5

Structural Interventions

Frederick R. Bloom, R.N., Ph.D., and Deborah A. Cohen, M.D., M.P.H.

Overview and Summary of Review Methods

The term "structural intervention" is a relative newcomer to a longstanding mode of implementing changes beyond the individual in order to change health behaviors and health outcomes. As such, there remain variations in the precise definition of the term. In 1995 there was increasing use of the term applied to HIV/AIDS interventions. Sweat and Denison (1) differentiate structural levels of causation from other macro-levels in that structural interventions influence laws, policies, and standard operational procedures implemented through activism, lobbying, and changes in policy. Interventions that they review pair structural-level intervention with those that are environmental (influencing living conditions, resources and opportunities, and recognition of other levels of causation). O'Reilly and Piot (2) portray structural intervention as synonymous with "enabling approaches" (3). These are defined as interventions that change the social or physical environment to enable changes in determinates of risk. Interestingly, this is categorized as environmental intervention by Sweat and Denison (1). O'Reilly and Piot (2) differentiate structural interventions from other interventions including the community level, described as those pertaining to a fixed geographical area. More recent writers have included community-level interventions as a type of structural intervention (4). Thus, there is clearly disagreement in the limits of what may be considered a structural intervention.

Some of the difficulties in finding a clear definition of structural intervention are reflections of the multi-disciplinary aspects of public health, where different theoretical frameworks and terms refer to similar concepts (5). In addition, structural interventions may be linked to other levels of intervention either directly or indirectly. For example, implementation of a national immunization program might be considered a structural intervention because of the policy and organizational changes. However, this same intervention is dependent on 1) a biomedical intervention preventing infection by increasing host resistance to infection by altering biological factors; 2) community-level intervention using messages to increase vaccination acceptability; and 3) individual level intervention involving patient care by health care providers, and so on. These latter three interventions may have been developed independently

Behavioral Interventions for Prevention and Control of Sexually Transmitted Diseases. Aral SO, Douglas JM Jr, eds. Lipshutz JA, assoc ed. New York: Springer Science+ Business Media, LLC; 2007.

through research, indirectly instilling a multi-level approach to the program, or implemented as part of the structural intervention directly, as part of a multi-level intervention program.

In 1998, in an attempt to provide a clearer definition of structural intervention in the context of HIV prevention, an internal workgroup at the Centers for Disease Control and Prevention (CDC) endeavored to clarify the structural barriers and facilitators of HIV prevention (6). This resulted in a broad framework of nine systems (governments, service organizations, businesses, workforce organizations, faith communities, justice systems, media organizations, education systems, and health care systems) and four levels of barriers or facilitators for HIV prevention (economic resources, policy supports, societal attitudes, and organizational structures).

Working Definition of Structural Intervention

Blankenship et al. (6) also take a broad view of structural intervention, stating that structural interventions in public health alter "the context within which health is produced or reproduced." (We interpret the term *reproduced* to indicate restoration of optimal health when health is impaired.) The definition of structural intervention that we shall use in the following discussion will consider the "context" as the environmental factors that influence STD prevention. These systems will be divided into four broad categories of structural factors (7,8). The following is not a comprehensive list, but is presented to afford the reader a better understanding of this framework:

- product availability, e.g., interventions involving:
  - condoms, which may reduce risk
  - drug availability and use, which may increase risk
- social structures/policies, e.g., interventions focused on:
  - community social change/social norm change
  - political system change
  - legislative system change
- physical aspects of product or broader environment, e.g., interventions that address changing the physical environment, such as:
  - crack cocaine "shooting galleries"
  - sex clubs, bathhouses
- media and cultural messages, e.g., interventions that seek to change the cultural environment through:
  - media campaigns
  - local media (pamphlets, fliers)

Thus, structural interventions for STDs will be reviewed in terms of the primary target of an intervention as an (i.e., environmental factor based on the above four categories). However, structural interventions embedded within multi-level interventions have been equally important, both in their contribution to STD and HIV prevention, and as antecedents to today's structural intervention endeavors. Since structural intervention may be a compelling aspect of multilevel interventions in terms of broadening the effect on public health at a population level, we shall also provide a limited review of important historical examples of multilevel interventions with key structural intervention components.

In order to facilitate our review of structural intervention, we conducted database and library searches based on personal knowledge of structural intervention and related literature. In addition, database searches were conducted using MEDLINE, PSYCHLIT, SOCIOFILE, CINAHL, AIDSLINE, and PUBMED. Relevant articles were reviewed and antecedent articles were identified from citations. The following discussion will begin with a historical perspective on structural intervention and will reveal how structural interventions have been critical to the development of public health in general and STD prevention more specifically.

Historical Perspective

Early Antecedents to Structural Intervention

Though the term *structural intervention* is relatively new, structural interventions in terms of policy change and manipulation of societal and cultural level factors are not. Efforts to improve health and control disease through manipulation of the environment or changes in policy are longstanding (though not uniformly effective) in human history. For example, the first efforts for sanitation and irrigation date back to the ancient Greeks and Romans who developed aqueducts to benefit the entire population (influence product availability). Efforts to control plague in 1600s through the extermination of rodent populations in Frankfurt (9) are another early example (changing the physical or broader environment). The development of what we now call structural intervention, as a key element of public health practice, has more recent antecedents in social hygiene, social medicine, and human ecology as early as the mid-1800s.

