Difficult-To-Reuse Needles for the Prevention of HIV Infection Among Injecting Drug Abusers

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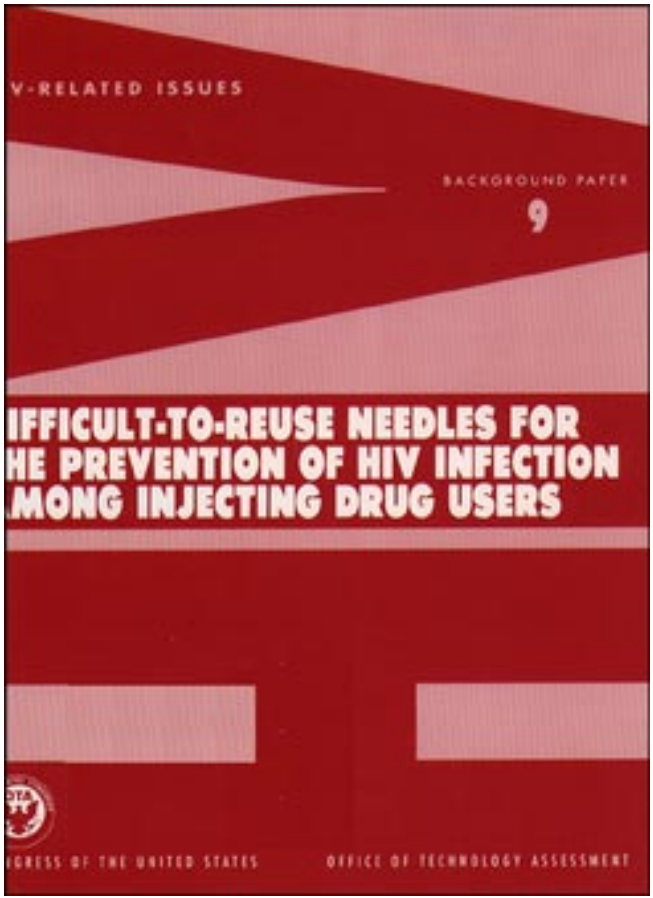

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Foreword

Substance abuse places a significant burden on both our Nation's citizens and our economy. The high incidence of human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) among injecting drug users through the sharing of needles compound this problem. One-third of all cases of HIV are directly or indirectly linked to needle sharing at a cost to Federal taxpayers in excess of $1 billion during 1992 alone. To reduce the spread of HIV among injecting drug users, their children, and their sexual partners, some health experts including C. Everett Koop, the former Surgeon General of the United States, have proposed altering the design of needles and syringes so they are difficult or impossible to reuse.

This study was conducted in response to a request by the Subcommittee on Regulation, Business Opportunities, and Energy of the House Committee on Small Business. We evaluate the likelihood that a redesign of injection equipment would actually reduce HIV infections. We also examine the proposal's feasibility and some of its implications for the use of needles and syringes within the health care system.

This background paper is the ninth in OTA's series of studies on HIV-related issues. The preceding papers in this series were: *Do Insects Transmit AIDS? (9/87); AIDS and Health Insurance--An OTA Survey (2/88); How Effective Is AIDS Education? (6/88); The Impact of AIDS on the Kaiser Permanence Medical Care Program (Northern California Region) (7/88); How Has Federal Research on AIDS/HIV Disease Contributed to Other Fields? (4/90); The Effectiveness of Drug Abuse Treatment: Implications for Controlling AIDS/HIV Infection (9/90); HIV in the Health Care Workplace (11/91);* and *The CDC'S Definition of AIDS: Implications of the Proposed Revisions (8/92).* Previous OTA reports addressing AIDS-related issues include: *Blood Policy and Technology (1/85); Review of the Public Health Service's Response to AIDS* (technical memorandum, 2/85); *The Cost of AIDS and Other HIV Infections: Review of the Estimates* (staff paper, 5/87); *Medical Testing and Health Insurance (8/88);* and *Adolescent Health (11/91).*

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Difficult-to-Reuse Needles and Syringes for the Prevention of HIV Infection Among Injecting Drug Users

Background Paper

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This background paper was prepared as part of OTA's ongoing HIV-related assessment.

Glossary of Abbreviations

DTR -difficult to reuse
AIDS —acquired immunodeficiency syndrome
HIV —human immunodeficiency virus
WHO —World Health Organization

Contents

Difficult-to-Reuse Needles for the Prevention of HIV Infection Among Injecting Drug Users

SUMMARY

Substance abuse is a major social problem with enormous human and economic costs against which the United States directs significant resources for law enforcement, interdiction, treatment, and prevention. Greatly increasing the costs of substance abuse is the problem of human immunodeficiency virus (HIV) infection among persons who inject illicit drugs. In the United States, approximately one-third of all cases of acquired immunodeficiency syndrome (AIDS) has been associated with the sharing of drug injection equipment either as a direct risk behavior or by being the child or sexual partner of someone who injects illicit drugs. A wide variety of prevention programs-from drug abuse treatment to over-the-counter sales of injection equipment to syringe exchange to bleach distribution-have led to large-scale reductions in AIDS risk behavior among injecting drug users. No prevention program, however, has led to complete risk elimination, and the persistence of new HIV infections among injecting drug users in places such as Amsterdam in the Netherlands (which has developed a relatively comprehensive AIDS prevention program) suggests the need for new strategies. The use of either single-use, self-destructing, non-reusable or auto-destruct injection equipment has received some attention as a possible means for further reducing HIV transmission among injecting drug users.

This paper reviews various possibilities of using non-reusable injection technologies for reducing HIV transmission among injecting drug users in the United States. It does not put forth the redesign of injection equipment as a policy option for congressional consideration; it merely examines some of the implications of a proposal put forth by some health experts. Sources of data used in this review include scientific publications, presentations at professional meetings, and interviews with knowledgeable individuals: active drug injecters, designers of new injection equipment, and officials of the Netherlands and Australia (where plans to utilize non-reusable injection equipment were considered but not implemented).

The analyses in this paper indicate that redesigning injection equipment is unlikely to reduce the spread of HIV and may have other unintended consequences. There is no syringe yet designed and feasible to manufacture that could not be defeated by someone seeking to reuse it. Distributing enough syringes to prevent the establishment of a black market for injection equipment that can be easily reused presents significant logistical and ethical dilemmas. In addition, evidence indicates that many of the proposed redesigns would interfere with usual drug-taking practices, making many drug users unlikely to accept them. Redesigned syringes would also likely cost more than current syringes and could significantly add to medical waste problems. Some injecting drug users have, however, indicated a willingness to use redesigned injection equipment in order to reduce the transmission of HIV. "Targeted" distribution of redesigned injection equipment could be used to identify those situations in which: 1) injecting drug users would be least likely to try defeating difficult-to-reuse equipment; 2) the cost, supply, and safe disposal problems would be manageable; and 3) use of difficult-to-reuse equipment would have the greatest impact on reducing HIV transmission among injecting drug users.

New designs of injection equipment have also been proposed to replace equipment that is currently intended to be reused with different patients in medical care settings and to reduce accidental puncture (needle stick) injuries. These purposes are substantially different from the purpose of reducing HIV transmission among persons injecting illicit drugs, and new designs for these purposes will be touched on only briefly in this paper.

