

# The Estimated Prevalence and Incidence of HIV in 96 Large US Metropolitan Areas

## ABSTRACT

**Objectives.** This study sought to estimate the size and direction of the human immunodeficiency virus (HIV) epidemic in US metropolitan statistical areas (MSAs) with populations greater than 500 000.

**Methods.** A "components model" from review of more than 350 documents, several large datasets, and information from 220 public health personnel was used. Data review focused on injection drug users, men who have sex with men, and high-risk heterosexual men and women.

**Results.** In the 96 MSAs, there are, broadly, an estimated 1.5 million injection drug users, 1.7 million gay and bisexual men, and 2.1 million at-risk heterosexuals, and, among them, an estimated 565 000 prevalent and 38 000 incident HIV infections. This implies about 700 000 prevalent and 41 000 new HIV infections yearly in the United States. Roughly half of all estimated new infections are occurring among injection drug users, most of them in northeastern cities, Miami, and San Juan. Gay and bisexual men still represent most prevalent HIV infections, although incidence—except in young and minority gay men—is much lower now than it was a decade ago. Relatively high prevalences of HIV in at-risk heterosexual persons in several cities indicate the potential for an increase in transmission among them.

**Conclusions.** This review and synthesis outline the comparative epidemiology of HIV in major US cities and identify populations for interventions. (*Am J Public Health*. 1996;86:642-654)

Scott D. Holmberg, MD, MPH

### Introduction

Public health researchers in 1986,<sup>1</sup> 1987,<sup>2</sup> and late 1989<sup>3</sup> estimated that between 600 000 and 1.2 million US residents were infected with human immunodeficiency virus (HIV) and that about 40 000 to 80 000 adult and adolescent Americans acquired the infection each year.<sup>3</sup> Despite the evident need to reestimate current HIV prevalence and incidence, particularly for local resource planning and prevention efforts, there are only a few ways to make such estimates: sample surveys, mathematical modeling, or "components models."<sup>4</sup> Population surveys have been attempted in the United States, but these have encountered logistic and political barriers<sup>5</sup> such that they are now usually considered infeasible. Statistical models, such as those using back calculation of acquired immunodeficiency syndrome (AIDS) cases,<sup>3</sup> result in great uncertainty as one projects from "historical" AIDS incidence to current HIV incidence<sup>6,7</sup>; further, as these models are based on national datasets, they are even more indefinite in describing local situations.

Can a reasonable outline of the groups at risk for HIV infection be constructed from available information in individual cities? Although the information needed to form a national picture from the regions in a components model<sup>4</sup> is scattered and of variable quality, better estimates are possible today than were possible several years ago. Since the last such estimates,<sup>3</sup> millions of HIV tests have been performed, hundreds of thousands of AIDS cases have been tabulated, and scores of epidemiological studies have been reported. There is also much additional relevant information in unpublished documents, manuscripts in preparation, workshop reports, conference presen-

tations and abstracts, local medical journals, newsletters, and various difficult-to-access documents.

Accordingly, all available information from specific studies, HIV testing sites, and unpublished information and opinions of local health officials was collected, reviewed, and analyzed. The focus of the evaluation was adults and adolescents in the 96 largest US metropolitan statistical areas (MSAs) and was restricted to members of the three main transmission categories: injection drug users, men who have sex with men, and persons at risk from heterosexual activity.

### Methods

To estimate at-risk population sizes and HIV seroprevalence and seroincidence in these groups, three general sources of information were used. First, specific studies of at-risk persons have been reported from all major and most smaller MSAs; these studies were the preferential source of information about HIV prevalence and transmission in any given MSA. Second, information was taken from reported AIDS cases in each city; from sexually transmitted disease (STD) clinics, counseling and testing sites, and drug treatment centers; and from other sources of population testing, such as the Veterans Administration and other

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The author is with the Division of HIV/AIDS Prevention, National Center for HIV, STD and TB Prevention, Centers for Disease Control and Prevention, Atlanta, Ga.

Requests for reprints should be sent to Scott D. Holmberg, MD, MPH, Division of HIV/AIDS Prevention, Mailstop E-45, Centers for Disease Control and Prevention, Atlanta, GA 30333.

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medical centers or household-based surveys. Finally, local and state health department and other health professionals provided estimates, impressions, and a great deal of unpublished, generally inaccessible data from their own agencies (a list of the data contributors is available from the author).

Estimates of prevalence and incidence were generated by and had to fulfill inclusion criteria based on multiple data sources, such as AIDS cases reported among persons in the transmission categories in the MSA; number and percentage of HIV-infected persons seen at counseling and testing sites, drug treatment centers, and STD clinics; and other parameters.

### *Injection Drug Users*

*Size of the transmission category.* This group was composed of heterosexuals, homosexuals, and bisexual men and women who are current, active drug users (i.e., users of injection drugs within the previous 12 months). In the western and Pacific states of California, Oregon, Washington, Arizona, Colorado, Nevada, New Mexico, and Hawaii, in which HIV seroprevalence and risk of HIV are substantially higher among gay men than among injection drug users, gay and bisexual male injection drug users were considered in the risk category of men who have sex with men (see below). In each MSA, specific studies of injection drug users and estimates provided by federal agencies,<sup>8</sup> health departments, drug treatment services, and academic institutes were reviewed first. Studies have been performed to estimate the number of injection drug users in many of the largest such communities—notably New York,<sup>9,10</sup> Los Angeles,<sup>11–13</sup> and San Francisco.<sup>14–16</sup> Other estimates of injection drug users in states with a moderate to high incidence of AIDS were available from a Research Triangle Institute project done under contract with the Centers for Disease Control and Prevention (CDC).<sup>17</sup>

To verify the legitimacy of any estimate used, each estimate had to fulfill the following criteria:

- The National Institute on Drug Abuse (NIDA) and other agencies estimate that about 10% to 20% of injection drug users nationwide are in drug treatment at any given time.<sup>18,19</sup> The population of injection drug users in each MSA attending drug treatment centers was estimated from the CDC's national surveillance of such clinics,<sup>20–22</sup> from a survey in

1990 of attendance at 628 drug treatment centers in 161 communities (Ida Onorato and Marta Gwinn, unpublished data), and from data provided by state and local substance abuse agencies. With 11.3 taken as the mean of a wide inclusion range from 2.5 times (half the lower NIDA estimates of 5 times) to 20 times (twice the upper NIDA estimate of 10 times) the number of injection drug users in drug treatment centers, an estimate was derived based on 11.3 times the number of injection drug users in those MSAs in which injection drug users in drug treatment centers were estimated.

