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Preventing HIV Transmission via HIV Exposure Laws: Applying Logic and Mathematical Modeling to Compare Statutory Approaches to Penalizing Undisclosed Exposure to HIV

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Twenty-four U.S. states have enacted HIV exposure laws that prohibit HIV-positive persons from engaging in sexual activities with partners to whom they have not disclosed their HIV-status.¹ From a public health perspective, HIV serostatus exposure laws can be viewed as structural interventions that seek to limit the spread of HIV by acting at the policy level.² A central premise of these laws is that informed partners are more likely to protect themselves by declining sex, by substituting less risky activities for higher-risk ones, or by using condoms, than are uninformed partners. However, the effectiveness of these laws at preventing HIV transmission is not known.³

There is little standardization among existing HIV exposure laws, which vary substantially with respect to the sexual activities that are prohibited without prior serostatus disclosure.⁴ Among the strictest laws are those in Arkansas, Michigan, New Jersey, and Ohio which mandate disclosure prior to almost any type of sexual contact.³ Activities requiring prior serostatus disclosure include “sexual intercourse, cunnilingus, fellatio, anal intercourse, or any other intrusion, however slight, of any part of a person's body or of any object into the genital or anal openings of another person's body, but emission of semen is not required.”⁶ California's law is the least restrictive HIV exposure statute. The law criminalizes undisclosed exposure to HIV only when the HIV-positive person engages in *unprotected* anal or vaginal sex with an uninformed partner and does so intending to infect the partner.⁷ The California law offers HIV-positive persons a variety of choices for lawful sexual expression: they can either disclose their HIV status, use condoms during vaginal or anal intercourse, or engage in less risky sexual activities.

The effectiveness of HIV exposure laws in reducing HIV transmission risk critically depends on the extent to which HIV-positive persons comply with these laws and the extent to which compliance with the law reduces HIV transmission risk. These two factors, in contrasting measure, are in turn dependent on the specific sexual activities that are prohibited, in the absence of disclosure, by a particular HIV exposure law. Compliance is likely to be greatest when statutes provide multiple options for lawful sexual expression with a partner, such as the following actions: engaging in alternatives to anal or vaginal intercourse, using condoms for vaginal or anal sex, or disclosing their positive serostatus to prospective sex partners and negotiating a level of risk that is acceptable to both partners. The more options individuals have, the easier it should be for them to comply with the law. Conversely, because condom use is not 100% effective⁸ and because oral sex is not entirely safe,⁹ less restrictive laws that permit condom-protected vaginal and anal intercourse and/or oral sex without disclosure might be less effective in preventing HIV transmission than stricter laws that prohibit these activities.

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No empirical data are available regarding the effectiveness of HIV serostatus exposure laws. It is not known whether, in fact, HIV exposure laws are effective at reducing HIV transmission risk, or whether stricter laws are more or less effective than more flexible laws. We developed a relatively simple analytic framework for evaluating the HIV prevention effectiveness of HIV exposure laws and applied this framework to two general classes of exposure laws: “strict” exposure laws that require serostatus disclosure prior to any sexual activity and more “flexible” laws that allow exemptions for condom-protected intercourse or other low-risk activities. We were particularly interested in identifying the following: (a) the circumstances in which each type of law would be more effective at reducing HIV transmission risk than the no-law alternative, and (b) determining the conditions under which flexible laws would be more effective than strict laws, and vice versa.

Flexible laws always reduce transmission risk, and do so to a greater extent than do strict exposure laws when post-disclosure sex is riskier than low-risk sex.

Analytic Framework

As a first step toward evaluating the effectiveness of HIV exposure laws, we developed a simple model of the risk of HIV transmission from HIV-positive persons to their uninfected sex partners. Let D denote the proportion of sexual encounters in which HIV-positive persons disclose their serostatus, and let L and H represent the proportions of encounters that involve “low-risk” or “high-risk” sexual activities, respectively, *without prior serostatus disclosure*. Because these sexual risk behavior categories are mutually exclusive and exhaustive — i.e., every sexual encounter can be uniquely classified as belonging to one of the three categories — $D + L + H = 1$. If R_D , R_L , and R_H , respectively, denote the transmission probabilities associated with “post-disclosure sex” and with low- or high-risk sex in the absence of disclosure, then the average probability of HIV transmission during a particular sexual encounter is $R = DR_D + LR_L + HR_H$. (Of note, in this model an encounter could consist of a single sex act or multiple sex acts with the same partner.)