In the latter half of the 19th century, European scientists began to include the environment as a key factor in epidemiology and began to recommend or employ structural interventions to improve health on a population level (10). In an effort to improve social welfare and health, Virchow, working with typhus in 1848, recommended improvements in education and policy, alleviation of poverty, and intervention in social structure and policy (11). John Snow's efforts to control cholera in London through improvements in sanitation and provision of clean water from 1854 to 1856 are well known (12,13), primarily intervening in physical structure. Some of the most impressive and successful public health efforts through implementation of structural interventions were those implemented by Florence Nightingale between 1854 and 1898. Shortly after her arrival at the hospital at Scutari during the Crimean War, Nightingale implemented changes to the physical structure that housed the sick and procedural changes for their care and cleanliness. Following her return to England, she worked to improve health care for British soldiers through structural and policy changes in health care services and prevention through improved sanitation, nutrition, and care (14).

Public Health in the 20th Century: Structural Components and Multilevel Interventions

Structural interventions continued to be important internationally, through the turn of the century, with the Yellow Fever eradication efforts led by Walter Reed and others in Cuba and Panama, and Malarial Control efforts in the United States and abroad (relying strongly on changing physical aspects of the

environment—mosquito control). Structural intervention has been used effectively as a means of sustaining biomedical interventions through policy change or institutionalization of systems of biomedical or community-level interventions. The development of the Polela (also Pholela) Community Health Centers by Sidney and Emily Kark and John Cassel in South Africa during the 1930s and 1940s was one such intervention.

The Polela Center program was a national health care program that has served as a model for subsequent community health centers development. It was arguably one of the first attempts to integrate system-wide, structural changes on social and cultural levels with biomedical intervention(11,15). The Polela Health Center interventions were enacted as a coordinated pilot project designed to deliver health care to rural South African communities (16,17). This program was a multilevel intervention of structural, biomedical, community, and behavioral components. However, the most innovative features of this program were the structural interventions employed to overcome societal barriers to the provision of existing interventions for rural South Africans.

These innovative interventions involved changes to the physical environment, national policy and infrastructure, and social structure, as follows. Structural intervention on the physical environment was changed by building of a network of clinics in rural areas previously without clinics coupled with the development of community gardens. The former improved health care access, while the latter enhanced nutrition through increasing the availability of garden produce otherwise unavailable. Structural intervention through changes in national policy and infrastructure development were essential to the facilitation and delivery of biomedical intervention (clinical care and treatment, nutritional improvement), community-level intervention (coordinated clinic facilities located to serve geographical communities), and behavioral intervention (changing health-seeking practices toward clinic attendance, for instance, and facilitating use of community gardens for better nutrition). Structural intervention to influence the social structure was critical to interventions addressing STD prevention, as follows:

Sidney Kark suggested a structural intervention component for STDs including recommendations for social norm and behavioral changes to reduce syphilis incidence in Africans whose lives were transformed by diamond and gold mining, with the resultant social destabilization of existing communities (18). Unfortunately, this early attempt at structural intervention for STD (and the Polela Health Community Health Center project as a whole) was never adopted by the South African government because of political barriers including apartheid and the election of a new, less sympathetic government (19). Importantly, the scientists who worked on the Polela project continued to exert a great influence on public health; Cassel coming to the United States (UNC at Chapel Hill) to continue to integrate the idea of social determinants of health into epidemiology (20,21), and the Karks emigrating to Israel, continuing their work on community-oriented primary care (22). Their work in Polela and afterward served as a model for community health centers.

Similarly, between 1936 and 1947, Thomas Parran's work on syphilis included policy and program changes paralleling some aspects of the Polela Centers with the 1937 syphilis control program in the United States and the

Rapid Treatment Centers (RTCs) of the mid-1940s. Like the Polela projects, the RTCs were an innovative structural component of a multilevel intervention with biomedical and individual-level interventions. RTCs offered a newly designated physical space and policy that, to an otherwise unknown extent, provided STD treatment and counseling as a public health program. A national plan for the Syphilis Control Program and the institutionalization of the RTCs through structural intervention at the legislative level (National Venereal Disease Control Act of 1938) provided infrastructure and sustainability through policy change. Knowledge and awareness were targeted through a media campaign. Changes in the physical structure of STD treatment (development of Rapid Treatment Centers designated for STD treatment) provided the setting and a program (a set of policies and procedures) for biomedical and behavioral intervention based on traditional social work. Structural (or system-level) components of multi-level interventions continued to be widely implemented in international health from the 1950s through the 1980s covering a broad range of health concerns (23).

The use of structural interventions continued to expand following the WHO/UNICEF Alma Ata declaration of 1978 that linked health to structural conditions including political, social, and economic reform (24). This sparked a number of broad multilevel intervention programs targeting diarrheal diseases (insuring access to clean water), and respiratory diseases (reducing the prevalence of tobacco use, clean air standards) (23,25,26).

The HIV Pandemic: Structural Level as Primary Intervention

Though there is a rich literature on structural factors contributing to HIV/AIDS during the first decade of the epidemic, there is limited publication of structural interventions (5). Notable exceptions to this include documentation of grassroots social norm changes of reduced sexual risk in gay communities (community-level social-structure change), policy change at governmental levels, and physical structure changes such as the closing of bathhouses in the San Francisco (27). In addition, the 100% condom use program for commercial sex workers and their clients in Thailand was a structural intervention based on policy change, product availability (condoms), and change in the physical environment through monitoring of brothels (1). By 1995, structural intervention for HIV prevention in developing countries was well entrenched (1,3). During this same time period, Holmes called for intervention on the environment of health (from a human ecology perspective) to prevent bacterial STD transmission in developing countries and in the United States (28). This ecological perspective brought the health environment, and thus structural intervention, to the forefront as a means to alter the environment in which STD transmission occurs.

In the 1990s and through the present, structural interventions (though not always defined as such) became more evident in HIV and STD prevention internationally and domestically. For instance, policy changes that increased access to clean syringes were implemented in Australia, several European nations, and a few U.S. cities to reduce HIV transmission risk for intravenous drug users (IDUs) (29). A variety of public policy interventions for bathhouses were implemented as structural interventions to reduce sexual risk, though one analysis of these sometimes conflicting policies found them to be ineffective at reducing sexual risk (30).