From the perspective of a drug user, intravenous injection is by far the most cost-efficient method of administering drugs such as heroin and cocaine. Injection provides a strong drug effect through the rapid accumulation of drug in the brain, and allows almost all of the drug to be consumed. For persons who use illicit drugs, powerful economic incentives favor the injection method of administration. In a situation where injection equipment was scarce, even stronger economic incentives would favor reuse of injection equipment. Many of the current single-use, but easy-to-reuse needles and syringes available can be used dozens of times before the needle becomes too dull for further injection or the

syringe becomes clogged. Strategies for possible use of non-reusable injection equipment would thus need to include consideration of the strong economic incentives for injecting illicit drugs and for obtaining reusable injection equipment for use with illicit drugs.

It is probably better to consider potential new injection equipment as difficult-to-reuse (DTR) rather than truly non-reusable, and that is the term that will be used in this background paper. All designs of injection equipment surveyed for this paper could be defeated through one or more methods. Even if it was possible to produce impossible-to-reuse injection equipment, a system of non-reusable injection equipment could be defeated through: 1) hand-assembled, easy-to-reuse injection equipment; 2) illicitly manufactured, easy-to-reuse injection equipment; or 3) importation of easy-to-reuse injection equipment from other areas.

While there are interesting and important aspects of the technology of DTR injection equipment, use of such equipment to reduce HIV transmission among injecting drug users may well be more a question of the policy framework within which such equipment is adopted than of specific technologies proposed. DTR technology might, for instance, be adopted within general medical settings without simultaneous provision of equipment to persons injecting illicit drugs. This situation would create a scarcity of injection equipment in the illicit market, and trigger attempts to defeat the DTR technology through several means. This situation might actually lead to more multiperson use (sharing) of illicit drug-injection equipment and hence an increase in HIV transmission among injecting drug users.

DTR technology might also be adopted for use within general medical settings with concurrent efforts to fully provide DTR equipment to injecting drug users. The logistics of providing enough DTR equipment to drug injecters and of safely disposing of the used (potentially HIV-contaminated) equipment are, however, formidable problems. Redesigned syringes would also likely cost significantly more than current syringes and would add to medical waste. An additional problem would be the great difficulty in doing any pilot testing of such a strategy, given that a pilot test would require finding a geographic area with at least a modest number of illicit drug injecters and yet isolated from illicit supplies of easy-to-reuse injection equipment.

Another strategy would be to target distribution of DTR needles and syringes more selectively, to situations where multiperson use of injection equipment is highly likely, such as "shooting galleries" and among dealers who lend or give injection equipment to their customers. Previous research has indicated that sharing in these situations is particularly associated with rapid spread of HIV among drug injecters. Implementation of such a strategy would require cooperation between health care workers and persons involved in illicit drug use of a kind that would probably be difficult to achieve or to maintain. Such a strategy could be field-tested, however, without altering the use of injection equipment within usual medical settings. It would thus be possible to gain more field experience with the likely frequency and methods for defeating DTR technology, as well as provide the best means for furthering cooperation between health care workers and injecting drug users to reduce HIV transmission.

INTRODUCTION

Substance abuse is a major social problem with enormous human and economic costs. Current American efforts directed against this problem include numerous programs and policies for law enforcement, interdiction, treatment, and prevention. The elimination of illicit drug injection will no doubt require continued diligence, creativity, and resources. However, substance abuse does occur, and the transmission of HIV through multiperson use of equipment for injecting illicit drugs has become a major public-health problem in itself. Approximately one-third of AIDS cases in the United States are associated with the injection of illicit drugs. Moreover, HIV can spread very rapidly once it has been introduced into a local community of injecting drug users, with up to half of the drug injecters becoming infected within the next few years. Once HIV has become established among injecting drug users, it can then spread to their sexual partners and newborn children. In the United States, over half of the cases of heterosexual and perinatal transmission are related to illicit drug injection. (See Des Jarlais et al. (7) for a recent review of the international epidemiology of HIV among injecting drug users). This paper specifically focuses on one proposal to eliminate illicit drug injection as a route of HIV transmission-the redesign of syringes and needles to prevent their being used more than once.

A number of different programs to prevent further spread of HIV among injecting drug users have already been implemented. In almost all other countries, legal access to sterile injection equipment, whether through syringe exchanges, over-the-counter sales, or both, has been the predominant prevention strategy. In the United States, on the other hand, the expansion of drug abuse treatment programs and the distribution of bleach for disinfecting used injection equipment have so far been the preferred prevention strategies. (However, the National Commission on AIDS has recently called for legal access to sterile injection equipment for injecting drug users (14)).

A wide variety of AIDS prevention programs has led to risk reduction among injecting drug users (5), but a substantial number of new HIV infections are still occurring. This fact remains true even in places like Amsterdam that have both large-scale drug abuse treatment programs and large-scale syringe exchange programs (27). This discouraging trend suggests the need for additional AIDS prevention strategies for injecting drug users, in conjunction with drug abuse treatment, legal access to (current types of) injection equipment, and distribution of bleach programs.

The development of either single-use, self-destructing, or auto-destruct syringes as another method of preventing the transmission of HIV among injecting drug users has been advocated in the United States and in other countries. Former Surgeon General C. Everett Koop (21) has been one of the foremost advocates of such ''self-destructing" syringes in the United States. "Single-use" or "self-destructing" syringes had also been considered at one time as a means for reducing the spread of HIV among injecting drug users in both the Netherlands and Australia, although the method was not adopted in either country.

Scope of the Background Paper

This paper examines the possibility of how single-use, self-destructing, or auto-destruct syringes might best be used to help reduce the transmission of HIV among persons who inject illicit drugs in the United States. It does not put forth the redesign of injection equipment as a policy option for congressional consideration; it merely examines some of the implications of the proposal by Dr. Koop and others. The analysis includes an examination of potential policy, technical, and organizational problems that would have to be addressed in order to implement the use of such syringes in the United States. The question of whether persons who inject illicit drugs would have legal access to this new injection equipment and, even if they did have legal access, how sufficient quantities of equipment would be distributed, are two of the major policy and organizational issues addressed.

Before considering the problem of how new designs for injection equipment might be used to reduce the transmission of HIV among injecting drug users, it is important to note two points. First, most injection equipment used for medical purposes in the United States is intended only to be used once even though their designs permit multiple use. And second, the problem of HIV among injecting drug users is not the only reason for redesigning injection equipment. Some groups are involved in redesigning injection equipment in order to reduce the chances of accidental needle stick injuries that occur in health care settings with present equipment. Others are redesigning the injection equipment that is reused in health care settings in developed countries so that it would be single-use in the sense that it was intended to be used with only one patient (11). Most of these redesigns would not, however, prevent the equipment from being reused, especially if it was obtained for use in injecting illicit drugs. Consideration of these other reasons for redesigning injection equipment is beyond the scope of the present paper. However, before any such new designs were adopted on a large scale in the United States, some consideration should be given to the question of how the new designs might affect HIV transmission among persons who inject illicit drugs.

The World Health Organization (WHO) is also working toward using new designs for injection equipment in its childhood immunization programs in developing countries. The purpose of the new WHO designs is to reduce the chances of transmitting HIV and other blood-borne pathogens. This concern is also a fundamentally different problem than reducing HIV transmission among injecting drug users, but shares an important similarity in that-in the context both of developing countries and of illicit drug injection-there may be substantial economic and logistical incentives to reuse the injection equipment. This paper will therefore also consider some of the design criteria and design

solutions now being developed through the WHO efforts.

