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HIV Antibody Testing: Procedures, Interpretation, and Reliability of Results

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Introduction

In 1983 and 1984, scientists at the Institut Pasteur in Paris and at the National Institutes of Health identified and isolated the cause of AIDS: a virus now generally known as the human immunodeficiency virus (HIV). In early 1985, a commercial test for antibodies to HIV became available.

The test was originally developed to screen the blood supply and it has virtually eliminated transfusion-associated HIV infection. Quickly, however, requests were made for use of the test to screen groups of people. The most widely publicized early application was the Defense Department's screening of all potential military recruits.

In addition, a few States instituted screening of all inmates in their correctional institutions.

In the spring of 1987, calls for mass screening—and, increasingly, for mandatory mass screening—began to be heard. Pursuant to Presidential directive, the screening of all Federal prisoners and immigrants was begun. Subsequently,

From the Director

Acquired Immunodeficiency Syndrome—AIDS—has been called the most serious public health problem in the United States and worldwide today. Since it first appeared in 1981, there has been an enormous amount of uncertainty and fear about this fatal disease. Because they may be in contact with intravenous drug users and others at high risk for the disease, criminal justice professionals understandably are concerned about becoming infected with the AIDS virus while carrying out their duties.

Until a vaccine or cure for AIDS is found, education is the cornerstone of society's response to this deadly disease. Accurate information can help dispel misinformation about the disease and its transmission, thus enabling criminal justice personnel to

continue to perform their duties in a safe and professional manner.

Since 1985, the National Institute of Justice has worked with the Centers for Disease Control and other public health officials to provide important authoritative medical information about AIDS to criminal justice professionals.

This *AIDS Bulletin* is part of a new series designed to inform criminal justice professionals about the disease and its implications for criminal justice agencies. Future bulletins will summarize agency policies relating to AIDS, education programs, and legal and labor relations issues.

In addition, two special reports on AIDS—as AIDS relates to corrections and law enforcement agency procedures—have been

published and widely disseminated. A third report has just been published that addresses AIDS as it impacts probation and parole services.

President Reagan has said that the AIDS crisis "calls for urgency, not panic . . . compassion, not blame . . . understanding, not ignorance." The National Institute of Justice is working to ensure that criminal justice professionals have the accurate information they need to understand and deal with the risks created by AIDS. Until medical science can bring this deadly disease under control, our best defense is a well-informed citizenry.

James K. Stewart
Director

there has been a proliferation of proposals for screening State prisoners, marriage license applicants, persons admitted to hospitals, and other populations.

The position of the Centers for Disease Control (CDC) on testing underwent a subtle—but important—change during 1987. The CDC shifted from advocating voluntary counseling and testing of persons and their sexual contacts who have engaged in high-risk behaviors, to favoring “routine” counseling and testing of such individuals.¹ “Routine” means that testing will be performed as part of normal medical procedures unless the individual specifically declines to be tested. In other words, CDC has shifted the individual’s responsibility from requesting the test to declining the test.

There continues to be widespread controversy surrounding all policies and proposals to conduct *mandatory* screening for HIV antibodies. Proponents generally argue that effective prevention measures and medical care depend upon identifying infected individuals. They point to the value of targeted educational efforts; the utility of segregating infected persons in hospitals, correctional institutions, and other custodial facilities; the importance of health care, correctional, and custodial staffs knowing the HIV antibody status of the persons with whom they have regular contact; and the possible benefits of antibody status information to diagnosis and medical intervention.

Opponents counter that mandatory screening will be counterproductive because it will drive many potentially

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infected individuals underground and subject those who are tested to significant discrimination. Opponents also argue that the essential educational messages and prevention strategies remain the same, regardless of antibody status. They feel that differentially targeted educational programs may tend to create a false sense of security in seronegative populations and undermine the essential message that *everyone* must be careful. Precautions against unprotected exposure to blood and body fluids should be taken by *all* persons, regardless of antibody status. Opponents of mandatory mass testing fear that incomplete information on HIV status may undermine consistent application of these precautions. Finally, there is no effective therapeutic treatment for persons infected with HIV who remain asymptomatic. The available drugs are generally only prescribed when symptoms appear. Clinical trials regarding the benefit of AZT in treating asymptotically infected persons are currently in progress but the results will probably not be known until 1990.