- Data from persons attending HIV confidential counseling and testing sites in 82 MSAs from 1990 through 1993 were reviewed (Allyn Nakashima and Kimberly Todd, unpublished data). In cities such as Los Angeles,<sup>23,24</sup> San Francisco,<sup>14,16,25</sup> and the Bronx,<sup>26,27</sup> in which health and academic professionals had estimated the number of injection drug users in the community, an average of about 5.4% of all estimated injection drug users were tested at counseling and testing sites in those cities in any given year.<sup>28</sup> In the 82 MSAs with counseling and testing site data, 6.7% (SD = 3.8%; range = 1.1% to 14.7%) of the estimated total of injection drug users had attended these sites in 1992; these figures are in accord with the few studies done outside counseling and testing sites to determine the use of such sites by injection drug users<sup>29–33</sup> (A. T. Walker, R. Foster, and C. Khanyile, unpublished abstract). Thus, the estimated total number of injection drug users in a MSA was considered to be roughly 15 times (reciprocal of 6.7%) the number of injection drug users seen at counseling and testing sites in that area in 1992, with a plausible range, based on the standard deviation (3.8%, above), of 9.5 to 34.5 times the number of injection drug users seen at counseling and testing sites.

- The percentage of injection drug users in well-characterized populations was stratified into high injection-drug-use MSAs such as New York, San Juan, and Newark, where the numbers of users estimated by local health authorities were greater than 1.1% of the total 1992 census population; medium injection-drug-use MSAs such as Los Angeles, where the numbers of estimated users were 0.7% to 1.0% of the 1992 population; and low injection-drug-use populations such as most midwestern cities, in which injection drug users were estimated by local health officials to account for 0.2% to 0.6% of the area's 1992 population. Emergency

room mentions of heroin and morphine in the national Drug Abuse Warning Network (DAWN) database in 1991<sup>17</sup> (Janet Greenblatt, unpublished DAWN data, 1994) and deaths involving drug overdose in 40 cities in 1992<sup>34</sup> were examined and compared. Trends in (injection) drug use, as reported recently by ethnographers, treatment providers, and police sources,<sup>35</sup> as well as recent trends in AIDS incidence among injection drug users in major US cities,<sup>36</sup> were also examined and compared. Thus, one estimate of total injection drug users in an MSA was 0.4% (low), 0.8% (medium), or 1.3% (high) of the total 1992 population.

- The total number of injection drug users in an MSA was also calculated as the estimated number of living HIV-infected users in the MSA (including persons with AIDS) divided by the percentage (i.e., proportion) of HIV-infected users in the area. One estimate of living HIV-seropositive injection drug users was taken to be 2.5 (see below for derivation of this factor) times the number of reported AIDS cases among injection drug users in the MSA as of February 1994.

Thus, the measurements and estimates generated above needed to fulfill the following inclusion criteria: they had to be (1) between 2.5 and 20 times the number of injection drug users attending drug treatment centers in recent years (average); (2) between 9.5 and 34.5 times the number of injection drug users tested at counseling and testing sites in 1992; and (3) within 0.2% to 0.6%, within 0.7% to 1.0%, or more than 1.1% of the total 1992 MSA population in putatively low, medium, or high injection-drug-use cities, respectively. The final estimate of the number of injection drug users in an MSA was the mean of the estimates and measurements meeting the inclusion criteria.

*HIV prevalence.* Many multisite studies in most large MSAs<sup>26,29,37–43</sup> provided the first estimates for numbers and percentages of HIV-infected injection drug users. Current prevalence of HIV infection among injection drug users was also derived for many cities through ongoing serosurveillance of persons entering drug treatment centers and STD clinics.<sup>20–22,42</sup> Users entering treatment usually have lower HIV seroprevalence than users who are out of treatment.<sup>41,43–45</sup> The 5-year (1989 to 1993) HIV seroprevalence of heroin users admitted to 154 Department of Veterans Affairs (VA) hospitals<sup>39</sup> (Pam-

ela Hartigan, unpublished data) was also examined.

Inclusion criteria for estimates of seroprevalence (number or percentage infected) were as follows:

- The percentages of infected injection drug users seen at counseling and testing sites from 1990 to 1993 in 82 MSAs were reviewed. About 23% (12% to 30%) of HIV-seronegative and 13% (3% to 18%) of HIV-seropositive persons tested at these sites represent persons previously tested<sup>32,46</sup>: it was assumed that rates of retesting did not change substantially in the intervening few years. The prevalence of HIV infection among injection drug users in the community is almost always higher than the seroprevalence among injection drug users tested at counseling and testing sites.<sup>41,43-45,47</sup> Accordingly, any estimate of true seroprevalence of HIV among injection drug users in the community should plausibly be between 20% less than and twice as high as the seroprevalence among injection drug users at the counseling and testing sites over a 5-year period.

- The number of AIDS cases among injection drug users reported from each MSA was examined. The current ratio of HIV infection to AIDS is unknown,<sup>48</sup> but (1) 54% of cumulatively reported AIDS patients have died<sup>49,50</sup>; and (2) if prior total estimates of 600 000 to 1 200 000 HIV-infected persons nationally<sup>3</sup> and 360 000 AIDS cases by the new definition are correct, this implies a ratio of persons infected with HIV to those living with AIDS of between 3.6:1 and 7.2:1, and a ratio of those HIV-infected persons (both with and without AIDS) to the cumulative number of reported AIDS patients of 2.5 ( $\pm 0.85$ ). Thus, any estimate less than 1.7 times or more than 3.4 times the cumulative reported AIDS cases among heterosexual and gay or bisexual injection drug users was excluded. In a few MSAs with no other available or credible estimate, an estimate of HIV-infected injection drug users equal to 2.5 times the cumulative number of AIDS cases among such users in the area reported to CDC as of February 1994 was used.