METHODS

Several methods were used to obtain the data presented in this paper, including a review of the very limited literature now available on single-use syringes for injecting illicit drugs. In addition, interviews were conducted with: 1) a manufacturer of single-use syringes; 2) persons operating a syringe exchange in the United States; 3) 17 drug users attending syringe exchanges in the United States; 4) drug users who were part of a small field test of one possible design; and 5) officials who considered using single-use syringes in the Netherlands and Australia.

ECONOMIC FACTORS IN THE INJECTION OF ILLICIT DRUGS

The official policy of the United States is to discourage the nonmedical use of drugs such as heroin and cocaine by making them very expensive to the user (17). Some drug users spend literally hundreds of dollars per day on illicit drugs, such that the economics of obtaining drugs can become the dominating factor in their lives. Thus, before considering the various types of redesigned syringes, it will be very helpful frost to consider some of the basic economic factors of injecting illicit drugs versus other routes of administration, and of easy-to-reuse versus DTR equipment.

The relatively high price for the user in itself creates economic pressure to use methods of drug administration that the user finds cost-efficient. If the drug has been obtained at a high cost, the user will be motivated to administer the drug in a manner which both provides an intense drug effect and uses as much as possible of the drug. From the user's perspective, intravenous injection is by far the most cost-efficient method for administering most illicit drugs. Intravenous injection not only provides a particularly strong drug effect-because of how rapidly the drug is delivered to the brain-but also uses almost all of the drug. Of course, smoking a drug also provides rapid delivery to the brain, but a sizable portion of the drug fumes are not inhaled. Drug users report that intravenous injection is approximately three times as effective as other methods of administration in terms of drug effect per unit cost (3). This increased efficiency is clearly relevant only to drug users who are willing to inject and in situations where the cost of the drug is an important factor. In many parts of the United States, the supplies of heroin and cocaine are abundant enough that price is not an overriding factor for many drug users. Once a drug user develops an ever-increasing dependence on a drug, however, cost is likely to become an important factor for that individual, even if the drug is plentiful and low-priced in the city as a whole.

Drug injecters in New York had at one time reported that some needles and syringes were being reused in shooting galleries as many as 40 to 50 times-until the syringe clogged or the needle became too dull for another injection (12). The economic advantage of injection equipment easily reusable over one-use-only equipment is thus potentially very great. Again, the practical importance of this economic advantage would vary according to the relative availability of equipment for injecting illicit drugs. Currently, injection equipment in many localities throughout the United States is sufficiently available that many drug injecters often use a needle and syringe once and then discard the equipment (9). As will be discussed below, however, the introduction of new needle-syringe designs, if carried out under policy guidelines that forbade supplying injection equipment to injecting drug users, could dramatically increase the street value of easily reusable equipment.

These cost-efficiency factors become decisive only under conditions of great scarcity-both of the drugs themselves and of the injection equipment—and obviously apply only to persons who are willing to inject illicit drugs. While great scarcity of either injection equipment or drugs may not occur often among drug users, such scarcity is also not a rare occurrence. As tolerance for a drug increases, scarcity may occur at an individual level even if it is not occurring in a geographical area as a whole. Whether equipment for injecting illicit drugs would become scarce under a system of DTR syringes is one of the most important questions to be considered in assessing the likely effectiveness of any system that would attempt to use new syringe designs to reduce HIV transmission among injecting drug users.

This discussion of economic factors of injecting versus non-injecting and of easy-to-reuse equipment versus DTR equipment is not meant to imply that

economic factors are the sole determinant of the ways people use illicit drugs. In particular, it is not meant to imply that persons who inject illicit drugs are not concerned about AIDS. In fact, a great amount of evidence indicates that drug injecters throughout the world are concerned about AIDS, and further, that they have changed their behavior to reduce their risk of developing AIDS (7). Most of this risk reduction has occurred in the context of an increased supply of easy-to-reuse injection equipment. In situations of drug scarcity, economic considerations will strongly favor injection over other routes of administration, and in situations of equipment scarcity, economic considerations will strongly favor equipment that can easily be reused.

WORLD HEALTH ORGANIZATION PLANS FOR SELF-DESTRUCTING SYRINGE DESIGNS

As noted above, the WHO plans to use DTR syringes for childhood immunization programs in developing countries. Economic factors helped create the possibility for reuse of needles and syringes in the WHO program. The WHO childhood immunization program, thus, has important similarities with single-use illicit drug injection programs, where there also may be important economic factors leading to reuse of injection equipment.

The WHO initially formulated performance criteria for prospective self-destructing syringes; manufacturers then submitted over 200 different designs in accordance with these criteria. Not only did small entrepreneurial companies respond quite enthusiastically, but after some initial reluctance, large manufacturers also expressed positive interest (8). It now appears likely that the WHO will adopt a self-destructing syringe design (or will use machines that do not require needles for injection of childhood immunizations).

Several important differences can be noted between the WHO's modest performance criteria for single-use syringes, compared with what would be desirable performance criteria for the single-use syringes that could reduce HIV transmission among injecting drug users. The WHO criteria required only that the needle and syringe be difficult to reuse-not impossible or even exceedingly difficult. Additionally, in the case of childhood immunization, persons attempting to defeat single-use syringes will clearly not expend more than the legal cost of additional syringes to defeat the single-use design. In the illicit drug injection situation, however, if a scarcity of injection equipment exists, it may be quite profitable to expend many times the legal costs of additional syringes to defeat the single-use design. Finally, the WHO performance criteria applied only to needles and syringes combined as a single unit. The much more difficult problem of simultaneously designing separate single-use needles *and* single-use syringes was not addressed.

Based on the designs submitted to the WHO and presented at the First International Conference on Self-Destructing (Non-Reusable) Syringes (13), four general approaches to creating self-destructing, non-reusable, auto-destruct or single-use syringes can be considered:

- **A hydrophilic gel that can be placed within the syringe to disable the plunger or close the passageway through the syringe and needle. The** gel will absorb water and expand when it comes in contact with the solution to be injected. This expansion can either close the passageway through the syringe and needle directly, or else mechanically trigger a device that closes the passageway or disables the plunger in the syringe. Such syringe designs could be defeated either by removing the gel before the first use of the syringe, or by scavenging useful parts of the needle and syringe for use with hand-assembled injection equipment (e.g., cutting off the needle and attaching it to another syringe or syringelike device). (This latter strategy can, of course, be used to defeat almost all types of DTR syringe designs.) Moreover, two or more persons could potentially inject using a single syringe before the gel had expanded sufficiently to disable the syringe. The hydrophilic gel design also clearly could not be applied to many medical needles where a solution passes through the needle for an extended time, such as the needles used for intravenous infusions.
- Plungers **that are disabled when the user attempts to reload the syringe for a second injection.** Such syringe designs often involve a ratchet device that makes it difficult to pull the plunger back once the plunger has been fully inserted into the syringe barrel; the ratchet mechanism also creates a weak point in the plunger so that the plunger will break easily

when the user attempts to pull-back past the ratchet device. Such syringe designs could be defeated by removing the ratchet device or reinforcing the plunger so that it does not break when pulled back past the ratchet. The designs could also be defeated by removing the plunger and putting a suction bulb on the end of the syringe barrel. Parts might also be scavenged for use in hand-assembled injection equipment.

