Benefits and Costs of HIV Testing

DAVID E. BLOOM AND SHERRY GLIED

The benefits and costs of human immunodeficiency virus (HIV) testing in employment settings are examined from two points of view: that of private employers whose profitability may be affected by their testing policies and that of public policy-makers who may affect social welfare through their design of regulations related to HIV testing. The results reveal that HIV testing is clearly not cost-beneficial for most firms, although the benefits of HIV testing may outweigh the costs for some large firms that offer generous fringe-benefit packages and that recruit workers from populations in which the prevalence of HIV infection is high. The analysis also indicates that the testing decisions of unregulated employers are not likely to yield socially optimal economic outcomes and that existing state and federal legislation related to HIV testing in employment settings has been motivated primarily by concerns over social equity.

IN MAKING HIRING DECISIONS, EMPLOYERS TYPICALLY PAY great attention to characteristics thought to predict a worker's productivity, such as education, previous work experience, and various physical and psychological attributes. Increasingly in recent years, this information has been supplemented by results from tests for a variety of existing and potential health conditions, and for drug and alcohol use (*1–3*). These test results may provide further indications of likely productivity. They may also help in assessing the cost that a prospective employee will impose on a firm, and especially on the firm's cost of providing health-contingent benefits (*4*). Hiring an employee who imposes significant costs on a firm will diminish the firm's performance in the same way as would hiring a relatively unproductive employee.

The growing use of health-related tests in employment settings has its roots in three developments: (i) the increasing cost of health-contingent benefits offered by employers, (ii) the existence of relatively inexpensive biomedical tests designed to predict or assess health conditions, and (iii) the concern that firms with the most liberal compensation plans will attract a disproportionate share of individuals who place relatively sizable burdens on such plans (that is, the problem of adverse selection in response to health-related information that is not normally available to employers) (*5*). Each of these developments is well illustrated in the context of the human immunodeficiency virus (HIV) epidemic: the direct medical care costs associated with cases of HIV infection are substantial (*5–6*), tests for HIV infection are readily available (*7*), and individuals are likely to have better information about their own HIV status than are their employers—information that they may use in choosing an employer, or in making fringe benefit selections (*8*).

For these reasons, the HIV epidemic provides a natural context in which to explore the general issues that arise when employers screen prospective employees on the basis of their current and predicted future health. HIV testing is also important in its own right, given the large number of working-age Americans who may be infected with HIV and the growing number of firms who report having at least one HIV-infected employee (*9*). In this article, we attempt to shed some light on these issues by examining the incentives employers have to require negative HIV test results as a condition of employment. We also examine the extent to which the public interest in HIV testing will be adequately served by the decisions made by private employers.

A fundamental premise of the ensuing analysis is that a firm will test its employees for HIV infection when the firm's expected benefits of testing outweigh its expected costs. We discuss the benefits and costs of HIV testing in employment settings that are free of legal constraints on testing. We also report estimates of the magnitudes of these private benefits and costs. We compare these magnitudes in order to assess the conditions under which employers would tend to favor HIV testing in a competitive market economy. Finally, we consider whether society would benefit from adopting policies designed to influence the level of HIV testing in employment settings and discuss current legislation related to HIV testing in this area. In summary, we find that (i) the social benefits of HIV testing in employment settings are fundamentally different from the private benefits, implying that private behavior in the labor market will not necessarily result in a socially optimal level of HIV testing; and (ii) from the point of view of most employers, HIV testing is not cost beneficial given relevant estimates of the prevalence of HIV infection. In addition, the incentives not to test for HIV are reinforced by legal prohibitions against testing in most jurisdictions, and especially in those in which the incidence of AIDS is relatively high.

Incentives for Employers to Require HIV Tests

Consider an employer who is trying to fill a job vacancy by deciding between two applicants who have identical productivity-related characteristics. Assume it is known that one applicant is HIV-positive and the other is not. Assume further that the employer and his workforce and customers are "informed," in the sense that they recognize that HIV is not spread through casual contact. In the absence of any legal restrictions on the employer's hiring process, even this "informed" employer is likely to prefer the applicant who tested negative. As we argue below, this preference is mainly due to the increased probabilities of morbidity and mortality of the HIV-positive applicant, which suggest that he or she is likely to impose

D. E. Bloom is professor of economics in the Department of Economics, Columbia University, New York, NY 10027. S. Glied is assistant professor of public health and economics in the School of Public Health and Department of Economics, Columbia University.

relatively larger costs on the firm than would the HIV-negative applicant.