- The percentage of HIV-seropositive injection drug users seen at counseling and testing sites from 1988 through 1993 also provided inclusion criteria. A plausible range of seroprevalence was taken to be between 0.8 and 2.0 times the mean seroprevalence of injection drug users attending these sites over the 5-year period.

- A final criterion was derived from 25 municipal applicants in 1994 to the Health Resources and Services Administration (HRSA) for funding under the Ryan White Comprehensive AIDS Resources Emergency (CARE) Act of 1990 (George Ersek, unpublished HRSA data, 1994).

The final estimate represented the mean of all estimates and measurements that fell within inclusion criteria.

**HIV incidence.** Estimates of HIV incidence among injection drug users came preferentially from specific studies, from local and state health departments and drug treatment service agencies, and from preliminary data from community-based research projects (Richard Needle, NIDA unpublished data, 1994). The largest communities of injection drug users—such as those in New York, Los Angeles, Houston, Miami, San Juan, and Chicago—have all been studied in recent years. That HIV incidence in cohort studies could be underestimated because of a “cohort effect” (i.e., seroincidence in a closed cohort declines over time<sup>51,52</sup>) was considered.

In MSAs west of the Mississippi, HIV seroprevalence is low, usually 5% or less. When specific studies of HIV incidence among injection drug users were not available for such areas, incidence was estimated to be low from constant low HIV prevalence among injection drug users seen at drug treatment centers, counseling and testing sites, STD clinics, and VA hospitals.

Recent studies have indicated the annualized mortality rates for HIV-infected and uninfected injection drug users in New York (4.23% and 1.64%, respectively),<sup>51</sup> Philadelphia (5.5% and 1.2%, respectively),<sup>52,53</sup> and Baltimore (5.7% and 1.4%, respectively).<sup>54</sup> Consequently, differential loss of HIV-infected (taken at 5.0% per year) compared with uninfected (taken at 1.5% per year) injection drug users was considered in evaluating HIV seroprevalence trends, or their lack,<sup>42</sup> among this group at any site or study. (Sample calculations for HIV risk groups thought to have HIV incidence less than 1.0/100 person-years are available from the author.)

In many MSAs, HIV prevalence among injection drug users is comparatively low. That is, less than 10% and often less than 5% of users in the area are HIV infected, and HIV incidence is clearly less than 1 per 100 person-years. Thus, in these MSAs, a simplifying esti-

mate of an HIV incidence of 0.5 per 100 person-years (range = 0.2 to 1.0 HIV infections per 100 person-years) was used.

### Men Who Have Sex with Men

**Size of the transmission category.** Sexually active men who had sex with other men within the past 12 months were considered to be a group at risk for the purposes of this project. Estimates of total gay/bisexual male populations made by several public health departments—for example, those in New York,<sup>9</sup> San Francisco,<sup>35,36,55,56</sup> and Los Angeles<sup>11</sup>—have served as a first approximation of the number of gay and bisexual men in those cities.

- The proportions of men 45 years and older who have never been married<sup>57</sup> compared with the total male population aged 18 to 45 years in each MSA were calculated from 1992 US census data. While these proportions include many heterosexual men, they also *exclude* many gay and bisexual men—usually about 15%—who *have* been previously married<sup>58-61</sup> (Brad Bartholow, unpublished data, 1994). From census data, the proportions of men over 44 years old who have never married ( $Pr_{nm > 44}$ ) was 4.73% overall, ranging from 2.98% in Fort Worth to 13.26% in San Francisco. Multiplying this proportion by the number of men aged 18 to 45 years gave good agreement with estimates of (sexually active) gay and bisexual men based on population sampling in San Francisco<sup>15</sup> and Dallas.<sup>5</sup> In cities with many African-American men, who are twice as likely as White men to have never been married (14% vs 7% among 45- to 54-year-olds (data provided by Arlene Saluter, US Bureau of the Census, 1994), the proportion of never-married men over age 44 years ( $Pr_{adj}$ ) was adjusted for the proportion of the MSA that is African American ( $Pr_{AA}$ )<sup>62</sup>:

$$Pr_{adj} = (1 - \frac{1}{2}Pr_{AA})(Pr_{nm > 44}).$$

Thus, the estimate for each MSA was  $Pr_{adj}$  times the total 1992 male census population between 18 and 45 years of age, with inclusion criteria no lower than 3% (Fort Worth) or higher than 13% (San Francisco) of all men aged 18 to 45 years in the MSA.

- To assess the utility of census data, the percentage of all households in each MSA that had male/male heads of household was found to be directly proportional to the number of homosexual/bisexual men aged 18 to 45 years with reported AIDS from the MSA (Spearman correla-

tion coefficient,  $r_s = .92$ ;  $P < .001$ ; Bob Frey, analysis not shown).

- As was done with injection drug users, the numbers of self-identified gay and bisexual men seen at counseling and testing sites in 82 US metropolitan areas were reviewed. In cities in which the populations of these men had been estimated—San Francisco, New York, and Dallas—6.3% (SD = 2.4%) of all gay or bisexual men were tested yearly at the sites from 1990 through 1993. Thus, estimates of the number of men who have sex with men in an area were usually near 15.9 (reciprocal of 6.3%) and from 11.5 to 25.6 (range based on the SD of 2.4%) times the number of self-identified gay and bisexual men seen at counseling and testing sites in the MSA.

- As another corroboration, the number of gay bars that were nationally advertised in a widely used travel guide for homosexual men and women<sup>63</sup> was examined for each MSA; generally, in most (but not all) nontourist areas, the number of gay and bisexual men estimated by other techniques was between 1000 and 2000 times the number of advertised bars.