One design of this plunger-disabling syringe was inadvertently tested at an American syringe exchange site when the difficult to reuse syringes were accidentally included with other syringes to be exchanged. The drug user who received these syringes was amused to discover these syringes and reported that it took him about 30 seconds to defeat the disabling device. (He injected without pulling the plunger back far enough to disable it.)

- Needles that are disabled after the first use of the syringe. The WHO found these designs proved the least satisfactory. They were often the most mechanically complicated and, thus, prone to failure, whether while giving the initial injection or during the disabling. Even a very modest failure rate for the purposes of administering the initial injection would of course make these unacceptable for general medical use. Moreover, many of these devices required that the user actively disable the needle, so that a user who did not want to disable the syringe would not have to. Parts could also be scavenged for hand-assembled injection equipment. The major advantage of these designs-rather than in preventing reuse-appears to be in their potential for reduction in accidental needle stick injuries after the syringes have been used. Preventing such needle stick injuries is an important aspect of HIV transmission in health care settings, but is, nonetheless, a different issue than preventing HIV transmission among injecting drug users.
- Valves that prevent a second loading of the syringe. Many of these values incorporate a one-way flow mechanism that is activated after the syringe is loaded. The syringe can thus be emptied but not reloaded. However, many of these designs can be defeated by simply removing the valve mechanism in the following manner: First the plunger is removed, then the barrel of the syringe is cut near the needle end, then the valve mechanism is removed, and finally a bulb is placed over the end of the barrel to provide the suction necessary for further injections. Even for those designs where the valve mechanism could not be removed without totally destroying the syringe barrel, the needle could still be clipped off and combined with a medicine dropper for multiple-use injections.

Variations on these four types could conceivably be considered, as well as methods for defeating the specific variations. However, given that over 200 designs were submitted to the WHO, this review could lead to a long and extremely technical discussion. More useful to policy makers is to consider some general principles regarding single-use syringes.

CONCEPTUAL AND DEFINITIONAL CLARIFICATION OF SINGLE-USE INJECTION EQUIPMENT

The terms single-use, self-destructing, and nonreusable are confusing and, indeed, are probably misnomers with respect to injection equipment. First, most needles and syringes are already single use in that they are intended to be used only once and then discarded. The present equipment can, however, easily be reused many times. With respect to possible new designs, no design appears to be truly a ‘‘needle and syringe that cannot under any circumstances be used more than once. In the words of one manufacturer whose design was approved by the WHO, “All designs can be defeated.’ Of course, there can be no absolute certainty whether someone might develop a design for a needle and syringe that could not be reused and that could be produced at a reasonable cost. Unfortunately, there also can be no certainty that what initially appeared to be a truly undefeatable design might not eventually be defeated-even after it was adopted for general medical use in the United States. Therefore, rather than speak of single-use, self-destructing, or auto-destruct syringes, we will instead speak of difficult-to-reuse syringes. This more precise terminology is intended to change the focus to what realistically may be attainable with some creative thinking and resources.

SYSTEM ISSUES

Rather than just considering the merits of individual syringe or needle designs, policymakers should concentrate on the difficulties in establishing any system of single-use injection equipment, even if a perfect single-use syringe was developed. First, as suggested above, any attempt to impose either a single-use or difficult to reuse syringe system on illicit drug users can be defeated by the use of hand-assembled injection equipment. Indeed, prior to the introduction of the inexpensive, disposable but multiple-use diabetic combined needles and syringes, most illicit drug users did use hand-assembled injection equipment. The most common method these drug users used was to attach a medical needle to a medicine dropper (25). Many longtime heroin injecters say they preferred this type of equipment because the bulb permitted them finer control of the injection process. It is also worth noting that illicit drug users prefer medical needles, for injection over such hand-assembled equipment, but medical needles were far from required. In fact, needles used for inflating sports equipment have been sharpened by filing them against concrete, and then used for injecting drugs.

Thus, this potential for hand-assembled injection equipment by itself would be sufficient to defeat a single-use syringe system in the United States, even if there was a perfect single-use combined needle and syringe. We have yet to see any designs that would render all medical needles truly single-use and cannot imagine designs for reasonably priced single-use medicine droppers, single-use baby pacifiers, or single-use needles for inflating sports equipment.

Another factor worth noting is that some hand-assembled injection equipment may transmit more blood than the diabetic syringes now commonly used for injecting illicit drugs. Because some hand-assembled injection equipment would not require a lubricated plunger, it could also be reused more times than the diabetic syringes. Thus, the hand-assembled equipment might be more likely to transmit HIV.

Moreover, a systematic plan to use single-use/DTR syringes in the United States could be defeated by illicitly importing multiple-use syringes from other areas. According to one drug user interviewed for this paper, many of the syringes used for the injection of illicit drugs in southern California are already smuggled in from Mexico (2). If a scarcity of illicit injection equipment occurred in major cities, one would predict moderate-to-large-scale smuggling of multiple-use needles and syringes into the United States from other countries would transpire. For instance, in New York City, the current street value of a new illicit multiple-use needle and syringe ranges from $1 to $5 (the latter where the demand is high), but New York City also has a relatively steady supply of multiple-use injection equipment diverted from medical sources. If a scarcity led to a major increase in street prices for multiple-use injection equipment, then one would have to expect an even larger smuggling system to develop. Indeed, the lack of a sufficiently isolated geographic area was the reason the Dutch abandoned a plan to try single-use syringes as a method for reducing HIV transmission among injecting drug users (l).

If illicit importing of multiple-use injection equipment developed on a large scale, it is likely that only the multiple-use needles (i.e., without syringes) would be smuggled into the United States. Smuggling only needles would greatly reduce the bulk of the material to be smuggled, and these needles could then be readily affixed to medicine droppers or baby pacifiers to provide users with true multiple-use injection equipment.

If a severe shortage of illicit injection equipment developed and other countries also banned multiple-use injection equipment, then large-scale illicit manufacturing of multiple-use injection equipment might occur. It is difficult to formulate even an imprecise estimate of the likelihood of these events concurring. Given the ease with which injection equipment can now be hand-assembled, large-scale illicit manufacture of multiple-use injection equipment is probably quite unlikely. However, since there is relatively large-scale manufacturing of other paraphernalia for illicit drug use, such as plastic crack vials, the possibility of large-scale illicit manufacturing of multiple-use needles and syringes cannot be totally ignored. As is the case with the potential smuggling situation, it is likely that domestic illicit manufacturing would concentrate on producing multiple-use needles, which could then be affixed to medicine droppers or baby pacifiers to create multiple-use injection equipment. Needles are both relatively easy and inexpensive to manufacture. The precedent for the domestic manufacture of metal

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drug paraphernalia already exists: cocaine spoons, for instance, were successfully manufactured and sold, even though they provided no cost-effective advantage in drug consumption to users.

Even though a system of single-use needles and syringes does not provide the perfect solution for drug users who might share equipment because they could be defeated through one or more of the above mechanisms, nevertheless distribution of single-use/DTR equipment could help reduce HIV transmission among injecting drug users. Planning for how DTR needles and syringes might be used to reduce HIV transmission does, however, require recognition of the certainty that a supply of multiple-use injection equipment available for illicit drug use will always be available. This fact leads to the policy and organizational questions that policymakers need to address as part of any plan to use DTR syringes to reduce HIV transmission among injecting drug users. The next section examines these questions in greater detail.