In general, before deciding to conduct mandatory screening in any population, policymakers should determine (1) the precise objectives of the screening program, (2) exactly how the test results will be used to reduce transmission of the virus, and (3) that it would be impossible to achieve the same objectives through a

nonmandatory, or less extensive, testing program. If policymakers cannot clearly reach these determinations, they ought to decide against mandatory screening programs.

This *AIDS Bulletin* will not discuss the debate over mass screening in any further detail. The interested reader will find the issues of concern well covered in an extensive and rapidly growing literature.² Instead, this *Bulletin* summarizes some of the key technical issues surrounding HIV antibody testing: What is an HIV antibody test? What do the test results mean? What methods are used in the basic and confirmatory tests? How much do the tests cost? How reliable are confirmed results?

In reality, however, it is impossible to separate these technical issues from the ethical and legal issues surrounding HIV antibody screening. Thus, decisionmakers in the criminal justice system and elsewhere must consider all areas as they seek to develop rational and effective AIDS policies.

The nature and meaning of HIV antibody testing

There appears to be significant confusion about the nature and meaning of HIV antibody testing. Although terms such as “AIDS testing” are often used, and individuals are commonly said to have “tested positive for AIDS,” the fact is that there is no test for AIDS. The available tests do not determine whether or not an individual has AIDS; rather, AIDS can only be diagnosed through identification of opportunistic infections or malignancies indicating an underlying immune deficiency caused by HIV infection, or central nervous system disorders now known to be caused directly by HIV infection.

Readily available tests do not even detect the presence of HIV itself—only the presence of antibodies to the virus. Antibodies in the blood are evidence of the immune system’s attempt to fight off an infection. Actual culturing of the virus (i.e., growing the virus from a specimen of

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body fluid or tissue) is very difficult, time consuming, and expensive. It is currently performed only in a small number of research laboratories. However, *antigen* tests, which detect a part of the virus, may be available within the year.

A properly confirmed positive result (see below) for HIV antibodies means that the individual was infected at some time in the past, although the test cannot pinpoint the date of infection. However, CDC recommends that all persons with confirmed positive test results be considered infected and capable of transmitting the virus to others.

A great deal of uncertainty surrounds the questions of whether and when an infected individual will develop AIDS. The *average* time between initial HIV infection and the appearance of symptoms appears to be about 8 years, but the range in individual cases is extremely broad. Because of this long incubation period and the relative newness of the disease, it is not known precisely what percentage of infected individuals will go on to develop AIDS, or even evidence milder symptoms of HIV infection, sometimes called AIDS-Related Complex (ARC). Current estimates are that 65 to 100 percent of infected persons will progress to diagnosed AIDS.³

Notably, a negative result on the HIV antibody test means only that the individual was not infected with HIV (or was infected but had not yet developed antibodies) at the time the blood sample was taken. It says nothing about the likelihood of future infection or susceptibility to infection. Indeed, this is one of the key messages to present in posttest counseling of seronegative persons. Individuals who have engaged and are continuing to engage in high-risk behaviors should be told that their negative result represents "pure luck" and that the only way to reduce their likelihood of becoming infected in the future is to discontinue these behaviors immediately or, at least, to begin taking appropriate precautionary measures.⁴

What is an HIV antibody test?

Antibody tests detect the presence of antibodies to the AIDS virus—they do not determine whether or not an individual has AIDS. *There is no test for AIDS.*

What do the test results mean?

A properly confirmed positive result for HIV antibodies means that the individual was infected with the virus at some time in the past, although the test cannot pinpoint the date of infection. However, CDC recommends that all persons with confirmed positive test results be considered infected and capable of transmitting the virus to others. According to the latest guidelines from CDC, an individual should be considered positive for antibodies to HIV when a sequence of three tests is consistently positive.

What methods are used in the basic and confirmatory tests?

The basic test is an Enzyme-Linked Immunosorbent Assay (ELISA or EIA). The ELISA test is generally performed on blood drawn through venipuncture, although a version based on a blotted fingerprick is now being used as well. If the first ELISA test is positive, a second ELISA is performed on the same specimen. If that test is also positive, a confirmatory test—usually the Western Blot test—is performed, also on the same blood sample.

How much do the tests cost?