Empirical evidence suggests that many HIV-positive persons and their sex partners take precautions — such as using condoms or deciding not to have sex — to prevent transmission of HIV after the HIV-positive person has disclosed his or her serostatus.¹⁰ We therefore assumed that post-disclosure sex is less risky than high-risk sex. We also assumed, as a tautology, that high-risk sex is riskier than low-risk sex. However, the risk associated with post-disclosure sex could be either higher or lower than the risk for low-risk sex depending on which activities are subsumed under the rubric of “low-risk” sex and on the precautions undertaken to prevent HIV transmission following serostatus disclosure. Notably, our “post-disclosure sex” scenario encompasses the possibility that the couple might decide against having any type of sex following serostatus disclosure by the HIV-positive partner.

Now consider an HIV prevention intervention that prompts some group of HIV-positive persons to change their sexual behaviors, resulting in new proportions of serostatus disclosure and of low- and high-risk sex without disclosure, D^* , L^* , and H^* . Let R^* represent the average risk of HIV transmission to uninfected partners associated with the new behaviors. The overall reduction in HIV transmission risk due to the intervention is

$R - R^* = (D - D^*)R_D + (L - L^*)R_L + (H - H^*)R_H$. [1] The intervention is considered *effective* if it reduces HIV transmission risk (i.e., $R^* < R$).

HIV Exposure Laws

In this section, the analytic framework developed above is used to assess the effectiveness of the two types of HIV exposure laws discussed above. The first type (i.e., “strict” laws) prohibits

any and all sexual activity by HIV-positive persons without prior serostatus disclosure, whereas the second type (i.e., “flexible” laws) criminalizes only high-risk sexual activities without prior serostatus disclosure.

Effectiveness of Strict and Flexible Exposure Laws Compared to No Law

“Strict” exposure laws require that HIV-positive persons disclose their HIV-status to prospective partners before engaging in *any* sexual activity. Compliance with strict exposure laws therefore should produce a net migration away from both low-risk and high-risk sexual activities without disclosure, toward “post-disclosure sex.” Consequently, if post-disclosure sex is less risky than low-risk sex (i.e., $R_D < R_L$), then a strict exposure law would reduce HIV transmission risk relative to the “no law” alternative because strict exposure laws require that HIV-positive persons eschew the two riskiest activities (low- and high-risk sex without disclosure), in favor of post-disclosure sex (see Figure 1).

However, if post-disclosure sex is riskier than low-risk sex (i.e., $R_L < R_D$), then substituting disclosure for low-risk sex *increases* transmission risk. In this situation, whether or not a strict exposure law reduces HIV transmission risk depends on the proportion of HIV-positive persons who comply with the law by disclosing their serostatus to sex partners rather than engaging in high-risk sex, and the complementary proportion of persons who disclose rather than practice low-risk sex; this is discussed further below.

In contrast to strict exposure laws, which criminalize all sexual activities in the absence of serostatus disclosure, flexible exposure laws only prohibit engaging in high-risk sexual activities (such as unprotected vaginal or anal intercourse) without prior serostatus disclosure. No disclosure is required prior to engaging in low-risk activities (e.g., condom-protected intercourse). A sexually-active HIV-positive person can comply with a flexible law either by disclosing his or her serostatus to prospective sex partners, or by engaging in low-risk sexual activities. The net impact of these laws is to reduce the incidence of high-risk sex without disclosure in favor of the two lower-risk activities (low-risk sex and disclosure), as illustrated in Figure 1. Consequently, flexible exposure laws produce an overall reduction in HIV transmission risk compared to the “no law” alternative, regardless of whether post-disclosure sex is riskier than low-risk sex without disclosure ($R_L < R_D$), or vice-versa ($R_D < R_L$).