As noted above, others are working to redesign injection equipment to reduce both the reuse of injection equipment in health care settings and the chances of accidental puncture injuries (needle sticks) in such settings. Most of these new designs are easy-to-reuse and, thus, would not raise new questions about the spread of blood-borne pathogens among persons who inject illicit drugs. Some of the designs, however, are difficult to reuse and their widespread adoption within health care settings would raise important policy questions in regard to HIV transmission among illicit drug injecters.

THE CRITICAL POLICY QUESTION

The most important question in considering the possible effect of DTR syringes on the transmission of HIV among injecting drug users is not the technical question of exactly how difficult to reuse the syringes might be. Instead, the critical policy question is should legal injection equipment be supplied to persons who want to inject illicit drugs? If a policy decision was made to adopt or require DTR injection equipment for general medical use, *but such equipment were not to be supplied to persons injecting illicit drugs, HIV* transmission among drug injecters would actually increase. Most needles and syringes used by illicit drug injecters are diverted from medical sources and can be easily reused. However, it is very unlikely that enough extra needles and syringes would be diverted from medical sources to make up for the increased difficulty in re-using the new equipment. In particular, one of the most common sources of needles and syringes for illicit drug injection is the sale by diabetics of their injection equipment. If diabetic syringes were truly difficult to reuse, then a real scarcity of equipment for injecting illicit drugs could develop.

The substitution of truly DTR injection equipment for the current easy-to-reuse disposable equipment would mean a scarcity-but not an absence-of multiple-use injection equipment available to illicit drug injecters. As noted above, some multiple-use equipment would still be available, whether through defeating the single-use design, through hand-assembled equipment, or through purchasing illicitly imported or manufactured equipment. The most likely outcome of such a situation would be an increase in the number of persons sharing the reduced numbers of multiple-use injection equipment, and hence an increase in the transmission of blood-borne viruses among drug injecters. A reduction in the availability of sterile injection equipment for illicit drug users appears to have been one of the major reasons for the very rapid spread of HIV in Edinburgh (20). The consideration of this possible factor for the increase in HIV transmission led participants at the First International Conference on Self-Destructing Syringes to adopt a resolution that single-use syringes should not be considered for normal medical uses *unless* injection equipment were simultaneously supplied to illicit drug injecters (13).

At present, no consensus has developed in the United States on whether injection equipment should be made legally available to persons who inject illicit drugs. The issue comes to bear on two sets of relevant State laws. Twelve States require prescriptions for the sale of injection equipment; these States tend to have large numbers of persons injecting illicit drugs (e.g., New York, California, Illinois). Moreover, 48 States (19) have laws criminalizing the possession of paraphernalia for illicit drug injection. Over the past several years, however, two States (Hawaii and Connecticut) have changed their laws to permit syringe exchange, and legislators in several states are considering legalizing over-the-counter sales of injection equipment. Many people still greatly oppose providing legal injection

equipment to persons injecting illicit drugs. Even if it is technically feasible to supply DTR syringes-or true single-use syringes, this opposition might remain.

Several arguments have been advanced in opposition to legal availability of injection equipment:

- One is that, by removing the fear of AIDS, legal availability of injection equipment would lead to an increase in illicit drug injection. However, all studies to date of legal availability have failed to substantiate any increase in illicit drug injection (6). The possibility that legally available single-use injection equipment would lead to a reduction in HIV transmission would not counter this argument; if anything, it would reinforce the argument.
- A second argument is that legal distribution of injection equipment would "send the wrong message" about illicit drug use, and appear to "condone" illicit drug use. Again, legal distribution of DTR or single-use equipment rather than multiple-use equipment would not appear to counter this argument, and may reinforce it.
- A third argument against legal distribution is simply that such programs would not work, that illicit drug injecters would continue to share injection equipment even if it were legally available; in particular, that they would still share ''cookers"l and rinse water. Single-use or DTR syringes would directly address part—but not all-of this argument against legal distribution.

Hence, the policy controversy around legal access to injection equipment is one of the greatest impediments to the implementation of DTR syringes in the United States. Opponents of legal access for multiple-use equipment also tend to be no less opposed to legal access for DTR equipment. Moreover, even many potential proponents of DTR injection equipment have stated that they will not support use of such equipment in general medical care unless the same injection equipment is simultaneously made legally available to injecting drug users. Until this impasse is resolved at a national level, any plan to use DTR injection equipment could not be implemented in the United States.

Despite this great obstacle to implementation of any plan for DTR injection equipment, it is still worthwhile to examine what forms such plans might take. Before doing so, however, it will be helpful to consider the views of active drug injecters themselves toward single-use/DTR syringes. The views of active drug users provide important insights as to why drug users might defeat DTR injection equipment programs, even if legal equipment was legally available to them.

USERS' VIEWS

Active drug injecters were interviewed in Australia when DTR syringes were being considered as a possible HIV prevention technique in that country (28). Also, we interviewed a group of active drug injecters in the United States specifically for this paper. (In both countries, the interviews were conducted with the explicit assumption that injection equipment would be legally available.) In addition, an ex-drug user who is now a research professional has devoted considerable thought to the issues involved (25). Although the drug injecters in both Australia and the United States expressed considerably diverse opinions, several common themes emerged from both sets of interviews.

First, many drugs injecters expressed a general receptiveness to the idea of DTR syringes. Of course, the drug injecters interviewed in both countries were aware of the threat of AIDS, and thus were generally open to ideas about how they might protect themselves from AIDS.

However, the drug users revealed specific concerns about DTR injection equipment beyond the possibility of HIV transmission. Many drug injecters, particularly in the United States, practice what is called ''booting' when they inject. Booting refers to injecting some of the drug solution, partially refilling the syringe with blood from the vein and then again injecting part of the drug/blood solution. The specific partial injection/refilling procedure is repeated several times within a single complete injection. The multiple-pulsed delivery of drug to the brain that occurs with booted injections is believed to create a more extended and pleasurable drug effect than can be achieved with a single-pulse injection. In many ways, booting resembles multiple

1''Cookers'' are metal bottle caps or spoons used t. prepare drugs for injection. The drug and water are placed in the cooker which is then heated until the drug is dissolved.

injections, and most (though not all) of the designs for DTR syringes also do not permit booting. Interviewees disclosed that the lack of a booting possibility would lead many injecters to find or make multiple-use injection equipment even if DTR equipment was readily available.

Secondly, injecting drug users often have difficulty in locating veins suitable for injection, usually because so many veins have already collapsed due to frequent injections. Many injecters will pull back the syringe plunger to determine if they have successfully located a vein. Syringes that would not provide for such aspiration would not be useful to them and would lead to a large demand for multiple-use injection equipment.

A third concern voiced by the drug users is the need to inject successfully, or at least to be able to recover the drug if something should go wrong during injection. Even with the multiple-use equipment currently in use, many things can go wrong while attempting to inject, and such problems would be compounded with many of the DTR-syringe designs. For instance, if the user is having prolonged difficulty in hitting a vein, the hydrophilic gel-type syringes could have already shut off the plunger by the time the drug could be injected. In general, then, the greater design complexity of the DTR equipment not only increases the likelihood that something would go wrong during the injection, but also make it that much more difficult to recover the drug if something did go wrong. It would not take a large number of occasions where expensive drugs were lost due to problems incurred with DTR equipment in order to prompt drug injecters to go back to multiple-use equipment.