Testing costs vary considerably, depending on how the testing is conducted. When buying test kits in high volume, testing may cost as little as \$2 to \$3 per subject, which would include ELISA tests and any Western Blot confirmatory tests necessary. Otherwise, the reported range for ELISA testing is from \$5 to \$40, depending on whether the agency draws the blood and sends it out to a laboratory for testing or sends individuals to private physicians to be tested. The Western Blot test is much more expensive than the ELISA. The average cost per test is \$75 with an approximate range of \$25 to \$150.

How reliable are confirmed results?

There are two areas of serious concern about the reliability of HIV antibody tests: (1) the problem of lag time between infection and the appearance of detectable antibodies; and (2) technical problems with the tests and testing procedures that may produce incorrect results. The lag time makes it impossible to guarantee detection of all infected members of a population through one-time screening. The technical problems cause currently available HIV antibody tests to be subject to error, even when recommended confirmatory procedures are used. Both problems should be of serious interest to society and must be carefully considered before any testing program—particularly a mandatory testing program—is instituted.

Basic and confirmatory tests used

According to the latest guidelines from CDC, an individual should be considered positive for antibodies to HIV when a sequence of three tests is consistently positive.⁵ The basic test is an Enzyme-Linked Immunosorbent Assay (ELISA or EIA). The ELISA test is generally performed on blood drawn through venipuncture (in which blood is drawn by puncturing a vein through the skin), although a version based on a blotted

fingerprick is now being used as well.⁶ If the first ELISA test is positive, a second ELISA is performed on the same specimen. If that test is also positive, a confirmatory test—usually the Western Blot test—is performed, also on the same blood sample.⁷

The ELISA test was developed in the mid-1980's for the screening of blood supplies. The presence of HIV antibodies is signaled by a color reaction quantified through the use of a spectrophotometer. The results are measured on a continuous numerical scale representing a color

“The available tests do not determine whether or not an individual has AIDS; rather, AIDS can only be diagnosed through identification of opportunistic infections or malignancies indicating an underlying immune deficiency caused by HIV infection, or central nervous system disorders now known to be caused directly by HIV infection.”

density reaction to the level of antibodies in the blood. The higher the antibody level, the greater the optical density or color change. Therefore, a decision must be made as to the “cutpoint” on this scale that distinguishes positive and negative results. Manufacturers of the test kit recommend setting a specific cutpoint for each kit based on the degree of reaction to the known positive and negative control samples supplied.⁸ Interpretation of results is a key factor in the ultimate reliability of the test.

The Western Blot test is used to confirm twice-repeated positive ELISA results. For this test, inactivated virus is separated into component parts and “blotted” onto special paper. Complexes of viral protein and antibodies are seen as spots or bands in the final preparation. The Western Blot test is not sold commercially as a kit nor does it have standardized interpretive procedures.

Because the ELISA was initially developed to screen blood, the recommended cutpoints are deliberately set quite low to minimize false-negative results. When screening blood, it is better to discard possibly uninfected donations than to use possibly infected blood. Of course, the low cutpoint designed for blood screening produces a relatively high false-positive rate when the test is used to screen people. As a result, it has been suggested that

cutpoints be set relative to the presumed level of actual infection in the population to be tested and to the consequences of inaccurate results; that is, a higher cutpoint for a population with a lower prevalence of infection and a lower cutpoint for a population with a higher prevalence of infection.⁹

Numerous efforts are currently underway to develop testing methods for reliable direct detection of HIV, as well as to improve the antibody tests. As noted, improved testing technology may be available within a year.¹⁰

The costs of HIV antibody testing

Testing costs vary considerably, depending on how the testing is conducted. At one extreme, testing may be furnished at no charge at numerous CDC-funded alternative test sites. If many individuals are to be tested and blood-drawing and laboratory capabilities are available in-house, a low-cost option is the direct purchase of ELISA test kits. One of these kits typically can be used to perform several hundred individual tests. When buying kits in high volume, testing may cost as little as \$2 to \$3 per subject, which would include ELISA tests and any Western Blot confirmatory tests necessary. Otherwise, the reported range for ELISA testing is from \$5 to \$40, depending on whether the agency draws the blood and sends it out to a laboratory for testing or sends individuals to private physicians to be tested.

The confirmatory Western Blot test is much more expensive than the ELISA. The average cost per test is \$75 with an approximate range of \$25 to \$150. Of course, the Western Blot is only performed if two ELISA tests are positive.