An employer might be able to avoid certain employment costs by rejecting job applicants who test positive for HIV. These avoided costs, which represent the expected benefits to an employer of HIV testing, are set forth in Table 1. There are three main items to note with respect to Table 1. First, the benefits of not employing qualified applicants who test positive for HIV vary substantially among firms in different cities and different employment size categories. Because the lifetime medical care costs of treating AIDS patients are substantially lower in some cities than in others, and because health care costs are a sizable fraction of total avoided costs, firms located in cities with high health care costs for AIDS patients (for example, New York City) (*5*) will perceive, other things equal, the benefits of

Table 1. Expected value of costs avoided by hiring an HIV-negative individual instead of an otherwise identical HIV-positive individual. Low-cost city estimates are based on health care cost data for San Francisco. High-cost city estimates are based on health care cost data for New York City. Small-firm estimates are based on the degree of experience rating and the benefits offered by a firm with about 50 employees. Large-firm estimates are based on the degree of experience rating and the benefits offered by a firm with about 1000 employees. We assume that all costs are incurred at the end of each period. All estimates are in 1987 dollars, rounded to the nearest 100 dollars. The estimates represent simulations of the experience of "average" firms in different cities and employment size categories. The experience of a particular firm will depend on its specific characteristics.

Sources of avoided costs	Large firm		Small firm	
	High-cost city	Low-cost city	High-cost city	Low-cost city
		*Health insurance**		
Health care cost	$ 80,000	$40,000	$80,000	$40,000
Degree of experience rating (%)	100	100	50	50
Firms offering (%)	100	100	80	80
Cost to firm	$ 80,000	$40,000	$32,000	$16,000
		Life insurance†		
Death benefit	$ 23,200	$23,200	$23,200	$23,200
Degree of experience rating (%)	100	100	10	10
Firms offering (%)	94	94	40	40
Cost to firm	$ 21,800	$21,800	$ 900	$ 900
		Disability insurance‡		
Sick leave	$ 1,200	$ 1,200	$ 1,200	$ 1,200
Firms offering (%)	91	91	36	36
Long-term disability	$ 17,800	$17,800	$17,800	$17,800
Degree of experience rating (%)	100	100	10	10
Firms offering (%)	69	69	10	10
Cost to firm	$ 13,400	$13,400	$ 600	$ 600
Total insurance cost to firm	$115,200	$75,200	$33,500	$17,500
		Pension§		
Value of offset	−$ 4,000	−$ 4,000	−$ 1,100	−$ 1,100
Firms offering (%)	61	61	33	33
Pension offset received by firm	−$ 2,400	−$ 2,400	−$ 360	−$ 360
Present value discount factor‖	1.25	1.25	1.16	1.16
Discounted hiring and training cost **	$ 700	$ 700	$ 680	$ 680
Total discounted differential cost if individual develops AIDS	$ 90,900	$58,900	$29,300	$15,500
Probability that an HIV-positive individual develops AIDS††	0.35	0.35	0.15	0.15
Expected value of costs avoided	$ 31,800	$20,600	$ 4,400	$ 2,300

*Sources of data used in calculations: Bloom and Carliner (*5*) for health care costs; Tewksbury (*11*) for experience rating; ICF Incorporated (*10*) for benefits offered. Figures on the cost of treating AIDS patients are used as estimates of the cost of treating seropositive individuals because there is no direct information on the latter. Although this procedure may introduce some bias, its direction is unclear and its magnitude is not likely to be large [See Bloom and Glied (*6*) especially pages 190 to 191 for some discussion relevant to this point. †Forty-five percent of life-insurance policies pay annual earnings, 34% pay twice annual earnings, and the remainder pay a lump sum, usually about $10,000 (*43*). We ignore the probability of death from other causes because death rates from other causes in the 25 to 44 age group are less than 0.3% per year (*44*). Sources of data: *Statistical Abstract* (*12*) for average annual earnings; Tewksbury (*11*) for experience rating; ICF Incorporated (*10*) for benefits offered. ‡The disability cost is calculated on the basis of the following assumptions: (i) people with AIDS work for 40% of the available work days during the first year after diagnosis and do not work during their second year after diagnosis (*45*); (ii) sick leave is available for 15 days in firms with disability policies (*43*); (iii) individuals who are not HIV-infected do not use any sick days (if such individuals do take sick days, the estimate reported here will be an overestimate of the true cost of sick leave); (iv) long-term disability policies replace about 60% of income (*43*). Sources of additional data: *Statistical Abstract* (*12*) for average annual earnings; Tewksbury (*11*) for experience rating; ICF Incorporated (*10*) for benefits offered. §Pension offset is calculated based on the following assumptions: (i) pensions replace on average 21% of income (*46*); (ii) individuals collect pensions for 14.5 years after retirement at age 65 (*46*); (iii) in 1983, among firms offering pensions, 35% of small firms and 79% of large firms offered defined benefit pension plans (*47*) [Defined benefit plans, which are a declining proportion of all benefit plans, are primarily funded by employer contributions and do not usually pay benefits to a decedent's estate. On average, defined benefit pensions are fully vested after 10 years] (*47*); (iv) 50% of employees at small firms and 80% of employees at large firms remain at the firm for 10 years; (v) the probability that a 35-year-old male will survive to collect his pension at age 65 is 77% (*46*). The source of data on the percentage of firms offering this benefit is ICF Incorporated (*10*). ‖The discount rate is calculated by assuming equal probabilities of becoming ill during each year of job tenure and a real interest rate of 5%. The calculations are relatively insensitive to variations in the real interest rate. **Average hiring and training costs are $1750 (*48*). The procedure for calculating the added cost of hiring and training an individual who subsequently develops AIDS is described in Glied (*15*) based on job tenure data from Brown, Hamilton, and Medoff (*49*). ††The probability of developing AIDS during an individual's expected tenure at the firm is calculated on the basis of the following: (i) average job tenure is 5 years at small firms and 8 years at large firms (*49*) and (ii) the individual is assumed to have become infected on the day he begins work. The source of data on the probability of developing AIDS is Rutherford (*13*).

