HIV Prevalence in Detroit, Highland Park and Hamtramck Adjusted for Population Decline – Summary Report

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Background

Between 2000 and 2010, the tri-city area of Detroit, Highland Park and Hamtramck (figure 1) experienced a 25%, 30%, and 2.4% reduction in population respectfully. [1] Exploratory analysis implicates emigration as the mechanism behind the reduction.[i] Emigration is almost certainly inflating HIV prevalence rates calculated by current methods. This report proposes a method to apply the general population migration rates to persons living with HIV (PLWH). The migration proportions are then used to calculate an adjusted HIV prevalence rate. Coupled with current prevalence calculations, a range capturing the true HIV rates in the three cities is estimated.


Figure 1. Tri-city Map

When HIV surveillance programs were constructed in the early to mid-1980s, the life expectancy for persons diagnosed with HIV was less than 18 months [2]; there was no need to follow the movement of HIV infected persons within the country. Today, models predict that adherence to treatment allows persons living with HIV (PLWH) to have near-normal life expectancies. [3] [4] With the vast improvements in care arises the need to maintain current residences of PLWH. Understanding the geographic distribution of the disease is extremely helpful for care agencies, and it is important in establishing and evaluating public health programs.   Current residences may be collected by states if desired, but because it is not compulsory, many reporting bodies do not submit address updates to Michigan's HIV surveillance program. The dates of "current residences" of PLWH in Michigan date back to 1987, and many of the current addresses that are submitted only contain accurate and complete information at the state and county levels. Furthermore, updated residences can only be reported if individuals are in care. To truly understand the geographic distribution of HIV infection, the current city and preferably current zip code of all PLWH needs to be known. Obtaining truly current residences is a task CDC is investigating, however, the implementation of any mechanism is not scheduled for the near future.

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[i] Vital records list 174,150 births and 121,396 deaths in Detroit between 2000-2010, yielding a net vitals difference of + 52,754. Using *Population change = Births – Deaths + Migration*, a negative change (-25%) must therefore be due to emigration.

In the meantime, the geographic distribution of HIV is still determined using residence at HIV diagnosis or HIV Stage 3 diagnosis, formerly known as AIDS, if applicable. For the remainder of this report, residence at HIV or HIV Stage 3 diagnosis will simply be referred to as "residence at diagnosis". Calculating regional HIV rates with this address assumes a stable population and a net migration of PLWH of zero. Tri-city area census data proves the violation of the first assumption, and the second assumption is highly suspect. Over half of the PLWH diagnosed in the tri-city area were diagnosed at least ten years ago (figure 2). Given the sharp population decline, it is likely a portion of persons living in the tri-city area at the time of HIV diagnosis have emigrated. Despite this, all persons diagnosed in the tri-city area are included in Detroit, Highland Park or Hamtramck rate calculations resulting in inflated geographic HIV rates[ii].

Figure 2. HIV Diagnosis Dates of PLWH diagnosed in Detroit, Highland Park or Hamtramck
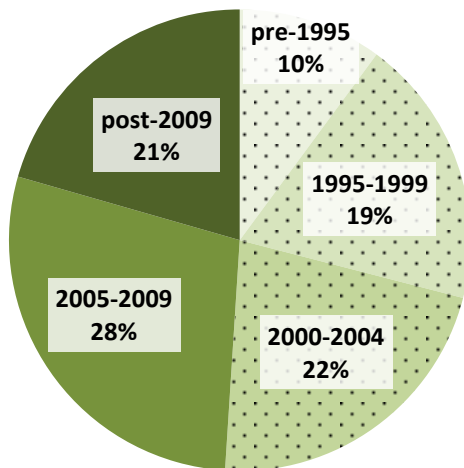
Consider the January 2013 statistics for black males in Detroit. Based on reported cases, the prevalence rate for this stratum is approximately 1,306 per 100,000 or 1 in 77 black males. Suppose emigration among PLWH follows the aggregate city rate (-25%). This yields an adjusted prevalence rate of 967 per 100,000 or 1 in 103 black males. While this comparison is crude, the rates under different migration assumptions paint distinct pictures of the current state of HIV in Detroit as well as the effectiveness of public health interventions.

The adjusted prevalence rates presented in this report are calculated with more nuanced migration probabilities. Sex, race and ethnicity, age at diagnosis, zip code of residence at diagnosis and decade of diagnosis are taken into account.

