in NEP availability and coverage within and between countries,

and sometimes within states or cities.

Why have these programs not been more widely adopted? Below, we review studies of NEP effectiveness and consider political and structural barriers to NEP implementation that have continued to hinder their expansion.

Studies of NEP effectiveness

NEPs have been associated with a number of positive health outcomes. In 1988, Buning and colleagues in Amsterdam reported declines in needle sharing and injection frequency associated with NEP participation (*18*). Other studies subsequently reported reductions in incidence of HIV, HBV, and HCV infections (*2*, *12*, *19*, *20*, *21*, *22*, *23*), decreased needle sharing among HIV-negative and HIV-positive persons (*22*, *24*, *25*), decreases in syringe reuse (*26*), and increased rates of entry into drug treatment programs (*8*, *9*, *10*) (Table 3 and 4).

In the United Kingdom and Australia, where NEPs were introduced early and vigorously within the context of a comprehensive prevention program including expanded methadone maintenance programs, HIV epidemics among IDUs have been essentially averted (*25*, *27*, *28*). Despite variations between programs, a recent international comparison showed that in 29 cities with established NEPs, HIV prevalence decreased on average by 5.8% per year, but it increased on average by 5.9% per year in 51 cities without NEPs (*29*). In New York City, NEPs have been associated with a dramatic decline in HIV incidence, which represents an HIV epidemic among IDUs that has essentially been reversed (*30*).

Although the overwhelming majority of studies have found NEPs to be associated with beneficial health outcomes, some studies have been equivocal in their findings. In 1997, one of the authors reported an HIV outbreak among IDUs that occurred in the presence of a high-volume NEP that had been introduced early (*31*). More recently, Hagan and colleagues (*32*) reported no benefit of NEP attendance upon incidence rates of HBV and HCV among IDUs in Seattle, Washington. On the other hand, Bruneau and colleagues reported a higher HIV incidence among NEP attendees compared to nonattendees in Montreal (*33*). These findings have generated controversy surrounding the evidence of NEP effectiveness among policy-makers, the lay community, and even scientists (*34*, *35*, *36*).

Among the scientific community, discussion has centered on possible explanations for higher observed incidence of HIV among NEP attendees relative to nonattendees in some settings (*35*, *36*, *37*). One of the most obvious explanations is that of selection bias, because NEPs tend to attract higher risk IDUs who engage in riskier behaviors compared to IDUs who tend to obtain syringes from other sources (*37*, *38*, *39*, *40*). Vancouver researchers demonstrated that selection bias could have entirely accounted for the higher HIV incidence rates observed among frequent versus infrequent NEP attendees (*37*). In San Francisco, IDUs who later began attending an NEP had higher HIV incidence rates than those who had never attended (*40*). Others have pointed out that the discrepant findings have tended to occur in settings where IDUs can legally purchase syringes in pharmacies (*38*, *39*, *41*). This would only serve to intensify the difference in risks between NEP attendees and nonattendees, because IDUs who can afford to buy syringes at pharmacies are likely to represent higher socioeconomic strata that are consistent with lower HIV risk propensities. Interestingly, extended follow-up of the Montreal cohort has revealed no significant differences with respect to HIV incidence among attendees and nonattendees of NEPs (*39*), which suggests that selection factors

operating earlier in the course of follow-up might explain their earlier findings.

To date, there appears to be no published evidence that NEPs cause negative societal effects. For example, there is no evidence that NEPs cause increases in drug use (*22*) or crime (*42*). Studies have failed to support the notion that NEPs indirectly contribute to the formation of high-risk needle sharing networks (*37*, *43*). There have been isolated, infrequent accounts of needle-stick injuries occurring in cities where NEPs exist. However, Doherty and colleagues (*44*) have demonstrated that there has been a significant decrease in the number of discarded needles on the street following the introduction of an NEP in Baltimore, which supports earlier studies (*45*, *46*). Although some contend that the evidence on NEP effectiveness remains open to interpretation, there is widespread agreement among scientists that NEPs do not cause social harms (Table 5).

Political barriers to the expansion of NEPs: the case of the United States

The concept of providing sterile syringes to drug users to reduce the spread of blood-borne diseases has been hotly debated in some settings, but perhaps nowhere more so than in the United States, where the debate has raged on for more than a decade. On a national level, several policy statements have overtly hindered the implementation of NEPs. In November 1988, a federal ban on U.S. funding for NEPs was enacted, which has been upheld despite the conclusions of several government-commissioned reports, many of which have specifically called for a lifting of the ban, albeit unsuccessfully (*2*, *47*-*50*) (Table 6).

The reasons for opposition to NEPs in the United States are multifaceted and complex, but are perhaps best viewed in terms of the policy of "zero tolerance" toward illicit drug use and the "war on drugs" that predated the HIV/AIDS epidemic (*51*-*53*). From this standpoint, drug use is viewed as a moral or criminal problem that should be punished rather than a medical problem that requires prevention and treatment. Interestingly, an analysis of 47 U.S. national surveys indicated that most Americans do not think that the war on drugs has succeeded, but they do not want to relinquish these efforts (*54*). Different ideologies toward drug abuse and HIV prevention have been reported to create uneven policies regarding the adoption of NEPs in other settings, such as England and Wales (*55*) and Brazil (*39*).

Despite the lack of federal funding, in 1999 there were over 160 NEPs operating in 39 U.S. states, the District of Columbia, and Puerto Rico (*56*). Yet the ban has clearly taken its toll. In a survey of 81 NEPs across the United States, Paone and colleagues (*57*) reported that NEPs that operated illegally were significantly less likely to offer crucial ancillary services, such as onsite HIV testing and counseling and formal arrangements for referrals to drug-abuse treatment services (Table 7). As it is well documented that NEPs can be an effective bridge to drug-abuse treatment, it is tragic that a country that has staked its reputation on zero tolerance of illicit drug use has maintained policies that prevent drug users from availing themselves of services to help them quit.