- The total number of men who have sex with men in an MSA was also calculated as the estimated number of HIV-infected gay and bisexual men—taken to be 1.75 times the number of reported AIDS cases among this population in the MSA as of February 1994 (see below)—divided by the percentage (prevalence) of HIV-infected gay and bisexual men in the MSA (as below).

Thus, estimates needed to fulfill the following inclusion criteria: they had to be (1) within 0.03 to 0.13 times the total male population aged 18 to 45 years in the MSA (1992 census estimate); (2) within 11.5 to 25.6 the number of gay and bisexual men seen at the counseling and testing sites in the MSA in 1992; and (3) within 1000 to 2000 times the number of advertised gay bars in the area. The final estimate was taken to be the mean of the estimates derived above that fulfilled inclusion criteria.

*HIV prevalence.* Specific studies provided first approximations of infected gay and bisexual men in many MSAs.<sup>64,65</sup> HIV prevalence among this population in a given MSA was considered likely to be lower than seroprevalence among highly sexually active gay and bisexual men tested in recent years at STD clinics.<sup>21,66</sup>

AIDS cases reported to the CDC were used to validate the estimated

number of HIV-infected gay and bisexual men in each city. By a rationale similar to that used for injection drug users, the estimated number of living HIV-infected gay and bisexual men was about 1.75 (approximately 1.5 to 2.0) times the total number of AIDS cases reported among this population in each MSA. Accordingly, one estimate of prevalence was 1.75 times the number of cumulative reported AIDS cases among gay and bisexual men in the MSA, divided by the estimated number of gay and bisexual men in the MSA.

Thus, estimates and measurements of prevalence were tested by the following inclusion criteria: namely, they had to be (1) between 0.75 (half the lower bound) and 4.0 (twice the upper bound) times the cumulative number of AIDS cases reported to the CDC as of February 1994, divided by the estimated number of gay and bisexual men in the MSA; and (2) higher than the seroprevalence seen among gay and bisexual men attending counseling and testing sites in 1992 in the MSA, but lower than the seroprevalence seen in (highest risk) gay/bisexual men tested at STD clinics in recent years. As above, the final estimate was taken to be the mean of estimates generated by and falling within inclusion criteria.

*HIV incidence.* HIV incidence estimates came preferentially from many specific studies. As with injection drug users, HIV seroincidence was also sometimes estimated from time trends in seroprevalence, almost always markedly declining, among gay and bisexual men being seen at STD clinics<sup>66</sup> and counseling and testing sites in recent years, as well as from declining seroincidence in fixed or closed cohorts, such as the Multicenter AIDS Cohort Study<sup>67</sup> or San Francisco cohorts of homosexual and bisexual men.<sup>68</sup>

In almost all cities, there has been a marked drop in HIV seroprevalence among gay and bisexual men seen at all testing sites in recent years. Because subtle drops or inconsistent changes in seroprevalence—for example, by 1% or 2% per year—may obscure true HIV incidence,<sup>69,70</sup> only marked and consistent declines in seroprevalence among this population were considered indicative of low incidence.<sup>66,71–74</sup>

#### *Persons at Risk through Heterosexual Contact*

Estimates of heterosexual women and, even less frequently, of heterosexual men at highest risk for HIV infection have been made only a few times, notably in

New York City<sup>9,75,76</sup> and in San Francisco.<sup>55,77</sup> Differences in opinion about the definition and numbers of at-risk heterosexuals are to some extent unavoidable. However, an estimated 3 to 6 million US adults have sex with five or more partners per year,<sup>78</sup> and many encounters are unprotected.<sup>79</sup>

Based on reported AIDS cases, most (70% to 80%) persons infected through heterosexual contact are women. Also, most (80%) HIV-infected heterosexual men and women who do not use injection drugs have been infected through sexual contact with HIV-infected injection drug users and (for women) much less frequently with HIV-infected bisexual men<sup>80–82</sup>; thus, it is not unexpected that the geographic distribution of heterosexual AIDS cases has been essentially the same as the distribution of male injection drug–using AIDS cases.<sup>80,83</sup> Generally, male injection drug users have a mean of two to three female sex partners per year,<sup>84–86</sup> and at least 5% of regular female sex partners of male injection drug users are HIV infected.<sup>46,87</sup> Gay or bisexual men are obviously much less likely (about 20%) to have female partners<sup>88,89</sup> (Lois Conley, unpublished data, 1994).

*Size of the transmission category.* Given these considerations, it was decided to base estimates of at-risk heterosexuals directly on the number of injection drug users and bisexual men in the MSA, weighted for the percentage of those infected with HIV; estimates of at-risk heterosexuals generated by any formula had to accord with the few studies done of them. Accordingly, the number of heterosexual men and women at significant risk for HIV infection in each MSA ( $HET_{MSA}$ ) was defined as the estimated total number of injection drug users ( $IDU_{tot}$ ) plus the number of HIV-infected injection drug users ( $IDU_{HIV}$ ) plus a percentage (20%, reflecting the proportion of men who are bisexually active) of the estimated total of gay and bisexual men ( $MSM_{tot}$ ) and HIV-infected gay and bisexual men ( $MSM_{HIV}$ ):

$$HET_{MSA} = IDU_{tot} + IDU_{HIV} + (0.2)(MSM_{tot} + MSM_{HIV}).$$

That is, to “weight” the number of at-risk heterosexuals in each MSA according to the number of living HIV-infected injection drug users and bisexual men, infected injection drug users and bisexual men are counted twice (i.e., they could be consid-

TABLE 1—Estimated HIV Seroprevalence and Seroincidence in Representative Large US Metropolitan Statistical Areas (MSAs)