testing to be much greater than will firms located in low cost cities (for example, San Francisco) (*5*). Large firms are also likely to face higher costs of employing an HIV-positive individual than are small firms, because large firms are more likely to offer health-contingent fringe benefits, and to pay insurance premiums for those benefits that are more closely linked to the firms' claims experience (*10–11*).

Second, the expected present value of the avoided costs (reported in the last row of Table 1) is less than the lifetime medical care cost of treating an individual for AIDS. This result occurs because most of the costs associated with hiring an individual who develops AIDS are incurred in the future (and therefore must be discounted to reflect their burden at the time employment decisions are made), and because not all HIV-infected individuals will develop AIDS during their expected tenure at a firm.

Third, the costs avoided (in present value terms) by hiring an HIV-negative individual instead of an HIV-positive individual range from small, but nontrivial sums, to quite sizable amounts (for example, between 11 and 160% of median annual earnings received by a male worker in the United States in 1987) (*12*). These figures are much higher than they would be for most other illnesses primarily because (i) the lifetime medical care costs of treating AIDS patients are considerable, both absolutely and relative to other serious diseases and disabilities (*5*); (ii) the probability that a seropositive individual develops AIDS during his expected employment tenure is relatively high (15 to 35%) (*13*); and (iii) AIDS tends to strike individuals during their prime working years when the risk of disability or death due to other causes is low, and long before the age at which they would become eligible to receive pension benefits from defined benefit plans (*14*). For example, the present value of the costs avoided by rejecting a job application from a 55-year-old smoker (and instead hiring a 55-year-old nonsmoker who is otherwise identical to the smoker) have been estimated to be between $600 and $3500 (*15*). This differential is much smaller than that for an HIV-positive individual employed in a comparable firm because the smoker's expected medical care costs are lower, because a 55-year-old is more likely to succumb to nonsmoking-related diseases, and because a smoker who dies will forego a pension that he or she was closer to receiving.

We thus conclude that employers have well-defined, easily measurable, and nontrivial incentives to use HIV test results in making employment decisions, although there is considerable variation across employers in the strength of those incentives.

The Costs of HIV Testing

The two main HIV tests currently in use in the United States are the enzyme-linked immunosorbent assay (ELISA) and the Western blot (WB) blood tests (*7, 16*) (Table 2). The former is relatively simple and inexpensive while the latter is somewhat more complex and costly to perform and more difficult to interpret. Although both tests are quite accurate, neither is entirely free from error. For example, both have a nonzero probability of misclassifying individuals who are not truly HIV-infected as well as of misclassifying individuals who are truly HIV-infected.

Table 2 shows two estimates for the overall price of an HIV test (*17*). The low estimate is the Department of Defense's negotiated contract price for an ELISA/WB package (*7, 18*). The high estimates are the average prices for HIV tests paid by individuals tested under Illinois' mandatory premarital testing law during 1988 (*19*). These estimates differ primarily because the quoted price for the Department of Defense does not account for the costs of taking a blood sample and of post-test counseling and because the Department of Defense effectively receives a quantity discount on HIV test kits (for example, 1.2 million individuals were tested for HIV infection by the Department of Defense between October 1985 and July 1987) (*18*). Similarly, the small difference between the price of a WB test kit and the overall price of a WB test reflects the fact that a WB test can be performed on the same blood sample as the initial ELISA test (that is, it is not necessary to incur the cost associated with drawing a new blood sample).

The estimates in Table 2 suggest that the cost of HIV testing is much lower for large firms that can negotiate quantity discounts and that routinely require blood tests among their employees than it is for other firms. Indeed, large firms are more than six times as likely to require medical exams among their employees as are small firms (*20*).