Beyond the congressional ban on federal NEP funding, there are additional barriers to syringe access for drug users at the state level. There are 47 states that have drug-paraphernalia laws that prohibit the sale, distribution, and possession of syringes known to facilitate illicit drug use (*58*). Eight states require a prescription for syringe purchase and possession, and 23 maintain pharmacy regulations or practice guidelines restricting access. In a recent assessment of syringe access in 50 states, it was considered that 16 have only retail access to sterile syringes, nine have only NEPs, 22 have no "clearly legal" form of syringe access, and four have no legal form of syringe

access at all (Fig. 2, Scott Burris, 2001, personal communication). However, in recent months, several states, including Rhode Island, Connecticut, and New Mexico, have relaxed restrictions on physician prescription of syringes, as discussed more fully below (*59*). Some states, such as New York, have launched initiatives to permit pharmacies and health providers to register to provide syringes without a prescription (Table 8).

Logistical barriers to NEP implementation: case studies of Brazil and the Russian Federation

There are some regions of the world where NEPs have been rapidly expanding. Brazil was the first country in South America to introduce an NEP, which opened in Salvador, Bahia State, in 1994. In 1998, there were 12 NEPs across Brazil. In 1999, decriminalization of syringe distribution and exchange occurred in São Paulo and Santa Catarina states, thereby improving access to sterile syringes. By 2000, there were 33 NEPs operating across Brazil (Table 9). Brazil has paved the way for other countries to support NEPs. NEPs or syringe-distribution programs were introduced in Buenos Aires, Argentina, in 1999, and Bogota, Colombia, in 2000. However, in many of these settings, fiscal restraints and opposition from police and religious authorities continue to limit program activities (*39*).

Another region that has made remarkable strides in implementing harm-reduction programs is the Russian Federation. Along with Ukraine, Kaliningrad, and the newly independent states, the Russian Federation has witnessed an explosive HIV epidemic among IDUs since the late 1990s (*60*). In the Russian Federation alone, there are an estimated 1 million IDUs. As of December 2000, there were at least 42 NEPs in the federation, of which over half began within the previous year. However, a survey of 25 NEPs in this region revealed that less than 1% of IDUs were being reached on a monthly basis (Table 10, David Burrows, 2001, personal communication). This calls into question the important issue of coverage.

Attaining optimal coverage: A sterile syringe for every injection?

Coverage can be quantitatively defined as the number of sterile syringes provided to IDUs divided by the number of injections during a specified time frame (*73*). In simple terms, this is the ability of an NEP to provide a sterile syringe for every injection, according to the public health ideal. Although numbers of injections will vary according to drug-use patterns and other factors, if one makes the rudimentary assumption that the average user injects twice a day, this suggests that each injector would require about 730 syringes per year to meet the goal of "one set, one shot."

In light of the barriers described above, it is worthwhile to examine how well NEPs in various settings are able to meet this public health objective. As depicted in the tables (Tables 11, 12, 13, 14), the number of syringes provided per IDU in NEPs operating in many developing countries is far below what would be required if a sterile syringe was used for every injection.

Even in regions where syringe availability is considered excellent, there are dramatic variations within and between countries. For example, in the United Kingdom, over 27 million syringes were exchanged or sold in 1997, and there were over 2000 NEP outlets (Table 13). Nevertheless, the estimated number of syringes provided per IDU per year varied from 180 to 540 in England and Wales (personal communication, Lucas Weissing, Gerry Stimson, and Jim Parsons, 2000). At the other extreme, NEPs have only just begun in Northern Ireland.

Coverage of NEPs fares no better in North America. In 1993, an evaluation of 16 North

American NEPs reported that these programs seldom reach more than 30% of the IDUs in their communities (*19*). In 1996, 12% of U.S. NEPs reported exchanging more than 0.5 million syringes per year, and the total number of syringes exchanged was estimated at 14 million (*57*) (Table 14). This pales in comparison to a national estimate of 1.3 billion injections per year among a total of about 1.5 million IDUs (*61*).

Inadequate syringe coverage might also have contributed to limited syringe-exchange program effectiveness in Canadian cities. In Montreal, less than 5% of the estimated syringe demand was being met during the period when HIV incidence was escalating among IDUs (*62*) (Table 15). Even with extensive measures to expand NEPs and pharmacy sales in Montreal, these programs were estimated to meet about 10% of the demand for sterile syringes in 1999 if the estimated number of injections per year had remained stable (C. Morisette and P. LeClerc, personal communication, 2001). In Vancouver, where over 2 million syringes per year have been exchanged since 1996, it was estimated that 5 million to 10 million syringes would be required annually to attain the goal of a sterile syringe for every injection (*31*).

Low syringe coverage is also thought to underlie an HIV outbreak that occurred in Katmandu in the late 1990s, despite the fact that HIV prevalence remained low in the initial years following the introduction of an NEP (*13*). Although the number of syringes available per IDU is not known for a given time period, it was estimated that perhaps 700 of an estimated 15,000 IDUs had ever been reached by the program (personal communication, Nick Crofts, 2000).

Unless NEPs are greatly expanded, adequate coverage of sterile syringes to IDUs in virtually any city is unlikely to meet our lofty public health goal. This goal, however, is certainly worth attaining. A national policy of funding NEPs, pharmacy sales, and syringe disposal in the United States was estimated to cost US$34,278 per HIV infection averted, which is well below the lifetime costs of treating an individual's HIV infection (*63*). However, in settings where HIV incidence is less than 2% per year, the cost effectiveness of sterile syringe provision through pharmacy sales exceeds that of NEPs, which argues strongly in favor of increased access through pharmacies in settings where this is possible (*64*).

Obtaining optimal coverage of sterile syringes to IDU communities: Alternatives to NEPs

To achieve meaningful coverage, we should therefore consider viable alternatives or supplementary services to syringe exchange that are appropriate to local settings. In particular, legal access to syringe purchase in pharmacies and provisions allowing physicians to prescribe syringes to IDUs are urgently needed. In some European countries (e.g., France), pharmacies are the most common source of sterile syringes among IDUs (*65*).

Yet even where pharmacy sales of syringes are legal, barriers persist. In a survey of pharmacists in Alaska, there was no difference in selling practices between a city with a paraphernalia law and cities without such laws (*66*). This supports the notion that syringe sales to nondiabetics are often left to the discretion of the individual pharmacist, whose own moral principles may dictate their behavior. Cost and hours of operation are also barriers for some drug users. Finally, in some developing countries, there is an inadequate supply of sterile syringes. Nevertheless, these venues have tended to be an underutilized source of syringes and risk-reduction messages. In Connecticut, partial repeal of syringe prescription and paraphernalia laws was associated with decreases in syringe sharing and increases in syringe sales, suggesting that efforts to expand syringe

access through pharmacies in settings where this is feasible are almost certainly worthwhile (*67*).