Relative Effectiveness of Strict and Flexible Exposure Laws

But which type of HIV exposure law is *more* effective at reducing HIV transmission risk, strict laws or flexible laws? The answer to this question critically depends on whether or not post-disclosure sex is riskier than low-risk sex.

Comparison of Strict and Flexible Exposure Laws When $R_L < R_D$

If post-disclosure sex is riskier than low-risk sex ($R_L < R_D$), then flexible laws would be expected to produce greater reductions in HIV transmission risk than would strict laws for the following reasons. First, although both types of laws can be complied with by substituting disclosure for high-risk sex, flexible laws offer an alternative means of compliance when disclosure is not a viable or desirable option — namely, substituting low-risk sex for high-risk sex. Consequently, flexible laws would be expected to engender greater decreases in the incidence of high-risk sex than would strict exposure laws. Importantly, when $R_L < R_D$, replacing high-risk sex with low-risk sex — which is encouraged by flexible but not strict exposure laws — produces a greater reduction in risk than does replacing high-risk sex with disclosure. Thus, based on the laws' impact on high-risk sex alone, flexible laws should reduce HIV transmission risk to a greater extent than strict laws.

This advantage is accentuated further when low-risk sex is taken into account. Strict laws require that HIV-positive persons substitute disclosure for low-risk sex, which *increases* the risk of HIV transmission when $R_L < R_D$ (see Figure 1), thus potentially diminishing the overall effectiveness of these laws. In contrast, there is no legal incentive under a flexible law to substitute disclosure for low-risk activities (which already comply with the law), and therefore no danger of inadvertently increasing the risk of transmission.

For strict exposure laws, the maximum reduction in risk is obtained when HIV-positive persons substitute disclosure for high-risk sex, but, in defiance of the law, do not replace low-risk sex with disclosure (which increases risk when $R_L < R_D$). The same scenario produces the *minimum* risk reduction for flexible laws and, notably, does so without HIV-positive persons violating the law when they engage in low-risk sex. Even larger risk reductions are obtained under flexible laws when HIV-positive persons comply with the law by substituting low-risk sex, rather than disclosure, for high-risk sex. In short, flexible laws always reduce transmission risk, and do so to a greater extent than do strict exposure laws when post-disclosure sex is riskier than low-risk sex.

Comparison of Strict and Flexible Exposure Laws When $R_D < R_L$

The situation is much more complicated when low-risk sex is riskier than post-disclosure sex ($R_D < R_L$). As discussed above, because HIV-positive persons can comply with flexible laws either by disclosing their serostatus or by practicing low-risk sexual activities, flexible laws would be expected to produce larger reductions in high-risk sex than would strict laws. However, *if* strict and flexible laws engendered identical reductions in the incidence of high-risk sex, then strict laws would produce greater reductions in risk than flexible laws for two reasons. First, some HIV-positive persons might choose to comply with a flexible law by substituting low-risk sex for high-risk sex, instead of substituting disclosure (which is the least risky behavior when $R_D < R_L$); this is not an option under a strict exposure law. Second, strict but not flexible laws require that HIV-positive persons replace low-risk sex with disclosure, further decreasing the risk of transmission. Consequently, for any fixed decrement in the incidence of high-risk sex, the *maximum* risk reduction produced by flexible laws equals the *minimum* risk reduction produced by strict laws.

More generally, flexible laws might be more or less effective than strict laws depending on the following: (a) the overall decreases in non-compliant behaviors produced by the two types of laws; (b) the proportion of the decrease in non-compliant behaviors under a strict law that is due to the substitution of disclosure for high-risk sex, rather than for low-risk sex; and (c) the proportion of the decrease in non-compliant behaviors under a flexible law that is due to the replacement of high-risk sex with disclosure, rather than with low-risk sex. The following section presents numerical examples that illustrate these complexities.