Both the false positive and false negative rates associated with HIV tests are quite low for the practical purposes for which employers might use such tests. For example, suppose the true prevalence of HIV were 0.012% in a firm that employed 100,000 individuals. Suppose further that the firm decided to perform an ELISA test on all of its workers and a WB test on those workers who tested positive with ELISA. On the basis of these assumptions and the figures in Table 2, this testing protocol would yield 17 seropositive individuals (that is, individuals who tested positive on both the ELISA and the WB tests), of whom 12 would be true positives and 5 would be false positives. There would be essentially no false negatives in this firm (that is, 0.07 individuals) (7).

If it were legal, and if a firm followed a policy of not hiring (or dismissing) individuals who tested positive for HIV on both the ELISA and WB tests, the cost to the firm of type I and type II test errors would be small. As illustrated by the preceding example, false negatives, each of which could be quite costly to a firm (based on the results of the preceding section), almost never occur. On the other hand, false positives, whose occurrence is also rather infrequent in absolute terms (though far less so in relative terms in a low prevalence population), may impose only a minimal cost on employ-

Table 2. Selected facts about HIV tests. The ELISA is a simple test in which antibodies contained in blood that has been exposed to the HIV bind to HIV proteins in the test kit. The interpretation of results can be automated. The Western blot (WB) test is a complex test that identifies antibodies to the three major groups of proteins of the HIV. Test results must be interpreted by a skilled technician. An ELISA/WB package refers to a testing protocol in which individuals are initially tested using an ELISA test. Positive results are checked using a WB test, sometimes after a confirmatory ELISA test. All prices are in 1987 dollars (7).

Test characteristic	ELISA	WB	ELISA/WB package
Price of test materials	$ 3.50	$55	
Price per test performed			
Illinois premarital†	$30	$60	$35
Department of Defense			$ 4.40
False positive rate (%)‡			
Under ideal conditions	1.0	0.5	0.005
In actual use	1.7	4.7	0.08
False negative rate (%)‡			
Under ideal conditions	0.4	0.4	0.4
In actual use	0.6	9.3	0.6

*Western blot price is for an FDA-approved test kit (Du Pont Chemical, December 1989). †ELISA and Western blot prices are averages from Illinois hospitals that offer the test. The test package price is from the State of Illinois testing program. These prices include the drawing of a blood sample (*19*). ‡"In actual use" estimates are based on studies by the College of American Pathologists. The estimated false positive rate for the test package is based on the assumption that the test results are independent. Estimates of the false negative rate for the test package are based on an assumed population seroprevalence of less than 1% (7). The Department of Defense follows a testing protocol in which a Western blot test is only performed after two positive ELISA tests. A positive Western blot is then checked by performing another Western blot test on a new blood sample. The Department of Defense finds a false positive rate of 0.0007% (*18*).

ers who are not negligent in the administration of HIV tests and who can readily hire other workers.

Estimates of the cost an employer would expect to incur to identify an individual who is truly HIV positive are summarized in Table 3. The estimates are constructed from the two measures of the cost of HIV testing described in Table 2: (i) the Department of Defense estimate of $4.40 for an ELISA/WB package (which is a lower bound for large firms that normally require blood examinations as a condition of employment); and (ii) the Illinois premarital testing estimates for the ELISA and WB tests (which represent upper bounds for firms that do not normally require blood tests among their employees). The estimates are also constructed under varying assumptions about the true prevalence of HIV infection among the group of individuals from which a firm's workforce is drawn. These estimates of HIV prevalence range from a low of 0.01% (which represents the percentage of blood donors to the Red Cross in 1988 who were HIV-infected) to a high of 0.86% (which represents the Centers for Disease Control's 1989 upper bound estimate of the percentage of the adult U.S. population that has tested positive for HIV) (*14*).

The figures in Table 3 make it clear that the cost a firm would expect to incur to identify a seropositive individual depends importantly upon whether the firm normally requires blood examinations and receives quantity discounts on HIV test kits. The cost of HIV testing is roughly seven times lower for such firms than for small firms that do not normally require blood tests. The figures in Table 3 also indicate that the cost of HIV testing varies even more sharply across the range of prevalence estimates. To illustrate, for a firm that does not normally require its employees to undergo blood tests, it will cost an average of $3,700 to identify a single seropositive employee if the relevant rate of HIV prevalence is 0.86%; but if the prevalence rate facing that firm is 0.01%, the cost rises by a factor of 80 to $310,300, primarily because the firm has to test many more employees to identify someone who is truly seropositive.