Some U.S. states have recently endorsed physician prescription of syringes. For example, in Rhode Island, a survey of physicians found that 95% agreed that there is a legitimate medical reason for IDUs to be able to obtain sterile syringes. Most would prescribe syringes to prevent disease in IDUs if it were clearly legal to do so (*59*). In fact, in an analysis of the laws of the 50 U.S. states, the District of Columbia, and Puerto Rico, Burris *et al.* found that physicians in nearly all these jurisdictions can legally prescribe sterile injection equipment to IDUs (*64*). Pharmacists in most of these states were also found to have a clear or reasonable legal basis for filling the prescriptions. These findings suggest that prescribing syringes to IDUs could be an acceptable supplement to existing HIV prevention strategies, especially in countries where there are legal or financial barriers to syringe access. Efforts are needed to increase awareness among physicians and pharmacists, and encourage them to provide syringes to IDUs.

Another alternative source of sterile syringes is the syringe vending machine, which can provide syringes for free or for a nominal fee. Several countries, including France, Switzerland, Germany, and Australia, have incorporated syringe vending machines into their harm-reduction programs. Advantages of syringe vending machines include reduced cost of staffing, anonymity for the user, 24-hour access, and the ability to reach a different subset of IDUs. A report from Marseilles, France, found that relative to persons using pharmacies or NEPs, those using syringe vending machines were significantly younger and were less likely to have their own house, be HIV+, be enrolled in drug treatment, or share needles (*65*). Syringe vending machines could help reach a broader clientele of users if used in combination with other sources. However, because the cost of these machines would be prohibitive in some settings, they might not be acceptable in all cities. Importantly, the lack of human contact prevents the provision of other sterile paraphernalia needed for safer injection and active referrals to crucial ancillary services.

Qualitative aspects affecting syringe coverage

Beyond the need to ensure that adequate numbers of sterile syringes are available to meet the needs of IDUs, other important aspects that affect syringe coverage are the sociopolitical environment, local paraphernalia laws, and programmatic considerations, such as around-the-clock availability and changes in the risk environment. There are several cases where the protective effects of NEPs have been outweighed by local conditions.

The Vancouver HIV outbreak was believed to have occurred due to a combination of factors. There was a marked shift in local drug availability from heroin to cocaine, which necessitated more frequent injection (*31*). IDUs were concentrated within a 12-block radius, many residing in single-room occupancy hotels charging "exit fees" at night, which promoted needle sharing. Meanwhile, the city's efforts at harm reduction were primarily limited to syringe exchange with virtually no drug treatment (*37*). Syringe program cutbacks led to disruptions in coverage, and the lack of available HIV testing and counseling delayed identification of the outbreak.

Another illustrative case is that of Windham, Connecticut, where the city's only NEP was closed following a public controversy in which it was blamed for the city's drug problem, discarded syringes, and the region's economic decline. Following the NEP closure, IDUs significantly increased their use of unreliable syringes and more frequently reused or shared needles (*68*). Yet the city's problems with discarded needles remained.

The dramatic upheavals that accompany threats of war or economic collapse include social disruption, displacement, poverty, and despair, all of which increase vulnerability to diseases such as HIV/AIDS and other blood-borne and sexually transmitted infections. Socioeconomic collapse following the fall of the Iron Curtain was associated with an epidemic of injection drug use in Ukraine, Russia, and many of the newly independent states. In many of these regions, infrastructure to provide IDUs with HIV/AIDS information, sterile syringes, and HIV testing and counseling is lacking.

Recent world events following the terrorist attacks on the United States have had lasting effects on national security and are expected to indirectly influence the twin epidemics of injection drug use and HIV infection. Pressure on Afghanistan has led 1.5 million Afghan refugees to flee into neighboring countries such as Pakistan. In Pakistan, even prior to the arrival of the most recent wave of refugees, 15% to 20% of drug users on the street were Afghans (personal communication, Tariq Zafar, 2001). Security alerts on the Afghanistan-Pakistan borders have disrupted the production and supply of heroin from Afghanistan, which is the world's largest heroin producer. In Pakistan and elsewhere, it is anticipated that this will promote transition to injection among drug users who have traditionally inhaled fumes of heroin burned on a foil ("chasing the dragon"). To date, there is one NEP in operation in Lahore, Pakistan, whereas no such programs reportedly exist in any other countries adjacent to Afghanistan (Fig. 1). Urgent interventions will therefore be needed to avert transition to injection and provide mechanisms to ensure adequate syringe coverage for IDUs in this turbulent region.

In addition, in New York City, concerns have been expressed among some former IDUs that sudden increases in security following the disaster at the World Trade Center, with transient social disruption, might cause many to relapse to injection drug use as a way to cope. According to rapid ethnographic observations by staff at the Center for Urban Epidemiologic Studies in the week following the disaster, some injection and noninjection drug users were reporting increases in drug use. Perceptions of some users were that with borders closed not only in New York but also nationally, the supply of heroin might decrease and prices increase. Increasing prices could lead to lower purity; to avoid withdrawal, some noninjectors might inject. Clearly, these perceptions will need to be assessed carefully, as the public health implications could be important; the recent trend of declining HIV infection rates among IDUs in New York (*30*) could be reversed if this happens. The role of NEPs and access to syringes through pharmacies becomes important, as does making sure access to drug treatment remains and is expanded, to reduce secondary and indirect damage around these disasters.

Recommendations for future research

Beyond our suggestions for improving syringe access and coverage, our review of the literature suggests that there is considerable room for improvement. To date, most studies have focused on NEP effectiveness and have not taken into account alternate sources of syringes. Studies are needed in both developed and developing countries to determine what proportion of IDUs need to be reached by NEPs and other types of syringe access programs to prevent or reverse an HIV epidemic. In particular, estimates of the proportion of injections using sterile syringes from various sources are needed, as this is a more valid assessment of coverage than estimates of the proportion of drug users "ever reached." Such studies will need to take into account local factors, such as the types of drugs being injected (e.g., opiates or stimulants), changing behaviors of IDUs over time, and exposure to other types of interventions (e.g., drug treatment programs and voluntary HIV testing and counseling).