The reliability of test results

There are two areas of serious concern about the reliability of HIV antibody tests: (1) the problem of lag time between infection and the appearance of detectable antibodies; and (2) technical problems with the tests and testing procedures that may produce incorrect results.

Lag time between infection and appearance of antibodies

CDC estimates that, on average, 6 to 12 weeks elapse between an individual's infection with HIV and the appearance in the blood of detectable antibodies to the virus.¹¹ However, there have been isolated reports of lag times of up to 6 months, and recent data suggest that even longer delays in antibody appearance may not be unusual. In addition, there is new evidence that the virus may sometimes go into a latent period, during which it is still present (and the person is still infectious) but its antibodies are undetectable by available tests.¹²

These facts are extremely important because infected individuals are capable of transmitting the virus from the instant they are infected. Infectiousness, in other words, does not await the appearance of detectable antibodies. Negative antibody test results based on blood drawn during this lag time are, in effect, false negatives. Such instances have produced the very small number of HIV infections associated with transfusions administered since universal screening of blood supplies began in 1985. The blood transfused in these cases was donated by infected persons before the antibodies had appeared.

The lag time problem should also be of concern to policymakers contemplating any type of mass screening program. The lag time makes it impossible to guarantee detection of all infected members of a population through one-time screening. Leaving aside the other reliability problems (discussed below), repeated followup testing of populations would be necessary to maximize the probability of detecting all infected individuals. This may have serious cost and logistical implications. However, an effective antigen test, when it becomes available, may eliminate the lag time problem because it detects a portion of the virus itself, rather than just antibodies to the virus.

Technical issues regarding the tests

The currently available HIV antibody tests are subject to error, even when recommended confirmatory procedures are used. The major problem appears to be with false-positive results, although false

negatives may also occur, particularly in the high-risk populations that are of special interest to criminal justice agencies. False positives are of particular concern to persons being tested, who may suffer mental anguish and be subjected to severe discrimination. On the other hand, false negatives are of concern to persons

who may subsequently be infected by individuals they believe to be free of HIV. Both problems should be of serious interest to society and must be carefully considered before any testing program—particularly a mandatory testing program—is instituted.

The *precision* of a biomedical test is expressed in terms of the consistency of its results—that is, it is highly precise if it always yields the same results when repeated under similar circumstances. However, HIV antibody test results have been shown to be affected by relatively minor variations in temperature, humidity, and other factors.¹³

Procedural variations and quality control deficiencies can also adversely affect the performance of HIV antibody tests. The Western Blot is particularly susceptible to human error and variability of results because most laboratories use unlicensed test kits. As a result, unlike the ELISA test, the Western Blot is not usually based on a standardized commercial product. However, the ELISA is also subject to variation because of the possibility that different testing facilities will use different criteria for setting the positive-negative cutpoint that is critical to interpreting the test results. The lack of uniform quality control and proficiency standards for laboratories also results in test variability.¹⁴

The *accuracy* of biomedical tests is generally measured in terms of sensitivity and specificity. CDC estimates that the sensitivity and specificity of currently licensed ELISA tests are both 99 percent or higher (assuming that a double ELISA test is performed), and these estimates do not appear to be in question. Ninety-nine percent *sensitivity* means that, on average, the test will correctly identify 99 out of every 100 *infected* individuals. Ninety-nine percent *specificity* means that, on average, the test will correctly identify 99 out of every 100 *uninfected* individuals.

Figure 1

Hypothetical HIV Antibody Screening in a Population of 500 With a 20% True Prevalence of Infection

		True Infection Status		Antibody Test Results		False Results as % of True Group
		n	%	Negative Result	Positive Result	
True Groups	Infected	100	20	1.0	99.0	1% ^a
	Uninfected	400	80	396.0	4.0	1% ^b
	Total	500	100	397.0	103.0	
	False Results as % of all Test Results in Category			0.3% ^c	3.9% ^d	

^aThis reflects the test sensitivity of 99%.

^bThis reflects the test specificity of 99%.

^cThis is the percentage of all negative results that would be false.

^dThis is the percentage of all positive results that would be false.

Figure 2

Hypothetical HIV Antibody Screening in a Population of 500 With a 1% True Prevalence of Infection

		True Infection Status		Antibody Test Results		False Results as % of True Group
		n	%	Negative Result	Positive Result	
True Groups	Infected	5	1	0.05	4.95	1% ^a
	Uninfected	495	99	490.00	5.00	1% ^b
	Total	500	100	490.05	9.95	
	False Results as % of all Test Results in Category			0.01% ^c	49.8% ^d	

^aThis reflects the test sensitivity of 99%.