Although the expected costs of identifying one truly HIV-positive individual range from $500 to $310,300, very few firms are likely to face testing costs at the lower end of this range. About two-thirds of firms do not require any of their employees to undergo blood tests (*20*). In addition, the two highest prevalence rates in Table 3 are likely to be well above those faced by most employers because those rates are calculated for a population that includes (i) a substantial number of "heavy drug abusers" (that is, about 225,000, or 15 to 23% of all those estimated to be HIV infected) (*21*) who are relatively unlikely to be active participants in the formal labor market and (ii) a non-negligible number of individuals who are too young, too old, or too sick (because they have AIDS) to participate actively in the labor market. In addition, most firms presumably recruit workers from a population with a lower rate of HIV prevalence than that found in the U.S. military. Indeed, the military draws a disproportionately large number of recruits from demographic groups among whom the prevalence of HIV infection is known to be relatively high: young males, blacks, and Hispanics (*14*).

Table 3. Costs of identifying one truly HIV-positive individual under alternative assumptions about the prevalence of HIV and the cost of HIV testing. These figures are based on "in actual use" (Table 2) estimates of the false positive and false negative rates associated with the different HIV tests. The figures change little if they are based on the "under ideal conditions" estimate. All figures are in 1987 dollars.

Price of test	Cost for various prevalence estimates:			
	U.S. upper limit* (0.86%)	U.S. lower limit† (0.29%)	U.S. military‡ (0.14%)	Blood donors§ (0.01%)
$4.40 package	$ 500	$ 1,500	$ 3,200	$ 44,000
$30 ELISA, $60 WB (if necessary)	$3,700	$10,800	$22,400	$310,300

*Assumes that 1.5 million Americans are truly HIV-positive in an adult population of 174 million people. This prevalence estimate is roughly the upper limit estimate by the Centers for Disease Control in 1989 (*14*). The numbers in parentheses represent the percentage of the population infected. †Assumes that 500,000 Americans are truly HIV positive. See Hay *et al.* (*50*). ‡Estimate based on Department of Defense testing of new recruits (*14*). §Estimate based on testing donors of blood to the Red Cross in 1988 (*14*).

In addition to the direct costs of HIV tests noted above, employers may also bear certain indirect costs associated with testing. These costs can arise if the practice of testing for HIV makes it more difficult for an employer to recruit or retain employees. This situation might occur if actual or prospective employees have strong preferences against testing. For example, employees may find the blood test procedure unpleasant, or may fear that a positive test result (which may be a false positive) will lead to discrimination, or to a loss of eligibility for nongroup health and life insurance benefits (*22*). In addition, employees may prefer not to know whether they are infected (*23*). Under these circumstances, firms that hire workers in competitive labor markets and that require HIV tests will have to offer greater compensation to actual or prospective workers than will otherwise identical firms who do not require HIV tests. The cost estimates reported in Table 3 should thus be viewed as lower bound estimates of the actual cost that employers will incur to identify truly HIV-positive individuals, because our calculations do not account for (i) these indirect costs to employers of HIV testing and (ii) other costs related to maintaining the confidentiality of test results, such as providing counseling for individuals.

Comparing the Benefits and Costs of HIV Testing

It is natural for firms to compare the cost of identifying an individual who is seropositive (the figures in Table 3) with the benefit of having that information [the costs it can expect to avoid by not hiring or by dismissing that individual (see Table 1)]. This comparison suggests that HIV testing is not cost-beneficial for most small firms. The expected benefit of $2,300 to $4,400 is far below the expected cost of identifying a seropositive individual in a low-prevalence working population: $22,400 to $310,300 (*20*). Similarly, HIV testing is not likely to be cost-beneficial for most large firms, although it may be cost-beneficial for some large firms that recruit workers from populations with a relatively high HIV prevalence. For example, the costs large firms can expect to avoid by identifying a seropositive individual ($20,600 to $31,800) exceed the costs they will incur to identify such an individual if the true prevalence of HIV infection is 0.14% and the firm faces the lower cost of HIV testing. But, the expected benefits of HIV testing (the cost savings) fall far short of the expected cost of HIV testing if the true prevalence is closer to 0.01%, a more reasonable assumption for most large firms, as argued above (*24*).

Thus, most profit-maximizing employers are not likely to find HIV testing to be a cost-beneficial personnel policy, even if they are permitted to use test results in making employment decisions. This conclusion is strengthened insofar as the cost calculations upon which this analysis is based underestimate the true cost of HIV testing (for reasons noted in the preceding section). This conclusion is further strengthened by the fact that our analysis does not account for the possibility that an individual who tests negative for HIV at the time he is hired will become infected with the virus during his tenure with an employer. If this situation were common, it might be appropriate to consider a protocol of testing employees periodically. However, retesting individuals who were previously found to be

seronegative is especially unlikely to be cost-beneficial because the prevalence of HIV infection in such a population is likely to be very low (lower than the lowest prevalence estimates in Table 3). In the context of a single test protocol, the possibility that a previously uninfected individual will become infected leads to a reduction in the benefits of testing.