To date, there is a scarcity of research that includes biologic outcomes, such as HIV incidence. Longitudinal studies are ideal for conducting such investigations, but these

studies are costly and time-consuming. Studies are also needed to determine what types of programs or what structural components of specific programs are ideal for reaching different risk populations, such as young IDUs, men having sex with men who inject drugs, sex workers, and prisoners. It remains to be determined which types or combinations of syringe access programs are ideal for various sets of conditions, for example, cities where injection drug use is emerging as a relatively new behavior, or those with mature or nascent HIV epidemics. International studies with standardized assessments will be needed to address these questions.

Finally, an area of growing global concern is the finding that HCV incidence among IDUs is consistently higher relative to that of HIV, due at least in part to its greater transmissibility. HCV infection can result in serious liver disease including cirrhosis and hepatocellular carcinoma. Approximately 80% to 85% of HCV infections result in a chronic carrier state where patients are infectious and capable of transmitting the virus to others (*69*). In some settings, morbidity and mortality attributable to HCV infections among IDUs could exceed that for HIV, because HCV prevalence among populations of established IDUs often exceeds 80%. These findings signal an urgent need for preventive interventions with rigorous evaluations, because prevention of HCV infection could prove much more difficult than HIV prevention (*32*). Interventions that effectively reduce high-risk transmission behaviors among HCV-infected IDUs could also have a significant impact on HIV prevention in this population.

Conclusions

Although NEPs have achieved global expansion since the first was introduced 17 years ago, NEPs exist in less than half of the countries reporting HIV infection among IDUs. Coverage of NEPs in most developed and developing countries is low and varies considerably within and between countries, states, and cities. If we are to truly achieve optimal syringe coverage both quantitatively and qualitatively, we must have diverse syringe sources. Our review of the above syringe sources underscores the need to offer a range of venues where sterile syringes are available to IDUs to achieve maximal syringe coverage. Examples of alternative or supplemental approaches to enhancing sterile syringe access include pharmacies, physician prescription, and vending machines. Additional research is needed to determine what types of programs and which combinations are necessary to reach specific subgroups of IDUs and prevent or reverse epidemics of HIV and viral hepatitis.

In both developed and developing countries, the collective experience indicates that there have been both intentional and unintentional barriers to the provision of sterile syringes to IDU communities. Although these barriers are often specific to local settings, there are often common structural, legal, and ideological barriers that can be identified, which is the first step to overcoming them. There is a pressing need to create supportive environments to sustain NEPs and other syringe access programs if we are to protect the health of drug users, their families, and their surrounding communities.

References

1. S. D. Holmberg, The estimated prevalence and incidence of HIV in 96 large US metropolitan areas. *Am. J. Pub. Health* 86 (5), 643-654 (1996). PubMed.

2. J. Normand, D. Vlahov, L. E. Moses, Eds., Preventing HIV transmission: the role of sterile needles and bleach. (National Academy Press, Washington, D.C., 1995).

3. S. R. Friedman, W. de Jong, A. Wodak, Community development as a response to HIV among drug injectors. *AIDS* 7 (suppl. 1), S263-S269 (1993).

4. D. C. Des Jarlais and S. R. Friedman, HIV epidemiology and interventions among injecting drug users. *Intl. J. STD AIDS* 7 (suppl. 2), 57-61 (1996).

5. E. J. C. van Ameijden, J. K. Watters, J. A. R. van den Hoek, R. A. Coutinho, Interventions among injecting drug users: do they work? *AIDS* 9 (suppl. A), S75-S84 (1995).

6. E. H. Kaplan, K. Khoshnood, R. Heimer, A decline in HIV-infected needles returned to New Haven's needle exchange program: client shift or needle exchange? *Am. J. Public Health* 84(12), 1991-1994 (1994). PubMed.

7. E. H. Kaplan and R. Heimer, HIV incidence among New Haven needle exchange participants: updated estimates from syringe tracking and testing data. *J. Acquir. Immune Defic. Syndr. Hum. Retrovirol.* 10(2), 175-176 (1995). PubMed.

8. R. Heimer, Can syringe exchange serve as a conduit to substance abuse treatment? *J. Subst. Abuse Treat.* 15(3), 183-191 (1998). PubMed.

9. R. Brooner, M. Kidorf, V. King, P. Beilenson, D. Svikis, D. Vlahov, Drug abuse treatment success among needle exchange participants. *Public Health Rep.* 113 (suppl. 1), 129-39 (1998). PubMed.

10. S. A. Strathdee, D. D. Celentano, N. Shah, C. Lyles, G. Macalino, K. Nelson, D. Vlahov, Needle exchange attendance and health care utilization promote entry into detoxification. *J. Urban Health* 76(4), 448-460 (1999). PubMed.

11. J. A. van den Hoek, H. J. van Haastrecht, R. A. Coutinho. Risk reduction among intravenous drug users in Amsterdam under the influence of AIDS. *Am. J. Public Health* 79(10), 1355-1357 (1989). PubMed.

12. E. J. C. Van Ameijden and R. A. Coutinho Maximum impact of HIV prevention measures targeted at injecting drug users, *AIDS* 12, 625 (1998). PubMed.

13. A. Peak, S. Rana, S. Maharjan, D. Jolley, N. Crofts, Declining risk for HIV among injecting drug users in Kathmandu, Nepal: the impact of a harm-reduction programme. *AIDS* 9, 1067-1070 (1995). PubMed.

14. V. M. Quan, A. Chung, A. S. Abdul-Quader, The feasibility of a syringe-needle-exchange program in Vietnam. *Subst. Use Misuse* 33, 1055-1067 (1998). PubMed.

15. J. Gray. Operating needle exchange programs in the hills of Thailand. *AIDS Care* 7, 489-499 (1995). PubMed.

16. J. Nelles, The contradictory position of HIV-prevention in prison: Swiss experiences. *Int. J. Drug Policy* 1, 2-4 (1997).

17. N. Crofts, J. Webb-Pullman, K. Dolan, An analysis of trends over time in social and behavioral factors related to the transmission of HIV among injecting drug users and prison inmates. (AGPS, Canberra, Australia, 1996).