Description of the Types of Structural Intervention Currently for STD/HIV

Structural interventions should be used whenever the desired process or mechanism involves a change in the environment or ecology within which health and illness are embedded. This implies that one or more given factors that influence health and illness have been identified, that a target population can be influenced by such change, and that a mechanism for structural intervention can be identified or developed. For example, structural interventions to reduce syphilis in gay men have been employed in Los Angeles, California, with some immediate success (31). Interventions included a media campaign and increased condom availability in community settings serving high-risk individuals, such as bars and nightclubs.

In addition to the previously mentioned Thai intervention for brothels, legislation and policy have been shown to be key elements in prevention for injection drug users, whether in relation to laws governing pharmacies or operational procedures employed by pharmacies (32,33). Use of the Internet to facilitate the availability of laboratory testing for STDs in an area with increasing syphilis for gay men is an innovative structural intervention using internet technology to increase product availability (lab testing initiation, lab results, and STD prevention information) (34). The following sections will provide detail relating to structural information across the four categories discussed: product availability, policy and social structures, media and cultural messages, and physical structures.

Product Availability

Condom Availability

Condom availability simply provides access to condoms and does not necessarily require overt motivational or educational messages. The rationale for these programs is that by simply increasing the number of condoms available and accessibility to them, condom use will increase. Usually, however, condom availability is coupled with some motivational or marketing message, to increase awareness and to make condoms appear to be socially acceptable and desirable. Globally, condom social marketing, condom subsidies, and condom availability have been the cornerstones of HIV prevention campaigns. In the United States, condom availability has been an explicit component of 1) condom social marketing programs, 2) school-based condom availability programs and 3) clinic- and community-based condom availability programs. In contrast, condom availability is often an unacknowledged component in 1) group, peer, and street outreach interventions, and 2) individual and group counseling, with or without HIV testing (37–43).

Expected proximate outcomes: Increase in proportion of sexual encounters in which a condom is used.

Needle Exchange Programs

Needle/syringe exchange programs provide sterile needles to individuals who return used needles in exchange, thereby reducing the likelihood of reuse of an infected needle. These programs have the added advantage that they may reduce the number of discarded needles and syringes on streets. Needle exchange programs (NEPs) are in operation in many states and cities in the

United States. They operate through fixed or mobile sites and can include van stops, scheduled street exchange sites, or even provide delivery services. Almost all U.S. needle exchange programs (NEP) provide only one syringe for each syringe brought in to the NEP, but many provide small numbers of syringes to IDUs making their first visit to the NEP (44–47).

Expected proximate outcomes: Reduction in proportion of drug injections in which a previously used syringe is used.

Needle Deregulation

In many states there are laws and regulations that inhibit availability of sterile needles and syringes to IDU. These include laws requiring prescriptions for needles/syringes and laws banning the possession of needles/syringes as "drug paraphernalia." These laws are not present or are not enforced in many states, and some states have passed laws that make explicit exemptions in them to increase the availability of sterile needles/syringes to IDU. By allowing IDU to purchase their own sterile needles/syringes, needle deregulation efforts should reduce the likelihood that IDU will reuse infected needles/syringes from others (33,48–51).

Expected proximate outcomes: Reduction in the proportion of drug injections in which a previously used syringe is used.

Alcohol Taxes

Alcohol use has been associated with high-risk behaviors in many studies, including high-risk sexual behavior. While reducing alcohol availability is not usually considered as an HIV prevention strategy for individuals, it may be a useful tool to reducing HIV transmission in populations. Alcohol availability is determined by a variety of factors, including the strictness and strength of enforcement of alcohol beverage control laws, the price of alcohol (often associated with alcohol taxes), the number and type of outlets where alcohol can be purchased, and the places where alcohol consumption is permitted (e.g., in public settings, cars, or clubs). Increases in alcohol taxes have specifically been followed by reductions in STDs (50,51).

Expected proximate outcomes: Reduction in number of sex partners, increase in proportion of sexual encounters in which a condom is used.

Policy and Social Structures

Community Mobilization and Street Outreach Programs

Outreach to persons at risk can be conducted in a variety of ways and for various purposes, including its use as a mechanism to bring people in to receive other interventions. In this context, however, we use the term *Street Outreach* to describe a community-based strategy in which the risk-reduction intervention is delivered in community settings, usually outdoors in high-incidence neighborhoods. The goal of the intervention is to reduce the spread of HIV and STDs by increasing condom use, reducing the sharing of needles, and increasing HIV testing (and STD testing in some cases). Street outreach is usually conducted by peers from the community in which it is undertaken and involves a face-to-face personal interaction with high-risk persons. Community mobilization campaigns, on the other hand, also involve street contacts by peer educators, but the aim is to change the norms of risky behavior for an entire community. However, the two programs in practice may be similar, because people with whom outreach workers have contact may continue to spread

risk-reduction messages; thus, individuals in the target communities who have not been personally reached by outreach workers still get messages about safer sex and drug use through others (52,53).

Expected proximate outcomes: Reduction in the number of sex partners, increase in proportion of sexual encounters in which a condom is used, reduction in the proportion of drug injections in which a previously used needle is used; increase in number of individuals tested for HIV, STD, or both.

Opinion Leader Programs

These programs identify, train, and enlist the help of key opinion leaders to change risky sexual norms and behaviors; they have been well evaluated only as they have been applied to men who have sex with men (MSM). The program is based on diffusion of innovation/social influence principles, which states that trends and innovations are often initiated by a relatively small segment of opinion leaders in the population. Once innovations are visibly modeled and accepted, they then diffuse throughout a population, influencing others. Their ultimate goal is reduction of sexual risk behavior in MSM (55–57).