Although previous studies have found migration of PLWH to urban areas for treatment and migration to rural areas to be near family, they were conducted before 1997. [5] Great strides were made in the effectiveness and availability of HIV treatment during and after 1995. Furthermore, migration is tied to factors such as race and poverty; because the face of the HIV epidemic has greatly changed since the early 1990s, migration trends for PLWH would likely also change. Therefore, migration studies conducted pre-1997 were deemed inapplicable.

[ii] HIV rate per 100,000 in Detroit = No. of PLWH and diagnosed in Detroit (1981-present) /Total number of persons currently living in Detroit*100,000. Note: the numerator ignores movement, but those who have left Detroit are removed from the denominator.

To obtain a baseline knowledge of migration among PLWH in and around the tri-city area, 38% (n=2,468) of the PLWH who were diagnosed in or are currently living in the tri-city area were sampled based on their most recent address date. Immigration events may have had a higher probability of being captured in the sample compared to emigration events resulting in a conservative estimate of eight percent net emigration from the tri-city area. For more information on this sample, see the full report.

Overview of Methods
The direction and magnitude of migration in each zip code by the selected demographics was calculated using 1990, 2000, and 2010 US Census data and 1990-2009 Michigan vital record data. Migration proportions were calculated for both decades of interest (1990-2000 and 2000-2010)[iii]

The migration proportions were then applied to persons with matching demographics living with HIV as of January, 2013 who were diagnosed in the tri-city area. Based on the individual's year of diagnosis and corresponding migration proportions, a probability was calculated indicating the likelihood that a person diagnosed in the tri-city area, still lives in Detroit, Highland Park or Hamtramck. These proportions are then used to calculate the adjusted prevalence rate. This rate is the lower limit of the range likely to contain the true rate of HIV in the tri-city area. The upper limit is the prevalence rate calculated using residence at diagnosis. This upper limit assumes zero net migration among PLWH.

Estimating Prevalence

Once final migration probabilities were assigned, the adjusted prevalence was calculated by summing the probabilities, much like a weight, across any desired category of cases. Figure 3 and table 1 present a comparison of HIV prevalence rates by zip code. The majority of sex, race and ethnicity, and age category estimations resulted in adjusted prevalence rates significantly lower than the current rates calculated from reported PLWH diagnosed in the tri-city area.

Figure 3. Percent decrease of tri-city area HIV infection rates by zip code, 1990-2010 when migration rates of the general population are taken into account
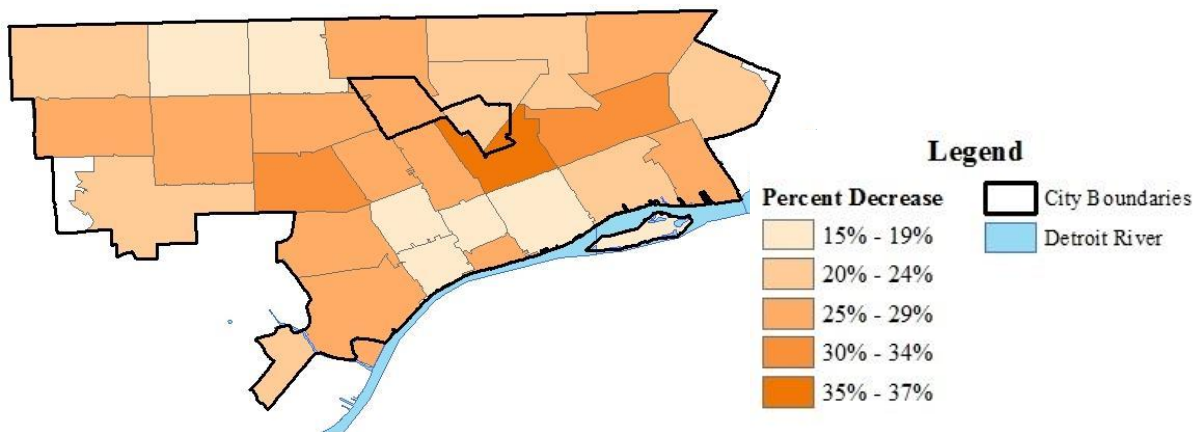
iii Migration proportions for 1990-2000 and 2000-2010 were calculated with the same methods when possible. The only discrepancy was the 1990 census did not collect ethnicity specific sex, race and age data.