MSA and Risk Group	Estimated No.	Estimated HIV+		Estimated HIV-, No.	Estimated Incidence per 100 Person-Years	Estimated New Infections per Year, No. (Range)
		No.	%			
<b>California: Los Angeles—Long Beach (9 092 242 population)</b>						
IDU	88 000	3 340	3.8	84 660	0.2	169 (68, 254)
MSM	125 000	28 300	22.6	96 700	1.0	967 (387, 1 451)
HET	122 000	1 550	1.3	120 450	0.3	317 (127, 475)
<b>California: San Francisco (1 640 990)</b>						
IDU	23 000	3 300	14.3	19 700	1.9	374 (150, 561)
MSM	54 000	22 000	40.7	32 000	1.4	448 (179, 672)
HET	41 500	640	1.5	40 860	0.3	122 (49, 183)
<b>District of Columbia: Washington—Md—Va—WV (4 362 693)</b>						
IDU	39 100	5 680	14.5	33 420	4.1	1 370 (548, 2 055)
MSM	45 000	10 900	24.2	34 100	0.7	239 (95, 358)
HET	56 000	1 360	2.4	54 640	0.5	247 (99, 371)
<b>Florida: Miami (2 016 726)</b>						
IDU	31 000	6 800	21.9	24 200	2.5	605 (242, 908)
MSM	26 000	8 170	31.4	17 830	1.0	178 (71, 267)
HET	45 000	2 300	5.1	42 700	1.0	426 (170, 639)
<b>Georgia: Atlanta (3 141 878)</b>						
IDU	23 000	3 340	14.5	19 660	2.0	393 (157, 590)
MSM	31 500	9 000	28.6	22 500	<1.0	113 (45, 225)
HET	34 400	950	2.8	33 450	0.6	187 (75, 281)
<b>Illinois: Chicago (7 586 706)</b>						
IDU	58 100	10 500	18.1	47 600	2.5	1 190 (476, 1 785)
MSM	74 000	12 040	16.3	61 960	1.0	620 (248, 930)
HET	85 800	1 300	1.5	84 500	0.3	254 (101, 380)
<b>Indiana: Gary (618 450)</b>						
IDU	6 300	170	2.7	6 130	<1.0	30 (12, 61)
MSM	2 700	300	11.1	2 400	<1.0	12 (5, 24)
HET	7 000	50	0.7	6 950	0.1	7 (3, 11)
<b>Maryland: Baltimore (2 445 950)</b>						
IDU	32 000	5 550	17.3	26 450	4.0	1 060 (424, 1 590)
MSM	37 100	4 400	11.9	32 700	0.8	262 (131, 425)
HET	45 800	930	2.0	44 870	0.4	179 (72, 269)
<b>Massachusetts: Boston—Brockton—Nashua, NH (5 637 882)</b>						
IDU	28 000	4 600	16.4	23 400	1.5	351 (140, 527)
MSM	61 300	8 400	13.7	52 900	<1.0	270 (108, 405)
HET	46 500	750	1.6	45 750	0.3	137 (55, 206)
<b>Michigan: Detroit (4 303 014)</b>						
IDU	35 000	3 460	9.9	31 540	1.0	315 (125, 475)
MSM	35 100	4 860	13.8	30 240	<1.0	151 (60, 302)
HET	46 000	500	1.1	45 500	0.2	96 (38, 143)
<b>New Jersey: Newark (1 911 074)</b>						
IDU	30 000	11 400	38.0	18 600	3.5	651 (260, 977)
MSM	16 000	2 860	17.9	13 140	1.0	131 (53, 197)
HET	45 200	2 900	6.4	42 300	1.3	549 (220, 824)

(Continued)

TABLE 1—Continued

MSA and Risk Group	Estimated No.	Estimated HIV+		Estimated HIV-, No.	Estimated Incidence per 100 Person-Years	Estimated New Infections per Year, No. (Range)
		No.	%			
<b>New York: New York (8 557 768)</b>						
IDU	168 300	69 000	41.0	99 300	4.4	4 369 (1 748, 6 553)
MSM	150 900	44 000	29.2	106 900	1.0	1 007 (403, 1 510)
HET	276 000	11 800	4.3	264 200	0.9	2 351 (940, 3 526)
<b>Pennsylvania: Philadelphia—NJ (4 960 043)</b>						
IDU	51 400	6 140	11.9	45 260	3.0	1 358 (543, 2 037)
MSM	41 100	8 630	21.0	32 470	<1.0	162 (65, 324)
HET	67 500	1 260	1.9	66 240	0.4	265 (106, 397)
<b>Puerto Rico: San Juan (1 857 143)</b>						
IDU	22 000	8 900	40.5	13 100	4.9	642 (257, 963)
MSM	22 500	2 800	12.4	19 700	2.0	394 (158, 591)
HET	37 000	1 600	4.4	35 400	0.9	315 (126, 473)
<b>Texas: Dallas (2 801 818)</b>						
IDU	16 300	540	3.3	15 760	<1.0	75 (30, 157)
MSM	26 700	7 100	26.6	19 600	<1.0	98 (39, 147)
HET	19 600	340	1.7	19 260	0.3	60 (24, 91)
<b>Texas: Houston (3 551 775)</b>						
IDU	65 200	4 000	6.1	61 200	0.9	551 (220, 826)
MSM	48 000	13 000	27.1	35 000	<1.0	175 (70, 350)
HET	81 400	900	1.1	80 500	0.2	172 (69, 258)
<b>Washington: Seattle—Bellevue—Everett (2 122 126)</b>						
IDU	20 600	500	2.4	20 100	<1.0	101 (40, 201)
MSM	42 700	6 000	14.1	36 700	1.0	367 (146, 548)
HET	30 800	260	0.8	30 540	0.2	49 (20, 74)

Note. HIV = human immunodeficiency virus; HIV+ = HIV-infected persons; HIV- = HIV-uninfected (susceptible) persons; IDU = injection drug users; MSM = men who have sex with men; HET = men and women at risk from heterosexual transmission.

ered to have had two opposite-sex partners per year) since they are also included in  $IDU_{tot}$  and  $MSM_{tot}$ .