Expected proximate outcomes: Reduction in the number of sex partners, increase in proportion of sexual encounters in which a condom is used.

Supervised Activities for Youth

If youth are supervised, in theory they have less time to engage in high-risk behaviors. There are many types of programs that involve youth in supervised activities. Very few studies have evaluated the impact of supervised activities on HIV risk behaviors. However, one program that placed youth in community service activities showed a reduction in unprotected sex (57).

Expected proximate outcomes: Reduction in the number of sex partners, reduction in the frequency of sexual intercourse.

STD National Policy-Level Interventions

Policy changes at the federal level of public health in terms of STD Program Operations Guidelines are intended to drive modifications in standard of care as practiced by state and locally funded clinics, while treatment and lab testing guidelines focus on establishing a policy for best practices for individual care-providers thus influencing practice in the private sector as well, though these national guidelines have not been evaluated. Although increasing condom availability is a critical component of HIV/STD interventions, there are currently no federal guidelines that specify that all STD and HIV clinics should provide condoms to their clients. Such a policy could influence the two million patients seen in public STD clinics annually, and the estimated 500,000 HIV patients receiving medical care.

Expected proximate outcomes: Increase in awareness of changes to STD best practices for health care providers; increase in proportion of sexual encounters in which a condom is used.

Legal and Legislative-Level Interventions

California, Tennessee, Colorado, and Wisconsin have legal and regulatory environments that specifically allow partner-delivered medication (PDM) to treat specified STDs. Other states do not specifically allow this practice, while some clearly restrict partner-delivered medication. Golden et al. demonstrated

the efficacy of having patients infected with gonorrhea and chlamydia deliver medication to their partners to provide presumptive treatment and prevent reinfection in the initially diagnosed patients (58). State laws facilitate (or hinder) implementation of this biomedical intervention through manipulation of the legislative environment, and are potent sustained structural interventions. However, their effect on STD transmission depends on their primary intent, and other factors in the environment. For instance, laws that restrict partner-delivered medications have, as their primary intent, the protection of patients from adverse effects related to partner use of medication without medical supervision. This restriction, while being very effective at preventing adverse reactions to pharmaceutical agents, limits efforts to reduce STD reinfection.

Expected proximate outcomes: Reduction in the rates of gonorrhea and Chlamydia reinfection.

Media and Cultural Messages

Media Campaigns

Media interventions are efforts to use both small and large media to promote products or behaviors related to HIV prevention and are discussed in greater depth in Chapter 6 in this volume. Nevertheless, they are structural interventions designed to alter the social environment as a means of health improvement or disease prevention. Media campaigns promoting condom use have been very successful in Europe and in developing countries. Large-scale media campaigns have not been used for condom promotion in the United States to date. Because HIV and the behaviors associated with its transmission are often stigmatized in the United States, large-scale campaigns have been very general, information-based, or fear-based and have not been found effective. Campaigns using small media have been much more commonly employed, and these include the distribution of novellas, posters, flyers, and other promotional items. These smaller campaigns can be less visible to the general public and more targeted at a variety of subgroups. However, intervention effectiveness has not been well documented. Media campaigns as intervention are discussed in greater detail in Chapter 6 (59,60).

Expected proximate outcomes: Reduction in the number of sex partners, increase in proportion of sexual encounters in which a condom is used.

Physical Structures

Bathhouse Regulations/Closure

Bathhouses are establishments for men to have sex (often anonymously) with other men. Many establishments have rules that require condoms be used during sex, but these policies may not be enforced. The enhanced opportunities for sex with many individuals increase the risk of disease transmission. Recently, syphilis outbreaks have been traced to bathhouses. Bathhouses can be further regulated to enforce condom use or be closed if condom use is not routine. This intervention was used in some cities in the 1980s, but it has not been evaluated (30,61,62).

Expected proximate outcomes: Reduction in the number of sex partners, increase in proportion of sexual encounters in which a condom is used.

Crackhouse or Shooting Gallery Regulation or Closure

Crackhouses and shooting galleries serve as places for people to engage in sex, non-injection drug use, injection drug use, or all of these. These establishments exist outside of the law, but in theory may be identifiable and subject to regulation or closure. This intervention has not been evaluated (64,65).

Expected proximate outcomes: Reduction in the number of sex partners, increase in proportion of sexual encounters in which a condom is used, reduction in the proportion of drug injections in which a previously used syringe is used.

Closure of Alcohol Outlets

Given that the properties around alcohol outlets are often venues for loitering and antisocial behaviors, such as public drinking or even drug use and drug sales, particularly in low-income, minority neighborhoods, closure of these outlets may eliminate opportunities for people to meet each other and engage in high-risk behaviors. A study of the effects of closing alcohol outlets in the wake of the 1992 Los Angeles Civil Unrest indicated a greater decline in gonorrhea cases in neighborhoods where alcohol outlets were closed compared to neighborhoods where they remained open (66).

Feasibility and Barriers

Policy Changes, Politics, and Social Norms

A key element in the feasibility of conducting a structural intervention is the support or lack thereof at the level of intervention, whether governmental, societal, or institutional level. If the political climate is in opposition to any facet of the policy change or the intended outcome, feasibility of implementation is decreased. This complexity cannot be overestimated. Stakeholders, leaders, social norms, and the changing nature of policy over time all play a part in feasibility of successful implementation of structural intervention. Considering the Polela example previously mentioned, the governmental policy toward indigenous peoples in 1945 supported structural intervention to improve their health and health care, only to reverse this decision in 1948 with the election of the Nation Party government.