18. E. C. Buning, R. A. Coutinho, G. H. van Brussel, G. W. van Santen, van Zadelhoff, Preventing AIDS in drug addicts in Amsterdam. *Lancet* 1:1(8495), 1435 (1986).

19. P. Lurie *et al.*, The public health impact of needle exchange programs in the United States and abroad. Summary, conclusions and recommendations (School of Public Health, University of California, Berkeley, 1993).

20. D. C. Des Jarlais *et al.*, Maintaining low HIV seroprevalence in populations of injecting drug users. *J. Am. Med. Assoc.* 274 (15), 1226-1231 (1995). PubMed.

21. H. Hagan *et al.*, Reduced risk of hepatitis B and hepatitis C among injection drug users in the Tacoma Syringe Exchange Program. *Am. J. Pub. Health* 85(11), 1531-1537 (1995). PubMed.

22. D. Vlahov *et al.*, Reductions in high-risk drug use behaviors among participants in the Baltimore needle exchange program. *J. Acquir. Immune Defic. Syndr. Hum. Retrovirol.* 16(5), 400-406 (1997). PubMed.

23. E. Drucker, P. Lurie, A. Wodak, P. Alcabes, Measuring harm reduction: the effects of needle and syringe exchange programs and methadone maintenance on the ecology of HIV. *AIDS* 12 (suppl. A), S217-230 (1998).

24. R. N. Bluthenthal, A. H. Kral, L. Gee, E. A. Erringer, B. R. Edlin, The effect of syringe exchange use on high-risk injection drug users: a cohort study. *AIDS* 14(5), 605-611 (2000). PubMed.

25. J. Vertefeuille, M. A. Marx, W. Tun, S. Huettner, S. A. Strathdee, D. Vlahov, Decline in self-reported high risk injection-related behaviors among HIV seropositive participants in the Baltimore needle exchange program. *AIDS and Behavior 2000* 4(4): 381-388.

26. R. Heimer, K. Khoshnood, D. Bigg, J. Guydish, B. Jungue, Syringe use and reuse: effects of syringe exchange programs in four cities. *J. Acquir. Immune Defic. Syndr. Hum. Retrovirol.* 18, S37 (1998). PubMed.

27. G. V. Stimson, AIDS and injecting drug use in the United Kingdom, 1987-1993: the policy response and the prevention of the epidemic. *Soc. Sci. Med.* 41(5), 699-716 (1995). PubMed.

28. G. V. Stimson, Has the United Kingdom averted an epidemic of HIV among injection drug users? *Addiction* 91, 1085-1088 (1996).

29. S. Hurley, D. Jolley, J. Kaldor, Effectiveness of needle-exchange programmes for prevention of HIV infection. *Lancet* 349, 1797 (1997). PubMed.

30. D. C. Des Jarlais *et al.*, HIV incidence among injection drug users in New York City, 1992-1997: Evidence for a declining epidemic. *Am. J. Public Health* 90, 352-359 (2001). PubMed.

31. S. A. Strathdee *et al.*, Needle exchange is not enough: Lessons from the Vancouver injecting drug use study. *AIDS* 11, F59-F65 (1997). PubMed.

32. H. Hagan, J. P. McGough, H. Thiede, N. S. Weiss, S. Hopkins, E. R. Alexander, Syringe exchange and risk of infection with hepatitis B and C viruses. *Am. J. Epidemiol.* 149, 203-213 (1999). PubMed.

33. J. Bruneau *et al.*, High rates of HIV infection among injection drug users participating in needle exchange programs in Montreal: Results of a cohort study. *Am. J. Epidemiol.* 146, 994-1002 (1997). PubMed.

34. A. R. Moss, Epidemiology and the politics of needle exchange. *Am. J. Public Health* 90, 1385-1387 (2000).

35. R. Coutinho, Needle exchange, pragmatism, and moralism. *Am. J. Public Health* 90, 1387-1388 (2000).

36. P. Lurie, Invited commentary: Le mystère de Montréal. *Am. J. Epidemiol.* 146, 1003-1006 (1997).

37. M. T. Schechter *et al.*, Do needle exchange programmes increase the spread of HIV among injection drug users? An investigation of the Vancouver outbreak. *AIDS* 13, F45-F51 (1999). PubMed.

38. D. R. Gibson, N. M. Flynn, D. Perales, Effectiveness of syringe exchange programs in reducing HIV risk behavior and HIV seroconversion among injecting drug users. *AIDS* 15, 1329-1341 (2001).

39. F. I. Bastos, S. A. Strathdee, Evaluating effectiveness of syringe exchange programmes: Current issues and future prospects. *Soc. Sci. Medicine* 51, 1771-1782 (2000). PubMed.

40. J. A. Hahn, K. M. Vranizan, A. R. Moss, Who uses needle exchange? A study of injection drug users in treatment in San Francisco, 1989-1990. *J. Acquir. Immune Defic. Syndr. Hum. Retrovirol.* 15, 157-164 (1997). PubMed.

41. D. Vlahov, B. Junge, The role of needle exchange programs in HIV prevention. *Public Health Rep.* 113 Suppl 1, 75-80 (1998). PubMed.

42. M. A. Marx, B. Crape, R. S. Brookmeyer, B. Junge, C. Latkin, D. Vlahov, and S. A. Strathdee, Trends in crime and the introduction of a needle exchange program. *Am. J. Public Health* 90, 1933-1936 (2000). PubMed.

43. B. Junge, T. Valente, C. Latkin, E. Riley, D. Vlahov, Syringe exchange not associated with social network formation: Results from Baltimore. *AIDS* 14, 423-426 (2000). PubMed.

44. M. C. Doherty, B. Junge, P. Rathouz, R. S. Garfein, E. Riley, D. Vlahov, The effect of a needle exchange program on numbers of discarded needles: A 2-year follow-up. *Am. J. Public Health* 90, 936-939 (2000). PubMed.

45. K. J. Oliver *et al.*, Impact of a needle exchange program on potentially infectious syringes in public places. *J. Acquir. Immune Defic. Syndr.* 5, 534-535 (1992).

46. M. C. Doherty *et al.*, Discarded needles do not increase soon after the opening of a needle exchange program. *Am. J. Epidemiol.* 145, 730-737 (1997). PubMed.