Even with a very large effort to supply equipment to drug injecters, DTR equipment would probably increase the likelihood of a drug user finding himself or herself with drugs to inject, but without working injection equipment. This scenario would be an extremely frustrating situation. Many of the interviewed drug users anticipated this situation arising with DTR equipment, and stated that they would always keep a multiple-use needle and syringe as backup. Thus, even among drug injecters who were regularly using DTR equipment a demand for supplemental multiple-use equipment would still remain.

Finally, many of the interviewed users simply did not believe that DTR equipment was necessary to reduce HIV transmission and that availability of DTR equipment would not reduce transmission. They believed that sharing of injection equipment was primarily due to lack of readily available injection equipment. If enough equipment for everyone to have his or her own needle and syringe existed, then injecters would have no reason to share, and DTR equipment would not be necessary anyway. Moreover, because so much more equipment would be needed with DTR equipment, changing to DTR might actually lead to a reduction in the overall availability of sterile injection equipment, and thus to increased sharing of the limited multiple-use equipment that was still available.

The opposition to DTR syringes expressed by drug users in Australia was sufficient to lead officials there to abandon their plans for using such equipment to reduce HIV transmission among injecting drug users (28). A fundamental aspect of the national AIDS prevention strategy in Australia is to work collaboratively with drug users to change their injection and sexual behavior. Therefore, an attempt by health authorities to unilaterally impose DTR equipment over the objections of a large segment of the user population would greatly damage the trust and cooperative relationships that health officials have worked hard to establish.

Both the Australian and United States drug users expressed a similar range of opinions about DTR syringes. While some users seemed open to exploring almost any method for reducing HIV transmission, others voiced strong concerns about the specific injection needs of persons injecting illicit drugs, and a general skepticism about the whole idea of non-reusable injection equipment as a method of AIDS prevention.

NEW DESIGN CRITERIA AND NEW TECHNOLOGIES

As noted above, the DTR syringe design criteria adopted by the WHO for its childhood immunization program are different from the criteria that one would use for DTR injection equipment for persons injecting illicit drugs. The WHO criteria not only presumed a lower motivation to defeat the single-use features, but also did not address the special concerns of illicit drug injecters, such as booting or the recovery of expensive illicit drugs if the initial injection is not successful.

Thus, if DTR injection equipment is to be successfully used to reduce HIV transmission among injecting drug users, anew process of setting design criteria-and of evaluating proposed designs against those criteria-would need to be implemented. First, it would be helpful if either current or former drug injecters should participate in the process of setting design criteria and evaluating the proposed designs. Since reduction of HIV transmission depends greatly on whether drug injecters are willing to actually use-rather than try to defeat—the DTR equipment, it will be important to be aware of their perspective throughout the design process.

Second, it would be advisable to broaden the scope from designing single-use or difficult-to-reuse injection equipment to a concept of controlled reuse injection equipment. A needle and syringe that could be reused only after cleaning with a viricidal disinfectant (such as bleach or alcohol) might be quite effective in reducing HIV transmission among injecting drug users. This latter possibility would have the advantage of requiring fewer needles and syringes to be distributed to injecting drug users.

This second observation is not meant to advocate either of these two types of needles and syringes. Moreover, it would be just as important as with DTR equipment that any such controlled reuse injection equipment be designed to meet the specific injection needs of the drug injecters. Controlled reuse equipment may, however, provide some possibilities of reaching the same goal of AIDS prevention through slightly different means.

DISTRIBUTION ISSUES

If reducing HIV transmission among drug injecters is to be accomplished with DTR injection equipment, then the method selected to provide the equipment to the drug injecters becomes a critical question. If not enough equipment is provided, then one has to expect that the drug injecters will attempt to defeat the single-use designs, to hand-assemble multiple-use equipment, or to purchase smuggled or illicitly manufactured multiple-use equipment. As noted above, a situation where DTR equipment was used for normal medical injections without simultaneous provision of equipment to illicit drug injecters might actually lead to increased transmission of HIV.

The specifics of how DTR injection equipment might be distributed to illicit drug injecters clearly depend on the characteristics of the specific injection equipment. If controlled reuse equipment rather than single-use equipment is to be used, then the distribution problems would be different, and probably much less difficult. Even without knowing the specifics of the equipment to be used, however, it is possible to outline two different types of distribution strategies.

The Blanket Strategy vs. Targeted Approach

Most planning for DTR injection equipment has used a blanket distribution strategy. In that strategy, DTR equipment would replace the current multiple-use equipment for medical injections. (Note that it would be impossible to replace all multiple-use needles and syringes with truly non-reusable needles and syringes.) At the same time that use of the current injection equipment for medical uses was being replaced by DTR equipment, large-scale efforts to provide DTR injection equipment to illicit drug injecters would be undertaken. These efforts would probably have to include both over-the-counter sales of such injection equipment and syringe-exchange programs.

Implementing such a blanket approach poses several obvious difficulties. The first problem is the sheer number of needles and syringes that would have to be distributed to drug injecters. Many persons injecting, heroin typically inject several times per day on a regular basis. In Amsterdam, which has both over-the-counter sales and large-scale syringe exchanges-and where heroin is the predominant drug for injection-each needle and syringe is used an average of two times (l). This average usage rate would imply that the number of needles and syringes in circulation among injecting drug users would have to be doubled for DTR injection equipment.

The blanket distribution problem would be even worse in the context of cocaine injection. Most of the persons who inject illicit drugs in the United States inject cocaine as well as heroin. Persons who inject cocaine often do so in “binges,” when they will inject from 10 to 20 times in rapid succession. (Typically, they continue to inject until the supply of cocaine is exhausted.) DTR syringes would require either that cocaine injecters store large surplus numbers of syringes, or that a superb distribution system be set up for getting enough DTR injection equipment to drug users.

Using the above Amsterdam estimate on the number of DTR syringes needed per year per injecter--and, conservatively, doubling it to adjust for the higher frequencies of cocaine injection—would require a system that could distribute from 1 billion to 11/2 billion sterile DTR needles and syringes annually to injecting drug users in the United States. (An estimated 1 to 1.5 million injecting drug users live in the United States). New York City alone, with its estimated 200,000 drug injecters, would need to distribute 200 million DTR syringes per year. Such a system would require over-the-counter sales (given the large numbers and extensive geographic coverage provided by pharmacies), many syringe-exchange locations (probably including call-in exchange delivery, such as a few exchanges already provide), and numerous exchange/vending machines, where new injection equipment could be obtained by placing either used equipment or special tokens into the machine.

The ultimate test of a blanket distribution system for DTR injection equipment is the comparison between the ease of obtaining multiple-use equipment (thus defeating the system) versus the ease of obtaining new DTR equipment (thus preserving the system). It is worth recalling that the drug users interviewed for this paper did not believe that a sufficiently extensive and efficient distribution system would ever be set up for DTR needles and syringes. The great majority of them stated that they would keep a multiple-use needle and syringe as backup, in case they could not readily obtain DTR needles and syringes.