In the case of NEPs, the feasibility of implementation is lessened related to whether states have laws prohibiting possession of hypodermic needles. Interestingly, as mentioned, some states with laws that prohibit possession of needles do not enforce those laws, and those states have existing NEPs despite what appears to be a barrier to feasibility. School systems and parents of children enrolled in schools are formidable facilitators or opponents of structural interventions based on their disapproval or encouragement of school-based intervention (see Chapter 12 in this volume). Both respond to and support social norms for child-rearing, education, and responsibility for a child's health.

Unintended Consequences

In addition to the feasibility of structural intervention implementation, consideration of unintended consequences has several important ramifications. Bloom et al. call for ongoing evaluation of structural interventions to help respond to and interrupt unintended consequences (67). They discuss how efforts to reduce HIV transmission may have contributed to the more recent rise in syphilis infections in HIV-infected gay men. Policy and media interventions were

employed at various societal levels to implement the need for all sexually active persons to "know your HIV status," "know your partner," and adopt safer sex strategies (e.g., abstinence is safest, condom use provides some safety, oral sex is less risky than anal sex). This set of messages was well suited to HIV prevention, and there is evidence that gay men engage in HIV sero-sorting to reduce HIV transmission risk. However, Bloom, et al. found that some men contracted syphilis because they considered only their risk for HIV transmission based on HIV sero-sorting and other HIV prevention strategies (e.g., the perception that unprotected oral sex is at low risk for transmission of HIV) while ignoring other prevention strategies (abstinence, consistent condom use) (67). This unintended consequence could be ameliorated through ongoing evaluation and follow-up intervention to respond to gay men's selection of HIV prevention strategies that places them at risk for other STDs (67).

Cost Effectiveness

An analysis of the cost effectiveness of structural level HIV/STD interventions indicates that structural interventions are generally more cost effective than individual level interventions (Table 1) (68). The reason has to do with the large number of people that can be reached with a structural intervention and the relatively low cost per person reached. Structural interventions are generally more cost effective when they are targeted in geographical areas with a high prevalence of HIV or STD. For this reason, interventions targeting high school youth in the United States are generally not cost effective in the short term because the HIV prevalence is so low. Similarly, even high-risk women in the United States tend to have a relatively low prevalence of HIV, so in order for any intervention to be cost effective for the purposes of preventing HIV transmission, the interventions have to be very inexpensive.

Table 1 Cost effectiveness of HIV prevention structural interventions.

Intervention	Cost per infection prevented
Videos in STD clinics, single session*	$4,700
Community mobilization (Mpowerment) (53)	$12,000
Needle exchange-high prevalence areas (42)	$13,000
Mass media campaigns (59)	$18,000
Opinion leader programs (54)	$23,000
Needle exchange-medium prevalence areas (42)	$47,000
Condom availability/accessibility (36)	$47,000
Street outreach†	$110,000
Youth supervision programs (57)	$3,100,000
Street outreach targeting women in low-income housing‡	$3,400,000

*O'Donnell CR, O'Donnell, L, et al. Reductions in STD infections subsequent to an STD clinic visit: using video-based patient education to supplement provider interactions. *Sexually Transmitted Diseases*. 1998;25:161–168.

†Wendell DA, Cohen, DA, et al. Street outreach for HIV prevention: effectiveness of a state-wide program. *International Journal of STD & AIDS*. 2003;14:334–340.

‡Sikkema KJ, Kelly, JA, et al. Outcomes of a randomized community-level HIV prevention intervention for women living in 18 low-income housing developments. *American Journal of Public Health*. 2000;90:57–63.

Benefits and Challenges

As has been shown, structural interventions are quite varied in scale, population or system targeted, and in the methods used to enact change. Methods by necessity must be different when lobbying for and enacting legislation or other government policy, implementing media campaigns at a variety of population levels, changing aspects of the provision of goods and services, changing the social and physical environment, or for other efforts. Formal evaluation is not always practical for large-scale structural intervention. That is, structural interventions are often enacted in an environment with many confounding variables present or emerging.

For instance, consider the following scenario for a given locale: A peer opinion leader intervention may be initiated by a community agency, while a media campaign is undertaken by a health department, and legislative changes are enacted. Regardless of whether STD rates fall, rise, or remain constant following these interventions, determining how these or other structural interventions contribute to STD prevention cannot always be accomplished through standard research protocols.

When evaluation is not feasible, reassessment of the local population to gain an understanding of social norms and risk behavior, knowledge and awareness of STDs, access to services, and other factors is needed. Since structural interventions apply to continually evolving systems, the need for recurrent and responsive interventions should always be considered. One of the strongest benefits of structural intervention is the capacity of such interventions to reach large numbers of people without an inordinately high cost. In addition, some structural interventions can be sustained over an extended period of time (e.g., legislation and documented policy changes in particular). However, there is always potential for structural intervention to become outmoded if not responsive to the changing environment. The difficulty in evaluating such large-scale intervention in a natural and changing environment is an important limitation but can be moderated through continued involvement and assessment of affected populations and structural aspects of systems in their environment.

As has been seen in the previous discussion of complex changes in risk behavior through social norm change (know your partner, know your HIV-status, use condoms, choose safer sex options), once these concepts are adopted by a group, there is potential for drift and reshuffling of key directives, that in this case, provided a less risky environment for HIV transmission, yet increased risk for syphilis or other STDs (67).