The Public Interest in HIV Testing

In a decentralized market economy, profit-maximizing employers will decide whether to require HIV tests as a condition of employment primarily on the basis of the benefit-cost calculations described above (absent any legal restrictions on HIV tests). The expected benefits of HIV testing will fall short of the costs for most firms, though some large firms that recruit workers from high HIV prevalence populations may find HIV testing to be cost-beneficial.

Society can benefit from HIV testing in employment settings if HIV testing reduces the total cost of the epidemic or leads to a distribution of that cost that is more desirable from society's standpoint. According to economic theory, the testing outcomes that emerge from the voluntary interactions of firms and workers will reduce the total cost of the epidemic if two conditions hold: (i) the social and private costs of HIV testing are equal and (ii) the expected social and private benefits of HIV testing are equal. In such a case, government policies that either promote or discourage HIV testing in employment settings can only be socially beneficial if they sufficiently improve the distribution of these (now larger) costs.

The first of the above two conditions does not appear to be violated. The social cost of HIV testing includes the cost of conducting and analyzing an HIV test and the amount that a representative individual would be willing to pay to avoid undergoing an inherently unpleasant test. Because there is no reason to think that the market for HIV tests is noncompetitive, or that the labor market will not fully account for workers' attitudes toward being tested, the social and private costs of HIV testing are likely to correspond closely.

By contrast, there is no reason to believe that the social and private benefits of HIV testing will be equal. The private benefits of testing are enjoyed by firms to the extent that testing allows them to shift the cost of the epidemic away from themselves (and onto other economic agents). While cost-shifting would not be expected to influence the overall magnitude of the epidemic, it may lead to a more desirable distribution of society's economic resources. These distributional benefits, however, do not enter the decision-making process of most firms. Furthermore, it is uncertain whether employment testing improves the distribution of economic resources, largely because so little is known about the final incidence of the costs of the epidemic (that is, the extent to which these costs will ultimately be borne by HIV-infected individuals and their families, other users of the health care system, employees and shareholders of firms that do not test for HIV, and taxpayers) (*5*).

There are several other potentially large sources of social benefits associated with HIV testing that are distinct from the private benefits described earlier and the cost-shifting benefits described immediately above. These benefits, which are considerably more difficult to estimate than the private benefits defined above, can arise because informing individuals of their HIV status has the potential to (i) prolong the lives of those already infected with HIV (through the prophylactic use of certain drug therapies); (ii) resolve many individuals' uncertainty about their health status; and (iii) control the future spread of the disease (through the impact of HIV test results on behavior) (*25*).

First, the extent to which the lives of HIV-infected individuals can be prolonged by the prophylactic use of drug therapies (such as AZT and aerosolized pentamidine) is still largely unknown. In addition, the impact of these drug therapies on the direct medical costs of HIV-infected individuals is also uncertain and will depend on the changing cost of these drug therapies, the costs associated with any side effects due to the use of the drugs, and the extent to which medical costs are incurred further in the future (*6*). To the extent that these prophylactic drug therapies prolong or enhance the quality of life—for which there is some evidence—the indirect cost associated with an HIV infection, that is, the value of the years of life lost, will unambiguously fall, though by a magnitude that would be difficult to estimate (*26, 27*).

Second, in most models of economic behavior, individuals would pay to resolve uncertainty. Based on these models, one might conclude that HIV test results confer benefits upon individuals (and therefore upon society) because they reduce individual uncertainty. This conclusion might be qualified, however, by the results of recent studies that suggest that some individuals may prefer to delay the resolution of certain sources of uncertainty (*23*). These benefits (or negative benefits) are not readily measurable.

Third, changes in individual behavior related to HIV transmission can have a profound impact on the future magnitude of the epidemic. If each seropositive individual infects other individuals, who in turn infect others, then even a small change in transmission rates can have a large cumulative effect on the total number of individuals who ultimately contract the disease and on the cost of the epidemic. The effect of changes in HIV transmission rates on the economic impact of the epidemic will depend on the cost of each AIDS case, the transmission rates among individuals, and the magnitude of changes in those rates.

Suppose, for example, that each seropositive individual in some population infects, on average, 0.8 other individuals per year (*28*), and that the present value of direct and indirect costs to society of an individual newly infected with HIV is $600,000 (*5*). If just one seropositive person reduced the number of individuals he infects per year by 10%, to 0.72 persons per year, the present value of the cost savings over an 11-year period (that is, the expectation of life of a newly infected individual) (*29*) would amount to nearly $25 million.