Table 1. Reported vs. adjusted prevalence of PLWH as of January, 2013, diagnosed in the tri-city area

Demographic Characteristics	Reported Prevalence		Adjusted Prevalence				Census 2010	Emigration Among PLWH (gen pop'l migration rates applied)	
	Num	Rate per 100,000	Num	99% CI	Rate per 100,000	99% CI	Num	Percent	99% CI
Race/Ethnicity [1]									
White*	356	640.2	217	(185, 248)	389.9	(333.4, 446.4)	55,604	-39%	(-48%, -30%)
Black*	5,271	898.6	4,019	(3962, 4076)	685.2	(675.4, 694.9)	586,573	-24%	(-25%, -23%)
Hispanic*	166	341.0	131	(104, 157)	268.7	(214.1, 323.3)	48,679	-21%	(-37%, -5%)
Other	150	654.4	135	(107, 164)	590.1	(465.2, 715.1)	22,921	-10%	(-29%, 9%)
Sex & Race									
Male*	**4,355**	**1,289.7**	**3,333**	**(3259, 3406)**	**986.9**	**(965.1, 1008.7)**	**337,679**	**-23%**	**(-25%, -22%)**
*White**	*290*	*998.8*	*178*	*(149, 207)*	*613.6*	*(514.8, 712.5)*	*29,034*	*-39%*	*(-48%, -29%)*
*Black**	*3,828*	*1,404.4*	*2,955*	*(2878, 3033)*	*1,084.3*	*(1055.8, 1112.7)*	*272,577*	*-23%*	*(-25%, -21%)*
*Hispanic**	*124*	*489.8*	*97*	*(74, 120)*	*382.0*	*(291.8, 472.3)*	*25,314*	*-22%*	*(-40%, -4%)*
Other	*113*	*1,050.8*	*102*	*(77, 127)*	*950.4*	*(717.9, 1182.9)*	*10,754*	*-10%*	*(-32%, 13%)*
Female*	**1,588**	**422.2**	**1,169**	**(1102, 1237)**	**310.9**	**(293, 328.9)**	**376,098**	**-26%**	**(-31%, -22%)**
*White**	*66*	*248.4*	*39*	*(25, 52)*	*145.4*	*(95.1, 195.8)*	*26,570*	*-41%*	*(-62%, -21%)*
*Black**	*1,443*	*459.6*	*1,063*	*(998, 1129)*	*338.7*	*(318, 359.6)*	*313,996*	*-26%*	*(-31%, -22%)*
Hispanic	*42*	*179.8*	*34*	*(20, 48)*	*146.0*	*(86.7, 205.2)*	*23,365*	*-19%*	*(-52%, 14%)*
Other	*37*	*304.1*	*33*	*(19, 47)*	*271.6*	*(154.7, 388.6)*	*12,167*	*-11%*	*(-49%, 28%)*
Age at Jan, 2010									
Not yet born	1	N/A	1	N/A	N/A	N/A	N/A	N/A	N/A
0 - 9 years	16	15.3	13	(5, 22)	12.8	(4.5, 21)	104,308	-17%	(-71%, 37%)
10-19 years	261	213.0	230	(193, 267)	187.6	(157.7, 217.5)	122,550	-12%	(-26%, 2%)
20-29 years*	993	971.9	766	(706, 826)	749.4	(690.8, 808)	102,172	-23%	(-29%, -17%)
30-39 years*	1,162	1,256.4	824	(766, 883)	891.2	(828.2, 954.3)	92,485	-29%	(-34%, -24%)
40-49 years*	1,821	1,895.5	1,347	(1277, 1417)	1,402.0	(1329.2, 1475)	96,071	-26%	(-30%, -22%)
50-59 years*	1,278	1,277.7	1,009	(943, 1075)	1,009.0	(943.2, 1074.7)	100,025	-21%	(-26%, -16%)
60-69 years*	352	546.2	268	(232, 304)	415.9	(359.4, 472.3)	64,448	-24%	(-34%, -14%)
70-79 years	54	157.1	40	(26, 55)	116.9	(75.2, 158.7)	34,369	-26%	(-52%, 1%)
80+ years	5	20.5	3	(0, 7)	13.8	(0, 30.4)	24,361	-33%	(-100%, 48%)
Total*	**5,943**	**832.6**	**4,502**	**(4466, 4538)**	**630.7**	**(625.7, 635.8)**	**713,777**	**-24%**	**(-25%, -24%)**

[1]Persons described as white, black, or other are all non-Hispanic; persons described as Hispanic may be of any race.