Whether strict or flexible exposure laws are more effective when low-risk sex is riskier than post-disclosure sex critically depends on how effective the two types of laws are at reducing the incidence of high-risk sex, and on the magnitudes of the risks associated with the various sexual options.

Numerical Examples

In this section, data from an empirical study of the sexual behavior of HIV-positive heterosexual, gay, and bisexual men are used to illustrate the analytic findings presented above.¹¹ Suppose that high-risk sex is defined as unprotected vaginal or anal intercourse, and low-risk sex is equated with condom-protected intercourse.

Let ε denote the effectiveness of condoms at reducing HIV transmissionure sex (which includes the possibility of no sex) and with low during intercourse between an HIV-infected person and his or her sex partner and, as before, let R_D , R_L , and R_H , respectively, denote the transmission risks associated with post-disclosure sex (which includes the possibility of no sex) and with low- or high-risk sex in the absence of disclosure. Because HIV transmission during condom-protected sex is possible only when the condom fails, $R_L = (1 - \varepsilon)R_H$ (in this expression, $1 - \varepsilon$ represents the probability that the condom is ineffective; in this situation the risk of transmission is the same as if no condom were used). For example, assuming that condoms are 90% effective, on average,¹² low-risk (condom-protected) sex is only one-tenth as risky as high-risk (unprotected) sex: $R_L = 0.1R_H$.

Following HIV-positive serostatus disclosure, a couple could decide to have unprotected intercourse, use a condom during intercourse, or forgo intercourse entirely. Let S represent the proportion of couples who decide to have intercourse, with or without a condom, following the HIV-positive partner's serostatus disclosure, and let C denote the likelihood that a condom is used if intercourse occurs. The post-disclosure risk of transmission, R_D , then equals $S\{CR_L + (1 - C)R_H\} = S(1 - \varepsilon C)R_H$.¹³

In the source study, the condom-use rate following serostatus disclosure was $C = 77.6\%$.¹⁴ For this value of C and a condom effectiveness value of $\varepsilon = 90\%$, post-disclosure sex is riskier than low-risk sex ($R_L < R_D$) if and only if the proportion of couples who decide to have intercourse following the HIV-positive partner's serostatus disclosure exceeds that of 33.2%. We are not aware of any published estimates of the proportion of persons who agree to intercourse or decide to forgo it after learning that their partner is HIV-positive. We therefore treated this parameter as an unknown that could range from one half the equilibrium value ($S = 33.2\%/2 = 16.6\%$) to twice this value ($S = 2 * 33.2\% = 66.4\%$). Thus, the numerical analyses assume that approximately 1/6th to 2/3rds of potential sex partners would agree to sex after learning the HIV-positive person's serostatus. Most of this sex (77.6%) would be condom protected. The corresponding values for the risk of post-disclosure HIV transmission range from $R_D = 0.19R_H$ ($S = 16.6\%$) to $R_D = 0.2R_H$ ($S = 66.4\%$); when $S = 33.2\%$ (and therefore post-disclosure sex and low-risk sex are equally risky), $R_D = R_L = 0.1R_H$ (see Table 1).

Table 1 lists the reductions in the risk of HIV transmission obtained by replacing: (a) a single act of high-risk sex by low-risk sex; (b) high-risk sex by disclosure; and (c) low-risk sex by disclosure. As shown, replacing high-risk sex by low-risk sex reduces the risk of transmission by 90%, and replacing high-risk sex by disclosure reduces it by 80% ($S = 66.4\%$) to 95% ($S = 16.6\%$). In contrast, replacing a single act of low-risk sex with disclosure would, at best, reduce risk by only 5% ($S = 16.6\%$), and could inadvertently increase it by as much as 10% ($S = 66.4\%$).