Structural intervention has several compelling aspects. making it an important tool for public health and STD prevention:

- Potential for low-cost intervention reaching relatively high numbers of persons
- Potential sustainability of changes in health systems

At the same time, there are serious challenges and limitations:

- Formal evaluation may be costly and time consuming
- Evaluation may be difficult or impossible relating to confounding variables

- System-level changes, though sustained, may drift over time, requiring some plan for reassessment and subsequent intervention to refocus or shift changes to minimize unintended consequences
- Unintended consequences may be large in proportion to the reach of intervention

Recommendations for Practice

When designing structural interventions, the benefits and challenges described in the previous section should all be considered. A broad assessment of the geographic community should be conducted, including populations at risk and the local health systems (public, private, community-based, or traditional/lay health). By gaining a better understanding of these aspects, potentially undesirable consequences can be identified and possibly averted. For instance, a health clinic may wish to improve access to care for a particular population. An assessment can provide information as to the barriers to access for that population, and, if broadly conducted, provide information on potential barriers to care for other populations that may be currently using the clinical facilities. If we understand the varying and sometimes conflicting needs of the said populations, we can make certain that one group's access to care will not be improved at the expense of another. The structural intervention can be tailored to provide the best access for all populations served.

In addition, a clear understanding of what is within a given entity's locus of control will assist in planning a successful intervention. One possibility to address this, a logic model of local STD prevention, may serve as a guide to help identify what system-level interventions are possible, and whether those changes have the potential to influence the desired outcome. Alternatively, a taxonomy of factors influencing a particular problem area, developed during assessment activities, may elucidate similar information. For instance, if an entity planning a structural intervention cannot influence laws nor legislation that restrict needle-exchange, it is irrelevant whether the capacity is there, whether training for outreach workers is developed, whether there is adequate availability of these potential services, or whether facilities exist or can be modified to provide the service. Identification of product availability, social structure and policy, and physical structures mentioned previously may also help to better define the desired outcomes of the intervention and potential influences on success.

Whenever feasible, a formal evaluation plan can be developed along with planning for structural intervention, and implemented as part of the process. A number of structural interventions have successfully been evaluated as previously discussed. However, regardless of whether formal evaluation is or is not possible, follow-up assessments conducted at set intervals will help to identify areas of further concern. Doing so will not prevent unanticipated consequences of intervention but will help to identify such consequences so that additional intervention may be implemented as indicated. In addition, valuable feedback may be provided without the additional delay of waiting for surveillance data to show a recurring or secondary problem.

In summary, structural interventions, whether implemented as part of a multi-level intervention or developed as a sole intervention, are integral to

STD and HIV prevention specifically and public health in general. These potentially low-cost, high-effect interventions can be of great value to programs with limited (or more expansive) resources, provided there is a willingness to attend to the recommendations made in this chapter (e.g., preliminary and follow-up assessments and evaluation whenever possible). In many cases, structural interventions have been shown to be successful and cost effective and should be considered as a proven public health tool. Each situation requiring structural intervention may have unique features in terms of population diversity, health system characteristics, and social and material resources or challenges. Because of this variability, there remains a need to evaluate proven models of structural interventions applied in a variety of circumstances (after tailoring to local conditions). In addition to this, other promising or widely used interventions would also benefit from further research as to the possibilities and limits for wider dissemination.

References

1. Sweat MD, Denison JA. Reducing HIV incidence in developing countries with structural and environmental interventions. *AIDS*. 1995;(suppl A):S251–S257.
2. O'Reilly KR, Piot P. International perspectives on individual and community approaches to the prevention of sexually transmitted disease and human immunodeficiency virus infection. *J Infect Dis*. 1996;174(suppl. 2):S214–S222.
3. Tawil O, Verster A, O'Reilly, KR. Enabling approaches for HIV/AIDS prevention: can we modify the environment and minimize the risk. *AIDS*. 1995;9:1299–1306.
4. Manhart LE, Holmes KK. Randomized controlled trials of individual-level, population level, and multilevel interventions for preventing sexually transmitted infections: what has worked? *J Infect Dis*. 2005; 191(suppl 1):S1–S178.
5. Parker RG, Easton D, Klein CH. Structural barriers and facilitators in HIV prevention: a review of international research. *AIDS*. 2000;14(suppl 1):S22–S32.
6. Blankenship KM, Bray SJ, Merson MH. Structural interventions in public health. AIDS 2000;14(suppl. 1):S11–S21.
7. Cohen DA, Scribner R. An STD/HIV prevention intervention framework. *AIDS Patient Care and STDS*. 2000;14:37–45.
8. Cohen DA, Scribner RA, Farley TA. A structural model of health behavior: a pragmatic approach to explain and influence health behaviors at the population level. *Preventive Med*. 2000;30:146–154.
9. Forsyth A. The plague within: why the lessons of ecology not modern medicine hold the solution to the current AIDS epidemic. *Equinox*. 1987;Nov/Dec:136–152.
10. Susser M. *Causal Thinking in the Health Sciences*. Oxford University Press: London, 1973.
11. Trostle J. Early work in anthropology and epidemiology: from social medicine to the germ theory, 1840-1920. In: Janes CR, Stall R, Gifford SM, eds. *Anthropology and Epidemiology*. The Netherlands: D Reidel; 1986; p. 35–57.
12. Centers for Disease Control and Prevention. 150th anniversary of John Snow and the pump handle. *MMWR Morb Mortal Wkly Rep*. 2004;53:783.
13. Lilienfeld DE. John Snow: the first hired gun? *American Journal of Epidemiology*. 2000;152:4–9.
14. Gill G. Nightingales: the extraordinary upbringing and curious life of Miss Florence Nightingale. New York: Ballantine Books; 2004.
15. Geiger HJ. Community-oriented primary care: a path to community development. *Am J Public Health*. 2002;92:1713–1716.
16. Anderson MR, Smith L, Sidel VW. What is social medicine? *Monthly Review*. 2005;56:27–34.