Under the above assumptions, testing would appear to be unambiguously socially beneficial because the magnitude of social benefits considerably exceeds the private (and social) cost of HIV testing in all of the populations examined in Table 3. However, the social benefits of testing would be smaller if the annual rate of new infections per seropositive individual were lower than 0.8; they would also be lower if the relative reduction in risk behavior were less than 10% (which is consistent with several studies that report very little behavioral response to HIV test results) (*30–32*). For example, if each seropositive individual infected only 0.08 other individuals per year, and if the reduction in the transmission rate of a seropositive individual who was informed of his seropositivity were only 3%, then the economic benefits of testing over 11 years would be less than $18,300, or less than the cost of testing in the low-prevalence populations in Table 3. In fact, in some studies, individuals who were informed of their HIV status actually increased their high-risk behavior (*33, 34*). In such cases, this component of the social benefits of testing is negative.

The ability to generalize from the above simulations is limited because all of the parameters used are estimates based on self-selected samples of individuals who voluntarily underwent confidential or anonymous HIV tests in nonemployment settings. In addition, the social costs and benefits of HIV testing will be affected by the false positive and false negative rates of the HIV tests. For example, false positive results can diminish the social benefits of testing by creating mental stress and by leading to unnecessary

changes in behavior, including the inappropriate use of prophylactic drug therapies. False negative results can also diminish the social benefits of testing by leading individuals to delay changes in their behavior or in their use of prophylactic drug therapies. These considerations magnify our already considerable uncertainty about the net social benefits of HIV testing.

The Legal Environment

The divergence of the private and social benefits of HIV testing in employment contexts suggests that the testing policies of unregulated employers are not likely to yield socially optimal economic outcomes. Unfortunately, existing information does not permit one to determine whether these policies result in too much or too little testing from a social point of view. Thus, there is little basis for arguing that policies that promote or discourage HIV testing are desirable on grounds that they will reduce the total cost of the epidemic. Yet, policy-makers have been and continue to be active in crafting regulations in this area. Current state legislation governing HIV testing is summarized in Table 4 along with annual rates of AIDS incidence in each state (per 100,000 population) for the period November 1988 to October 1989 (*35*). States are divided into those in which HIV testing is currently prohibited in virtually all employment contexts and those in which HIV testing is not explicitly prohibited; the latter set is subdivided into states in which employers are prohibited from discriminating against employees on the basis of their HIV status and those in which such discrimination is not prohibited.

Table 4. State laws pertaining to HIV testing in employment settings and AIDS annual incidence rates per 100,000 population from November 1988 to October 1989 (*35*).

Testing prohibited*	Testing permitted	
	Cannot discriminate†	Can discriminate‡
District of Columbia 81	New York 36	Georgia 18
Florida 27	New Jersey 29	Texas 15
California 22	Maryland 15	Hawaii 15
Massachusetts 13	Nevada 15	Louisiana 11
Washington 10	Connecticut 13	Virginia 7
Rhode Island 8	Delaware 12	Mississippi 6
Utah 5	Colorado 11	North Carolina 6
Wisconsin 3	Illinois 10	Alabama 6
Vermont 3	South Carolina 9	Tennessee 5
Iowa 2	Pennsylvania 9	Ohio 5
	Oregon 9	Kansas 4
	Arizona 8	New Hampshire 4
	Missouri 8	Arkansas 3
	Michigan 6	Kentucky 3
	New Mexico 6	Nebraska 3
	Oklahoma 5	Wyoming 3
	Indiana 5	North Dakota 1
	Maine 5	South Dakota 1
	Minnesota 4	
	Alaska 3	
	West Virginia 3	
	Idaho 2	
	Montana 2	

*Sources for state laws on testing are Leonard (*51*) and Bowleg and Bridgham (*52*). These laws state, in general, that an employer may not require an HIV test as a "condition of employment." †State regulation of discrimination on the basis of HIV status is based on the judicial review of existing statutes that prohibit discrimination against individuals perceived to be handicapped [see National Gay Rights Advocates (*36*)]. ‡This category includes states without prohibitions against handicap discrimination in employment, or in which statutes that prohibit discrimination only apply to individuals who have an actual handicap, or that have anti-discrimination statutes that exclude communicable diseases.

Although HIV testing as a condition of employment is only specifically illegal in ten states, it is effectively illegal for most firms in the 24 other states in which discrimination on the basis of an individual's HIV status is prohibited. Firms governed by federal law (for example, firms that hold federal contracts or that receive federal funds) also fall into this category (*36*). Even in states in which testing is permitted, a policy of testing only those individuals who have characteristics that are correlated with being seropositive (for example, gender, race, ethnicity, age, marital status, sexual orientation, and so on) may violate broader anti-discrimination statutes (*37*).