- The number of non-injection drug-using women attending counseling and testing sites in the MSAs was compared with the number of at-risk heterosexuals in each MSA by the above calculations. In cities with good data on counseling and testing site attendance, heterosexuals were found to be a mean of 2.25 (inclusion criteria, 1.5 to 4.2) times the number of non-injection drug-using heterosexual women attending those clinics in 1992.

- Estimated numbers of heterosexuals were also corroborated with 1992 census data. In MSAs with low numbers of heterosexuals at risk, such as Wichita and Cincinnati, these were 0.7% or less of the 1992 population; in cities with medium numbers of heterosexuals at risk,

such as Atlanta and Riverside—San Bernardino, Calif, these were about 1.0% (0.8% to 1.3%) of the population; and in cities with high numbers of at-risk heterosexuals, such as New York (3.4%), Miami (2.1%), and San Francisco (2.2%), these were 1.4% or more of the population. Calculations of at-risk heterosexuals were checked to conform with data from referenced literature<sup>90,91</sup> and correspondents' impressions.

- Because of the strong association between heterosexual HIV infection, "crack" cocaine smoking, and syphilis in diverse northeastern urban cities,<sup>92-94</sup> small midwestern cities,<sup>95</sup> and southern rural settings,<sup>96-98</sup> available data on crack use<sup>99-101</sup> and recent primary and secondary syphilis rates<sup>102</sup> were examined to corroborate or exclude correspondents' impressions regarding the relative numbers of at-risk heterosexual men and women in their MSAs.

**HIV prevalence.** The prevalence of HIV in all at-risk heterosexuals was considered proportional to recent HIV seroprevalence in non-injection drug-using women seen at STD clinics and counseling and testing sites. To derive inclusion criteria in each MSA, the percentage of women who were found to be HIV seropositive on testing at STD clinics—that is, women at highest risk for heterosexual acquisition of HIV—provided a high estimate of prevalence in the female heterosexual population, whereas the percentage who were HIV seropositive on testing at counseling and testing sites, where many women at low or no risk may be tested, furnished a low estimate of prevalence.

- Estimates of seroprevalence in each MSA were also compared against the (much lower) HIV seroprevalence in childbearing women in the National Sero-surveillance database.<sup>21,103</sup> Estimated HIV

**TABLE 2—Estimated HIV Seroprevalence and Incidence, All 96 US Metropolitan Areas with Populations > 500 000**

Risk Group	Estimated No.	Estimated HIV+		Estimated HIV-, No.	Estimated Incidence per 100 Person-Years	Estimated New Infections per Year No. (Range)
		No.	%			
IDU	1 460 300	204 000	14.0	1 256 300	1.5	19 000 (7 600, 28 500)
MSM	1 718 700	314 400	18.3	1 404 300	0.7	9 800 (3 900, 14 700)
HET	2 070 600	47 300	2.3	2 023 300	0.5	9 300 (3 700, 14 000)
Total	5 249 600	565 700	10.8	4 683 900	0.8	38 100 (15 200, 57 200)

Note. HIV = human immunodeficiency virus; HIV+ = HIV-infected persons; HIV- = HIV-uninfected (susceptible) persons; IDU = injection drug users; MSM = men who have sex with men; HET = men and women at risk from heterosexual transmission.

prevalence in at-risk heterosexual men and women in those 27 MSAs was considered to be from 5.7 to 22.5 (mean  $\pm$  SD) times the measured HIV prevalence in childbearing women.

• The factors for assessing the ratio of reported AIDS cases to HIV-infected heterosexual men and women were the same as those considered for injection drug users and gay and bisexual men (above). Final estimates of HIV-infected non-injection drug-using men and women were checked to be about four (two to five) times the number of AIDS cases among heterosexual women in the MSA reported to the CDC as of February 1994.

**HIV incidence.** Where available, estimated HIV incidences among non-injection drug-using women—such as in Los Angeles,<sup>11,104</sup> New York City,<sup>9,76,77</sup> San Francisco,<sup>55,56,105</sup> and Dallas<sup>5</sup>—were used as a first derivation of HIV incidence in all (both male and female) at-risk heterosexuals. As for the other risk groups, HIV incidence was also estimated from time trends in seroprevalence among non-injection drug-using heterosexual men and women seen at STD clinics and counseling and testing sites in recent years. In almost all MSAs, the estimated seroincidence among at-risk heterosexuals was clearly less than 1 per 100 person-years. Accordingly, a simplifying estimate was used: HIV incidence per 100 person-years was considered to be approximately 0.2 times the prevalence of HIV-infected heterosexuals, with a range from 0.4 to 1.5 times this estimated seroincidence.

## Results

A complete table of site-specific estimates of the at-risk populations and their HIV prevalence and incidence in all 96 MSAs is available from the author. The

results are based on information from more than 220 correspondents, more than 350 published and unpublished sources, and the several large datasets indicated.

**Injection drug users** (Tables 1 and 2). The cumulative estimated number of living injection drug users in the 96 MSAs is 1.46 million, of whom 204 000 are HIV infected. Nationally, an estimated 19 000 injection drug users are infected each year, implying an HIV incidence of about 1.5 per 100 person-years in susceptible (HIV-uninfected) injection drug users. Northeastern cities from Boston to Washington, DC, as well as Miami and San Juan, had many injection drug users (more than 500 000) and the highest overall prevalence in them (mean for those cities = 27%; range = 16% to 41%). Estimated incidence was from two to five infections per 100 person-years in these eastern cities (Table 1), implying more than 12 000 incident infections yearly. Thus, most incident HIV infections among injection drug users occur in these MSAs and about one third of all incident HIV infections occur in injection drug users in these MSAs.

**Men who have sex with men** (Tables 1 and 2). There are about 1.7 million (current) gay or bisexual men in the 96 MSAs. More than 300 000 living gay or bisexual men are thought to be HIV infected, and about 9800 continue to acquire HIV infection per year: thus, the incidence of HIV in (uninfected) gay or bisexual men is about 0.7 new (incident) infections per 100 person-years. As with injection drug users but to a lesser extent, there is geographic variation in the HIV incidence rates for this group. Gay and bisexual men in San Francisco (1.4 new infections per 100 person-years), New York and Miami (each, 1.0 per 100 person-years), Los Angeles (1.5 per 100

person-years), and San Juan (2.0 per 100 person-years) continue to have substantially higher HIV incidence than that observed in most other cities, where estimated incidences among the population were usually less than 1.0 per 100 person-years (Table 1).