These estimates highlight the importance, at the individual level, of reducing high-risk sex in favor of disclosure or low-risk sex. At the group or population level, the relative importance of a particular sexual activity depends not only on how risky it is, but also on the incidence of that activity. In Gary Marks and Nicole Crepaz's study, the disclosure rate was $D = 51.9\%$, and the condom use rate in the absence of disclosure was 72.7%.¹⁵ Overall, sex occurred without prior serostatus disclosure $100\% - 51.9\% = 48.1\%$ of the time. Condoms were used on 72.7% of these occasions, hence the low-risk (condom-protected) sex rate is $L = 48.1\% * 72.7\% = 35.0\%$; similarly, the high-risk (unprotected) sex rate is $H = 48.1\% * (100\% - 72.7\%) = 13.1\%$ (notice that $D + L + H = 100\%$). As indicated in Table 1, although high-risk sex accounted for only 13.1% of the sexual activities in Marks and Crepaz's study, it was responsible for between 48.5% ($S = 66.4\%$) and 68.2% ($S = 16.6\%$) of the potential risk of HIV transmission.

HIV Prevention Effectiveness of Strict and Flexible Exposure Laws

Table 2 lists the potential reductions in HIV transmission risk produced by strict and flexible exposure laws as a function of the proportion of high-risk sex acts that are replaced by disclosure or low-risk sex. As shown, when $R_L = R_D$, strict and flexible exposure laws are equally effective, and each 10% decrease in the incidence of high-risk sex is associated with a 5.4% reduction in the risk of HIV transmission.

In contrast, when post-disclosure sex is riskier than low-risk sex is taken into account. Strict laws require that HIV-positive persons substitute disclosure for low-risk sex, low-risk sex ($R_L < R_D$), flexible laws are at least as effective as strict laws at reducing HIV transmission risk. Flexible laws produce a maximum risk reduction of 38.8% to 43.7%, depending on whether HIV-positive persons choose to comply with the law by substituting low-risk sex or disclosure, respectively, for high-risk sex (see Table 2). For strict exposure laws, the maximum risk reduction never exceeds 38.8% — which is obtained when all high-risk sex but no low-risk sex is replaced by disclosure — because substituting disclosure for low-risk sex increases the risk of HIV transmission when $R_L < R_D$.

Finally, when low-risk sex is riskier than post-disclosure sex ($R_D < R_L$), the maximum risk reduction for flexible laws ranges from 61.4% to 64.8%, whereas the maximum risk reduction for strict laws ranges from 64.8% to 73.9%. If the two types of laws were equally effective at decreasing the incidence of high-risk sex, then for any specified decrease in the incidence of high-risk sex, strict laws would produce at least as large a reduction in transmission risk as would flexible laws (see Table 2). This is true because, in addition to encouraging HIV-positive persons to substitute disclosure for high-risk sex, strict laws also require the substitution of disclosure for low-risk sex, a substitution that is not required by flexible laws.

Importantly, however, strict and flexible exposure laws are unlikely to generate equivalent decreases in the incidence of high-risk sex — larger decreases would be expected for flexible laws, which allow HIV-positive persons to replace high-risk sex with *either* disclosure or low-risk sex. Suppose that strict and flexible exposure laws produced equivalent reductions in non-compliant behaviors (high- and low-risk sex for a strict law, and high-risk sex for a flexible law). For the parameter values listed in Table 1, it can be shown that a flexible law would be more effective than a strict law if the flexible law reduced the incidence of high-risk sex by 25.6% or more, compared to a strict law. Conversely, a strict law would be more effective than a flexible law that reduced the incidence of high-risk sex by less than 17.4% more than the strict law. (No definitive conclusions can be reached for a flexible law that reduced high-risk sex by between 17.4% and 25.6% compared to a strict law.)

Logical analysis and mathematical modeling techniques can make an important contribution to the construction of a rational basis for decisions about a highly contested public health policy issue. The results of the analyses indicate that, under most (though not necessarily all.) circumstances, both, strict and flexible exposure laws can be expected to reduce HIV transmission risk relative to the no-law alternative, with flexible exposure laws producing the greater reduction in risk.

These specific cut-off points (25.6% and 17.4%) naturally depend on the parameter values used in the analysis (see Table 1). If, for example, post-disclosure sex were completely safe (i.e., if no partners agreed to sex after learning their partner's HIV-positive status), then the cut-off points would increase substantially, to 68.9% and 42.2%. In short, whether strict or flexible exposure laws are more effective when low-risk sex is riskier than post-disclosure sex critically depends on how effective the two types of laws are at reducing the incidence of high-risk sex, and on the magnitudes of the risks associated with the various sexual options.