^bThis reflects the test specificity of 99%.

^cThis is the percentage of all negative results that would be false.

^dThis is the percentage of all positive results that would be false.

In other words, 1 percent of infected persons will be false negatives on the test, and 1 percent of uninfected persons will be false positives on the test. This does not mean, however, that 1 percent of all positive or negative tests will be false. The percentage of positive (or negative) results that are false depends on the true prevalence of infection in the tested population and on the sensitivity and specificity of the test.

Consider the two examples depicted in Figures 1 and 2. In Figure 1, the true prevalence of infection in a population of 500 is 20 percent. The sensitivity and specificity of the test are both assumed to be 99 percent. There are 400 uninfected persons of whom about 1 percent, or four people, will have a false-positive test result. About 1 percent, or one person, of the 100 infected persons will have a false-negative test result. Thus, a total of 103 people will test positive, of whom four will be false positives—3.9 percent of all positive results will be false.

Figure 2 shows that when the true prevalence of infection is lower, the rate of false positives will increase, simply because there will be a larger number of truly uninfected individuals, about 1 percent of whom would test falsely positive. In Figure 2, the true prevalence of infection is 1 percent in the hypothetical population of 500, and the percentage of positive results that are false rises to almost 50 percent. The number of false positives would continue to rise with increases in the size of the tested population.

Thus far, the discussion assumes that only a double ELISA test has been performed. Reducing false-positive rates depends heavily on the ability of the Western Blot confirmatory test to eliminate falsely positive results from ELISA tests and thus increase the specificity of the entire test sequence. Properly performed, the Western Blot is more highly specific than the ELISA. Assuming it improves specificity by about 1/2 of 1 percent, the percentage of positive results that are false

Figure 3

Hypothetical Application of Mass Screening for Antibodies to HIV in a Population of 25,000 Inmates

True Prevalence of Infection %	False Positives by Test Sequence Specificity ^a					
	99.5%		99.9%		99.99%	
	n	% ^b	n	% ^b	n	% ^b
0.5	124	50.0	25	16.7	2	2.0
1	124	33.2	25	9.0	2	1.0
3	121	14.0	24	3.1	2	0.3
5	119	8.7	24	1.9	2	0.2
10	113	4.3	23	0.9	2	0.1
20	100	2.0	20	0.4	2	0.04
30	88	1.2	18	0.2	2	0.03

^aTest sequence sensitivity is assumed throughout to be 99.5%. With 99.5%, 99.9%, and 99.99% specificity, .5%, .1%, and .01% respectively, of truly uninfected persons will be false positives.

^bFalse positive results as a percentage of all positive results. In calculating this percentage, positive results include all truly infected persons, minus false negatives, plus false positives.

in the hypothetical high-prevalence population (Figure 1) above would be cut in half (to 2 percent) while, in the lower prevalence in population (Figure 2), it would be reduced by about one-third to 34 percent—still a very significant proportion.

Unfortunately, as noted, the Western Blot as performed in most laboratories is not a standardized test like the ELISA. The definition of a positive Western Blot has changed over time and remains a matter of disagreement. Thus, application of the Western Blot is more susceptible to variation and its overall performance is less amenable to systematic evaluation.¹⁵ Nevertheless, these hypothetical results underscore the importance of the Western Blot test in reducing the number of false positives. *In any testing program, great care should be taken to maximize quality control in all phases, but particularly in the Western Blot confirmatory phase.*

Because of the apparent susceptibility of these tests (particularly the Western Blot) to quality control problems, and because of the dramatic effect of losing even a fraction of 1 percent in specificity to such problems, several researchers contend that

the number of false positives will be unacceptably high in populations where the actual incidence of infection is very low (such as persons applying for marriage licenses or positions as police officers). These researchers have calculated that the percentage of positive results that will be false after the entire test sequence (including the Western Blot) in very low-risk populations could be in the range of 28 to 90 percent.¹⁶

The prevalence of HIV infection in most prison populations in the United States is probably between 0.5 and 5 percent, with a few jurisdictions sharply higher. Figures released in October 1987 by the Federal Bureau of Prisons indicate that about 3 percent of Federal prisoners are infected with HIV¹⁷. Figure 3 represents a hypothetical application of mass screening for HIV antibodies to a population of 25,000 inmates, when the true prevalence of infection ranges from 0.5 to 30 percent and the specificity of the entire testing sequence ranges from 99.5 to 99.99 percent—a range encompassing the values assumed by most researchers. The sensitivity of the test sequence is held constant at 99.5 percent.