Legal restrictions on HIV testing or on the use of HIV test results in making personnel decisions thus reinforce the economic incentives against testing in most jurisdictions (that is, in 33 states and the District of Columbia) and in firms that must comply with federal laws. It is interesting to note that the incidence of AIDS in these jurisdictions (that is, the rate per 100,000 population at which new AIDS cases were diagnosed from November 1988 to October 1989) is nearly twice as high as in the 17 states in which HIV testing and discrimination based on HIV test results are permitted. Coupled with the economic incentives against testing in low-prevalence settings, these legal prohibitions against testing in most high-prevalence settings result in there being a very limited level of testing in the U.S. economy. Indeed, even in jurisdictions where HIV testing is not legally prohibited, fewer than one in 16 firms require HIV tests as a condition of employment (*38*).

In July 1990, President Bush signed the Americans with Disabilities Act (Public Law 104-327), the employment provisions of which will take effect in July 1992. Those provisions prohibit virtually all U.S. employers of 25 or more employees from discriminating in their employment practices on the basis of whether an individual has an actual disability or is perceived to have a disability (starting in July 1994, the act will cover firms employing 15 or more employees). The act also contains an explicit prohibition on pre-employment medical screening. Assuming that employers comply with this act (which can reasonably be expected in the case of HIV testing, based on the foregoing analyses), HIV and other forms of medical testing in employment settings will effectively be eliminated among medium and large employers (*39*). Because the preceding analysis suggests that small employers are least likely to find HIV testing cost-beneficial, their exemption from the provisions of the act should be relatively inconsequential (*40*).

Given the absence of evidence to justify social policies regulating HIV testing in employment contexts on grounds that it would reduce the total (present and future) cost of the epidemic, equity considerations have presumably governed the design of the state and federal laws promulgated in this area. Indeed, this observation is consistent with the form and substance of the Americans with Disabilities Act, which treats individuals with potential health risks similarly to other categories of individuals who are protected from the outcomes generated by markets (for example, individuals with handicaps, older workers, women, and minorities). In addition, the passage of laws that prevent employers from testing for HIV (or from using test results as a basis for making employment decisions) may affect the distribution of economic resources by deflecting some of the costs of the epidemic away from public hospitals and taxpayers and concentrating them on workers and firms' shareholders (*41*).

Conclusion

Employers who offer the most generous fringe benefit packages and who recruit workers from populations that have a high prevalence of HIV infection are the ones most likely to find that the benefits of HIV testing exceed the costs. Changes in the benefits and

costs of HIV testing (for example, in the price of test kits or in the lifetime cost of treating HIV infection) will change the number of employers in this category. These employers will have incentives to circumvent the spirit of the legislative prohibitions on testing, such as those that will take effect under the Americans with Disabilities Act. For example, they may screen prospective employees on the basis of characteristics that they believe are correlated with the outcomes of HIV tests. They may also limit the eligibility or generosity of their health-contingent benefits. [They are especially likely to do this if individuals who either suspect or know that they are HIV-positive elect, on the basis of that information, to work for employers who offer generous benefit packages (*42*).] The latter practice will leave many employees who test negative in those firms with less than optimal levels of health-contingent benefits—a real social cost of achieving the distributional objectives that presumably led to the legal prohibitions on testing.

The net social benefits of testing may also change in the future (though not necessarily in the same direction or to the same extent as the net benefits to employers). If they increase, society could potentially benefit from additional testing. In order to realize these potential benefits, society may adopt policies that promote or permit HIV testing. However, to the extent that society continues to be concerned over the distributional implications of HIV testing, it may limit the contexts in which test results can be used (for example, by only promoting confidential HIV testing). Alternatively, society may permit HIV testing in a broad set of contexts and use other policy instruments (such as national health insurance or expanded welfare eligibility for seropositive individuals) to further its distributional objectives.

It may seem callous, or irrelevant, to think of HIV testing as an economic issue. However, a failure to recognize the likely response of the labor market to the epidemic and to HIV testing will not make that response disappear. Compassionate societies may wish to divert some of the costs of the AIDS epidemic away from those who are already HIV-infected. However, social policies are more likely to succeed in reducing the magnitude of those costs and distributing them more broadly if they explicitly account for the response of rational individuals and firms to the incentives created by the epidemic.

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39. There are some exceptions to this act, among them a provision permitting employment decisions to be made on the basis of disabilities that crucially relate to the performance of work (for example, poor eyesight for a potential pilot).
40. Employees in firms with fewer than 25 employees account for about 25% of the U.S. labor force, whereas employees in firms with fewer than 15 employees account for slightly less than 18% of the U.S. labor force (S. Dixon, personal communication).
41. Our analysis does not rule out the possibility that public policy-makers may promote social equity and economic efficiency through policies that restrict testing in employment contexts and encourage testing in nonemployment contexts.
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