Discussion

The preceding analyses demonstrate that flexible exposure laws are always effective (i.e., reduce HIV transmission risk relative to no law) when post-disclosure sex is riskier than low-risk sex, whereas strict laws may or may not be effective in this situation. Moreover, when post-disclosure sex is riskier than low-risk sex, flexible exposure laws are more effective than strict laws. In contrast, when post-disclosure sex is less risky than low-risk sex, both types of laws are effective at reducing HIV risk, and which type of law is more effective depends on their respective compliance rates and on the particular behavioral changes adopted by HIV-positive persons to comply with these laws.

Unlike strict laws, flexible laws offer HIV-positive persons several lawful choices for sexual expression beyond mandatory disclosure. As such, for many HIV-positive persons little or no behavioral change is needed to comply with these laws, which are consistent with public health recommendations and presumptive norms regarding the need to practice safer sex in any relationship in which there is a possibility of HIV transmission.¹⁶ Importantly, under a flexible law, individuals who are reluctant to share sensitive information about their HIV-positive serostatus may choose to practice alternatives to penetrative sex or to use condoms during penetrative sex. HIV-positive persons do not have to disclose potentially harmful information before their first sexual interaction with an individual because flexible laws allow intimacy and trust to develop incrementally.

A potential drawback of flexible exposure laws relative to their strict counterparts is that flexible laws do less to protect partners' autonomy to determine the level of risk they are willing to assume. Whereas strict laws require that prospective partners be informed of the potential risk of HIV transmission, however slight, prior to agreeing to engage in any sexual activity, flexible laws require disclosure only prior to engaging in the riskiest sexual behaviors (e.g., unprotected anal and vaginal sex). Flexible laws compromise partner autonomy insofar as it is the law rather than the partner that establishes when risk is great enough to warrant disclosure. Under either type of law, however, potential sex partners can assert their autonomy by affirmatively seeking information about the other's HIV serostatus.

The illustrative mathematical analyses are subject to several limitations. First, these examples focus on individual sex acts rather than sexual partnerships. Unlike practicing safer sex, which must be repeated throughout the course of a relationship, serostatus disclosure need only occur once within a partnership. Consequently, a partnership-level analysis might produce somewhat different numerical results than the sex act-level analysis presented here. The key unknown in either type of analysis is the risk associated with post-disclosure sex. At the sex act level, a couple might decide to forgo sex, engage in non-penetrative sex, use condoms, or have unprotected intercourse. A sexual relationship, in contrast, presumes sexual activity, which may progress from an initial phase of safer sex behaviors to unprotected intercourse as the relationship matures and intimacy increases.¹⁷ Too little is known about the development of sexual intimacy within serodiscordant relationships and its implications for sexual risk behaviors to adequately model transmission risks in long-term partnerships.

This article demonstrates how logical analysis and mathematical modeling techniques can make an important contribution to the construction of a rational basis for decisions about a highly contested public health policy issue. The results of the analyses indicate that, under most (though not necessarily all) circumstances, both strict and flexible exposure laws can be expected to reduce HIV transmission risk relative to the no-law alternative, with flexible exposure laws producing the greater reduction in risk. Additional research is needed to refine key behavioral parameter values, to gain further insight into the risk of HIV transmission within

both short- and long-term serodiscordant relationships, and to empirically assess the behavioral, psychological, and social implications of HIV exposure laws.

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(a) $R_D < R_L$ (b) $R_L < R_D$ **Figure 1.**

Schematic illustration of strict and flexible HIV exposure laws when: (a) post-disclosure sex is less risky than low-risk sex ($R_D < R_L$) and (b) post-disclosure sex is riskier than low-risk sex ($R_L < R_D$). Arrows show expected directions of behavioral changes prompted by the laws. When $R_D < R_L$, both strict and flexible exposure laws reduce HIV risk compared to no law because compliance with either type of law requires the substitution of lower-risk activities for higher-risk activities. The same is true for flexible laws when $R_L < R_D$. In contrast, strict laws could inadvertently increase risk when $R_L < R_D$ because they encourage HIV-positive persons to replace low-risk sex with a riskier activity (post-disclosure sex).