The percentages of positive results that would be false under this hypothetical application of mass screening show dramatic variations. At one extreme—99.5 percent specificity and 0.5 percent true prevalence—fully one-half of confirmed positive results will be false. More than 120 uninfected inmates would be mislabeled as HIV infected, with all of the potential problems associated with such a designation. Even at 99.9 percent specificity and 1 percent true prevalence, almost 10 percent of positive results would be false—not an insignificant proportion. At the other extreme, if we assume 99.99 percent test sequence specification, the percentage of positive results that would be false is extremely low regardless of the true prevalence of infection. A hypothetical percentage of false-positive results may be calculated easily for any scenario by substituting the population size, estimated true prevalence of infection, and estimated test sequence sensitivity and specificity.

Again, these results demonstrate the importance of maximizing the specificity of the test sequence and ensuring quality control in all testing procedures. The potentially high percentages of false-positive results in low-prevalence populations also underscores the importance of determining in advance how test results are to be used. In most settings, the actions that can be taken in response to a positive test result are limited by legal, ethical, and economic realities. If a high percentage of positive results could also be false, the negative consequences of testing may far outweigh the presumed benefits.

Just as low-risk populations may present a serious false-positive problem, in high-risk populations, the problem of false negatives may reach fairly serious proportions.¹⁶ For example, in the New York State prison population of about 35,000 inmates, where the true prevalence of infection is about 17 percent,¹⁹ about 30 infected persons would not be identified through an HIV antibody screening program, assuming test sensitivity of 99.5

“... testing should be viewed as only one part of an overall strategy for reducing the HIV transmission, and used only with adequate safeguards for confidentiality and protection against discrimination.”

percent. Although the percentage of false-negative results is very low (about 1/10 of 1 percent), the absolute number of false negatives would pose problems if efforts to reduce transmission were based on segregating seropositive inmates. This should be of real concern to any policymaker considering HIV antibody screening as the basis for controlling the spread of infection in a high-risk population.

Further complicating the picture is the possibility that intravenous drug users may be particularly prone to false-positive results because of their likely exposure to multiple viruses that may create antibodies mistakenly recognized by the ELISA test as HIV antibodies. Certain other groups of both high- and low-risk individuals may be similarly prone to false-positive results. These include women who have borne more than one child, persons who have received blood transfusions, persons with alcoholic hepatitis, and homosexual men who have participated in receptive anal intercourse.²⁰ In general, these cross-cutting potential problems suggest the need for real caution in decisions to institute any large-scale testing program.

Conclusion

In the past year, there have been numerous proposals to extend HIV antibody mass screening to various new populations. Many proposals have called for mandatory screening. Despite common statements to the contrary, there is no test for AIDS—only tests for antibodies to HIV, the virus which causes AIDS. Decisions to institute or extend HIV antibody screening must be based on a full understanding of the

meaning and reliability of the tests. In view of the ethical, legal, and practical problems that surround the use of test results, the purpose of any testing program should also be carefully considered. HIV antibody screening should not be considered a panacea for the problem of AIDS in our society. Instead, testing should be viewed as only one part of an overall strategy for reducing HIV transmission, and used only with adequate safeguards for confidentiality and protection against discrimination.

Theodore M. Hammett, Abt Associates, Inc., is Project Director and author of several NIH-sponsored studies on AIDS.