17. Trostle J. Anthropology and epidemiology in the twentieth century: a selective history of collaborative projects and theoretical affinities. 1920 to 1970. In: Janes CR, Stall R, Gifford SM, eds. *Anthropology and Epidemiology*. The Netherlands: D. Reidel; 1986. p. 59–94.
18. Kark S. The social pathology of syphilis in Africans (Reprinted from *South African Medical Journal* 23:77–84). *International Journal of Epidemiology*. 2003 [1949]; 32:181–186.
19. Reddy PS, Mbewu AD, Nogoduka CM. Commentary: Sexually transmitted infection in South Africa: 50 years after Sidney Kark. *International Journal of Epidemiology*. 2003;2:189–192.
20. Cassel JC. The contribution of the social environment to host resistance. *American Journal of Epidemiology*. 1976;104:107–123.
21. Cassel JC, Patrick RC Jr, Jenkins CD. Epidemiology analysis of the health implications of culture change: a conceptual model. *Annals of the New York Academy of Sciences*. 1960;84:938–949.
22. Mullan F. Community-oriented primary care: an agenda for the '80s. *New England Journal of Medicine*. 1982;307:1076–1078.
23. Mull JD. The primary health care dialectic: history, rhetoric, and reality. In Coreil J, Mull JD, eds. *Anthropology and Primary Health Care*. Boulder, CO: Westview Press; 1990.
24. Kendall C. The implementation of a diarrheal disease control program in Honduras: is it 'selective primary health care' or 'integrated primary health care.' *Social Science and Medicine*. 1988;27:17–23.
25. Coreil J. The evolution of anthropology in international health. In: Coreil J, Mull JD, eds. *Anthropology and Primary Health Care*. San Francisco: Westview Press, 1990.
26. Foster G. Applied anthropology and international health: retrospect and prospect. *Human Organization*. 1982;41:189–197.
27. Shilts R. *And the Band Played On*. New York: St. Martin's Press; 1987.
28. Holmes KK. Human ecology and behavior and sexually transmitted bacterial infections. *Proceedings of the National Academy of Science*. 1994;91: 2448–2455.
29. Taussig JA, Weinstein B, Burris S, Jones TS. Syringe laws and pharmacy regulations are structural constraints on HIV prevention in the US. *AIDS*. 2000;14(suppl. 1): S47–S51.
30. Woods WJ, Binson D, Pollack LM, Wohlfeiler D, Stall RD, Catania JA. Public policy regulating private and public space in gay bathhouses. *Journal of AIDS*. 2003;32:417–423.
31. Chen JL, Kodagoda D, Lawrence AM, Kerndt PR. Rapid public health interventions in response to an outbreak of syphilis in Los Angeles. *Sexually Transmitted Diseases*. 2002;29:277–284.
32. Groseclose SL, Weinstein B, Jones TS, Valleroy LA, Fehrs LJ, Kassler WJ. Impact of increased legal access to needles and syringes on practices of injecting-drug users and police officers—Connecticut. *Journal of AIDS and Human Retrovirology*. 1995;10:82–89.
33. Taussig J, Junge B, Burris S, Jones TS, Sterk CE. Individual and structural influences shaping pharmacists' decisions to sell syringes to injection drug users in Atlanta, Georgia. *Journal of American Pharmacological Association*. 2002;42(6 suppl 2):S40–S45.
34. Haines E. San Francisco to use web site in effort to promote syphilis testing, treatment. *Los Angeles Times*. June 21, 2003.
35. Arnold CB, Cogswell BE. A condom distribution program for adolescents: the findings of a feasibility study! *American Journal of Public Health*. 1971;61:739–750

36. Bedimo AL, Pinkerton SD, Cohen DA, Gray B, Farley TA. Condom distribution: a cost-utility analysis. *International Journal of STD & AIDS*. 2002;13:384–392.
37. Calsyn DA, Meinecke C, Saxon AJ, Stanton V. Risk reduction in sexual behavior: a condom giveaway program in a drug abuse treatment clinic. *American Journal of Pubic Health*. 1992;82:1536–1538.
38. Cohen DA, Nsuami M, Martin DH, Farley TA. Repeated school-based screening for sexually transmitted diseases: a feasibility strategy for reaching adolescents. *The American Academy of Pediatrics*. 1999;104:1281–1285.
39. Hanenberg R, Rojanapithayakorn W, Kunasol P, Sokal D. The impact of Thailand's HIV control programme, as indicated by the decline of sexually transmitted diseases. *Lancet*. 1994;344:243–245.
40. Robinson NJ, Silarug N, Suraiengsunk S, Auvert B, Hanenberg R. Two million HIV infections prevented in Thailand: estimate of the impact of increased condom use. Program and abstracts of the XI International conference on AIDS; 1996; Vancouver, British Columbia, Canada.
41. Rojanapithayakorn W, Hanenberg R. The 100% Condom Program in Thailand. *AIDS*. 1996;10:1–7.
42. Heimer R, Khoshnood K, Bigg D, Guydish J, Junge B. Syringe use and reuse: effects of syringe exchange programs in four cities. *Journal of AIDS and Human Retrovirology*. 1998;18(suppl 1):S37–S44.
43. Jacobs P, Calder P, Taylor M, Houston S, Saunders LD, Albert T. Cost effectiveness of Streetworks' needle exchange program of Edmonton. *Canadian Journal of Public Health*. 1999;90:168–171.
44. Kaplan EH. Economic analysis of needle exchange. *AIDS*. 1995;9:1113–1119.
45. Kaplan EH, Heimer R. A model-based estimate of HIV infectivity via needle sharing. *Journal of Acquired Immune Deficiency Syndromes*. 1992;5:1116–1118.
46. Centers for Disease Control and Prevention (CDC). Assessment of street outreach for HIV prevention—selected sites, 1991-1993. *Journal of the American Medical Association*. 1993;270:2675.
47. Calsyn DA, Saxon AJ, Freeman G, Whittaker S. Needle-use practices among intravenous drug users in an area where needle purchase is legal. *AIDS*. 1991;5:187–193.
48. Cotten-Oldenburg NU, Carr P, DeBoer JM, Collison EK, Novotny G. Impact of pharmacy-based syringe access on injection practices among injecting drug users in Minnesota, 1998 to 1999. *Journal of Acquired Immune Deficiency Syndromes and Human Retrovirology*. 2001;27:183–192.
49. Holtgrave DR, Pinkerton SD, Jones TS, Lurie P, Vlahov D. Cost and cost-effectiveness of increasing access to sterile syringes and needles as an HIV prevention intervention in the United States. *Journal of Acquired Immune Deficiency Syndromes & Human Retrovirology*. 1998;18(suppl 1):S133–S138.
50. Chesson H, Harrison P, Kassler WJ. Sex under the influence: the effect of alcohol policy on sexually transmitted disease rates in the United States. *Journal of Law and Economics*. 2000;XLIII:215–238.
51. Scribner R, Cohen D, Farley T. Geographic relation between alcohol availability and gonorrhea rates. *Sexually Transmitted Disease*. 1998;25:544–548.
52. Kahn JG, Kegeles SM, Hays R, Beltzer N. Cost-effectiveness of the Mpowerment Project, a community-level intervention for young gay men. *Journal of Acquired Immune Deficiency Syndromes & Human Retrovirology*. 2001;27:482–491.
53. Kegeles SM, Hays RB, Coates TJ. The Mpowerment Project: a community-level HIV prevention intervention for young gay men. *American Journal of Public Health*. 1996;86(8 Pt 1):1129–1136.
54. Kelly JA, St. Lawrence JS, Stevenson LY, Hauth AC, Kalichman SC, Diaz YE, Brasfield TL, Koob JJ, Morgan MG. Community AIDS/HIV risk reduction: the effects of endorsements by popular people in three cities. *American Journal of Public Health*. 1992;82:1483–1489.