**Heterosexual men and women** (Tables 1 and 2). There are an estimated 2.07 million men and women at high risk for HIV infection through heterosexual intercourse; women at risk are thought to outnumber men by a ratio of 4:1. Roughly 47 300 (2.3%) living heterosexuals are thought to be HIV infected, and an estimated 9300 are acquiring HIV infection each year. Thus, the incidence of HIV in HIV-seronegative heterosexuals in the United States is estimated to be about 0.5 new (incident) infections per 100 person-years. Reflecting the risk of HIV transmission from injection drug-using men to non-using women, most new HIV infections among heterosexuals are apparently occurring along the eastern seaboard. About 2400 new infections—roughly one quarter of all heterosexual transmission—may be occurring in the New York City MSA alone.

**Totals** (Table 2). There are probably more than 5.2 million residents in the 96 MSAs who are at substantial risk for HIV infection, of whom an estimated 565 700 (10.8%) are HIV infected. In the 96 MSAs, there are an estimated 38 100 new HIV infections yearly.

Since about 85% of all AIDS cases are reported from these MSAs—10% are from small cities and 5% are from rural areas<sup>50</sup>—there are 660 000 projected HIV-infected injection drug users, gay and bisexual men, and at-risk heterosexuals nationwide. Also, besides the three major transmission categories considered here, there are currently an estimated 10 000 HIV-infected infants,<sup>103,106</sup> 4000 to 10 000 HIV-infected hemophilic men (Sarah Wiley, unpublished data from 125 hemophilia treatment centers, January 1995), and, by calculation from previous estimates,<sup>107</sup> 4000 to 6000 HIV-infected blood transfusion recipients living in this country today. Thus, for the United States, there are an estimated 700 000 living HIV-infected persons—including those with AIDS—and 41 000 incident infections per year.

## Discussion

This components model suggests that there are now about 700 000 HIV-

infected persons (including living AIDS patients) in the United States. This estimate corresponds to information from the most recent national household survey<sup>108</sup> and reflects putative trends for decreasing HIV incidence<sup>109</sup> and increasing HIV deaths.<sup>50</sup>

The estimates of the numbers of persons in two of the three main transmission categories of HIV infection— injection drug users and men who have sex with men—are in accord with the few previous national estimates available, but these estimates are not without problems. The estimate of injection drug users, roughly 1.5 million, derived by summing the estimated numbers of users in each of the 96 MSAs, accords with recent estimates of 1.1 to 1.9 million injection drug users in the United States.<sup>1,4,17,19</sup> Still, the estimate of injection drug users in any given MSA may be high because local estimates may ultimately come from persons or organizations that benefit from highlighting or overestimating the drug abuse problem in their locality. The estimate of about 1.7 million current gay and bisexual men (defined as those with same-sex contacts in previous year)—based on somewhat “firmer” information such as census data on never-married men in each city—indicates that, overall, slightly more than 4% of men aged 18 to 45 years in these large MSAs are currently homosexual or bisexual. This estimate falls within the broad estimates that between 1% and 10% of adult US men are gay or bisexual<sup>5,64,110–112</sup> and is very close to the most recent and comprehensive national survey of male sexual behavior (3.7% of men in the 100 largest metropolitan areas<sup>113</sup>). Nonetheless, there is inherent controversy and uncertainty, often related to problems with definition, in any estimate of the size of this group or of at-risk heterosexuals. Also, self-reported risk data, because of denial of injection drug use, may ultimately lead to overestimates of the number of gay and bisexual men or heterosexuals at risk for HIV infection. On the other hand, focusing on heterosexuals at “highest” risk can obscure for other heterosexuals the lower but real possibility of HIV infection for them.

Estimates in this project have obvious and unavoidable methodological limitations. Although every attempt was made to make estimates plausible and consistent with a wealth of data, final decisions on inclusion ranges and other variables were necessarily arbitrary. Some data are contradictory. For example, some studies have indicated that injection drug users in

treatment may<sup>41,43,45</sup> or may not<sup>114</sup> be less likely than out-of-treatment users to be HIV seropositive; thus, inclusion ranges on numbers of or HIV prevalence in injection drug users calculated from clinic attendance needed to be wide. Yet other data are thorny to interpret. Declining HIV prevalence in persons at risk seen at counseling and testing sites<sup>115</sup> or in street-recruited samples<sup>116</sup> may result not from real declines in HIV prevalence (and seroincidence) in tested populations but rather from a bias caused by the attendance of persons at progressively less risk for HIV infection—essentially a cohort effect.<sup>117</sup> Also, inconsistent or subtle changes in seroprevalence may mask an incidence as high as two or three infections per 100 person-years.<sup>69,70</sup> In this analysis, low seroincidence was imputed only when seroprevalence trends were greatly declining (usually among gay or bisexual men), and such trends were sustained over at least a few years.

Various methodologies for estimating populations at risk have had widely different success. A house-to-house survey of homosexual and bisexual men in areas of San Francisco in the mid-1980s provided a workable estimate of the total gay and bisexual population in San Francisco.<sup>118</sup> However, a national plan for household surveys of populations at risk for HIV was abandoned after a pilot study in Dallas, Tex, indicated that such persons were less likely than others to participate in such surveys and that such surveys required substantial resources and generated public concerns.<sup>5</sup> If household surveys are politically or logistically difficult, it may nonetheless be possible to estimate at-risk populations through capture-recapture methodologies.<sup>119</sup> This principle of comparing independent samples can be made statistically more powerful by using three or more independent samples.