Notes

1. Centers for Disease Control (CDC), “Public Health Service Guidelines for Counseling and Antibody Testing to Prevent HIV Infection and AIDS,” *Morbidity and Mortality Weekly Report* 37, August 14, 1987: 509–515.
2. See, e.g., T.M. Hammett, *AIDS in Correctional Facilities: Issues and Options* (3d edition: Washington: National Institute of Justice, U.S. Department of Justice, 1988), esp. Chapter 4; R. Bayer et al., “HIV Antibody Screening: an Ethical Framework for Evaluating Proposed Programs,” *Journal of the American Medical Association*, October 3, 1986; 256: 1768–1774; L.O. Gostin et al., “The Case Against Compulsory Casefinding in Controlling AIDS—Testing, Screening and Reporting,” *American Journal of Law and Medicine* 1987; 12: 7–53; M.A.R. Kleiman and R.W. Mockler, “AIDS, The Criminal Justice System and Civil Liberties,” *Governance: Harvard Journal of Public Policy*, Summer-Fall 1987; 5: 48–54.
3. Studies by CDC and the San Francisco Department of Public Health, reported in *AIDS Policy and Law*, June 15 and June 29, 1988.
4. D.C. Des Jarlais and S.R. Friedman, “Target Groups for Preventing AIDS Among Intravenous Drug Users,” Draft, Narcotic and Drug Research, Inc., New York, 1986.
5. CDC, “Public Health Service Guidelines for Counseling and Antibody Testing.”

6. For the successful application of the blotted fingerprick procedure to another biomedical test, see M.D. Garrick et al., "Sickle Cell Anemia and Other Hemoglobinopathies: Procedures and strategy for screening employing spots of blood on filter paper as specimens," *New England Journal of Medicine*, 1973; 288: 1265-1268.
7. CDC, "Public Health Service Guidelines for Counseling and Antibody Testing."
8. M.J. Barry et al., "Screening for HIV Infection: Risks, Benefits, and the Burden of Proof," *Law, Medicine and Health Care*, December 1986; 14: 259-267.
9. Barry, "Screening for HIV Infection."
10. See, e.g., "New Specific ELISA May Beat Western Blot," *Medical World News*, October 12, 1987.
11. CDC, "Public Health Service Guidelines for Counseling and Antibody Testing."
12. A. Ranki et al., "Long Latency Precedes Overt Seroconversion in Sexually Transmitted HIV Infection," *Lancet*, September 12, 1987; 2:589-593. Data on the possibly recurrent latent period were presented at the Fourth International Conference on AIDS, Stockholm, June 1988.
13. J. Morgan et al., "Potential Source of Error in HTLV-III Antibody Testing" (letter), *Lancet*, 1986; 1: 739-740; I. Cayzer and S. Field, "Elimination of Source of Error in HTLV-III Antibody Testing" (letter), *Lancet*, 1986; 1: 1032-1033.
14. Barry, "Screening for HIV Infection," J.S. Schwartz et al., "HIV Test Evaluation, Performance and Use," *JAMA*, May 6, 1988; 259: 2574-2579.
15. CDC, "Update: Serologic Testing for Antibodies to HIV," *MMWR* 36, January 8, 1988: 833-840, 845. Schwartz, "HIV Test Evaluation."
16. Barry, "Screening for HIV Infection," K.B. Meyer and S.G. Pauker, "Screening for HIV: Can We Afford the False Positive Rate?" *New England Journal of Medicine*, July 23, 1987; 317: 238-241.
17. M. Specter, "Some Inmates with AIDS Virus to be Isolated," *Washington Post*, October 24, 1987, p. A14; see also Hammett, *AIDS in Correctional Facilities* (3rd Edition), Figure 2.7.
18. Barry, "Screening for HIV Infection."
19. Data from a 1-month blind study of all incoming inmates at the Downstate Correctional Facility. Presented at the Fourth International Conference on AIDS, Stockholm, June 1988.
20. Barry, "Screening for HIV Infection;" R. D'Aguila et al., "Prevalence of HTLV-III Infection Among New Haven, Connecticut, Parenteral Drug Abusers in 1982-1983" (letter), *New England Journal of Medicine*, January 9, 1986; 314: 117-118; N.Z. Zafar, "Screening for Antibodies to HTLV-III/LAV in our Population: A Word of Caution," *Journal of the Pakistani Medical Association*, April 1987; 37:84-85.

For additional information on HIV antibody testing and other AIDS-related issues, contact:

- **NIJ AIDS Clearinghouse**, 301-251-5500. This Clearinghouse has publications available to the criminal justice community, such as *AIDS in Correctional Facilities: Issues and Options*, Third Edition, and *AIDS in Probation and Parole Services*, that explore testing and its impact on institutional and community corrections settings.
- **National AIDS Information Clearinghouse**, 301-762-5111. To request any of the several CDC publications that the Clearinghouse is distributing, such as *If Your Test for Antibody to the AIDS Virus Is Positive*, or *Understanding AIDS*, call 800-458-5231.

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