55. Kelly JA, St. Lawrence JS, Diaz YE, Stevenson LY, Hauth AC, Brasfield TL, Kalichman SC, Smith JE, Andrew ME. HIV risk behavior reduction following intervention with key opinion leaders of population: an experimental analysis. *American Journal of Public Health*. 1991;81:168–171.
56. Pinkerton SD, Holtgrave DR, DiFranceisco WJ, Stevenson LY, Kelly JA. Cost-effectiveness of a community-level HIV risk reduction intervention. *American Journal of Public Health*. 1998;88:1239–1242.
57. O'Donnell L, Stueve A, San Doval A, Duran R, Haber D, Atnafou R, Johnson N, Grant U, Murray H, Juhn G, Tang J, Piessens P. The effectiveness of the Reach for Health Community Youth Service Learning Program in reducing early and unprotected sex among urban middle school students. *American Journal of Public Health*. 1999;89:176–181.
58. Golden MR, Whittington WLH, Handsfield HH, Hughes JP, Stamm WE, Hogben M, Clark A, Malinski C, Helmers JRL, Thomas KK, and Holmes KK. Effect of expedited treatment of sex partners on recurrent or persistent gonorrhea or chlamydial infection. *New England Journal of Medicine*. 2005;352:676–685.
59. Dubois-Arber F, Jeannin A, Konings E, Paccaud F. Increased condom use without other major changes in sexual behavior among the general population in Switzerland. *American Journal of Public Health*. 1997;87:558–566.
60. Lehmann P, Hausser D, Somaini B, Gutzwiller F. Campaign against AIDS in Switzerland: evaluation of a nationwide educational programme. *British Medical Journal*. 1987;295:1118–1120.
61. Farley TA. Cruise control: bathhouses are reigniting the AIDS crisis. It's time to shut them down. *Washington Monthly*. 2002;Nov.
62. Mutchler MG, Bingham T, Chion M, Jenkins RA, Klosinski LE, Secura G. Comparing sexual behavioral patterns between two bathhouses: implications for HIV prevention intervention policy. *Journal of Homosexuality*. 2003;44:221–242.
63. Green TC, Hankins CA, Palmer D, Boivin JF, Platt, R. My place, your place, or a safer place: the intention among Montreal injecting drug users to use supervised injecting facilities. *Canadian Journal of Public Health*. 2004;95:110–114.
64. Kerr T, Wood E, Small D, Palepu A, Tyndall MW. Potential use of safer injecting facilities among injection drug users in Vancouver's Downtown Eastside. *Canadian Medical Association Journal*. 2003;169:759–763.
65. Wood E, Kerr T, Spittal PM, Li K, Small W, Tyndall MW, Hogg RS, O'Shaughnessy MV, Schechter MT. The potential public health and community impacts of safer injecting facilities: evidence from a cohort of injection drug users. *Journal of Acquired Immune Deficiency Syndrome*. 2003;32:2–8.
66. Cohen DA, Ghosh-Dastidar B, Bluthenthal R, Scribner R, Farley TA, Robinson P, Scott M, Miu A, Kerndt PR. Gonorrhea and the 1992 Civil Unrest in Los Angeles. Program and abstracts of the XV International Conference on AIDS; July, 2004; Bangkok, Thailand.
67. Bloom FR, Whittier DK, Leichliter JS, McGrath JW. Gay men, syphilis, and HIV: the biological impact of social stress. In Feldman D, ed. *AIDS, Culture, and Gay Men*. Gainesville, FL: University Press of Florida (*in press*).
68. Cohen DA, Wu SY, Farley TA. Comparing the cost-effectiveness of HIV prevention interventions. *Journal of AIDS*. 2004;37:1404–1414.