The other aspect of the distribution problem, of course, is safe disposal of this greatly increased volume of potentially HIV-contaminated injection equipment. Syringe exchanges throughout the world have return rates that range from about 60 percent to almost 100 percent, depending on the policies, operating hours and other characteristics of the exchange. Studies of syringe exchanges have found that successful exchange programs actually reduce the number of needles and syringes left in public places (18). Syringe exchanges have reduced the public-discarding of used injection equipment by giving economic value to the used equipment (i.e., it can now be exchanged for free new injection equipment). DTR injection equipment, however, would have considerably less economic value than multiple-use injection equipment, and one would have to expect that return rates would decrease as the absolute numbers of needles and syringes distributed increased. At the very least, numerous publicly accessible, tamper-proof 'sharps' containers would have to be setup in high-drug-use areas, in order to make safe disposal of used injection equipment as easy as possible.

Policymakers should note that failure to safely dispose of the increased number of DTR needles and syringes would be a serious problem. A public perception that legalizing the distribution of DTR syringes to drug users would lead to an increase in HIV-contaminated litter in public areas would greatly undermine support for the distribution of DTR equipment to that population.

The distribution and disposal systems would not only have to be large and efficient, but would also have to protect the anonymity of the injecting drug users. As long as possession of the drugs to be injected is a crime, drug injecters will want to protect their identities when they participate in the distribution and disposal programs. The need to protect anonymity is of great importance with respect to law-enforcement personnel, but also applies to friends, employers, relatives and sexual partners. Having to handle much larger numbers of needles and syringes could itself compromise the person's ability to keep his or her drug injection a secret.

Consideration of the problems in distributing and safely disposing of the large numbers of needles and syringes leads back to one of the concerns expressed by many of the drug users interviewed in both the United States and Australia. Rather than attempting to setup the very extensive and efficient distribution and disposal systems that would be needed to provide large amounts of DTR injection equipment to the drug users, many of the drug users said that it would be simpler to provide them with enough multiple-use equipment so that everyone could always have his or her own equipment, without having to share.

The aforementioned problems with a blanket approach to distributing DTR injection equipment to drug users do not necessarily imply, however, that the approach would fail to reduce HIV transmission among the drug users. Rather, these potential problems merely indicate that this strategy could not be expected to work perfectly (i.e., in such a way that all injections are with new equipment and that no "needle sharing" transmission of HIV occurs). Nonetheless, a blanket DTR equipment distribution

system, even though it might be far from perfectly implemented, could still reduce HIV transmission sufficiently to justify its costs. The task of evaluating precisely how well such a system would have to work leads to a final problem with the blanket approach. This measurement problem produces the great difficulty in conducting any pilot study of the approach. Such a study would require finding a location that was sufficiently isolated that large amounts of multiple-use injection equipment could not be smuggled in easily. As noted above, Dutch officials were at one time interested in conducting a pilot study of the effectiveness of DTR injection equipment, but abandoned their plan when they could not find a suitable location for the pilot study.

A suitable location would also require a large enough number of drug users to conduct the pilot test. Unless the illicit drugs were being produced locally, this location would have to be one where large amounts of illicit drugs were being brought in from elsewhere to supply the local market of drug injecters. It is difficult to imagine an area anywhere in the developed world where, if large amounts of illicit drugs are being shipped in, large amounts of multiple-use injection equipment could not be shipped in simultaneously. Such locations might be found in the countries where heroin and cocaine are produced, but the results from a trial study conducted in other countries might not reflect what would happen in the United States.

The difficulties in finding such an isolated locality suggest that any pilot program would have to be conducted on a national basis. Bringing multiple-use injection equipment into a given locality would simply be too easy without national borders and customs barriers to interdict illicit equipment. Considering the many things that might go wrong in a pilot study, conducting the study on a national basis would require an extraordinary degree of confidence and courage among the public-health, community, and political leaders of the country.

TARGETED DISTRIBUTION OF DIFFICULT-TO-REUSE INJECTION EQUIPMENT

Rather than trying to get all drug injecters to use new equipment each time they inject (the blanket distribution approach), it might be possible to use DTR equipment in a more targeted distribution to prevent HIV transmission among injecting drug users. All illicit drug injections are not equally likely to transmit HIV. Injections where each person is injecting alone, using his or her own equipment, can be considered as posing zero risk of HIV transmission. Conversely, some injection situations are particularly likely to lead to rapid transmission of HIV (10). "Shooting galleries," where users rent injection equipment, use it, and then return the needle and syringe to the owner of the gallery-who then rents it to the next drug injecter--are especially dangerous in terms of HIV transmission. Similarly, injection with ' 'dealer's works' '-equipment that a drug dealer lends to customers who want to inject immediately after purchasing-is also highly likely to spread HIV among a population of drug injecters.

Even if only shooting gallery equipment and dealer's works equipment could be replaced with DTR injection equipment, there could be a very significant impact on HIV transmission. (The exact impact would depend on the frequency, within a given area, of injections occurring in shooting galleries or with dealer's works, as well as the background HIV seroprevalence in that area, among other factors.)

A major advantage of placing DTR equipment in shooting galleries and with dealers is that individual injecters would not be reusing the equipment, and thus would have no economic interest in multiple-use equipment. Given their concerns about AIDS, these injecting drug users would therefore be likely to prefer DTR equipment.

Obviously, the person who is operating the shooting gallery, or the dealer who is lending out injection equipment, would still have an economic preference for multiple-use injection equipment. This economic preference could be reversed, however, if DTR equipment was supplied to the gallery operators and dealers at no cost (probably on an exchange basis).

Conducting such targeted distribution of DTR injection equipment would require cooperation between health care workers, on the one hand, and shooting gallery operators and dealers, on the other. Establishing such cooperation is obviously not easy, but it has previously been done in New York (22), Miami (4) and in Minneapolis-St. Paul (16) for the purposes of bleach distribution and research.

Moreover, the aforementioned distribution and disposal problems would obviously be far more

manageable with a targeted (rather than a blanket) distribution system—although maintaining the anonymity of the shooting-gallery operators and dealers would remain an important issue.

Targeted distribution of DTR injection equipment also would not require changes in the normal medical use of the current styles of needles and syringes. This fact is a major advantage in terms of designing equipment for drug injecters, but it also means that the overall market for the successful design would be quite limited. Finding a manufacturer might also prove difficult.

Admittedly, the concern that successful distribution of DTR equipment would have no major advantage over successful distribution of multiple-use injection equipment could apply to targeted distribution as much as it does to blanket distribution. The targeted situations, however, are situations where multiple-use equipment would have no economic advantage for the drug user, and where multiple-person use of the same equipment would otherwise continue to be particularly likely to lead to rapid HIV transmission among drug injecters in the community. In that sense, targeted distribution of DTR equipment could even be fully compatible with simultaneous large-scale distribution of multiple-use equipment to injecting drug users in the community at large.

A final advantage of a targeted distribution approach is that small pilot studies could be (relatively) easily conducted. If the pilot studies were successful, then staged expansion could gradually be added. That targeted distribution would ever expand to the level of full blanket distribution is unlikely, but local experts could monitor the drug scene to identify places where particularly high-risk injection was occurring.