While there are difficulties and uncertainties in making estimates of populations at risk for HIV infection, large cities with the biggest at-risk populations have performed multiple studies of them, and these give a consistent representation of the numbers of persons already or currently becoming HIV infected. In smaller MSAs with fewer data, there is more uncertainty. However, HIV incidence in them has generally remained low, so errors in estimates will little influence the general national or regional picture.

The “ruralization” of HIV and AIDS—that is, the tendency for more and more infections to occur outside the 96

MSAs reviewed here—is still largely undefined and complicates the estimate of nationwide HIV incidence. An increase in AIDS cases,<sup>120–122</sup> HIV infection, or both has been most evident in the South—Georgia,<sup>123,124</sup> North Carolina,<sup>125,126</sup> Tennessee,<sup>127</sup> Mississippi,<sup>98,128</sup> Florida,<sup>96</sup> and Louisiana<sup>129</sup>—and in California,<sup>130,131</sup> as well as in specific at-risk groups such as gay and bisexual men in small (southern) cities.<sup>128,132</sup> A few studies of HIV infection or AIDS in people living in rural areas of the South indicate that most putatively exurban HIV infections are, in fact, acquired in big cities.<sup>125–127</sup> However, these studies are limited and now several years old. Thus, an obvious area of needed epidemiological research and public health intervention is to define indigenous HIV infection in small cities and rural areas, particularly in the South.<sup>91</sup>

In the large MSAs, three subepidemics are important foci for future research and prevention efforts. First, most new infections among injection drug users are occurring in MSAs between Boston and Washington, DC, in Miami, and in San Juan, PR. Given the many injection drug users in these MSAs and their comparatively high HIV seroincidence (generally, two to five infections per 100 person-years), the HIV epidemic is now clearly driven by infections occurring among injection drug users, their sex partners, and their offspring. Still, there is good evidence that HIV seroincidence in injection drug users has declined substantially over the past several years in the largest drug-using communities such as in New York,<sup>51</sup> northern New Jersey,<sup>133</sup> and Los Angeles.<sup>134</sup> While some of the observed declines in HIV incidence must reflect the early “saturation” of injection drug users who were most at risk for HIV and who did become infected, there have nonetheless been major changes in risk behaviors of injection drug users.<sup>18,104,135–137</sup> In New York City and northern New Jersey, the epicenter of the HIV epidemic among injection drug users, many injection drug users are demonstrably switching to safer practices, such as using sterile, never-used needles and syringes; cleaning needles and works; switching from injection to sniffing heroin and cocaine<sup>35</sup> (as the purity of these drugs has increased since the mid-1980s); or abstaining from drug use altogether.<sup>136,137</sup> These trends signify the usefulness and effectiveness of programs designed to reduce risk among injection drug users and indicate that further prevention efforts in this population are worthwhile and necessary.<sup>135,138</sup>



Several studies now indicate that HIV infection rates in gay and bisexual men are generally much lower than they were 10 to 12 years ago,<sup>71,139</sup> indicating major changes in the numbers of sex partners and the level of high-risk sexual behavior in most gay and bisexual men in most places since before 1985.<sup>140,141</sup> Still, an important second subepidemic is occurring among young<sup>67,142-148</sup> and minority<sup>63,71,149-152</sup> gay and bisexual men, who have HIV infection rates typically two to three times those of older or White gay and bisexual men.

Finally, another worrisome subepidemic involving young heterosexual women—and, in parallel but less evident, heterosexual men<sup>153,154</sup>—is emerging.<sup>36,83,155-158</sup> Many correspondents, particularly from the Southeast, independently commented on the remarkable rise in AIDS cases and HIV infections seen among young women in their metropolitan areas. Beyond this anecdotal information, a consistent profile of the highly at-risk person is emerging from AIDS surveillance data<sup>103,121,122</sup> and from specific studies both in northern inner cities<sup>75,92,93,159</sup> and in small cities and rural areas of the South<sup>96,97</sup>; this is of a generally young, minority, indigent woman who uses crack cocaine; has multiple sex partners; trades sex for crack, other drugs, or money; and has positive serologic tests for genital ulcerative disease such as syphilis and herpes simplex type 2. Since persons fitting this profile are frequently seen at STD clinics and other medical care facilities, particularly emergency rooms, these sites might provide further opportunities for counseling and intervention.

In summary, this review of all available data about HIV infection indicates that there are approximately 700 000 HIV-infected US residents and about 41 000 new infections per year, and that both HIV prevalence and incidence are beginning to decline. Effective efforts to reduce HIV infection will target injection drug users on the East Coast, young and minority homosexual and bisexual men, and young and minority heterosexual men and women who smoke crack cocaine and have many sexual partners. □

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## ***APHA Announces Search for Executive Director***

APHA has begun a national search to find an Executive Director. We are seeking a proven public health professional who will share the national leadership of our association with strong volunteer leadership, as well as plan and direct the supporting activities of approximately 70 APHA staffpersons. Our Search Committee plans to present finalist candidates to the APHA Executive Board expeditiously. This is a Washington, DC-based position.

Strong candidates will have education and experience that provide a basis for defining and planning the success of APHA during the late 20th and early 21st centuries, and the demonstrated ability to combine volunteer and staff resources to ensure that success.

Finalist candidates will meet the following criteria:

- An advanced degree in public health, medicine, or another related discipline
- A demonstrated commitment to and knowledge of public health
- A comprehensive understanding of public health issues, system components, and opportunities
- At least 10 to 12 years of progressive and highly relevant experience
- Experience in the management, leadership, or administration of a health organization
- Demonstrated ability to shape and direct the implementation of long-term strategic plans
- Demonstrated administrative success, including the development and control of financial resources
- Strong evidence of ability to lead a complex organization with diverse groups, especially those with strong volunteer leadership
- A background that includes both public health and staff responsibility is especially desirable
- A demonstrated ability to coordinate involvement of the association in the public policy arena and the skills and experience to represent APHA in public fora, media communications, and legislative testimony

If you are qualified and interested in this position, or if you can recommend qualified candidates, please write to the Chair, Search Committee, c/o APHA, 1015 15th Street, NW, Washington, DC 20005.