47. U.S. General Accounting Office, Needle exchange programs: Research suggests promise as an AIDS prevention strategy. U.S. Government Printing Office, Washington, D.C., 1993 (Publication no. GAO/HRD 93-60).

48. National Commission on AIDS. The twin epidemics of substance abuse and HIV (National Commission on AIDS, Washington, D.C., 1991).

49. Evidence-based findings on the efficacy of syringe exchange programs: an analysis from the Assistant Secretary for Health and Surgeon General of the scientific research completed since April 1998. Office of the Surgeon General (Washington, D.C.), 2000. Available online.

50. Interventions to prevent HIV risk behaviors. NIH Consensus Statement 15, 1-41 (1997).

51. M. D. Newcomb, Substance abuse and control in the United States: ethical and legal issues. *Soc. Sci. Med.* 35(4), 471-479 (1992). PubMed.

52. E. Drucker, Drug prohibition and public health: 25 years of evidence. *Public Health Rep.* 114(1), 14-29 (1999).

53. E. H. Kaplan, Needle exchange or needless change? The state of the debate. *Infect. Agents Dis.* 1(2), 92-98 (1992). PubMed.

54. R. J. Blendon and J. T. Young, The public and the war on illicit drugs. *J. Am. Med. Assoc.* 279(11), 827-832 (1998). PubMed.

55. J. M. Keene, G. V. Stimson, Professional ideologies and the development of syringe exchange: Wales study. *Med. Anthropol.* 18(1), 85-105 (1997). PubMed.

56. P. Coffin, Syringe availability as HIV Prevention: A Review of Modalities. J. Urban Health Bull. *New York Acad. Med.* 77(3), 306-330 (2000). PubMed.

57. D. Paone *et al.*, Syringe exchange in the United States, 1996: a national profile. *Am. J. Public Health* 89, 43-46 (1999).

58. L. O. Gostin, The legal environment impeding access to sterile syringe and needles: the conflict between law enforcement and public health. *J. Acquir. Immune Defic. Syndr. Hum. Retrovirol.* 18(suppl 1), 560-570 (1998).

59. J. D. Rich, T. L. Whitlock, C. W. Towe, M. McKenzie, V. Runarsdottir, M. Aboagye-Kumi, S. Burris, Prescribing syringes to prevent HIV: a survey of infectious disease and addiction medicine physicians in Rhode Island. *Subst. Use Misuse* 36(5), 535-550 (2001). PubMed.

60. K. L. Dehne, The emerging AIDS crisis in Russia: review of enabling factors and prevention needs. *Int. J. STD AIDS* 12(4), 277-278 (2001).

61. P. Lurie, R. Gorsky, T. S. Jones, L. Shomphe, An economic analysis of needle exchange and pharmacy-based programs to increase sterile syringe availability for injection drug users. *J. Acquir. Immune Defic. Syndr. Hum. Retrovirol.* 18 (suppl. 1), S126-132 (1998). PubMed.

62. R. S. Remis, J. Bruneau, C. A. Hankins, Enough sterile syringes to prevent HIV transmission among injection drug users in Montreal? *J. Acquir. Immune Defic. Syndr. Hum. Retrovirol.* 18 (suppl. 1), S57-59 (1998). PubMed.

63. D. R. Holtgrave, S. D. Pinkerton, T. S. Jones, P. Lurie, D. Vlahov, Cost and cost-effectiveness of increasing access to sterile syringes and needles as an HIV prevention intervention in the United States. *J. Acquir. Immune Defic. Syndr. Hum. Retrovirol.* 18 (suppl. 1), S133-138 (1998). PubMed.

64. S. Burris, P. Lurie, D. Abrahamson, J. D. Rich, Physician prescribing of sterile injection equipment to prevent HIV infection: time for action. *Ann. Intern. Med.* 133(3), 218-226 (2000). PubMed.

65. Y. Obadia, I. Feroni, V. Perrin, D. Vlahov, J. P. Moatti, Syringe vending machines for injection drug users: an experiment in Marseille, France. *Am. J. Public Health* 89(12), 1852-1854 (1999). PubMed.

66. C. R. Harbke, D. G. Fisher, H. H. Cagle, B. N. Trubatch, A. M. Fenaughty, M. E. Johnson, Telephone survey of Alaskan pharmacists' nonprescription needle-selling. *J. Urban Health* 77(1), 113-120 (2000). PubMed.

67. S. L. Groseclose, B. Weinstein, T. S. Jones, L. A. Valleroy, L. J. Fehrs, W. J. Kassler, Impact of increased legal access to needles and syringes on practices of injecting-drug users and police officers-Connecticut 1992-1993. *J. Acquir. Immune Defic. Syndr. Hum. Retrovirol.* 10(1), 73-81 (1995). PubMed.

68. R. S. Broadhead, Y. van Hulst, D. D. Heckathorn, The impact of a needle exchange's closure. *Public Health Rep.* 114(5), 439-447 (1999). PubMed.

69. J. H. Hoofnagle, Hepatitis C: the clinical spectrum of disease. *Hepatology* 26, 15S-20S (1997). PubMed.

70. D. C. Des Jarlais, M. Marmor, D. Paone, *et al.*, HIV incidence among injecting drug users in New York City syringe-exchange programmes. *Lancet* 348, 987-991 (1996). PubMed.

71. M. A. Marx, *et al.*, Impact of needle exchange programs on adolescent perceptions about illicit drug use. *AIDS Behav.* 5(4):379-386 (2001).

72. T. W. Valente, B. Junge, and D. Vlahov, Satellite exchange in the Baltimore needle exchange program. *Public Health Rep.* 113(Suppl 1):90-96 (1998). PubMed.

73. T. S. Jones, and D. Vlahov, Use of sterile syringes and aseptic drug preparation are important components of HIV prevention among injection drug users. *J. Acquir. Immune Defic. Syndr. Hum. Retrovirol.* 18 (Suppl 1):S1-5 (1998).