*Adjusted number of PLWH in the tri-city area is significantly less than the reported number of PLWH diagnosed in the tri-city area

Using the migration rates of the general population, an estimated 24% (99%CI: 24%-25%) of PLWH who were diagnosed in the tri-city area have emigrated out of Detroit, Highland Park and Hamtramck as of January, 2013. This emigration rate is six percent lower than the overall decline in the tri-city area between 1990 and 2010 (30%). The difference indicates that PLWH are indeed slightly less liking to emigrate compared to the overall population. Assuming the true emigration rate of PLWH is between

Table 2. Estimated range capturing HIV prevalence for Detroit, Highland Park and Hamtramck, as of January, 2013

Demographic Characteristics	Est. Range Num of PLWH		Est. Range Rate per 100,000		Census 2010 Num
Race/Ethnicity [1]					
White*	217 -	356	389.9 -	640.2	55,604
Black*	4,019 -	5,271	685.2 -	898.6	586,573
Hispanic*	131 -	166	268.7 -	341.0	48,679
Other	135 -	150	590.1 -	654.4	22,921
Sex & Race					
Male*	**3,333 -**	**4,355**	**986.9 -**	**1,289.7**	**337,679**
White	*178 -*	*290*	*613.6 -*	*998.8*	*29,034*
Black	*2,955 -*	*3,828*	*1,084.3 -*	*1,404.4*	*272,577*
Hispanic	*97 -*	*124*	*382.0 -*	*489.8*	*25,314*
Other	*102 -*	*113*	*950.4 -*	*1,050.8*	*10,754*
Female*	**1,169 -**	**1,588**	**310.9 -**	**422.2**	**376,098**
White	*39 -*	*66*	*145.4 -*	*248.4*	*26,570*
Black	*1,063 -*	*1,443*	*338.7 -*	*459.6*	*313,996*
Hispanic	*34 -*	*42*	*146.0 -*	*179.8*	*23,365*
Other	*33 -*	*37*	*271.6 -*	*304.1*	*12,167*
Age at Jan, 2010					
Not yet born	1 -	1	N/A		N/A
0 - 9 years	13 -	16	12.8 -	15.3	104,308
10-19 years	230 -	261	187.6 -	213.0	122,550
20-29 years*	766 -	993	749.4 -	971.9	102,172
30-39 years*	824 -	1,162	891.2 -	1,256.4	92,485
40-49 years*	1,347 -	1,821	1,402.0 -	1,895.5	96,071
50-59 years*	1,009 -	1,278	1,009.0 -	1,277.7	100,025
60-69 years*	268 -	352	415.9 -	546.2	64,448
70-79 years	40 -	54	116.9 -	157.1	34,369
80+ years	3 -	5	13.8 -	20.5	24,361
Total*	**4,502 -**	**5,943**	**630.7 -**	**832.6**	**713,777**

[1]*Persons described as white, black, or other are all non-Hispanic; persons described as Hispanic may be of any race.*

zero and 24%, the true prevalence rate in the tri-city area is between the adjusted prevalence rate and the reported prevalence rate presented in Table 2.

Concluding Remarks

Poverty is a key factor affecting migration, and it is closely correlated with HIV infection. Although the economic status of PLWH is unknown, some of the demographic variables accounted for in the migration calculations such as sex, race and ethnicity, and zip code of residence at diagnosis are proxies. This is demonstrated by the lower emigration rate among PLWH (24%) compared to the general population emigration rate (30%).

Possible factors affecting migration among PLWH in Detroit, Highland Park and Hamtramck that could not be accounted for include care resources such as linkage to care programs, support groups and public transportation. PLWH may not emigrate as readily as the general population because there are more resources for PLWH in the tri-city area. Lower emigration rates among PLWH compared to the general population are suggested by the conservative emigration rate among the sampled PLWH previously mentioned (eight percent net emigration from the tri-city area). For this reason, the prevalence estimate is presented as a range—somewhere between the adjusted prevalence (the lower limit) and the reported prevalence (the upper limit).

While the estimates regarding migration among persons diagnosed with HIV in Detroit, Highland Park, or Hamtramck are reasonable, they are still estimates. Knowing the true geographic distribution of PLWH will aide care agencies and optimize prevention and treatment programs. Therefore, current residence information is crucial for sound HIV surveillance programs.

Glossary of Key Terms

Adjusted Prevalence (Frequency or Rate): Prevalence of HIV after applying the migration proportions of the general population to PLWH.

Estimated Prevalence Range (Frequency or Rate): The rage capturing the true HIV prevalence/HIV prevalence rate. Lower limit = reported prevalence; upper limit = adjusted prevalence.

Migration Proportions/Probabilities: Migration rates of the general population by select characteristics.

PLWH: Person(s) living with HIV

Reported Prevalence (Frequency or Rate): Prevalence or rate of PLWH assuming zero net migration/using residence at diagnosis.

Reference

Data sources include:

Michigan census data: 1990, 2000 and 2010

Michigan vital records: 1990-2009

MDCH HIV Surveillance data, January 2013

Works Cited

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