Figure 2.

Potential HIV transmission risk reduction produced by strict and flexible HIV exposure laws as a function of the proportion of high-risk sex acts that are replaced by either disclosure or low-risk sex and whether post-disclosure sex is riskier ($R_D < R_L$) or less risky than low-risk sex ($R_L < R_D$). The overall reduction in transmission risk also depends on whether HIV-positive persons comply with flexible laws by substituting disclosure or low-risk sex for high-risk sex and, for strict laws, whether or not they substitute disclosure for low-risk sex as well as for high-risk sex. Several scenarios are shown: (A) All low-risk sex is replaced by disclosure; (B) Only high-risk sex is replaced by disclosure (the incidence of low-risk sex is unchanged); (C) High-risk sex is replaced by low-risk; and (D) Low-risk sex and post-disclosure sex are equally risky.

Table 1

HIV Transmission Risk Model

		$R_D < R_L$	$R_D = R_L$	$R_L < R_D$
		$S = 16.6\%^a$	$S = 33.2\%$	$S = 66.4\%$
Relative HIV Transmission Risk				
	High-risk sex risk (R_H)	R_H	R_H	R_H
	Low-risk sex risk (R_L)	$0.1R_H$	$0.1R_H$	$0.1R_H$
	Post-disclosure sex risk (R_D)	$0.05R_H$	$0.1R_H$	$0.2R_H$
	Overall risk of transmission (R) ^b	$0.192R_H$	$0.218R_H$	$0.270R_H$
% Change in HIV Transmission Risk^c				
	High-risk sex → Low-risk sex	90	90	90
	High-risk sex → Disclosure	95	90	80
	Low-risk sex → Disclosure	5	0	-10
Potential Risk (% of Overall Risk)^d				
	High-risk sex ($H = 13.1\%$)	68.2	60.1	48.5
	Low-risk sex ($L = 35.0\%$)	18.2	16.1	13.0
	Post-disclosure sex ($D = 51.9\%$)	13.5	23.8	38.5

^a S = Proportion of couples who decide to have protected or unprotected intercourse after the HIV-positive partner discloses his or her serostatus

^b Overall risk of transmission: $R = DR_D + LR_L + HR_H$.

^c Percentage risk reduction (or risk increase if negative) produced by replacing a single instance of first activity (e.g., high-risk sex) with second activity (e.g., low-risk sex).

^d Percent of total transmission risk, for the cohort as a whole, due to high-, low- or post-disclosure sexual activities, taking into account the prevalence of each activity (H , L , and D , respectively).

Table 2
Risk Reduction Effectiveness of Strict and Flexible Exposure Laws*

Decrease in High-Risk Sex Due to Exposure Law		0%	25%	50%	75%	100%
$R_L < R_D^d$	Strict exposure laws	-13.0 to 0.0	-3.3 to 9.7	6.4 to 19.4	16.1 to 29.1	25.8 to 38.8
	Flexible exposure laws	0.0	9.7 to 10.9	19.4 to 21.8	29.1 to 32.8	38.8 to 43.7
$R_L = R_D$	Strict and flexible laws	0.0	13.5	27.0	40.6	54.1
$R_D = R_L$	Flexible exposure laws	0.0	15.4 to 16.2	30.7 to 32.4	46.1 to 48.6	61.4 to 64.8
	Strict exposure laws	0.0 to 9.1	16.2 to 25.3	32.4 to 41.5	48.6 to 57.7	64.8 to 73.9

^d R_D and R_L denote the HIV transmission risks associated with post-disclosure and low-risk sex, respectively.

* Table values indicate minimum to maximum percentage change in HIV transmission risk (negative values indicate risk increases).