Table 1. Number of countries, regions, and territories reporting injection drug use (IDU) and HIV among IDUs

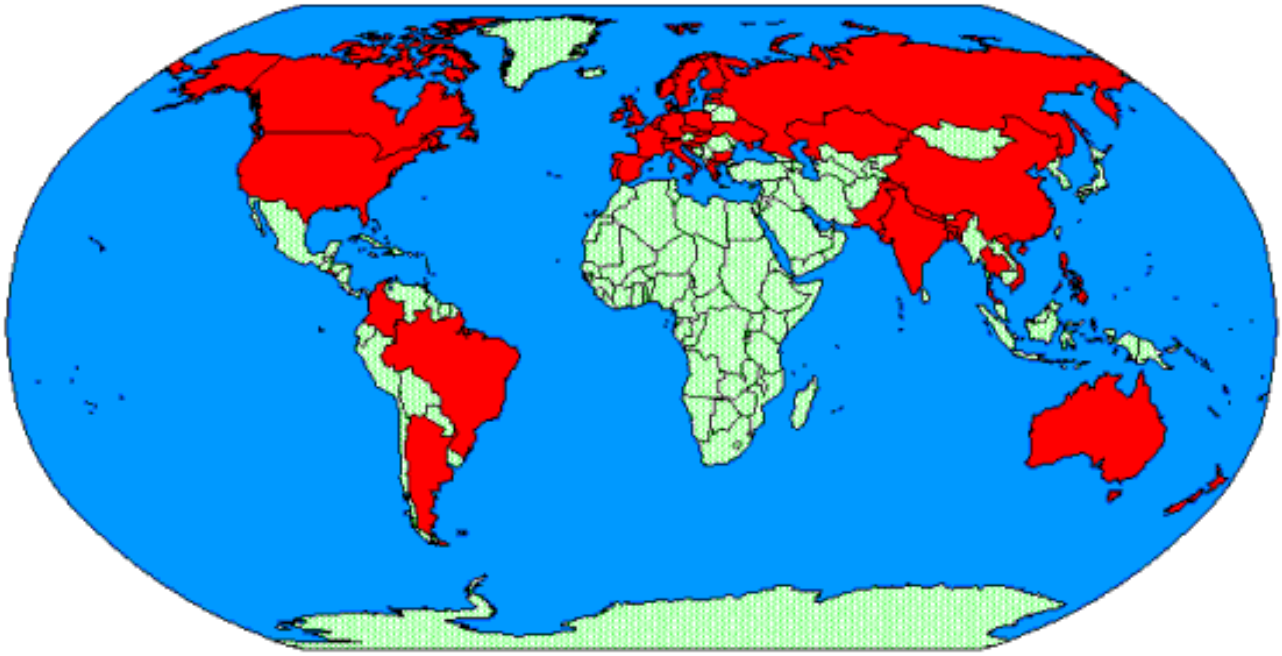
	1992	1995	1996	1998	1999
IDU	80	118	121	128	134
HIV/IDU	52	78	81	103	114
% of total	65	66	67	80	84

Source: A. Ball, 2001 (personal communication).

Table 2. Potential ancillary services provided by syringe distribution and exchange programs

- Condoms (male and female)
- HIV testing and counseling
- Referrals to drug treatment and medical care
- Overdose prevention
- Screening, diagnosis, and treatment (e.g., STDs, TB)
- Provision of vaccine (e.g., HBV, HAV)
- Wound/abscess care
- Multivitamins

Figure 1. Global expansion of needle exchange programs (December 2000)



■ Countries with at least one existing needle exchange program (n=46).

Table 3. Estimated reductions in HIV incidence associated with attendance at a needle exchange program (NEP)

• **New Haven.** 33% reduction (based on surveillance of exchanged syringes) (7)
• **Amsterdam.** 50% reduction (combined effect of NEP, HIV testing and counseling, and methadone) (12)
• **New York.** 70% reduction (comparing NEP vs. non-NEP attendees across 4 cohorts) (70)

Table 4. Case-control study of the effectiveness of needle exchange programs, Tacoma, Washington, United States

Outcome	Odds ratio*	% risk reduction
HBV	5.5	83%
HCV	7.3	86%

*odds of HBV or HCV infection associated with nonuse of needle exchange programs (21).

Table 5. No evidence that needle exchange programs are associated with:

- Increased drug use (22)
- Permissive attitudes toward drugs among youth (71)
- Formation of high-risk needle sharing networks (37, 72)
- Increases in discarded needles (44)
- Increases in crime (42)

Table 6. Government commissioned reports summarizing the effectiveness of needle exchange programs