IMPLICATIONS OF DIFFICULT-TO-REUSE SYRINGES FOR GENERAL MEDICAL USE

This paper is concerned with the possible use of difficult-to-reuse injection equipment to reduce the transmission of HIV and other blood-borne pathogens among injecting drug users in the United States. It is not intended to examine the possible use of new technologies to reduce the transmission of HIV and other viruses within health care settings. With the possible exception of the Florida dentist case, health care worker-to-patient transmission of HIV within health care settings does not appear to be a substantial problem in the United States. Similarly, patient-to-patient transmission of HIV through reuse of injection equipment without proper sterilization also has not been an important mode of transmission in the United States (15,26).

The AIDS epidemic has, however, led to increased concern over infection control procedures within health care settings. This increased concern has led to suggested redesigns of injection equipment to reduce the need to use the same equipment for different patients, and to reduce the likelihood of accidental puncture wounds (needle sticks) with injection equipment. Such redesign does not necessarily make the equipment more difficult to reuse. For most injection equipment used in this country's health care settings, little if any economic incentive to reuse the equipment exists, and thus little purpose in making it difficult to reuse. To the extent that new designs are difficult to reuse, the implications for HIV transmission among injecting drug users should be considered, but it would appear unlikely that transmission among persons using illicit drugs would be a major consideration in the possible adoption of new designs to improve infection control in health care settings.

On the other hand, the implications for health care are important to consider settings if difficult to reuse equipment were adopted in order to reduce HIV transmission among injecting drug users in the United States. The implications for health care settings would to some extent depend on the particular DTR technologies adopted but, to a much greater extent, they would depend on the policy framework within which the DTR technologies were implemented.

If a system of DTR injection equipment was implemented with a policy decision not to provide legal equipment to injecting drug users, then there would be several likely consequences for health care settings. DTR injection equipment is likely to cost as much or more than the current single-use but easy-to-reuse equipment. The additional cost would depend on the specific design and is impossible to predict at present, though some designs submitted to the WHO appear to cost about the same as current equipment.

The use of DTR equipment in health care settings might also slightly increase medical-waste disposal

costs. Costs for proper disposal of potentially infectious medical waste are already rising as universal precautions are adopted in more health care settings. The additional disposal costs incurred by substituting a one-time-only use policy for equipment that is currently used multiple times would probably not be a major factor in any continued rise.

If there was to be a large-scale substitution of difficult-to-reuse equipment for the current easy-to-reuse equipment within a policy framework of not providing equipment to injecting drug users, one should expect a substantial increase in the illicit market value for injection equipment. The increase in the illicit market value would be particularly high for injection equipment where the DTR features could easily be defeated, and for injection equipment such as intravenous infusion needles, where it may not be possible to incorporate DTR features.

A large increase in the illicit market value for injection equipment could lead to an increase in security problems for many large urban hospitals. While no quantitative data could be located for this paper, security at many large urban hospitals is already a major concern, and an increase in the illicit market value for injection equipment would only add to that concern. At this point, however, no predictions can be made about the costs for added security.

The situation of diabetic injections with DTR equipment requires special consideration. First, while diabetic injections are supposed to be with single-use needles and syringes, many diabetics do reuse the current easy-to-reuse equipment. No quantitative data could be located on how frequently injection equipment is reused but, from several informal interviews with diabetics, this practice appears to be a common one. Substitution of DTR injection equipment would thus lead to a real increase in costs for diabetic injections or attempts by diabetics to defeat the DTR features. The mix of increased cost and the practice by diabetics of defeating the DTR features would probably depend on the specific nature of the DTR equipment (how easily it could be defeated) and who is paying for the injection equipment.

The substitution of DTR equipment for diabetic injections is also important for another reason. While it was not possible to obtain quantitative data, interviews with several AIDS prevention researchers (2,23,24) indicated that diabetic syringes are the predominant type of needle and syringe used for the injection of illicit drugs. In cities where prescriptions are required for the purchase of syringes, these needles and syringes are often sold by diabetics (who reuse single-use equipment for their own insulin injections). If the illicit market value of injection equipment was to increase markedly, diabetics with legal access to injection equipment would have more incentive to defeat the DTR features of syringes for their insulin injections and sell more needles and syringes on the illicit market.

Substitution of DTR injection equipment for the present easy-to-reuse equipment without simultaneous provision of equipment to injecting drug users, thus, could have very mixed effects on diabetics. For diabetics who did not attempt to defeat the DTR features, the substitution would probably lead to increased costs. For diabetics able to defeat the DTR technology and willing to sell some injection equipment on the illicit market, it could lead to a sizable increase in illicit income for them.

If a policy decision was made to substitute DTR equipment for current equipment that can be easily reused and to provide equipment to injecting drug users (via a blanket distribution approach discussed above), then there would be substantially different implications for health care settings. Within a blanket distribution approach, concern would not be with eliminating all sources of reusable injection equipment, but focused only on major sources.

To the extent that the blanket distribution of DTR equipment was providing drug injecters with sufficient injection equipment, there would be little or no economic incentive to obtain easy-to-reuse equipment. (Although, as noted in the interviews with active drug injecters, most of them would want to keep at least one easy-to-reuse needle and syringe in reserve.) A large-scale supply of DTR injection equipment would also reduce economic motives for diversion or theft of injection equipment from health care settings, so that the increased security needs discussed above would not be as great. Use of DTR equipment in health care settings would further reduce economic incentives for diversion or theft. Whether DTR equipment was used for particular types of injections in health care settings would probably depend heavily on the additional costs for adding DTR mechanisms to the specific injection equipment.

As noted above, substitution of DTR injection equipment for diabetic use would lead to some mixture of increased cost and of attempts to defeat the DTR technology. An increase in costs to diabetics may be provoke resentment on their part when injection equipment is being provided free (on an exchange basis) to persons who are injecting illicit drugs. Diabetics protested and delayed implementation of syringe-exchange programs in Canada (that provide easy-to-reuse equipment), because the diabetics believed it was unfair for the government to provide free injection equipment to illicit drug users while the diabetics themselves had to pay for their injection equipment. Hence, it is likely that free difficult-to-reuse injection equipment would also have to be offered to diabetics in the United States on an exchange basis as part of any plan to use DTR equipment within a blanket system for distributing to drug injecters.

A targeted distribution approach, which would place DTR injection equipment only into very high-risk injection situations such as shooting galleries and dealer's works, would not require changing the single use but easy-to-reuse equipment currently in medical use. This strategy would thus allow time for gaining some practical experience with the distribution of DTR equipment to injecting drug users-and their reactions in the field to such equipment—without at the same time having to change the patterns of normal medical injections.

CONCLUSION

The analyses in this paper indicate that most proposals for utilizing redesigned injection equipment are unlikely to reduce the spread of HIV and may have other unintended consequences. There is no syringe yet designed and feasible to manufacture that could not be defeated by someone seeking to reuse it. Distributing enough syringes to prevent the establishment of a black market for injection equipment that can be easily reused presents significant logistical and ethical dilemmas. In addition, evidence indicates that many of the proposed redesigns would interfere with usual drug-taking practices, making most drug users unlikely to accept them. Redesigned syringes would also likely cost more than current syringes and could significantly add to medical waste problems. Some injecting drug users have, however, indicated a willingness to use redesigned injection equipment in order to reduce the transmission of HIV. Targeted distribution of redesigned injection equipment could be used to identify those situations in which: 1) injecting drug users would be least likely to try to defeat DTR equipment; 2) the cost, supply, and safe disposal problems would be manageable; and 3) the use of DTR equipment would have the greatest impact on reducing HIV transmission among injecting drug users.

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