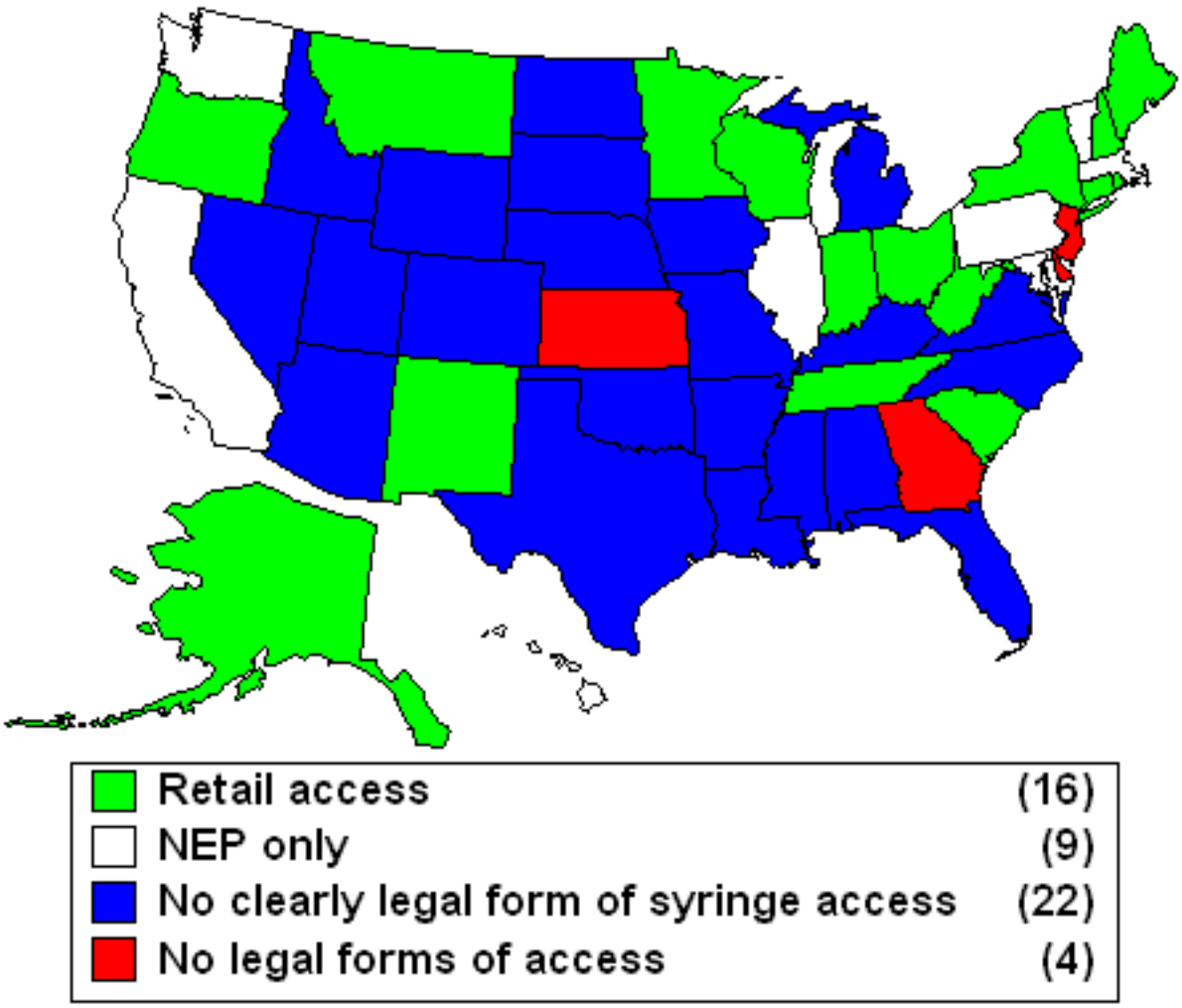
- 1991: National Commission on AIDS "twin epidemics" report (48)
- 1993: U.S. General Accounting Office report (47)
- 1993: CDC & USCF report of 16 NEPs in North America (19)
- 1995: National Academy of Sciences report (2)
- 1997: U.S. NIH Consensus Statement (50)

Table 7. Services offered and operational issues, by legal status, for U.S. syringe exchange programs, 1996

	Legal (n=46)		Illegal (n=41)	
	No.	(%)	No.	(%)
HIV counseling and testing	29	(63)	8	(20)***
Tuberculosis skin testing	19	(41)	3	(7)***
Secondary exchange	38	(83)	41	(100)**
Age minimum	23	(50)	10	(24)*
Drug treatment referrals	29	(63)	14	(34)*
Syringe disposals	18	(39)	8	(20)*
Lack of resources	19	(41)	29	(71)**
Staff shortage	17	(37)	29	(71)**

*P<.05; **P<.01; ***P=.001 Source: Paone *et al.* 1999

Figure 2. Access to sterile syringes without a prescription, United States, 2000



Source: Scott Burris, 2001 (personal communication).

Table 8. Sterile syringe access in New York City, United States, 1988-2000

- ~ 100,000 IDUs in New York City
- 1988: Pilot needle exchange program opened but closed in 1990
- 1992: New York Health Department launched five needle exchange programs
- 1990's: HIV incidence declines to <1%/year
- 2001: Expanded syringe access program
  - Pharmacies, health providers register to provide syringes without prescription
  - Access, risks/benefits, and disposal are evaluated

Source: Des Jarlais *et al.*, 2000 (30).

Table 9. Expansion of needle exchange programs in Brazil

- **1994:** First NEP in South America opened in Santos
- **1998:** 12 NEPs operating across Brazil
- **1999:** Decriminalization of laws that prohibit syringe distribution/exchange in two states
- **2000:** 33 NEPs operating across Brazil

Source: Bastos and Strathdee, 2000 (39).

Table 10. Needle exchange programs in the Russian Federation

• Recent, explosive epidemic of injection and blood-borne infections
• ~ 1 million IDUs
• At least 42 needle exchange programs
• 58% of needle exchange programs surveyed in December 2000 had opened in the last year

Source: Dave Burrows, 2001 (personal communication)

Table 11. Coverage of NEPs in various locations (2000)

Site	Year began	Estimated No. of syringes exchanged (2000)	No. of syringes/IUD
Vietnam, (Ho Chi Minh City)	1994	100,000	2
Bangladesh (Dhaka, Rajshahi)	1997-1998	51,000	2
India (New Delhi)	1998	10,000	1.25
Colombia (Bogota)	2000	10,000	28
Brazil (Pôrto Alegre)	1994	180,000	45-55
Canada (Vancouver)	1998	3,000,000	272
Canada (Montreal)	1989	1,100,000	73

Table 12. Survey of NEP coverage in the Russian Federation (n=25)

No. of needles exchanged previous month	No. of NEPs (%)
<5,000	11/25 (44)
5,000-10,000	10/25 (40)
10,000-15,000	2/25 (8)
15,000-20,000	2/25 (8)
Total: 157,779	25/25 (100)

Table 13. Sterile syringe access in the United Kingdom, 1997

- ~ 27 million syringes exchanged
- ~ 2000 NEP outlets
- ~180-540 syringes/IDU per year
- Number of syringes in Scotland 3-4 times less than in England and Wales
- NEP just introduced in Northern Ireland

Source: J. Parsons, G. Stimson, and L. Weissing (personal communications).

Table 14. Number of U.S. syringe exchange programs and syringes exchanged, by size of program, 1996 (n=84)

Size of program	Programs		Syringes exchanged	
	No.	%	No.	%
<10,000	23	27	64,737	<1
10,000-55,000	27	32	810,247	6
55,001-499,999	24	29	3,658,060	26
>500,000	10	12	9,407,628	67
Total	84	100	13,940,672	100

Source: Paone *et al.*, 1999 (57).

Table 15. Sterile syringe access in Montreal, Quebec, 1994-2000

- 1994: 338,000 syringes exchanged/sold (3.2% of syringe demand)

Response:

- Restrictions on number of syringes removed
- Expansion of NEP and pharmacy access
- 1999: 1.1 million syringes exchanges/sold (10.3% of syringe demand)

Source: Remis *et. al.*, 2000 (62), C. Morrisette and P. Leclerc, 2001 (personal communications).